Study No. 179

Adoption of Recommended Doses of Fertilizers on Soil Test Basis by Farmers

AGRO-ECONOMIC RESEARCH CENTRE

VISVA-BHARATI

SANTINIKETAN

2015

Study Team

Vivekananda Datta
Dipak Kumar Mondal
Soumen Ghosh
Rishav Mukherjee
Kali Sankar Chattopadhyay
Saumya Chakrabarti

Preface

The present study was undertaken at the instance of Directorate of Economics and Statistics, Ministry of Agriculture, Government of India, Krishi Bhavan, New Delhi as a coordinated study, the act of coordination being vested upon ADRTC, Institute for Social and Economic Change, Bangalore.

Based on the primary data collected from the state of West Bengal the present study evaluated the soil test programme and the pattern and determinants of participation of the farmers. It also examined the level of adoption and its constraints in the application of recommended doses of fertilizers based on soil test reports by the farmers. Finally, it analyzed the probable impact of adoption of recommended doses of fertilizers on crop productivity and income of farmers. This study has come out with interesting findings that soil testing and adoption of recommended doses of fertilizers among paddy and jute farmers have significantly raised both the production and productivity, but numbers of such farmers are found negligible. This study has identified some factors for the decline in participation by the farmers including non-availability of report card after testing, poor extension facilities, distant location of soil testing laboratories etc. At the same time the study has noted that the small number of soil test farmers who adopted the recommended doses of fertilizers could enhance their production and productivity and were significantly capable of diminishing the costs of other factors of production. It implies that if the farmers are pursued with technical efficacy of soil testing with appropriate administrative and extension services to them and the application of appropriate doses of fertilizers; agricultural sector could get rid of initial inertia and be transformed into self sufficient food economy needed for sustainable development. I sincerely feel that this study marks a contribution to knowledge and discourse.

The study team associated with the study consisted of Mr. Vivekananda Datta,Mr. Dipak Kumar Mondal, Mr. Soumen Ghosh, Mr. Rishav Mukherjee, Mr. Kali Sankar Chattopadhyay and Dr. Saumya Chakrabarty. All of them shouldered the responsibility of field investigation, computer digitisation of data, analysis of data, drafting and typing of the report. The secretarial assistance was received from Sarbosree M. A. Khaleque, N. Maji, D. Mondal, D. S. Das and A. R. Patra.

On behalf of the centre, the undersigned takes the opportunity to thanks the officials of the Government of West Bengal for their kind help and cooperation in carrying out the study. I also take this opportunity to thank the sample respondents in the study area

of the state of West Bengal for giving their valuable time at the stage of collecting primary data. Finally, I am especially thankful to Parmod Kumar, Professor and Head, ADRTC, Institute for Social and Economic Change, Bangalore for his excellent co-ordination in conducting the study.

A.E.R.Centre, Visva-Bharati
Santiniketan
June, 2015.

(Prof. Sudipta Bhattacharya)
Ex-Officio Director

CONTENTS

LIST OF TABLES

LIST OF FIGURES

Executive Summary

1.1 Background:

Soil health condition plays a very important role in enhancing the quality of crop production as well as the productivity levels in agricultural sector. In order to cater to the growing population with huge population base a recurrent phenomenon of over use of land has in the long run created a negative impact on the very basis of agricultural sector. Such type of preponderant pressure on land has created to a significant extent an unbalanced situation for the soil nutrients further deteriorating health condition of soils. Moreover, in order to enhance agricultural yield – to remain relevant in the contemporary competitive environment–the farmers indiscriminately apply chemical fertilizers and such inappropriate doses of fertilizer application creates a serious impact on environment and sustainability of agricultural sector.

The present study deals with the coherent principles of sustainable development and explicitly divided into two parts: a) soil testing for determining the appropriate dose of fertilizer and other nutrient use; and b) adoption/application of recommended doses of fertilizers etc and its probable impacts. The first one i.e. soil testing deals with Soil Health which is very sensitive and directly related with crop production. Any negligence of Soil Health has serious repercussion on growth and upbringings of plants. Mentioned earlier, continuous use of agricultural land for feeding such an enormous population is inflicting a gradual nutrient mining and to our utter dissatisfaction, such losses are being compensated through over use of fertilizer. Curiously, these compensation/replenishment are being done through purely unscientific processes and in an indiscriminate way. Due to intensive method of cultivation, nutrient mining along with the gradual degradation of micronutrients over the periods has caused irreparable losses to Indian soils. According to a recent estimate of the Fertilizer Association of India (FAI-2014) every year almost 34 million tons of plant nutrient in the form of NPK is being exhausted and in exchange only 26 million tons of NPK are being replenished through application of fertilizer resulting into a deficiency of 8 million tons every year. Besides such a huge NPK deficiency, a careless attitude of the farmers towards the application of fertilizer reduces the percentage of secondary supplements and micronutrient to an abysmal level. The FAI indicates that ‘as a result the deficiency of nutrients and micro nutrients in Indian soil reduces to the tune of 89%(N), 80%(P), 50%(K), 40%(Sulpher), 48%(Zinc), 33%(Boron) respectively’ (ibid.).

The agricultural experts have recommended an appropriate NPK ratio for Indian soil conditions, which is 4:2:1. 'In 1991-92, the year immediately preceding the decontrol of phosphatic and potassic fertilizers, the NPK ratio was 5.9:2.4:1. Consequent on decontrol of phosphatic and potassic fertilizers, the NPK ratio were distorted to 9.68:2.94:1 in 1993-94. The same has considerably improved to 5.3:2.2:1 in 2005-06. The farmers have to be educated in the matter of nutrient balance as it has a great long-term significance for the Indian agricultural economy and policy measures on balanced use of fertilizers have to be initiated.

Considering the importance of soil health management, proper application of recommended doses of fertilizer along with use of bio-nutrient for enhancing and maintaining sustainability in agricultural sector is seriously being taken into consideration. Thus, in order to disseminate proper ideas Government of India has formulated numerous schemes and task force committees with the help of agricultural and environmental experts.

1.2 Need for the study

Due to a lack of awareness among the farmers, there are wide spread problems related to the indiscriminate use of chemical fertilizers, mismanagement of surface water and over exploitation of ground water and other resources. The over use of chemical fertilizers in most parts of India in the last few decades has led to several problems affecting soil health, nutrient flow and natural environment. There is a need for promoting, among others, balanced use of fertilizers for increasing productivity of crops and for better absorption of nutrients from the applied fertilizers. It is suggested that, farmers should go for regular soil testing and use recommended doses of fertilizers as advised by the agricultural scientists. There is no systematic study undertaken so far for evaluating the effectiveness of such a programme of soil testing for nutrient deficiency and consequent adoption of recommended doses of fertilizers by farmers based on these soil tests. The present study examines the performance of the soil-test programme, the level of adoption and constraints in the application of recommended doses of fertilizers, impact on crop productivity and relevant institutional problems.

1.3 Objectives of the Study

The objectives of the study are as follows:

To evaluate the soil-test programme and the pattern and determinants of participation/non-participation of the farmers in such a project.

To examine the level of adoption and its constraints in the application of recommended doses of fertilizers based on soil test reports by the farmers.

To analyze the probable impact of adoption of recommended doses of fertilizers on crop productivity and income of farmers.

1.4 Summary and findings

Generally, adoption of recommended technique in agricultural sector is to a significant extent influenced by the socio-economic factors existing in the rural India. Availability of educational facilities along with social taboos make the situation more complex, and hence, a brief discussion about the socio-economic characteristics and demographic composition of the sampled farmers is necessary to have a glimpse on these particular issues.

Here, in the present study, we find that the farm size category of marginal farmers overwhelmingly dominates the farming classes and it is found that, almost 55% of farmers in Paddy and almost 71% farmers in Jute belong to this category. Though a significant percentage of small farmers (30% in Paddy and 24.17% in Jute) is found in the study, the representative figure in the case of medium and large farmers is negligible and virtually no big farmers are found in jute cultivation due to less interest and non-availability of large farmers in the study area.

Interestingly, in case of paddy it is found that, all of the respondents are middle aged educated male having on an average long 23 years' background in farming sector and 58.33% of them are members of agriculture related association/s. Altogether 92% of the respondents categorically mentioned that agriculture is their primary livelihood; 70% of them belong to General caste category and altogether 14.44% of the respondents represent the OBC group of the social caste system. The picture in case of control farmers cultivating paddy is more or less the same, the only difference is that, 81.6% have identified agriculture as their main occupation and it is found, they have more agricultural experience (in terms of years of involvement) in comparison to soil test farmers, i.e. the treatment group.

In case of Jute, educational standard of the respondents in comparison to the respondents for paddy cultivation is low, though the figure is encouraging in the sense that almost all of them are literate. Among the soil test farmers, 93.33% of them have stated that agriculture is their primary occupation; percentage figure in the case of control farmers is 100%. The control farmers have more agricultural experience, though in terms of membership of any association they are slightly lacking behind their counterpart.

In case of paddy, operational land holding among soil test farmers is marginally higher than that of control farmers. The corresponding figures for both these categories of farmers in Paddy and Jute are 5.86 & 372 and 3.63 & 2.93 (acre/household) respectively. Cropping intensity in Paddy for the soil test farmers (172%) is also higher than that of the control farmers (159%); the corresponding figure for Jute is 184% and 169% respectively.

Needless to mention, cropping intensity to a great extent is influenced by the availability of irrigational facilities. In the present study bore well commands a formidable percentage of total irrigation availabilities. The overall percentages of land irrigated through this system in Paddy and Jute are 63.28 and 84.82 and availability of canal irrigation is very small, the corresponding figures for both the Crops are 28.64 and 0.36 percent respectively.

As far as cropping pattern is concerned, it has been observed that, cultivation of paddy more or less plays a dominant role for all the categories of farmers. Potato and oilseeds including mustard and vegetables are the other important crops grown in the study area. Cultivation of Paddy in Jute areas is visibly higher than Paddy regions. Significantly, adoptions of HYV seeds for all agricultural crops among all categories of farmers reveal a very encouraging picture. Almost all the farmers (both Soil test and Control) use HYV seeds for paddy (both Aman and Boro) cultivation. The Control farmers use more HYV seeds than the soil test farmers for Jute cultivation. It shows that the soil test farmers depend more on traditional variety than the control farmers. In case of Potato, mustard, wheat and vegetables cultivation farmers use HYV seeds though visibly the traditional varieties have significant presence in both Paddy and Jute regions.

Interestingly, the value of output per unit of cropped area (Rs/acre) among soil test farmers for Paddy decreases, with the increase of size of farming and a reverse pattern is found in the case of control farmers. In the case of jute, value of output increases with the increase

of size of operational holding and it is true for both the soil test and control farmers. It signifies that in comparison to paddy growers the jute cultivators got better prices of their disposable commodities and have better market facilities in their respective regions. A comparison between the values of crop outputs for both of these two crops signify that the soil test farmers on an average get a better return than the control farmers. Definitely, it indicates that the soil test farmers are progressive in nature. The above fact justifies that, in the case of both paddy and jute, the soil test farmers have definitely an edge over the control farmers in holding and using agricultural machineries. It has been observed, both in terms of quantity and value, the soil test farmers spend more for mechanization in agriculture in order to get a positive return on their farm investments.

Mechanization in agriculture mostly depends upon the economic viability among farmers and such economic endeavors are greatly influenced through availability of credit from different sources. It has been observed that formal credit institutions viz. co-operative credit societies, commercial banks and RRBs play a very important role compared to that by the non-formal banking institutions in the study areas. In case of Paddy, nowhere it is found that the farmers got credit from village money lenders or any such institutions demand exorbitant rate of interest for their lending though such institutions are operating among jute cultivators and outstanding amount to these lenders are negligible. Above facts clearly indicate that the formal banking sector is doing well but not to that extent of eliminating completely the money lenders in these rural sectors.

With reference to the soil testing and recommended doses of fertilizer, it has been observed that in percentage terms the numbers of farmers decreases with an increase in size class of operational holding. Evidently, number of farmers is higher in the lowest stratum among all the size classes and in comparison to other farmers they have enough scope for soil testing. Besides this, there might be another reason, i.e. greater zeal and aspiration among marginal farmers to enhance their production as they have limited access to other inputs of production, despite the fact that, the farmers are constrained by a lack of easy access to soil testing laboratory. The laboratories are situated in the headquarters, which are far away from the villages; and the farmers consider the distance and cost of transportation as serious obstacles for soil testing.

On an average, one sample per plot for all categories of farmers was submitted for soil testing. In case of marginal farmers, the sample size was two or more with an anticipation of getting appropriate result for the sample submitted to the soil test laboratory.

Unfortunately, they were delivered different results corresponding to different samples of the same plot; this has created skepticism among the farmers regarding the very process and validity of the soil-testing programme. Moreover, it is found that, the average number of plots per household considered for soil testing increases with an increase in the size group. Average area covered under soil test (acre) per household for marginal, small, medium and large farmers for Paddy are 0.78, 1.01, 2.07 and 9.69 and for Jute the corresponding values are 0.71, 1.51 and 1.86 respectively. It has also been seen that, the farmers themselves had collected and sent their samples to the laboratories for testing their soil. Method of collection and handling of sample raise a big question about availability of agricultural extension facilities in the study areas. The cost of soil testing is mainly the travelling cost and in many cases, in order to avoid travelling hazards the farmers for both of these two crops prefer private company's laboratory or mobile van for testing their soil. Although the activities of Krishi Prayukti Sahayak (KPS) are not visibly prominent in handling and collection of soil samples from the farmers, interestingly, the farmers got information about the benefits of soil testing mostly from the Government sources (in many a cases, KPS).

While asked the farmers, about the reasons for soil testing most of them categorically mentioned that they expected better yield and wanted to know about the deficiency of the nutrients of their own land. Moreover, a significant portion of the farmers nodded for adoption of the new technologies and its application for better farming in near future.

A very discouraging picture is obtained from the findings of the reasons for not testing soil from the farmers. The control farmers aspired that they were interested to test their soils but non-availability of the extension officers and availability of the laboratories are major constraints for their non -testing. Another dismal picture about finding of the study, a negligible number of soil health card with the recommended doses of fertilizer were collected only from the farmers engaged in Paddy cultivation. On soil test basis the recommended doses of fertilizers found to be are 13.20, 31.19 and 26.72(kg/acre) for Urea, DAP and Potash for Paddy. No information relating to average quantity of split doses of fertilizers recommended by the stage of crop growth for soil test farmers is available for Paddy and Jute farmers.

In case of recommended doses of fertilizers by soil test farmers the scenario is not as good as expected. In fact, as an aggregate only 9.17% of soil tested farmers applied the recommended doses and most of them depend on the oral recommendation of fertilizer

given by Krishi Prayukti Sahayak(Agricultural extension personnel). Moreover it is found that in case of Paddy, as compared to marginal and small farmers the medium and large farmers apply recommended doses of fertilizers while in case of Jute the an opposite picture is seen.. Thus, with reference to both these two Crops a complete opposite picture in terms of the areas covered in case of application of recommended doses of fertilizer is clearly visible. Areas covered under the marginal farmers in Jute are found to be higher than Paddy. Overall; Percentage of applied farmer is higher in Jute and average area for the application of recommended doses of fertilizers is higher in paddy. Area covered as a percentage of the net operated area in comparison to Jute is found to be higher in Paddy.

One constraint analysis for studying the application of recommended doses was done and on that basis again inept performances while dealing with this important matter of the State Agricultural Extension Department can easily be surmised. From this analysis it is found that almost 33.94% of Paddy Growers and almost 43% of Jute cultivators clearly mentioned about the non availability of technical advice on method and timeliness of the application of fertilizers, even the same percentage of farmers in case of paddy complained about the difficulties to understand and follow the recommendations about application of appropriate doses of fertilizers available from the Government Sources. Despite the above facts it should not be pertinent to ponder that the control farmers are not aware as well as its consequences about soil testing. In our study area it is found a little over 83 % of marginal farmers and 69.23% of small farmers among Paddy cultivators are well aware of the effects of soil testing on crop production. The corresponding figure for control farmers in Jute among the small size class is 100% though the total figure bogged down to 85%. During Paddy cultivation it is found that soil test farmers as well as control farmers generally apply greater amount of Urea followed by DAP and MOP. Soil test farmers use grater amount of Urea and complex compared to control farmers. On the contrary, control farmers use greater amount of DAP, MOP and SSP and micronutrients. In case of jute cultivations, soil test farmers as well as control farmers use more Urea than Complex and DAP. Control farmers except MOP use all types of fertilizers as compared to soil test farmers.

Quantity of fertilizers in different stages of cultivation is different across these two categories of farmers. Soil test paddy farmers apply highest amount of Urea at the ‘after-inter-cultivation’ stage and DAP&SSP at the ‘Basal application stage’. Both soil test farmers and control farmers during Jute cultivation use higher amount of DAP, MOP, SSP

and complex at the 'basal application' stage. Next higher dose is applied at 'after-inter-cultivation' stage and then at 'vegetative growth' stage.

Timely application of fertilizer is one of the key factors for enhancing agricultural production and furthermore the timeliness depends on the availability of fertilizers from different sources. It is in the study found among sources; private fertilizer dealers play a very important role in providing fertilizers to the cultivators. As far as data available for sources of purchase of fertilizers is concerned almost 81% among soil test farmers and 87% of the control farmers purchase fertilizers from the private fertilizers shops/dealers. Despite Government interventions functioning of the District/Primary Agricultural Co-operative societies as regard to important sources of supplying fertilizers among farmers are not at all satisfactory. Cost of fertilizers by the control farmers in comparison to soil test farmers is higher because most of them purchase these important inputs of production from the private traders, and eventually the higher price of fertilizers affects their cost of production. The soil test farmers in comparison to control have greater access to Co-operative societies; and price of fertilizers in these societies is definitely lower than private traders.

Besides application of chemical fertilizers both soil test farmers and control farmers during Paddy and Jute cultivation use a formidable amount of organic manure (Bio-Fertilizers) also. It is in the study found that control farmers during paddy cultivation apply greater amount of organic fertilizers as compared to soil test farmers. The corresponding analyses of application of organic manure for Jute are more or less same.

The soil test farmers for both paddy and Jute have attained training program but as far as number and frequency of training program is concerned the soil test farmers in Paddy have attained more than their Jute counterparts. Training has also imparted to the control farmers for both Paddy and Jute but in case of information regarding average number of per household training they are mostly lacking behind than the soil test farmers.

The above analyses have so far confined in application of recommended doses of fertilizers among soil test and control farmers for Paddy and Jute. However, main objective of this study to assess the impact of adoption of recommended doses of fertilizers on production and productivity and also to have a glimpse on its effect on farm income of the concerned producers. Mentioned earlier, the farmers have applied fertilizers according to their own choices, moreover, lack of extension facilities and conventional

method of farming practices make the situation a little obscure. It has also been mentioned that in spite of the above facts some farmers (very few) have applied recommended doses of fertilizers on soil test basis. It has been observed that productivity of Paddy of soil test farmers in comparison to control farmers is higher across all size classes, though in case productivity of Jute the marginal and small size classes among control farmers have an edge over the soil test farmers. Interestingly, in terms of overall productivity in Jute the control farmers hold in advantageous position than the soil test farmers. Moreover, value of output among these categories of farmers is higher than soil test farmers. The reverse is true for Paddy farmers. A small number of farmers who adopted this technology and applied recommended doses of fertilizers got higher production both in Paddy and Jute. The most noteworthy feature of adoption of recommended doses of fertilizers in paddy is increase in crop yield with 'decrease in application of other inputs like seed, labor, and pesticides'. In case of adoption of this technique in Jute signifies increase in crop yield and 'improvement in Soil Texture'.

1.5 Conclusions

*Soil testing and adoption of recommended doses of fertilizers among farmers engaged in Paddy and Jute cultivation have enhanced the level of both production and productivity to a significant extent, but number of such farmers are found negligible.

- Most of the farmers after testing their sample did not get any report card.
- A negligible numbers of farmers got report card with soil health status only; recommendation of appropriate doses was not mentioned therein.
- Available extension facilities in soil testing and recommended doses of fertilizers services are found to be poor.
- Most of the Soil testing Laboratories are situated in long distances.
- Sample is collected by the farmers themselves. Scientific and technical knowhow about collection of samples among farmers are very poor.
- Farmers keep little reliance on Soil testing and Health status. It is reported that they got different results for different sample for same plots of land and even for different result for same sample.
- Timely availability of fertilizers is a great concern; source of availability is also a problem to them. Most of the farmers purchase fertilizers from the private fertilizer dealers. PACs or other Agricultural Co-operatives played a limited role.

- Private dealers charge higher price for their inputs.
- Functioning of Commercial and Rural Banks are quite satisfactorily, though operation of money lenders is visible in Jute cultivated regions.
- Even after soil testing, during application of NPK farmers rely more on oral recommendation of the KPSs than recommendation made in their report cards.
- Soil test farmers have attained more training than the control farmers.
- Soil test farmers in terms of value and quantity of farm machineries have definite edge over the control farmers. Cropping Intensity in these categories of farmers is found to be higher than the control farmers.
- During Paddy cultivation both of the soil test farmers and control farmers use more HY Varieties.
- Control farmers use more HYV seeds than soil test farmers during Jute cultivation.
- Bore well is the major source of irrigation for all crops.
- Both soil test farmers and control farmers use farm yard manure and bio-fertilizers during Paddy and Jute cultivation.

Whatever miniscule size of number it may be the soil test farmers who adopted recommended doses of fertilizers in Paddy and Jute cultivation got higher production and were capable of diminishing the costs of other factors of production to a significant extent. It implies if appropriate administrative and extension services are provided to the farmers and if and only if the farmers are pursued with technical efficacy of soil testing with the application of appropriate doses of fertilizers , agricultural sector could get rid of initial inertia and could bounce to an enormous scale resulting food self sufficiency and much needed sustainable development.

1.6 Policy Recommendations

- As the Soil testing Laboratories are situated in the long distances and as the Farmers collect sample on their own, the Extension Personnel in the District Agricultural Offices need to be more careful and attentive during implementation of this important programme and make it more a success. (ATTn: Directorate of Agriculture, Government of West Bengal).
- Supply of Soil Health cards without any recommendation of appropriate doses of fertilizers to the Farmers is considered as serious lapses on part of the Government Officials. Owing to the repercussion of the farmers such type of lackadaisical

attitude among the personnel must be checked and a review of providing Health Report Cards to the said farmers draw much needed attention. (ATTn: Directorate of Agriculture, Government of West Bengal).

- Sources and Availability of fertilizers in time is a great concern to the Farmers, Government sources need to provide NPK in time with an adequate amount. . (ATTn: Directorate of Agriculture, Government of West Bengal).
- Continuous mining of nutrients with inadequate doses of replenishment inputs make soil more and more susceptible to infertile, application of recommended doses of fertilizers with an admixture of manure and Bio-nutrient is capable to maintain and regain the soil health. Propagation of Organic Farming among the farmers is essential. (ATTn: Directorate of Agriculture, Government of West Bengal).
- Notwithstanding the existence of Commercial Banking, village money lenders are still operating in some places in rural areas. Panchayat officials should take note of it (ATTn: Ministry of Panchayat and Rural Development. Government of West Bengal).
- One comprehensive and wide program of disseminating the ideas of soil testing and awareness programme for recommendation doses of fertilizer Viz. KrishiMela (Agricultural fare) in every two or three months might be convened in each Agricultural Blocks and arrangement of instant issuing of Soil Health Card are felt essential for successful implementation of such important Government Programme. (ATTn: Directorate of Agriculture, Ministry of Panchayat and Rural Development. Government of West Bengal).
- Kisan Call Centre should be set up in all Panchayat offices to enable the farmers about the recent modern techniques being prescribed by the experts . (ATTn: Directorate of Agriculture, Government of India, Government of West Bengal).

Chapter-I

Introduction

1.1 Background

Adoption of recommended doses of fertilizers on soil test basis by farmers is a belated modern concept in agricultural sector especially in the state of West Bengal. Innovation of modern techniques particularly in agricultural arena in the Eastern region took an inordinate delay and West Bengal is no exception of that and it is evident through the introduction of the programme 'Bringing Green Revolution to Eastern India (BGREI)'. However, when it reaches, it comes vigorously causing a great concern to the environment and soil health.

Much has been discussed on the pertinence of Green Revolution and its impact on an economy especially on the rural sector, in other parts of India. Mechanization of agriculture with better and heavy use of seeds, fertilizers and irrigation so far have made a considerable impact in raising agricultural production and productivity but on the other side, an unscientific and indiscriminate application of agricultural inputs have to a significant extent altered the basic principles of sustainability of agriculture and development.

- The present study deals with the coherent principles of sustainable development and explicitly divided into two parts: a) soil testing and b) adoption of recommended doses of fertilizers. The first one, i.e. soil testing deals with Soil Health and is very sensitive an issue and directly related with crop production. Any negligence of Soil Health has serious repercussion on growth and upbringings of plants also. Owing to the huge population base and growth of population, agriculture is facing a tremendous pressure. Continuous use of agricultural land for feeding such an enormous population is inflicting a gradual nutrient mining and such losses are being compensated through indiscriminate fertilizer application. Curiously, this compensation /replenishment is being done through purely unscientific process and in an arbitrary way. Due to intensive method of cultivation, nutrient mining along with a gradual degradation of micronutrient over the period have caused irreparable losses to Indian soils. According to a recent estimate of the Fertilizer Association of India (FAI-2014):Every year almost 34 million tons of plant nutrient in the form of NPK is

being exhausted and in exchange only 26 million NPK are being replenished through application of fertilizer resulting into a deficiency of 8 million tones every year. Besides such huge NPK deficiency, a careless attitude of the farmers during the application of fertilizer reduces the percentage of secondary supplements and micronutrient to an abysmal level. The FAI indicates that 'as a result, the deficiency of nutrients and micro nutrients in Indian soil reduces to the tune of 89%(N), 80%(P), 50%(K), 40%(Sulpher), 48%(Zinc), 33%(Boron) respectively'. Rigorous and over use of cultivable land without proper nutrient management makes agriculture costly and having a direct impact on farm income.

The importance of appropriate fertilizer use in agricultural sector in India is getting prominence as in the present modern technique of cultivation occupies an important input as factor of production. The desired objective of attaining self-sufficiency in food is mostly guided by fertilizer's proper application and timely availability. Further, it is expected that a balanced and an appropriate dose should be maintained during consumption and application of different fertilizer nutrients.

The agricultural experts have recommended the appropriate NPK ratio under Indian soil conditions as: 4:2:1. 'In 1991-92, the year immediately preceding the decontrol of phosphatic and potassic fertilizers, the NPK ratio was 5.9:2.4:1. Consequent on decontrol of phosphatic and potassic fertilizers, the NPK ratio were distorted to 9.68:2.94:1 in 1993-94. The same has considerably improved to 5.3:2.2:1 in 2005-06. The farmers have to be educated in the matter of nutrient balance as it has a great long-term significance for the Indian agricultural economy and policy measures on balanced use of fertilizers have to be initiated. Apart from the need for increase in the consumption of fertilizers in appropriate ratio, there is a need to be evenly spread the consumption of fertilizers all over the country' (wg_11fertiliser).

In 1950-51 an estimated amount of 70,0000 tons of fertilizers (NPK) were used for agriculture purposes, it rose to manifold and in the year 2012-13 it reaches to 255lakh ton. Figure of application of plant nutrient in India during First Five Year Plan was 0.89kg/ha, it further rises to 128kg/ha in 2012-13. In case of West Bengal, over the years, the picture is somehow different. In 2011-12, the figure of total fertilizer use was 15 lakh 82 thousand ton and it reduces to 15 lakh 60 thousand ton. During the same period use of plant nutrient decreases from 169kg/ha to 162kg/ha. It has been observed, owing to downward trend in use of phosphate and potash an imbalance in application of NPK throughout India has

justified conducting this study. Proportionate figure of NPK use in India during 2010-11, 2011-12 and 2012-3 was 4.7:2.3:1, 6.7:3.1:1 & 7.9:3.1:1 and as a result use of Plant nutrient ($N+P_2O_5+K_2O$) kg/per hectare during that period varies from 141.3, 139.7 and 128.6 respectively (FAI-2014).

Generally, NPK consumption ratio of 4:2:1 is considered as desirable dose based on the recommendation of 120:60:30 NPK kg/ha for wheat and rice. However, the fertilizer dose has to be worked out based on soil analysis to find out i) available nutrient status of the soils and ii) the crop requirement of the nutrients, the difference of the two (II-I) is the required fertilizer dose for a given crop. There is wide variation in use of NPK ratio over the Zones throughout India, according to data available for NPK use ratio in Eastern Zone it is 5.0:2.4:1' (MOA-GOI, INM Division, Jan-2012). After a considerable period of inappropriate application of fertilizers due attention was given to degradation of soil and environmental pollution. Agriculture sector needed a balanced approach and Bio-fertilizer has been considered as one of the main instruments for sustainable development.

There is no denying the fact that 'bio-fertilizers are cheap, renewable and eco-friendly and its and proper application can to a significant extent supplement plant nutrients though they are not a substitute to chemical fertilizers. They improve health of the soil. Since it provides nutrients to soil in a small and steady manner, its immediate effects are not very visible. More and more use of chemical fertilizers kills all the microorganisms and hence use of Bio-fertilizer can replenish the soil health. Use of chemical fertilizers with supplementary use of Bio-fertilizer can help maintain the soil fertility over a long period' (wg_11fertiliser).

Considering the importance of soil health management, proper application of recommended doses of fertilizer along with sufficient use of bio-nutrient for enhancing productivity and maintaining sustainability in agricultural sector is essential. Accordingly, Government of India has formulated numerous schemes and task force committee with agricultural and environmental experts for its better execution and effective management in this important sector, which in no way can compromise the soil heath and ever-growing contamination of agricultural produce as well as environment.

One of the important Centrally Sponsored Scheme was Macro Management of Agriculture and its main role was to provide inputs 'for the promotion of soil test-based application of

chemical fertilizers, strengthening of soil testing facilities in the country and setting up of compost plants for conversion of bio-degradable waste into organic manure'.

Based on the recommendations of the Task Force on Balanced use of Fertilizer, the new Centrally Sponsored Scheme entitled "National Project on Management of Soil Health and Fertility (NPMSF-2008)" is formed. Main objectives and composition of 'National Project on Management of Soil Health and Fertility' is given below as it has relevance to the present Evaluation Study.

"Fertilizer consumption in India is highly skewed, with wide inter-state, inter-district and inter-crop variations. The NPK ratio, which is a measure of balanced use of fertilizer, shows wide inter-zonal and inter-state disparity. While existing variation from the ideal ratio is nominal in the South and the East zones, it is very wide in the North and the West zones. Indian soils not only show deficiency of NPK but also of secondary nutrients (Sulphur, Calcium and Magnesium) and micro nutrients (Boron, Zinc, Copper and Iron etc.) in most parts of the country. Besides the three primary nutrients (N,P,K), deficiency of Sulphur and micronutrients like Zinc and Boron in many of States, and of Iron, Manganese and Molybdenum in some States, has become a limiting factor in increasing food productivity. Intensive agriculture, while increasing food production, has caused second generation problems in respect of nutrient imbalance.

Needless to mention application of balanced fertilizer can reduce the soil degradation and uphold the much talked sustainable approach in agriculture sector .Balanced fertilization is normally defined as the timely application of all essential plant nutrients (which include primary, secondary and micronutrients) in readily available from, in optimum quantities and in the right proportion, through the correct method, suitable for specific soil/crop conditions. Components of balanced fertilization include judicious use of chemical fertilizers based on deficient soil nutrients as established by soil testing in conjunction with other sources of plant nutrients such as organic manures and bio-fertilizers. Interestingly, despite all technical know-how Government machineries have failed to disseminate these ideas to the actual stake holders.

Main constraints in promoting balanced use of fertilizers include inadequate and ill equipped soil testing facilities, neglect of organic manures, inadequate extension system, wide gap in dissemination of knowledge between research institutions, soil testing laboratories and the extension machinery, and lack of awareness among farmers about

benefits of balanced fertilization. ……In order to promote balanced use of fertilizers, Department of Agriculture & Co-operation launched during 1991-92 a Centrally Sponsored Scheme entitled "Balanced and Integrated Use of Fertilizers".

The main objective of the scheme was to promote integrated nutrient management, to disseminate information on the balanced and judicious use of chemical fertilizers (N,P,K) with secondary nutrient (Sulphur, Calcium, Magnesium) and micro nutrient (Zinc, Iron, Copper, Boron, Molybdenum, Manganese), in conjunction with organic sources of nutrients like green manures, organic manures (compost), vermin-compost etc. and bio-fertilizers based on a scientific soil test.

The scheme's main components were;

i. To establish compost plants to process bio-degradable city solid waste into compost.

ii. To strengthen soil testing facilities by setting up of new Soil Testing Laboratories (STLs) and strengthening of existing STLs.

iii. To conduct training courses for up-gradation of skills of staff of SLTs.

iv. To organize National Seminars/Regional Workshops on soil test based fertilizer recommendations. The scheme continued during subsequent plan periods and was subsumed under the Macro Management of Agriculture (MMA) Scheme in 2000.

New Scheme (NPMSF) for 11th Five Year:

a) Strengthening of Soil Testing Laboratories:

i. Setting up of new Soil Testing Laboratories (Static)

ii. Strengthening of existing Soil Testing Laboratories

iii. Capacity building through training of STL staff/extension officers/farmers and field demonstration/workshop etc. on balanced use of fertilizers.

iv. Creation of Data Bank for site specific balanced use of Fertilizers.

v. Adoption of village by STLs (10 Villages each) through Frontline Field Demonstration (FFD)

vi. Preparation of Digital District Soil Maps and Global Positioning System (GPS) based Soil Fertility Monitoring.

b) Promoting use of Integrated Nutrient Management:

i. Promotion of Organic Manure

ii. Promotion of Soil Amendments (lime/basic slag) in Acidic Soils

iii. Promotion and Distribution of Micronutrients

c) Strengthening of Fertilizer Quality Control Laboratories (FQCLS):

i. Continuation of Central Fertilizer Quality Control & Training Institute Faridabad (CFQC&TI)/Regional Labs.

ii. Strengthening of CFQC&TI/Regional Labs including setting up of 4 new Regional Labs

iii. Strengthening/up gradation of the existing Fertilizer Quality Control Laboratories

iv. Setting up of new Fertilizers Quality Control Laboratories by State Governments

v. Setting up of Fertilizer Testing Laboratories by Private/Co-operative Sector under PPP Mode for Advisory purpose.

vi. Setting up of 250 new Mobile Soil Testing Laboratories (MSTL) in country.'(www.agricoop.nic.in)

In view of the critical role played by soil testing in ensuring balanced and efficient use of fertilizer the Central Government advised all the State Governments to enhance and improve the soil-testing programme and invited a detailed Action Plan delineating existing status of soil testing facilities, soil health cards issued to the farmers etc. These communications indicate that an importance is being given by the Ministry of Agriculture, Government of India in promoting soil testing and balanced use of fertilizers for increasing agricultural production in the country.

1.2 Review of literature

Soil testing is mainly done for analyzing the fertility status of land which is essential for proper utilization of nutrient elements in soils and judicious management of the fertilizer for increasing crop production. Though both soil health and soil quality are synonymous, soil health is a qualitative term and often used by producers, whereas soil quality is a quantitative term and mainly used by scientists (HLS Tandon-2013).

The physical indicators of soil quality influence the chemical and biological properties of soil also. 'These three are not mutually exclusive rather they are inclusive. This demands wider recognition than what it has received so far. Hence the combined soil health index should be used encompassing the physical .chemical and biological quality of soil to

describe the soil health'. (R.Singh and K.K. Bandyopadhyay-2013). Soil health also considers the continued capacity of a soil to function as a vital living system, by recognizing that it contains biological elements that are key to eco system function within land-use boundaries. On farm assessment of soil quality and soil health is recommended to assist farmers in evaluating the effects of their management decisions on soil productivity. The main challenge is to develop soil health standards to assess changes which are practical and useful to the farmers (S.S. Pal and B. Gangwar-2013).

Soil testing plays an important role in crop farming. It is mainly done for evaluating the nutrients of soils used for crop production. Though in common parlance it defines the chemical and physical measurement of soil, but in a broader sense 'soil testing' includes interpretations, evaluations and fertilizer recommendations. It includes: a) accurate determination of the nutrient status of the soil. b) proper information from the farmer about the seriousness of any deficiency or excess that may exist in respect of various crops. c) formulations on the basis of which fertilizer need are to be determined d) expression of results in a manner that permits an economic evaluation of the suggested fertilizer recommendations.

A comprehensive knowledge of the soil resource is of fundamental importance for efficient land use planning. Green revolution by using high-yielding varieties and improved management technology has increased crop production at the cost of productivity of soil and possible risk of soil degradation. Decrease in the soil fertility and unbalanced use of nutrients are important factors responsible for stagnation or decrease in the crop yields over the years. Thus, it should be firmly understood that further increase in food production must be attained by judicious use of soil as a resource (K.N. Singh, A. Kumar, A.K. Tripathy, A.S. Rao and Salman Khan …2005

In order to interpret soil test values knowledge of both nature of soil and crop is required. 'Soil differs in their capacity to supply nutrients to crops, even if they contain similar soil test values of nutrients. Likewise, crops also vary in their nutrient requirement to attain a certain level of yield. Assessment of nutrient requirement for various crops and for different soils is essential for fertilizer recommendation and rational use of fertilizer.' This is normally done by soil–test – crop-response calibration, i.e. soil test calibration (B. Mandal, S.C. Kale., K. Bhattacharya. A.K. Jana and B.K. Bhattacharya-2002).

With the introduction of fertilizer responsive high yielding varieties and hybrid crops during 1960's, the general fertilizer recommendations and the interpretations of the soil test rating by the soil test laboratories needed to be reoriented.

The common perception about fertilizer use in India is that use of nitrogenous fertilizer has increased at a relatively faster rate compared to the use of potassic and phosphatic fertilizer and this has increased the imbalance in use of plant nutrients, which, in the long run, is considered to cause adverse impact on soil fertility and crop productivity.

Research conducted under the "All India Coordinated Research Project on Long Term Fertilizer Experiments" of ICAR provides strong evidence of this. It shows that continuous use of N alone produced decline in yield and has deleterious effect on long term fertility and sustainability (Indian Institute of Soil Science, 2000).

In India the quantitative refinements in the fertilizer recommendations based on the soil and plant analysis were made (1967-68) through the All India Coordinated Research Project for Investigation on Soil Test Crop Response Correlation (STCRC). In West Bengal the STCRC began to operate since 1968. One study was done to evaluate the crop response (in this case –Rice IR-8, Ratna) for application of fertilizer on soil test basis in the Gangetic alluvial soil. The salient findings of the study are - a) Fertilizer doses applied on the basis of targeted yield equations produced greater yields of different varieties of crops in comparison to other ad-hoc recommendations; b) Different multi-locational follow up trials with different crops recorded higher yield than the targets fixed in the equations; c) Evaluation of different soil test methods indicated the superiority of Olsen and alkanine KMnO4 methods for P and N respectively (B. Mandal, S.C. Kale., K. Bhattacharya, A.K. Jana and B.K. Bhattacharya - 2002).

Soil analysis and fertilizer recommendation with three major nutrients, viz, NPK surely loses its significance if some secondary and micronutrients are also not seriously taken into account. While evaluating the work of STCRC it has been observed much attention was not given to the varied agro-climatic zones of West Bengal and the crops covering zones and the recommendations was done uniformly. (B. Mandal, G.N. Chattopadhyay and B.K. Bhattacharya …2002……)

An identical picture is found in Andhra Pradesh where a spatial fertilizer recommendation system validated fertilizer adjustment equations (Generated by AICRP on Soil Test Crop Response Correlation) and Geographic Information System (GIS). Soil test-based fertility

management has a high degree of variability. Prevalence of small holding systems of farming as well as lack of infrastructural facilities for extensive soil testing are being identified as major constraints of soil test-based fertility management. (W. Iftikar, G.N. Chattopadhyay, K. Majumder and C.D.Sulewski - 2010).

The recommendation system suggested varied applications of nutrients for similar targeted yields in different districts of Andhra Pradesh (K.N. Singh, N.S. Raju, A. Subba Rao, A. Rathore, S.Srivastava, R.K. Samantaand and A.K. Majhi, 2005……).

The soil test crop response correlations studies needed to be undertaken in all the agro-climatic regions and for all important crops and cropping systems practiced widely (B. Mandal and M. Roy - 1985).

Concept of sustainability of Indian agriculture got a severe jolt because of deterioration in soil fertility. The data from soil testing laboratories and published literature were analyzed to determine the trend in fertility status of agricultural soils of India since 1967, when the Green Revolution set in. Based on the soil test values of N, P and K, soil samples were classified into three categories i.e., low, medium and high, and nutrient index was calculated for soils of different states. 'In some states like for example, West Bengal, Gujarat, Tamil Nadu, N fertility increased, while it declined in Orissa and Kerala Available information indicated that the soil organic carbon content either remained static or increased in certain regions of India. Therefore, contrary to the general perception, there has not been much depletion of soil fertility of agricultural soils of the country over the years' (H. Pathak - 2011).

ICAR-2011 prescribed a five-point strategy to accomplish the vision for enhancing soil efficiency, water and plant nutrients. These are: a) Enhancing nutrient and water use efficiency through Integrated Nutrient Management (INM), precision agriculture, fertilizer fortification and increasing input use efficiency; b) Sustaining soil and produce quality through Bio-fortification, organic farming and produce quality characterization and understanding resilience of degraded soils and restoration of their productivity; c) Bio-diversity and Genomics through characterization and prospecting of large soil bio-diversity, characterization of functional communities of soil organisms and testing of mixed bio fertilizer formulations; d) Climate change and Carbon sequestration through crop adaptation to climate change-rhizospheric studies, crop simulation modeling and remote sensing in climate change research, Tillage and nutrient interaction in soil,

conservation agriculture and carbon sequestration-especially in semiarid and sub-humid regions and Carbon sequestration research in the context of sustainable management of land and soil resources and conserving deteriorating environment; e) Minimizing Soil Pollution through Bio-remediation, quality compost production and establishing quality standards and soil wastes and waste waters-quality assessment and recycling (IISS, ICAR-Vision - 2030).

Considering the sustainability of rice-wheat cropping system (RWCS) of the Indo-Gangetic Plain, (Sher Singh, R.K.Malik, J..Dhankar, R.Garg, P.Sheoran, A. Yadav and B.R. Kamboj - 2011) opined that adequate crop nutrition in general and nitrogen (N) in particular holds the key to sound crop management. An excessive application or insufficient management of N means an economic loss to the farmer and may lead to yield penalties and environmental problems. 'Fertilizer use pattern for rice in RWCS in the IGP is region specific and diagnostic surveys have indicated that farmers are using more than the recommended levels of N to rice in Trans-Gangetic Plain and parts of upper Gangetic Plain representing Punjab, Haryana and Western Uttar Pradesh in India. Most of the farmers are not aware of N recommendation and are happy with their present N management practices in rice which are traditional and location specific' (ibid.). They observed, the farmers themselves adjust their nutrient management practices on the basis of their experiences, but scientific evaluation of recommendation is yet to come.

1.3 Need for the study

In the light of increased degradation of natural resources due to intensive cultivation and injudicious use, their sustainable management holds the key for ensuring sustainable food production. Due to lack of awareness among the farmers, there are widespread problems related to the indiscriminate use of chemical fertilizers, mismanagement of surface water and over exploitation of ground water. The over use of chemical fertilizers in most parts of India in the last few decades led to several problems affecting soil health, nutrient flow and natural environment. There is a need for promoting, among others, balanced use of fertilizers for increasing productivity of crops and for better absorption of nutrients from the applied fertilizers. It is suggested that farmers should go for regular soil testing and use recommended doses of fertilizers as advised by the agricultural scientists. In this connection, Task Force on Balance Use of Fertilizer recommended formulating a Centrally Sponsored Scheme entitled "National Project on Management of Soil Health and Fertility (NPMSF)". Accordingly, this scheme has been implemented since 2008-09 and it

encompasses three components viz. strengthening of soil testing laboratories (STLs), promoting use of integrated nutrient management and strengthening of fertilizer quality control laboratories. There is no systematic study undertaken so far for evaluating the effectiveness of the programme on crop productivity, extent of soil testing for nutrient deficiency and adoption of recommended doses of fertilizers by farmers based on the soil tests. Therefore, the present study examines the level of adoption and constraints in the application of recommended doses of fertilizers, impact on crop productivity and relevant institutional problems.

1.4 Objectives of the Study

The objectives of the study are as follows;

2. To examine the level of adoption and its constraints in the application of recommended doses of fertilizers based on soil test reports by the farmers.

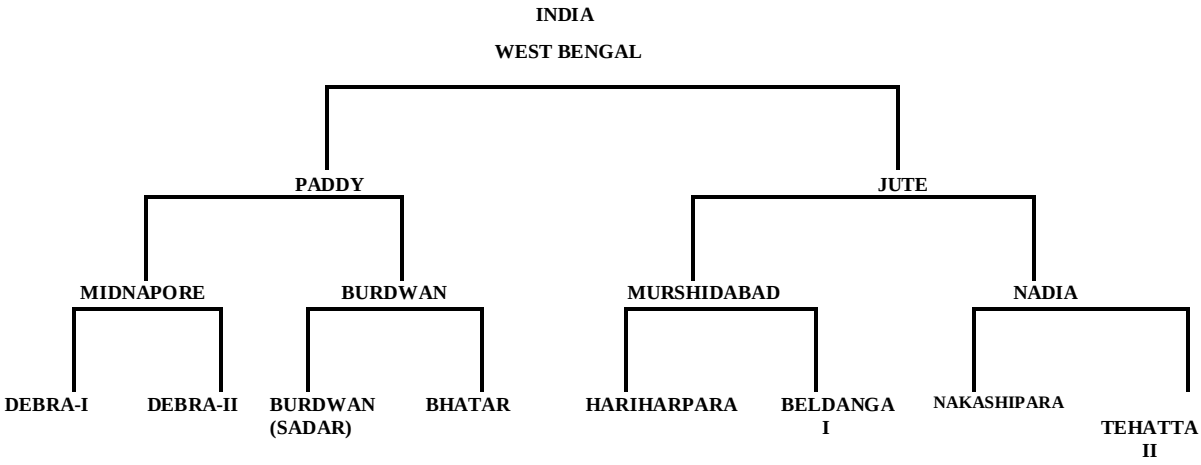
2. To analyze the impact of adoption of recommended doses of fertilizers on crop productivity and income of farmers.

1.5 Data and Methodology

The present study is essentially based on the primary data collected from the state of West Bengal. The reference period for the study is 2013-14. The list of farmers who got their soil tested are collected from the state Department of Agriculture for the year 2012-13 to assess the adoption of recommended dose of fertilizers. Two major crops (in terms of area) Viz. Paddy and Jute are selected for the study purpose. As per the requirement of the study design for each crop, two districts have been selected based on the crop area share within the state. From each district, two taluks/tehsils are selected again based on the crop area share. From the selected taluk, (in our case, Blocks) two clusters of villages comprising 3-4 villages per cluster have been selected for conducting the survey. In the study for Paddy, keeping the selection criterion in mind the districts of Midnapore and Burdwan are selected. The Blocks Debra-I and Debra-II in Midnapore district and Burdwan (Sadar) and Bhatar in Burdwan district have been selected for the study purpose. Similarly for Jute, the districts of Murshidabad and Nadia, considering the highest area of cultivation of the said crop in the state of West Bengal have been selected. The Blocks: Hariharpara and Beldanga in Murshidabad district and Nakashipara and Tehatta-II in Nadia district have been selected to gather information from the farmers. A sample of 60 soil test farmers for

Paddy and Jute have been selected randomly from each district for assessing the application of recommended dose of fertilizers and its impact on crop production. The cluster approach is followed to ensure that adequate number of soil test farmers is available for survey. Further, adequate care has also been taken to ensure that the selected villages fall under the agro-climatic conditions of sample districts and that the selected villages have certain common characteristics such as soil type, irrigation and crop variety etc.

Besides the soil-tested farmers, 30 control (non-soil test) farmers, for Paddy and Jute from the selected districts have also been selected purposively from the chosen cluster for differentiating the effect of the application of recommended dose of fertilizers on crop productivity and income. Thus, a total of 120 soil test farmers and 60 control farmers for each crop have been interviewed. A well structured questionnaire for getting information well skewed to the problem has been canvassed among the tested and controlled farmers in the study area



1.6 Organization of the Report

The Report consists of seven chapters. In the first chapter an elementary discussion of soil testing and need for appropriate doses of fertilizers in agriculture sector has been made. Moreover, a brief review of literature has also been incorporated to have a background for conducting the study.

The second chapter analyses the trends in fertilizer consumption in the state of West Bengal. The socio-economic characteristics and features of the sampled farmers viz. land

holdings, sources of irrigation, cropping pattern, assets holdings including availability of agricultural credit, etc. have been elaborately discussed in the third chapter.

The fourth chapter deals with the information and analyses of soil testing and application of fertilizers in recommended doses by the farmers in the study areas.

The constraints for adoption of recommended doses of fertilizers including application and method of application and use of organic farming and training in relation with the programme have vividly been discussed in chapter five.

Impact of adoption of recommended doses of fertilizers in raising agricultural productivity and income among the sample farmers has been discussed in chapter six.

The conclusive chapter seven describes the summary of the report mentioned in the earlier chapters and more importantly, recommend the policies for effective functioning of soil testing and adoption of recommended doses of fertilizers in agriculture sector.

CHAPTER-II

Trends in Fertilizer Consumption in the State

2.1 Background:

Fertilizer is the most important input in crop production. Thus, rapid and continuous growth in the use of Fertilizer is necessary to achieve self-sufficiency not only in food grain production but also to increase the production of commercial crops like jute, oilseeds, vegetables etc. In the present chapter, an attempt has been made to examine the trends of Fertilizer use both in terms of Fertilizer nutrient as well as product-wise during the period from 1980-81 to 2010-11 and 2002-3 to 2011-12 in West Bengal. However, there is a caveat: excessive use of fertilizer endangers the soil fertility in the long-run. Hence, for a sustainable agriculture, OPTIMUM use of fertilizer is necessary. In fact, the present study is commissioned only with such an objective.

2.2 Trend in aggregate Fertilizer consumption in the state by nutrients:

It is found that a major amount of plant nutrients is removed from soil every year by some high valued crops like Summer Paddy, Potato etc. The target of larger yield through improved varieties of crops and intensive cultivation of these crops also reduce the nutrients further. It is thus obvious that the huge reduction of nutrient from soil will definitely reduce soil fertility unless these deficiencies are filled up by natural or artificial ways. The principal method of supplementing natural recovery and for improving the productive capacity of soils is : (i) to add organic matter to the soil and (ii) to increase the amount of deficient nutrients by the application of chemical Fertilizers and organic manures .

Now, let us look at the patterns of the total consumption of chemical Fertilizers (N. P. and K.). In the state these values have increased from 2.83 lakh ton in 1980-81 to 4.08 lakh ton in 1985-86, 7.55 lakh ton in 1996-97, 12.31 lakh ton in 1999-2000, 13.65 lakh ton in 2006-07 and 16.44 lakh ton in 2009-10. Thus, during this 30 year period, consumption of chemical Fertilizers in West Bengal increased by 270 percent i.e. 9 % per year on an average (Table-2.1).

From the Figure-2.1.1 given below, we find a sharp increase in the total consumption of chemical Fertilizers (N. P. and K.) in the state during the period 1980-81 to 2010-11.

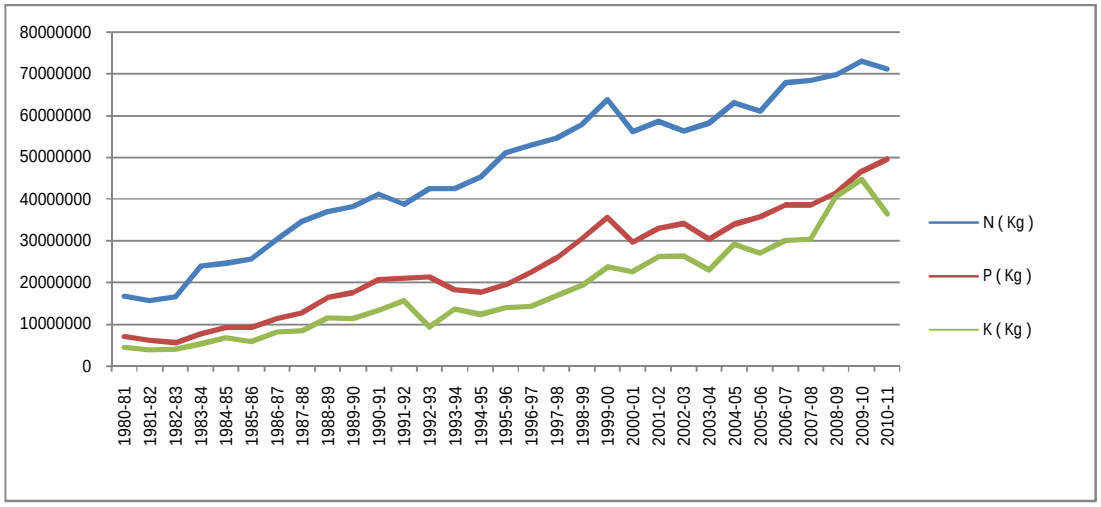
From our corresponding regressions (1, 2, 3 and 4), we also find that N. P. K. and total consumption of chemical Fertilizers have significant positive time trend, which means these are rising considerably over time.

Table- 2.1 Fertilizer Consumption in West Bengal by Nutrients (Quantity in tones)

Year	N	P	K	Total
1980-81	167321	70844	44669	282834
1981-82	156927	62470	39060	258457
1982-83	165765	56211	40233	262209
1983-84	238655	77315	53176	369146
1984-85	246244	91893	67592	405729
1985-86	256826	92312	59616	408754
1986-87	304023	113827	81827	499677
1987-88	347763	128916	84661	561340
1988-89	370925	164205	115578	650708
1989-90	381625	175756	113714	671095
1990-91	411896	206782	134330	753008
1991-92	387689	210433	157364	755486
1992-93	424680	212644	93962	731286
1993-94	425308	183212	136576	745096
1994-95	451911	177711	123960	753582
1995-96	512187	195221	140308	847716
1996-97	528172	224558	143368	896098
1997-98	546320	259859	169207	975386
1998-99	579698	305769	192483	1077950
1999-00	638748	355634	237389	1231771
2000-01	561880	296954	226252	1085086
2001-02	586841	329785	261556	1178182
2002-03	562998	341244	263377	1167619
2003-04	581965	304177	230080	1116222
2004-05	630945	339615	290899	1261459
2005-06	611400	357800	270500	1239700
2006-07	678432	386256	300467	1365155
2007-08	684543	385761	304434	1374738
2008-09	698200	415400	405700	1519300
2009-10	730700	467300	446500	1644500
2010-11	712400	495600	363800	1571800

Source: Statistical Abstract, B.A.E.&S,Govt.of West Bengal

Figure – 2.1 Fertilizer Consumption in West Bengal by Nutrients



Regression Analysis:

```
1. reg frt _n_ton year_sl, robust
Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) = 828.30
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.9617
                                                      Root MSE      =3.5e+
------------------------------------------------------------------------------
             |               Robust
    frt_n_ton |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   1.88e+07   654438.2    28.78   0.000     1.75e+07    2.02e+07
       _cons |   1.69e+08   1.21e+07    13.92   0.000     1.44e+08    1.94e+08
------------------------------------------------------------------------------

2. reg frt_p_ton year_sl, robust

Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) = 671.69
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.9532
                                                      Root MSE      =2.8e+07
------------------------------------------------------------------------------
             |               Robust
    frt_p_ton |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   1.35e+07   519828.3    25.92   0.000     1.24e+07    1.45e+07
       _cons |   2.59e+07    7888007     3.28   0.003      9776060    4.20e+07
------------------------------------------------------------------------------

3. reg frt_k_ton year_sl, robust

Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) = 206.23
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.9097
                                                      Root MSE      =3.4e+07
------------------------------------------------------------------------------
             |               Robust
    frt_k_ton |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   1.17e+07   815790.1    14.36   0.000     1.00e+07    1.34e+07
       _cons |   -7039710   1.10e+07    -0.64   0.526    -2.95e+07    1.54e+07
------------------------------------------------------------------------------
```

```
4. reg frt_tot_ton year_sl, robust

Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) =1242.57
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.9753
                                                      Root MSE      =6.5e+07

------------------------------------------------------------------------------
             |               Robust
  frt_tot_ton |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   4.40e+07    1248867    35.25   0.000     4.15e+07    4.66e+07
       _cons |   1.88e+08   1.80e+07    10.46   0.000     1.51e+08    2.25e+08
```

Where:

1. n= consumption of nitrogen in ton during the year from 1980-81 to 2010-11

2. p = consumption of phosphorus in ton during the period 1980-81 to 2010-11.

3.k = consumption of potash in ton during the period 1980-81 to 2010-11.

4.tot = consumption of total (n,p,k)in ton during the period 1980-81 to 2010-11.

2.3 Trend in per hectare Fertilizer consumption in the state by nutrients (kg/hect) :

Now, if we look into the per hectare use of fertilizer in the state by nutrients (N,P,K and Total) (i.e. kg per hectare of gross cropped area), it is found that in case of Nitrogen (N), it has increased from 21.84 kg in 1980-81 to 80.66 kg in 2010-11, in case of Phosphorus (P), it has increased from 9.25 kg to 56.11 kg and in case of Potash (K) it has increased from 5.83 kg in 1980-81 to 41.19 kg in 2010-11 per hectare of gross-cropped-area (GCA). In case of Total Nutrients (N,P and K), it has increased from 36.91 kg in 1980-81 to 55.57 kg in 1985-86, 87.17kg in 1991-92, 105.64 kg in 1997-98, 132.46 kg in 2004-04 and 177.96 kg per hectare of GCA in 2010-11. This means, during these 31 years, total consumption of chemical fertilizers increased 141.05 kg per hectare of gross cropped area, i.e. 4.55 kg per year (Table – 2.2).

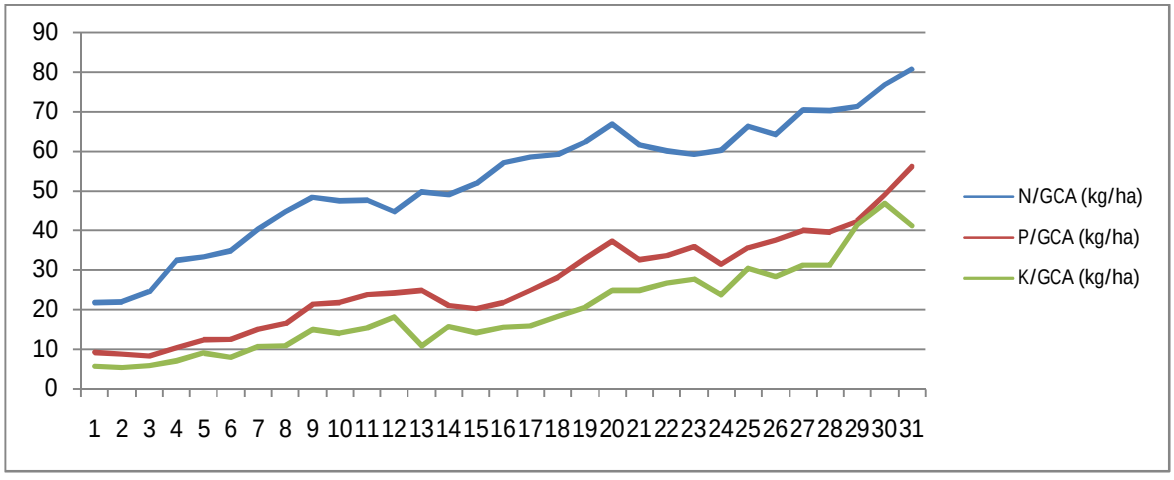
From the Figure – 2.2.2 given below, a sharp increase in the consumption of N.P.K. and total nutrient, kg per hectare of gross cropped area, is also found over the years, starting from 1980-81 to 2010-11.

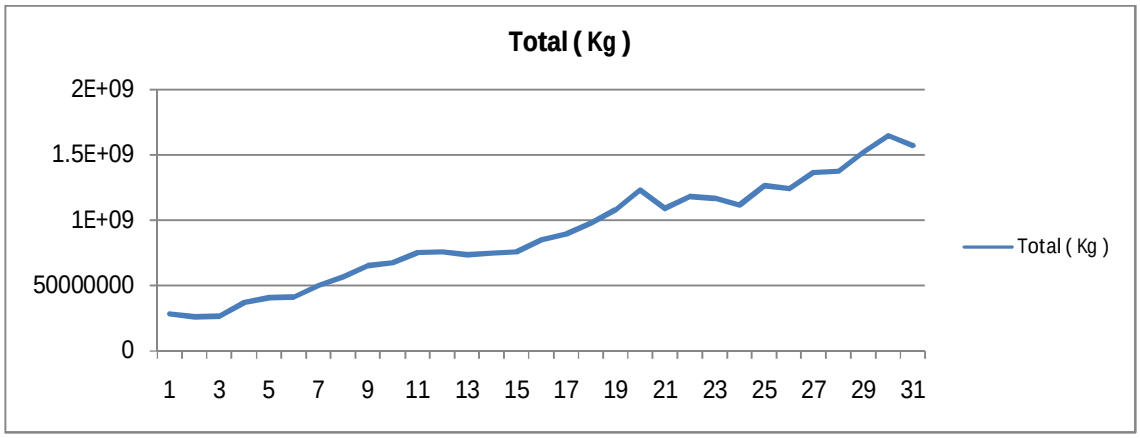
Table- 2.2 Fertilizer Consumption in West Bengal al by Nutrients (Kg/Hect.) of GCA

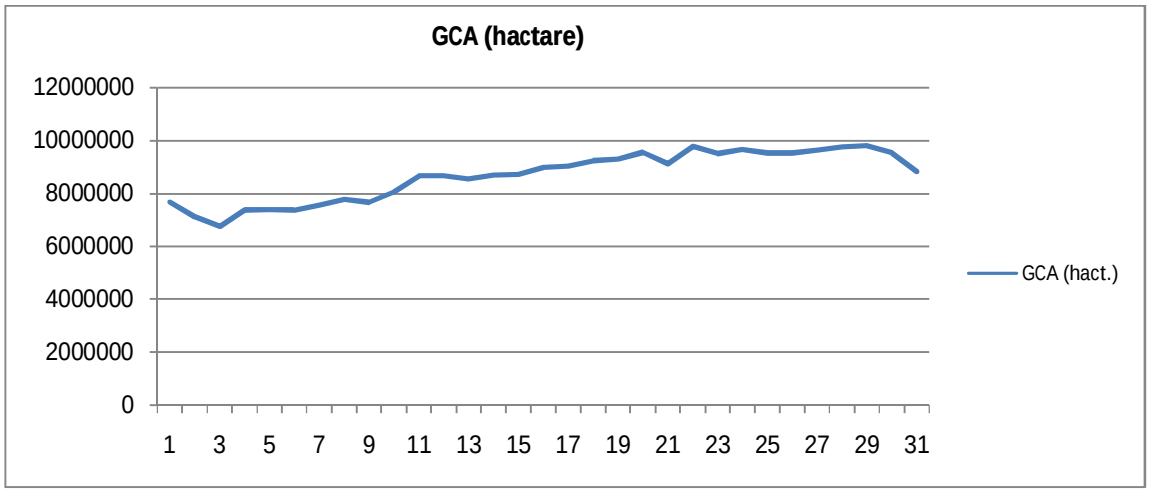
Year	GCA (Hectare)	N/GCA (kg/ha)	P/GCA (kg/ha)	K/GCA (kg/ha)	Total/GCA (kg/ha)
1980-81	7661600	21.83891	9.246633	5.830244	36.91579
1981-82	7121600	22.03536	8.771905	5.484723	36.29198
1982-83	6751100	24.55378	8.326199	5.959473	38.83945
1983-84	7369200	32.38547	10.49164	7.21598	50.09309
1984-85	7386400	33.33749	12.44084	9.150872	54.92919
1985-86	7355400	34.91666	12.55024	8.105066	55.57196
1986-87	7546400	40.28716	15.08362	10.84318	66.21396
1987-88	7774600	44.73066	16.58169	10.88943	72.20179
1988-89	7666000	48.38573	21.41991	15.07670	84.88234
1989-90	8045600	47.43276	21.84498	14.13369	83.41143
1990-91	8662280	47.55053	23.87154	15.50746	86.92954
1991-92	8666260	44.73545	24.28187	18.15824	87.17555
1992-93	8540250	49.72688	24.89904	11.00225	85.62817
1993-94	8680490	48.99585	21.10618	15.73367	85.83571
1994-95	8718120	51.83583	20.3841	14.21866	86.43859
1995-96	8972540	57.08384	21.75761	15.63749	94.47893
1996-97	9032940	58.47177	24.8599	15.87169	99.20336
1997-98	9233030	59.17017	28.1445	18.32627	105.6409
1998-99	9309640	62.26857	32.84434	20.67567	115.7886
1999-00	9545360	66.91712	37.25726	24.86957	129.0440
2000-01	9116600	61.63263	32.57289	24.81759	119.0231
2001-02	9778810	60.01149	33.72445	26.74722	120.4832
2002-03	9510420	59.19802	35.88107	27.69352	122.7726
2003-04	9661320	60.23659	31.484	23.81455	115.5351
2004-05	9522930	66.25534	35.66287	30.54722	132.4654
2005-06	9532607	64.13775	37.53433	28.37629	130.0484
2006-07	9634535	70.41668	40.09078	31.18646	141.6939
2007-08	9751508	70.19868	39.55911	31.21917	140.977
2008-09	9801516	71.23388	42.3812	41.39156	155.0066
2009-10	9530276	76.67144	49.03321	46.85069	172.5553
2010-11	8832348	80.65805	56.11192	41.1895	177.9595

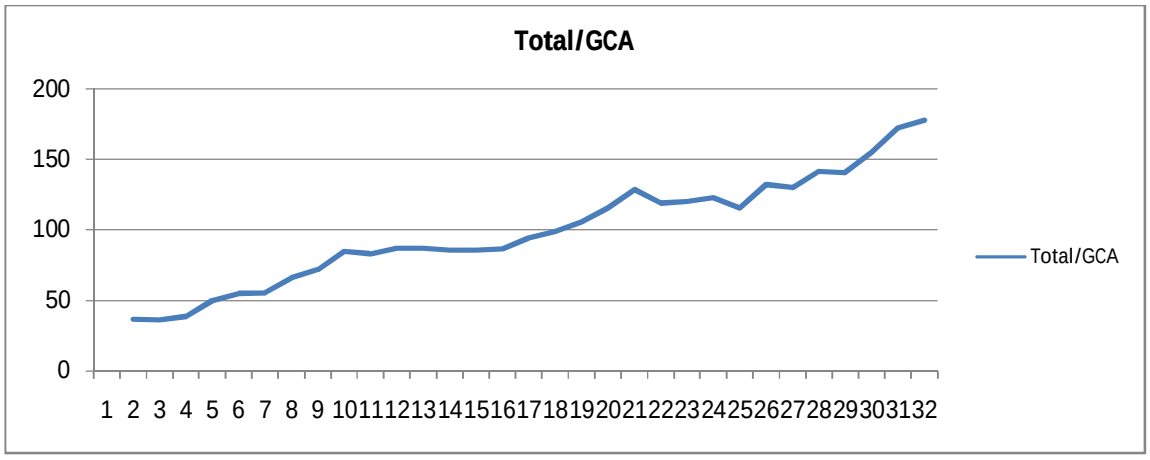
Source: Statistical Abstract .A.E.& S,Govt.of West Bengal

Figure –2.2 Fertilizer Consumption in West Bengal al by Nutrients (Kg/Hect.) of GCA




Total (Kg)
2E+09
1.5E+09
1E+09
50000000
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
Total (Kg)


GCA (hactare)
12000000
10000000
8000000
6000000
4000000
2000000
0
1 3 5 7 9 11 13 15 17 19 21 23 25 27 29 31
GCA (hact.)


Total/GCA
200
150
100
50
0
1 2 3 4 5 6 7 8 9 10111213141516171819202122232425262728293031 32
Total/GCA

Regression Analysis:

Regression analysis has been done on the basis of following

```
5. reg frt_n_gca year_sl, robust

Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) = 356.01
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.9316
                                                      Root MSE      = 4.1829
------------------------------------------------------------------------------
             |               Robust
  frt_n_gca |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   1.669573   .0884865    18.87   0.000     1.488598    1.850548
       _cons |    26.1033   1.764442    14.79   0.000     22.49461    29.71199
------------------------------------------------------------------------------

6. reg frt_p_gca year_sl, robust

Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) = 292.91
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.9271
                                                      Root MSE      = 3.3746

------------------------------------------------------------------------------
             |               Robust
  frt_p_gca |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   1.301164   .0760265    17.11   0.000     1.145672    1.456655
       _cons |   5.962021   .9959556     5.99   0.000     3.925063    7.998979
------------------------------------------------------------------------------
7. reg frt_k_gca year_sl, robust

Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) = 178.42
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.8950
                                                      Root MSE      = 3.6487
------------------------------------------------------------------------------
             |               Robust
  frt_k_gca |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   1.152122   .0862529    13.36   0.000     .9757148    1.328529
       _cons |   1.453926   1.123835     1.29   0.206    -.8445741    3.752427
------------------------------------------------------------------------------

8. reg frt_tot_gca year_sl, robust

Regression with robust standard errors                Number of obs =     31
                                                      F(  1,    29) = 518.23
                                                      Prob > F      = 0.0000
                                                      R-squared     = 0.9570
                                                      Root MSE      = 8.0842
------------------------------------------------------------------------------
             |               Robust
 frt_tot_gca |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     year_sl |   4.122858   .1811081    22.76   0.000     3.752451    4.493266
       _cons |   33.51925   2.544266    13.17   0.000     28.31564    38.72286
------------------------------------------------------------------------------
```

Where 5. n= consumption of nitrogen kg per hect. of GCA during 1980-81 to 2010-11

6. p= consumption of nitrogen kg per hect. of GCA during 1980-81 to 2010-11

7. k= consumption of nitrogen kg per hect. of GCA during 1980-81 to 2010-11

8. tot= consumption of nitrogen kg per hect. of GCA during 1980-81 to 2010-11

From our regression analyses, we also find that N. P. K. and total consumption of chemical Fertilizer (kg) per hectare of gross cropped area have significant positive time trend, which means these are changing considerably over time.

2.4 Trend in Fertilizer consumption in the state by products:

The product- wise Fertilizer consumption in West Bengal from 2002-03 to 2011-12 is shown in Table – 2.3 below.

Table- 2.3 Fertilizer Consumption in West Bengal by Products (Quantity in Tons)

Year	UREA	DAP	MOP	SSP	AS	10:26:26	14:35:14	15:15:15	12:32:16	20:20:20	28:28:28	GCA
2002-03	952040	366220	285080	393700	17650	295260	33540	72440	-	17690	24220	9510420
2003-04	1012090	317320	250110	381630	39980	249450	29450	73530	300	18220	26090	9661320
2004-05	1099040	335200	315560	395170	28570	334890	44720	54560	290	15690	18780	9522930
2005-06	1038650	344200	257580	391940	28410	383080	43730	65770	2310	20290	25610	9532607
2006-07	1165760	374870	283570	373920	17800	438080	58830	51890	2510	22690	22760	9634535
2007-08	1167400	378290	275710	300680	14400	475730	44400	51530	8590	42510	19390	9751508
2008-09	1165480	380200	459120	370850	12750	422950	11890	48660	70290	151970	3460	9801516
2009-10	1171250	438780	497170	295250	7290	494150	58940	34070	39850	196650	15160	9530276
2010-11	1126080	459060	323250	414110	13220	598520	39600	13530	18420	159410	9810	8832348
2011-12	1274300	476670	301540	424460	2680	486290	12810	53040	440	199250	26520	9212324

Source: F&A Stat. Eastern Region by Fertilizer association of India, Kolkata

From the above table it is found that use of most of the Fertilizers (Product-wise) increased from 2002-03 to 2011-12 in the state, such as, Urea increased from 9.52 lakh ton to 12.74 lakh ton, DAP from 3.66 to 4.77 lakh ton, MOP from 2.85 to 3.01 lakh ton, SSP from 3.94 to 4.24 lakh ton, 10:26:26 from 2.95 to 4.86 lakh ton, and 20:20:20 increased from 0.17 to 1.99 lakh ton. Although the consumption of some other products like AS has decreased from 0.17 to 0.02 lakh ton,14:35:14 has decreased from 0.33 to 0.12 lakh ton and 15:15:15 has decreased from 0.72 to 0.53 lakh ton in 2011-12.

2.5 Trend in Fertilizer consumption in the state by Products (kg/hect):

From product-wise Fertilizer consumption kg per hectare of gross cropped area in West Bengal it is also found that Urea increased from 100.10 kg to 115.41 kg in 2004-05 and 138.33 kg in 2011-12, DAP from 38.51 kg to 38.91 in 2006-07 and 51.74 kg in 2011-12,

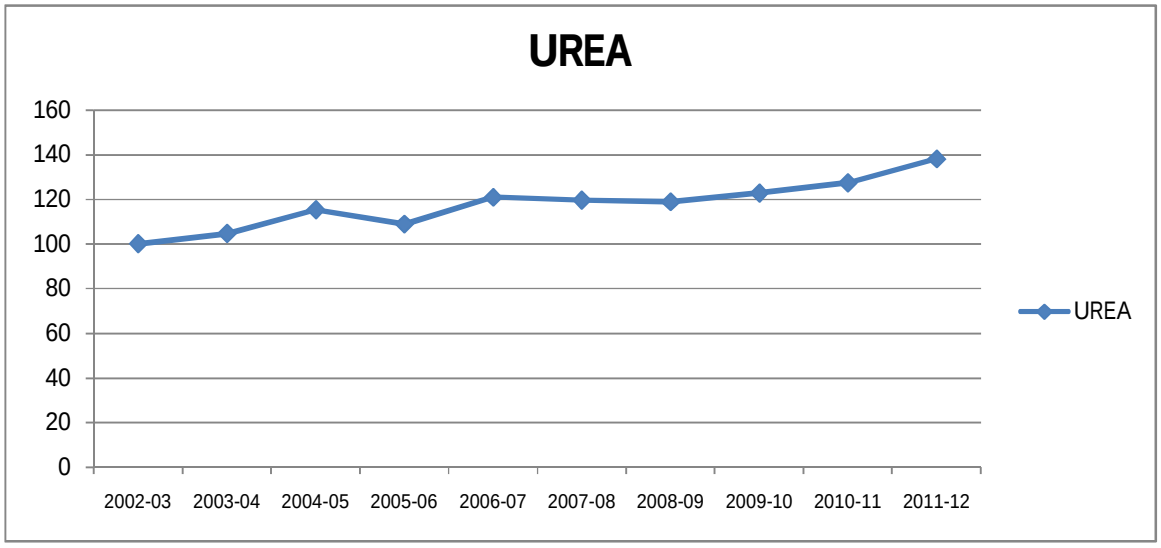
MOP from 29.98 to 33.14 kg in 2004-05 and 32.73 kg in 2011-12, SSP from 41.40 to 46.08 kg in 2011-12, 10:26:26 from 31.05 to 45.47 kg in 2006-07 and 52.79kg in 2011-12, 20:20:20 increased from 1.86 to 21.63 kg in 2011-12 and 28:28:28 increased from 2.55 in 2002-03 to 2.88 kg per hectare of gross cropped area in 2011-12. Of course, the consumption of some other products like AS has decreased from 1.86 to 0.29 kg, 14:35:14 has decreased from 3.53 to 1.39 kg and 15:15:15 has decreased from 7.62 to 5.76 kg per hectare of gross cropped area in 2011-12 (Table- 2.4).

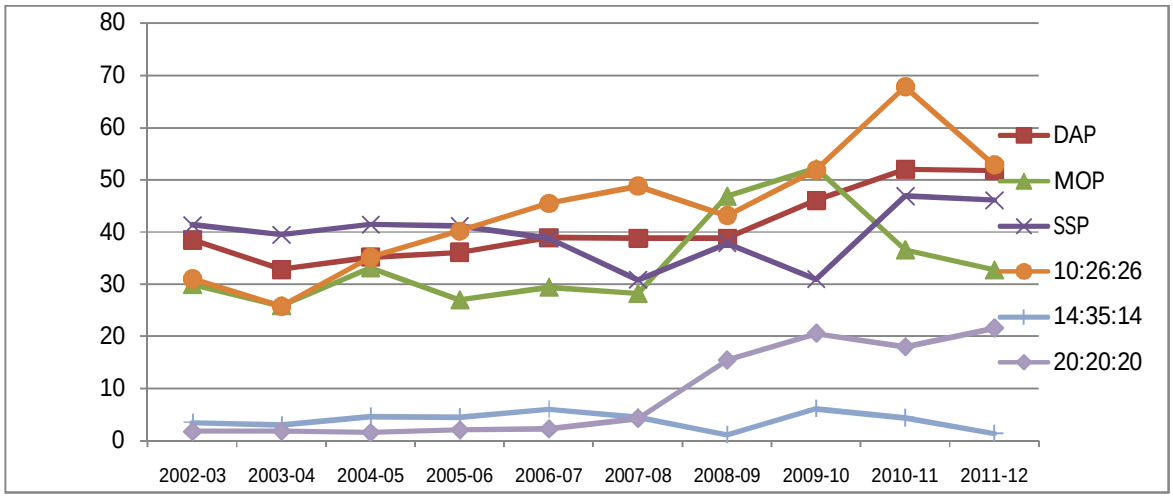
Table- 2.4 Fertilizer Consumption in West Bengal al by Products (Kg/Hect.) of GCA

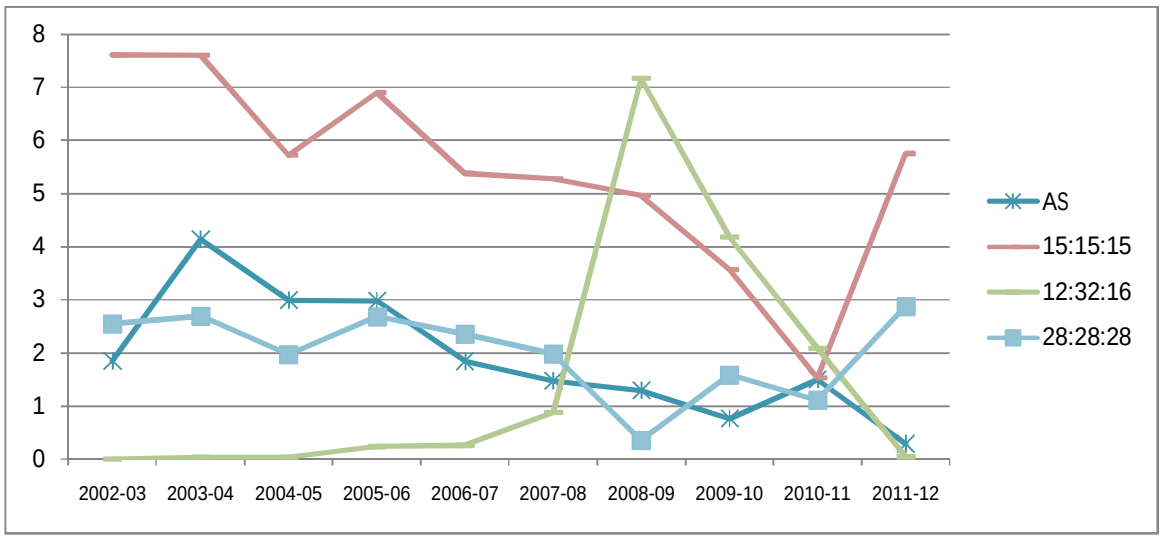
Year	UREA	DAP	MOP	SSP	AS	10:26:26	14:35:14	15:15:15	12:32:16	20:20:20	28:28:28
2002-03	100.10	38.51	29.98	41.40	1.86	31.05	3.53	7.62	-	1.86	2.55
2003-04	104.76	32.84	25.89	39.50	4.14	25.82	3.05	7.61	0.03	1.89	2.70
2004-05	115.41	35.20	33.14	41.50	3.00	35.17	4.70	5.73	0.03	1.65	1.97
2005-06	108.96	36.11	27.02	41.12	2.98	40.19	4.59	6.90	0.24	2.13	2.69
2006-07	121.00	38.91	29.43	38.81	1.85	45.47	6.11	5.39	0.26	2.36	2.36
2007-08	119.71	38.79	28.27	30.83	1.48	48.79	4.55	5.28	0.88	4.36	1.99
2008-09	118.91	38.79	46.84	37.84	1.30	43.15	1.21	4.96	7.17	15.50	0.35
2009-10	122.90	46.04	52.17	30.98	0.76	51.85	6.18	3.57	4.18	20.63	1.59
2010-11	127.49	51.97	36.60	46.89	1.50	67.76	4.48	1.53	2.09	18.05	1.11
2011-12	138.33	51.74	32.73	46.08	0.29	52.79	1.39	5.76	0.05	21.63	2.88

Source: F&A Stat. Eastern Region by Fertilizer association of India, Kolkata

Figure –2.3 Fertilizer Consumption in West Bengal al by Products (Kg/Hect.) of GCA







The above Figure – 2.4.1 also shows a sharp increase in the consumption of some Fertilizers like Urea, DAP, and MOP, SSP, 10:26:26, 20:20:20 and 28:28:28 kg per hectare of gross cropped area from 2002-03 to 2011-12. While, the consumption of some other products like AS, 14:35:14 and 15:15:15 has decreased substantially from 2002-03 to 2011-12.

Regression Analysis:

```
9. reg urea time, robust

Regression with robust standard errors                Number of obs =     10
                                                      F(  1,     8) =  60.05
                                                      Prob > F      = 0.0001
                                                      R-squared     = 0.8737
                                                      Root MSE      = 4.2112
------------------------------------------------------------------------------
             |               Robust
        urea |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   3.449457   .4451481     7.75   0.000     2.422944     4.47597
       _cons |   98.78485   2.682376    36.83   0.000     92.59928    104.9704
------------------------------------------------------------------------------
. dwstat
Durbin-Watson d-statistic (2,    10) = 2.268127


10. reg dap time, robust

Regression with robust standard errors                Number of obs =     10
                                                      F(  1,     8) =  16.33
                                                      Prob > F      = 0.0037
                                                      R-squared     = 0.7422
                                                      Root MSE      = 3.6155
------------------------------------------------------------------------------
             |               Robust
         dap |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |    1.91012   .4727037     4.04   0.004     .8200632    3.000177
       _cons |   30.38519   2.998988    10.13   0.000     23.46951    37.30087
------------------------------------------------------------------------------
. dwstat

Durbin-Watson d-statistic(  2,    10) =  1.113236


11. reg  mop time, robust

Regression with robust standard errors                Number of obs =     10
                                                      F(  1,     8) =   3.79
                                                      Prob > F      = 0.0875
                                                      R-squared     = 0.2825
                                                      Root MSE      = 7.8555
------------------------------------------------------------------------------
             |               Robust
         mop |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   1.534794   .7886088     1.95   0.088    -.2837412    3.353329
       _cons |   25.76535    3.15196     8.17   0.000     18.49692    33.03378
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic (  2,    10) =  1.533499
```

```
12. reg  ssp time, robust

Regression with robust standard errors                Number of obs =    10
                                                      F(  1,     8) =   0.05
                                                      Prob > F      = 0.8205
                                                      R-squared     = 0.0064
                                                      Root MSE      = 5.6706
------------------------------------------------------------------------------
             |               Robust
         ssp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .1418346   .6049553     0.23   0.821    -1.253195    1.536864
       _cons |   38.71306   2.383683    16.24   0.000     33.21628    44.20985
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic(  2,    10) =  1.652818

13. reg   as time, robust
Regression with robust standard errors                Number of obs =    10
                                                      F(  1,     8) =   7.34
                                                      Prob > F      = 0.0267
                                                      R-squared     = 0.6119
                                                      Root MSE      = .76192
------------------------------------------------------------------------------
             |               Robust
          as |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.2979358   .1099833    -2.71   0.027    -.5515578   -.0443138
       _cons |   3.553855   .7937069     4.48   0.002     1.723564    5.384146
------------------------------------------------------------------------------
. dwstat
Durbin-Watson d-statistic (2,    10) = 2.174589

14. reg   x1 time, robust
Regression with robust standard errors                Number of obs =     10
                                                      F(  1,     8) =  20.56
                                                      Prob > F      = 0.0019
                                                      R-squared     = 0.7855
                                                      Root MSE      = 5.9491
------------------------------------------------------------------------------
             |               Robust
          x1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   3.544936   .7817947     4.53   0.002     1.742115    5.347758
       _cons |   24.70554   3.513829     7.03   0.000     16.60264    32.80844
------------------------------------------------------------------------------
. dwstat
Durbin-Watson d-statistic(  2,    10) =  2.552697

15. reg  x2 time, robust
Regression with robust standard errors                Number of obs =     10
                                                      F(  1,     8) =   0.18
                                                      Prob > F      = 0.6786
                                                      R-squared     = 0.0207
                                                      Root MSE      = 1.7935
------------------------------------------------------------------------------
             |               Robust
          x2 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.0812841   .1890784    -0.43   0.679    -.5172998    .3547315
       _cons |    4.42599    .875312     5.06   0.001     2.407516    6.444463
------------------------------------------------------------------------------
. dwstat

Durbin-Watson d-statistic (2,    10) = 2.165145
```

```
16. reg  x3 time, robust

Regression with robust standard errors                Number of obs =    10
                                                      F(  1,     8) =   5.96
                                                      Prob > F      = 0.0405
                                                      R-squared     = 0.5683
                                                      Root MSE      = 1.2886

------------------------------------------------------------------------------
             |               Robust
          x3 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.4603954   .1886367    -2.44   0.041    -.8953924   -.0253985
       _cons |    7.96772   .7413604    10.75   0.000     6.25814      9.6773
------------------------------------------------------------------------------
. dwstat

Durbin-Watson d-statistic (2,    10) = 2.369016

17. reg  x4 time, robust

Regression with robust standard errors                Number of obs =    10
                                                      F(  1,     8) =  52.19
                                                      Prob > F      = 0.0001
                                                      R-squared     = 0.8078
                                                      Root MSE      = 4.0645

------------------------------------------------------------------------------
             |               Robust
          X4 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   2.594674   .3591643     7.22   0.000      1.76644    3.422909
       _cons |  -5.265462    2.48556    -2.12   0.067    -10.99717    .4662489
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic (2,    10) = 1.001791

18. reg  x5 time, robust

Regression with robust standard errors                Number of obs =    10
                                                      F(  1,     8) =   1.28
                                                      Prob > F      = 0.2905
                                                      R-squared     = 0.1577
                                                      Root MSE      = .78366

------------------------------------------------------------------------------
             |               Robust
          X5 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |  -.1055828   .0932817    -1.13   0.290    -.3206908    .1095253
       _cons |   2.599676   .3649661     7.12   0.000     1.758062    3.441289
------------------------------------------------------------------------------

. dwstat

Durbin-Watson d-statistic (2,    10) = 1.840643
```

```
19. reg x6 time, robust
Regression with robust standard errors                Number of obs =     9
                                                      F(  1,     7) =   1.76
                                                      Prob > F      = 0.2266
                                                      R-squared     = 0.1491
                                                      Root MSE      = 2.4504
------------------------------------------------------------------------------
             |               Robust
          X6 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        time |   .3503503   .2643198     1.33   0.227    -.2746668    .9753674
       _cons |  -.4430719   1.120628    -0.40   0.704    -3.092936    2.206792
------------------------------------------------------------------------------
. dwstat

Durbin-Watson d-statistic(  2,     9) =  1.390717
```

Where. Urea= consumption of uria kg per hect. of GCA during 2002-03 to 2011-12

dap = consumption of dap kg per hect. of GCA during 2002-03 to 2011-12

mop= consumption of mop kg per hect. of GCA during 2002-03 to 2011-12

ssp= consumption of ssp kg per hect. of GCA during 2002-03 to 2011-12

As =consumption of as kg per hect. of GCA during 2002-03 to 2011-12

X1 = consumption of 10:26:26 kg per hect. of GCA during 2002-03 to 2011-12

X2 = consumption of 14:35:14 kg per hect. of GCA during 2002-03 to 2011-12

X3 = consumption of 15:15:15 kg per hect. of GCA during 2002-03 to 2011-12

X4 = consumption of 12:32:16 kg per hect. of GCA during 2002-03 to 2011-12

X5= consumption of 14:35:14 kg per hect. of GCA during 2002-03 to 2011-12

X6= consumption of 28:28:28 kg per hect. of GCA during 2002-03 to 2011-12

From our regression analyses, we also find that consumption of Urea, DAP, MOP, SSP, 10:26:26, 20:20:20 and 28:28:28 kg per hectare of gross cropped area have significant positive time trend, which means these are rising significantly over time. While, the consumption of some other products like AS, 14:35:14 and 15:15:15 have insignificant time trend, which means these are not changing significantly over time.

2.6 Summary of the Chapter:

It has been observed that the trends of Fertilizer use in West Bengal, both in terms of Fertilizer nutrient (N, P and K) as well as product-wise, have very significant positive time trend, which means these are rising significantly over time. We find a sharp increase (9% per year on an average) in the total consumption of chemical Fertilizers (N, P, and K.) in the state over the years: 1980-81 to 2010-11. We also find a sharp increase (4.55 kg per year) in the consumption of N, P, K and total of N, P, K (kg) per hectare of gross cropped area over the years, during 1980-81 to 2010-11.

It has also been observed that there has been a sharp increase in the consumption of some Fertilizers like Urea, DAP, MOP, SSP, 10:26:26, 20:20:20 and 28:28:28 kg per hectare of gross cropped area from 2002-03 to 2011-12. While the consumption of some other products like AS, 14:35:14 and 15:15:15 have decreased substantially from 2002-03 to 2011-12, their quantities are small; e.g. AS has decreased from 1.86 to 0.29 kg,14:35:14 has decreased from 3.53 to 1.39 kg and 15:15:15 has decreased from 7.62 to 5.76 kg per hectare of gross cropped area in 2011-12.

Chapter- III

Socio Economic Characteristics of Sample Households

3.1 Introduction

This part of the report discusses the socio-economic scenario of the sample households. We try to analyse the distribution of sample households by farm size category, socio-economic characteristics of the sample households, details of operational land holdings, sources of irrigation, cropping pattern, area under HYV and value of the output, farm asset holding and details of agricultural credit available etc. for both the reference crops Paddy and Jute.

The Present study is based on the field-level data collected from the state of West Bengal. In West Bengal, there are two reference crops (i.e. Paddy and Jute). The reference period for the above study is 2013-14. We have selected four districts for our two reference crops. Selection of the districts have been done as per proposal of the study (as mentioned in detail, in the first chapter above), which was given by the Ministry. West Midnapore and Burdwan are the selected study areas for Paddy. Furthermore, Murshidabad and Nadia are the selected study area for Jute. From each district, two blocks have been selected. From every block, 30 Soil Test Farmers and 15 Control Farmers are identified based on stipulated criteria. Thus, in each crop, there are total 180 sample households. In this chapter, we use IBM SPSS 20 for cross tabulation and Microsoft Excel 2007 for graphs & diagrams. This chapter is mainly a descriptive section describing some of the basic characteristics of the sample households.

3.2. Distribution of sample households by farm size category

In our study, each block of the respective districts contains 30 soil test farmers and 15 control farmers. Therefore, in a whole district, we have 60 soil test farmers and 30 control farmers. We first classify the farmers by Farm Size (i.e. – Marginal, Small, Medium and Big). Consequently, we derive the following table.

Table 3.1: Distribution of Sample Households by Farm Size Category (% of households)

Particulars	Paddy		Jute	
	Soil test farmers	Control farmers	Soil test farmers	Control farmers
Marginal	55.00	70.00	70.83	73.33
Small	30.00	21.67	24.17	25.00
Medium	9.00	6.67	5.00	1.67
Large	6.00	1.66	0.00*	0.00*
Total	100.00	100.00	100.00	100.00

- No big farmers are present for Jute

Let us discuss first the reference crop Paddy. Among the Soil test farmers for Paddy, there are 55% Marginal farmers, 30% Small farmers, 9% Medium Farmers and the rest, i.e. 6% big farmers. On the other hand, for control farmers there are 70% Marginal farmers which is much more than the Soil test farmers. Again, 21.67% of total farmers are small, 6.67% are Medium farmers and the remaining 1.66% is big farmers which are little less compared to that for Soil Test Farmers.

Now we come to the reference crop Jute. Here also, for the soil test farmers for Jute there are 70.83% Marginal, 24.17% Small, 5% Medium Farmers and there exist no big farmer. On the other hand, for control farmers (for Jute) there are 73.33% Marginal farmers, which is much more than the soil test counter-part. Again, 25% of total farmers are Small which is little more and the rest, i.e. 1.67% belong to the Medium group which is much less than the Soil Test Farmers and there is also no big farmer.

In case of Jute crop, no large farmers were found, reasons behind this may be firstly, as Jute cultivation is labour extensive and large farmers are fully dependent on hired labour, they are not interested in Jute cultivation. Secondly, no big farmers for Jute crop were found in our study area.

We can see the distribution of sample households by Farm Size Category for both soil test & control farmer through the column diagram, as below.

Fig. 3.1. Comparison of Sample households household By farm size category for Paddy

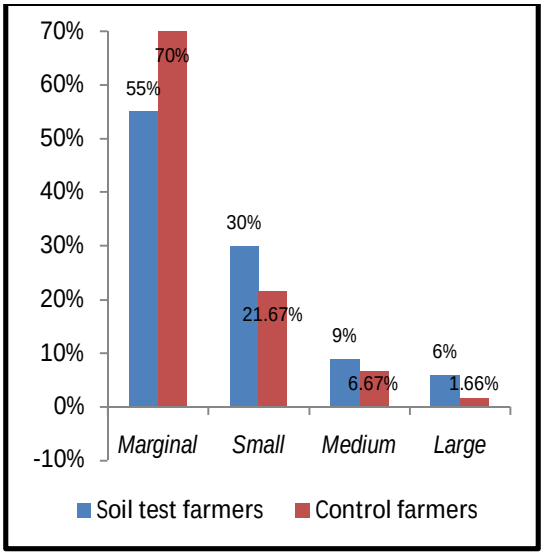
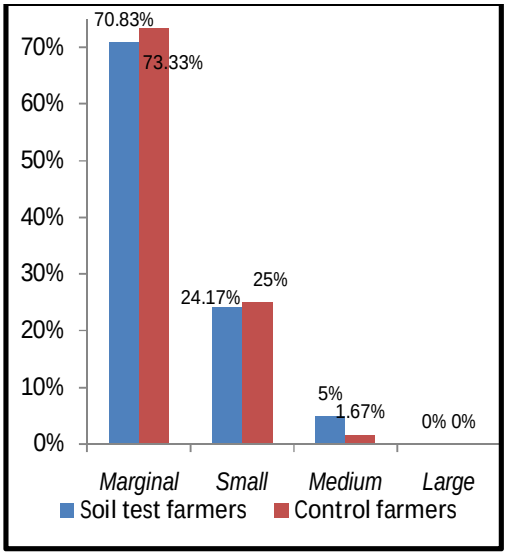


Fig 3.2 Comparison of sample by Farm Size category for Jute



3.3. Socio economic characteristics of the sample households

West Midnapore is the highest Paddy cultivation district in West Bengal in terms of area, and Burdwan is in the second place. Over two-thirds of the total production in West Bengal comes from Midnapore, Burdwan, 24 Parganas, Bankura, Birbhum and South Dinajpur districts.

3.3.a. Socio economic characteristics for Paddy Farmers

First, we shall discuss Paddy. The total number of soil test farmers for Paddy is 120 whereas 60 control farmers are there. Now, we can see the socio economic characteristics of the sample households of Paddy by the following table:

Table 3.2: Socio-economic Characteristics of Sample Households - Paddy Farmers

Particulars	Soil Test Farmers	Control Farmers	Overall
Number of sample farmer households	120	60	180
Average age of respondent (years)	45.19	49.87	46.75
Average years of respondent education**	2.24	2.13	2.21
Agriculture as main occupation (of respondents)	96.67	81.67	91.67
Gender (of respondents)			
Male	100	100	100
Female	0	0	0
Average family size	5.62	5.78	5.67
Average number of people engaged in agriculture	2.17	2.23	2.19
Average years of experience in farming	23.58	26.28	24.48
of farmers (respondents) being a member of any association	58.33	46.67	54.44
Caste (of households)			
SC	4.17	1.67	11.11
ST	8.33	16.67	3.33
OBC	17.5	8.33	14.44
General	70	73.33	71.11

** In the above table , for the variable "Average years of respondent education'' the result is not in terms of years; it is reported as per our Education Code (Illiterate-0, Primary (I-V)-1, Secondary (VI-X)-2, Higher Secondary (XI-XII)-3, Graduation & Above-4). Actually, it is the range for particular classes. For example, Average years of respondent education = 2.24 means that the particular farmer's year of education is above "Secondary".

First, we discuss the Socio-economic Characteristics of soil test farmers through the following points:

- Here average age of the respondent is 45.19 years. This represents more youth and middle-aged persons involved in the agricultural sector.
- Average standard of respondent education is greater than 'secondary'. It means class XI-XII.
- There are 96.67% of respondents whose main occupation is agriculture. That means, huge portions of the sample households are involved in agricultural sector.
- All the respondents are male.
- Average family size of the sample households is 5.62.
- Average number of members of a household engaged in agriculture is 2.17.
- In addition, average years of experience of a respondent in farming are 23.58.
- 58.33% of total respondents are member in any association or group or society.
- There are 70% general (caste) households, 17.5% are OBC households, 8.33% are ST households and the remaining 4.17% are SC households.

Now we turn to the control farmers:

- The average age of the respondent is 49.87 which represents that youth and middle-aged persons are involved more in agriculture like the soil test farmers.
- Average education standard is mainly greater than secondary (class XI-XII).
- 81.67% of respondents' main occupation is agriculture. That means, again huge portion of sample households is involved in the agricultural sector; but this proportion is a bit smaller than that for the soil test farmers (treatment group).
- All the respondents belong to male category.
- Average family size of the sample households is 5.78.
- Average number of members of a household engaged in agriculture is 2.23.
- Furthermore, average years of experience of a respondent in farming are26.28. That means, considerably experienced farmers are engaged in agriculture.
- 46.67% of the total respondents are members of any association or group or society. This is quite lesser than that for the soil test farmers.
- There are 73.33% general caste households, 8.33% are OBC households, 16.67% are ST households and the remaining 1.67% is SC households.

3.3.b. Socio economic characteristics for Jute

Now we turn to the Socio economic characteristics of the sample households for Jute as represented by the following table:

Table 3.3: Socio-economic Characteristics of Sample Households for Jute

Particulars	Soil Test Farmers	Control Farmers	Overall
Number of sample farmer households	120	60	180
Average age of respondent (years)	41.96	46.07	43.33
Average years of respondent education**	1.98	1.55	1.83
Agriculture as main occupation (of respondents)	93.33	100	95.56
Gender (of respondents)			
Male	99.17	100	99.44
Female	0.83	0	0.56
Average family size	5.14	5.53	5.27
Average number of people engaged in agriculture	1.9	1.77	1.86
Average years of experience in farming	19.90	25.98	21.94
of farmers being a member of any association	31.67	18.33	27.22
Caste (of households)			
SC	8.33	5	7.22
ST	0	5	1.67
OBC	23.33	15	20.56
General	68.33	75	70.56

** In the above table , for the variable "Average years of respondent education" the result is not in terms of years; it is as per our Education Code (Illiterate-0, Primary (I-V)-1, Secondary (VI-X)-2, Higher Secondary (XI-XII)-3, Graduation & Above-4). Actually, it is the range for particular classes. E.g. - Average years of respondent education = 2.24 means that particular farmer's standard of education is above "Secondary".

First, we discuss the Socio-economic Characteristics of soil test farmers through the following points:

- Here average age of the respondent is 41.96. This represents that mostly the youth and middle-aged persons are involved in agricultural sector.
- Average standard of respondent education is mainly below secondary. It means, class I to class V.
- There are 93.33% of respondents whose main occupation is agriculture. That means, huge portion of sample households are involved in agricultural sector.
- Here we find, 99.17% of respondents are male and remaining 0.83% is female.
- Average family size of the sample households is 5.14.
- The Average number of members of households engaged in agriculture is 1.9.

- Furthermore, average years of experience of a respondent in farming are 19.90.
- 31.67% of total respondents are members of any association or group or society.
- There are 68.33% general caste households, 23.33% are OBC households, and the remaining 8.33% are SC households.

Now we look at the control farmers group:-

- Here average age of the respondent is 46.07. This represents that mostly the youth and middle-aged persons are involved in agricultural sector like the soil test farmers.
- Average standard of respondent education is below 'secondary' (class I-V).
- All respondents' main occupation is agriculture. It is also found that, all of them are male.
- Average family size of the sample households is 5.53.
- The Average number of members of a household engaged in agriculture is 1.77.
- Average years of experience of the respondents in farming are 25.98. That means, considerably experienced farmers are engaged in agriculture.
- 18.33% of the respondents are members in any association or group or society. This value is quite lesser than that of the soil test/treatment farmers.
- There are 75% general caste households, 15% are OBC households, 5% are ST households and remaining 5% are SC households.

3.4. Details of operational land holdings

3.4. a. Operational land holdings for Paddy farmers

Operational land holding of the sample households for Paddy is shown in table3.4 below-

Table 3.4: Operational Landholding of the Sample Households (acre/household) - Paddy

Particulars	Soil Test Farmers	Control Farmers	Overall
Owned land	3.07	2.14	2.76
Leased-in	0.63	0.29	0.51
Leased-out	0.61	0.06	0.42
Uncultivated/Fallow	0.05	0.06	0.05
Net operated area	3.58	2.42	3.19
Net irrigated area	3.17	1.97	2.77
Net un-Irrigated area	0.41	0.45	0.42
Gross cropped area	5.86	3.72	5.15
Cropping intensity (%)	172	159	168

Here we discuss about the average land holding for soil test farmers. Average owned land for sample households is 3.07 acre. Leased in area is 0.62 acre/households, leased out area is 0.61 acre/households and uncultivated area is 0.05 acres/households. We can see, the net operated area per household is 3.58 acre, among the net operated land, net irrigated area per household is 3.17 acres and net un-irrigated area per household is 0.41 acres. Here, gross cropped area is 5.86 acre/households and cropping intensity per household is 172%.

For the control farmers, owned land per household is 2.14 acres, leased in land is 0.29 acres, leased out land is 0.06 acres & uncultivated land is also 0.06 acres per households. Here, net operated land is 2.42 acres and net irrigated land & net un-irrigated land is 1.97 acres & 0.45 acres respectively. In this category, gross cropped area per household is 3.72 acres and cropping intensity is 159%, which is much lower than the treatment farmers.

3.4.b. Operational land holdings for Jute farmers

Jute is one of the most important natural fibres in West Bengal. Nearly 85% of world's Jute cultivation is concentrated in the two sides of Ganges. Currently India is the largest producer of Jute fibre. In our study, following the same process like Paddy, we have taken two districts for Jute, i.e. Murshidabad and Nadia. The total number of sample households for soil test farmers in Jute cultivation is 120 and control farmer is 60. First, we take up the soil test farmers. Table 3.5 is the relevant one, as below.

Table 3.5: Operational Landholding of the Sample Households (acres/household) - Jute

Particulars	Soil Test Farmers	Control Farmers	Overall
Owned land	1.86	1.69	1.80
Leased-in	0.38	0.49	0.42
Leased-out	0.08	0.14	0.10
Uncultivated/Fallow	0.02	0.02	0.02
Net operated area	2.17	2.05	2.13
Net irrigated area	2.16	2.04	2.12
Net un-Irrigated area	0.01	0.01	0.01
Gross cropped area	3.63	2.93	3.40
Cropping intensity (%)	184	169	179

Here, for all the 120 soil test farmers, average owned land per household is 1.86 acres; leased in area is 0.38 acres, 0.08 acres for leased out area and uncultivated area is 0.02 acres per households. For Jute cultivation, in the above districts, net operated area is 2.17

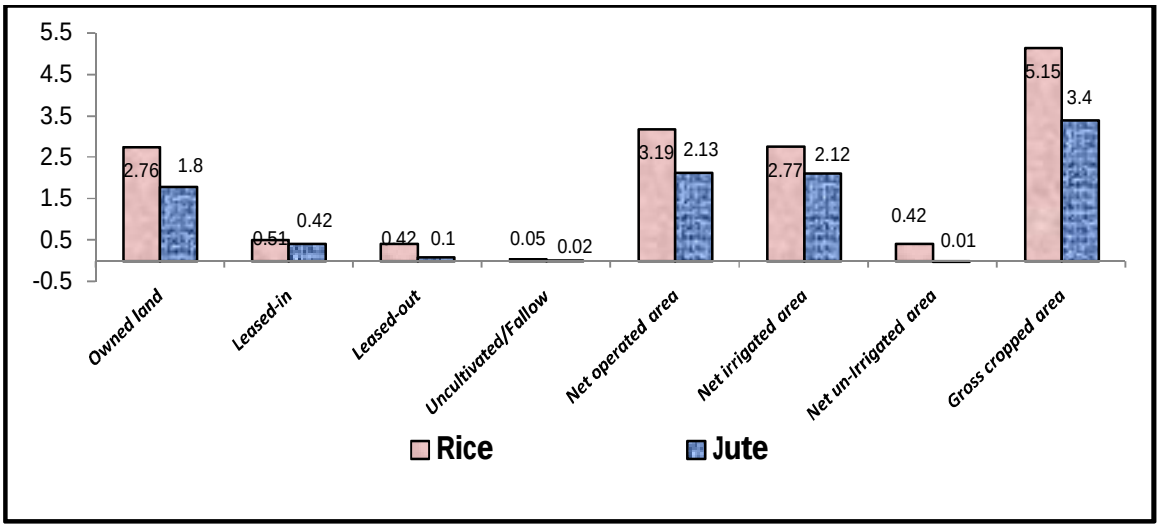
acres, which is distributed among net irrigated area and net un-irrigated area such as, 2.16 acres and 0.01 acres respectively. Gross cropped area per household is 3.63 acres and cropping intensity is 184.

Next, we look at the control farmers for Jute. Here, the average owned land per household is 1.69 acres, leased in area is 0.49 acres, leased out area is 0.14 acres and uncultivated area is 0.02 acres. Net operated area is 2.05 acres per households. Net irrigated land & net un-irrigated land are 2.04 acres & 0.01 acres respectively. Gross cropped area in that particular category is 2.93 acres and cropping intensity is 193, which is lower than the corresponding soil test farmers.

3.4. C Operational land holdings for Paddy & Jute farmers together

Here we discuss the overall results simultaneously for Paddy as well as Jute. For each crop, the total sample size is180 farmers (soil test + control taken together) and thus, the total sample size is 360. We can see the comparison between the two crops in terms of land holding in the following clustered column diagram. This is shown in Fig 3.3, as below –

Fig 3.3 Comparison between operational land holdings of Paddy & Jute farmers.



We derive the diagram by considering data for both Paddy & Jute, focusing on the land holding issue. In the above clustered column diagram, we can see that average owned land for Paddy is much higher than Jute. Again, leased in land for Paddy is slightly higher than Jute. For leased out area also, Paddy is showing a higher value. The overall net operated area per household in Paddy is 3.19 acres whereas for Jute, it is only 2.13 acres.

Also, if we compare the net irrigated and net un-irrigated areas for both the crops, we see, for Paddy the overall value are 2.77 acres and 0.42 acres respectively and for Jute the corresponding values per household are 2.12 acres and 0.01 acres respectively. Again, if we compare the overall average gross cropped area of both these crops, we find that, for Paddy, it is 5.15 acres, which is higher than that of Jute, for which the corresponding value is 3.40 acres.

3.5. Sources of irrigation:-

3.5.a Sources of irrigation for Paddy farmers

There are different kinds of sources of irrigation. Those are: open well, dug well, bore well, river, canal, pond, tanks etc. Here, in this section, we try to examine, what is the proportion of different sources of irrigation. To examine that, first, we consider the Paddy cultivators. The results are presented in the following table -

Table 3.6: Sources of Irrigation (% of net irrigated area) - Paddy

Particulars	Soil Test Farmers	Control Farmers	Overall
Open/ dug well	4.89	0.85	3.93
Bore well	62.12	67.01	63.28
Canal	28.64	28.60	28.64
Tank	0	1.29	0.3
River/Ponds and Others	4.35	2.25	3.85
Total	100	100	100

For soil test households, most of the farmers are dependent on bore well covering 62.12% of net cropped area. The second popular irrigation source is canal covering 28.64% of net cropped area. Then, Open/ dug well & River/Ponds and Other sources cover 4.89% & 4.35% of net cropped areas respectively.

For control farmers, the proportions of different sources are almost the same. Here, 67.01% of net cropped area is irrigated by bore well, whereas 28.60% of net cropped area by canal water. Then, irrigation by River/Ponds and Other sources cover 2.25% of net cropped area. Remaining portions are irrigated by Tank and Open / dug well, which are 1.29% and 0.85% respectively, of net cropped area.

These proportions of sources of irrigation are shown by the pie diagram, as below:-

Fig 3.4 Proportion of Sources of Irrigation in Paddy soil test farmers

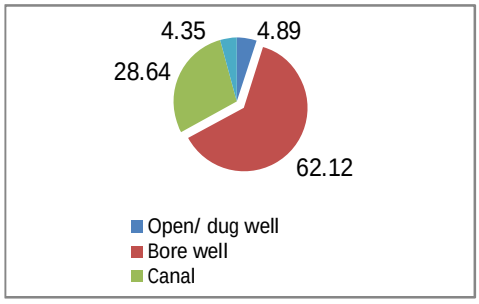
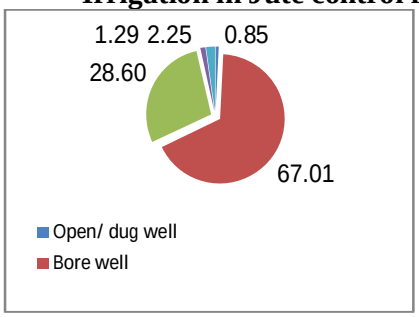


fig 3.5 Proportion of Sources of Irrigation in Jute control farmers



3.5. b Sources of irrigation for Jute farmers

Like Paddy, here also we try to examine the proportions of different sources of irrigation.

We look at the following table-

Table 3.7: Sources of Irrigation (% of net irrigated area)- Jute

Particulars	Soil Test Farmers	Control Farmers	Overall
Open/ dug well	8.97	5.77	7.95
Bore well	84.63	85.22	84.82
Canal	0.54	0	0.36
Tank	0	0	0
River/Ponds and Others	5.86	9.01	6.87
Total	100	100	100

We can see from the above table (table:-3.7), for the soil test farmers, the largest portion of area is irrigated by bore well, which is 84.63% of net cropped area. The next highest irrigation source is Open / dug well, which is 8.97% of net cropped area. River/Ponds and Other sources are irrigating 5.86% of net cropped area and a very small portion of net cropped area is irrigated by canal, which is only 0.54%.

Again, if we look at the control farmers, we can see that the primary source of irrigation is again Bore well which covers 85.22% of net cropped area. But, here 9.01% of net cropped area is irrigated by River/Ponds and Other sources. And, the remaining portion that is 5.77% of net cropped area is irrigated by Open /dug well.

These above proportions of area irrigated by different sources of irrigation can also be seen by the pie diagram, as below:-

Fig 3.6 Proportion of Sources of Irrigation Irrigation in Jute of soil test farmers

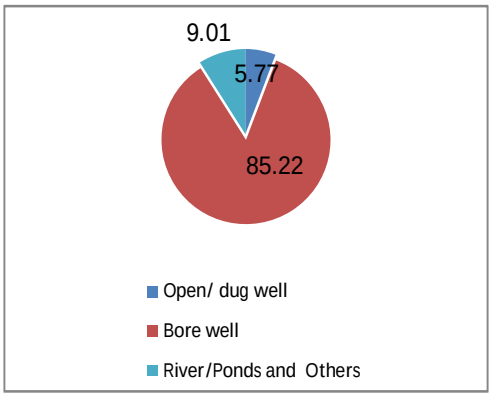
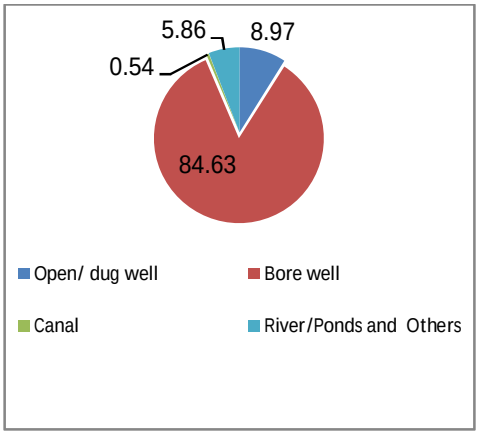


Fig 3.7 Proportion of Sources of control farmers



3.6. Cropping Pattern, Area under HYV and Value of Output

3.6.a. Cropping Pattern for Paddy Farmers

In West Bengal, agriculture is the leading occupation and Paddy is the principal food crop. In this section, we discuss about the cropping pattern of the sample households. We find the cropping pattern as follows:-

Table 3.8: Cropping Pattern of the Sample Households (% of GCA) - Paddy

Crops	Soil Test	Control	Overall
Kharif			
Paddy	54.63	57.90	55.42
Jute	0.00	0.00	0.00
Vegetables	0.57	0.99	0.67
Marigold	0.38	0.50	0.41
Other kharif crops	0.29	0.00	0.22
Robi			
Potato	10.05	9.67	9.96
Mustard Seed	4.21	5.38	4.49
Wheat	0.03	0.00	0.02
Tomato	0.11	0.00	0.09
Vegetables	0.12	0.05	0.11
Pulses	0.07	0.00	0.05
Other robi crops	0.57	0.09	0.45
Summer			
Paddy	24.10	20.94	23.34
Sesame	2.63	4.07	2.98
Other summer crops	0.18	0.00	0.13
Annual &Perennials			
Sugarcane	0.00	0.00	0.00
Tuberose	0.91	0.00	0.69
Vegetables	1.13	0.40	0.95
Other Annual & Perennials	0.01	0.00	0.01
GCA	100.00	100.00	100.00

The above table is showing us the cropping pattern of a whole agricultural year. The cultivation year is divided into three seasons Kharif, Robi & Summer. Let us discuss about the soil test farmers first. In kharif season, we see that Paddy is a major crop which covers 54.63% of gross cropped area and a very small percentage of gross cropped area is devoted to Vegetables, Marigold and Other Kharif Crops of the season. Again, considering the Rabi season, Potato is cultivated in 10.05% of gross cropped area. Mustard seed is cultivated in 4.21% of gross cropped area and very small plots of land are devoted to other crops. In summer season, Boro Paddy is cultivated in 24.10% of gross cropped area; Sesame (Til) in 2.63% of gross cropped area and 0.18% devoted to other summer crops. Annual or perennial vegetables are cultivated in 1.13% of GCA and tuberose in 0.91% of Gross cropped area.

Next, we come to the control farmers. Here, in kharif season, Paddy is cultivated in 57.90% of gross cropped area (GCA) and other kharif crops together are cultivated only in 1.50% of gross cropped area. In Rabi season, potato and mustard are cultivated in 9.67% and 5.38% of gross cropped area respectively. For summer Paddy, the cultivated area is 20.94% of GCA and sesame is 4.07% of GCA. But in this case, the share of annual and perennial crops is very low, it only 0.40% of gross cropped area.

3.6.b. Cropping Pattern for Jute Farmers

Now we discuss the corresponding results pertaining to the other reference crop, i.e. Jute. Here also, 120 soil test farmers and 60 control farmers have been considered. First, we discuss about the cropping pattern of the sample households. Now we will consider the following table .

Table 3.9 : Cropping Pattern of the Sample Households (of GCA)- Jute

Crops	Soil Test	Control	Overall
Kharif			
Paddy	20.96	23.02	21.56
Jute	22.77	23.18	22.89
Vegetables	2.27	1.02	1.91
Marigold	0.69	0.80	0.72
Other kharif crops	1.61	0.39	1.26
Robi			
Potato	2.00	1.02	1.72
Mustard Seed	11.00	9.55	10.58
Wheat	10.06	9.00	9.76
Tomato	0.02	0.38	0.12
Vegetables	2.35	4.51	2.97
Pulses	4.10	3.91	4.04
Other robi crops	3.50	2.74	3.28
Summer			
Paddy	7.21	9.19	7.78
Sesame	3.71	2.75	3.11
Other summer crops	0.40	0.41	0.73
Annual &Perennials			
Sugarcane	0.46	0.00	0.33
Tuberose	0.96	0.28	0.76
Vegetables	2.03	3.77	2.53
Other Annual & Perennials	3.90	4.07	3.95
GCA	100.00	100.00	100.00

First, we discuss the case of soil test farmers. Here we can see that 20.96% of gross cropped area is occupied by Aman Paddy, 22.77% occupied by Jute. On the other hand, vegetables, marigold and other Kharif crops together occupy only 4.57% of gross cropped area. In Robi season, mustard seed occupies 11% of gross cropped area and 10.06% of gross cropped area is occupied by wheat. Pulses are covering only 4.10% of GCA. In summer season, Boro Paddy covers only 7.21% of gross cropped area and sesame occupies only 3.71%. Here the share of total Annual & Perennials is 7.35% of gross cropped area.

If we consider the control farmers (for Jute), then in kharif season, Paddy is cultivated in 23.02% of gross cropped area; Jute covers 23.18% of gross cropped area and remaining kharif crops together cover only 2.21% of gross cropped area. In Robi season, mustard seed and wheat are cultivated in 9.55% and 9% of gross cropped area respectively. For Boro Paddy, the cultivated area is 9.19% of GCA and for sesame it is 2.75% of GCA. But, here, the share of all annual and perennial crops is only 8.12% which is much lower than others (Kharif, Robi,Summar)

Area under HYV

The farmers use mostly HYV seeds or Hybrid seeds. Let us look at the following table on HYV cultivation:

Table 3.10: Area under HYV of Major Crops (% of cropped area)

Crop name	Paddy Farmers	Jute Farmers
Soil Test Farmers		
Aman Paddy	99.48	100.00
Potato	86.36	33.02
Mustard Seed	27.31	42.33
Boro Paddy	100.00	100.00
Jute	0.00	57.86
Wheat	100.00	86.31
Control Farmers		
Aman Paddy	100.00	100.00
Potato	33.36	63.33
Mustard Seed	84.14	51.94
Boro Paddy	99.45	100.00
Jute	0.00	78.41
Wheat	0.00	74.72

In our above table for soil test Paddy farmers , we can see that Aman Paddy is cultivated by HYV seeds in 99.48% of cropped area, potato in 86.36% and Boro Paddy in 99.45% of cropped area.

For control farmers the figure is somewhat different. For Aman Paddy, use of HYV seed is in 100% cropped area, for potato it is 33.36%, and for Boro Paddy HYV is used in 99.45% of cropped area.

In our above table for soil test Jute farmers, we can also see that Aman Paddy is cultivated by HYV seeds in 100% of cropped area and Jute in 57.86% of cropped area. For mustard seed, HYV seed is used in 42.33% of cropped area and for wheat, it is in 86.31% of cropped area. Boro Paddy is cultivated by HYV seed in 100% of cropped area.

For control farmers the figures are somewhat different. Whereas in Aman Paddy, HYV seeds are used in 100% of cropped area, in Jute, it is in only 78.41% of cropped area. In mustard seed cultivation, HYV seed is used in 51.94% of cropped area and whole Boro Paddy is cultivated by HYV seed.

Value of Output (Reference Crop: Paddy)

Now we come to the other issue, i.e. the value of output and the value of output sold, both across the farm size groups. In this section, our reference crop is Paddy, which is cultivated more than one time in West Bengal. Hence, we have to add the corresponding values for different seasons to arrive at the aggregate numbers. That is why the output value is much higher for Paddy than the other reference crop, i.e. Jute. Now, we consider the following to discuss the value of output for Paddy.

Table 3.11: Aggregate Value of Crop Output- Paddy

Particulars	Value of Output		Value of Output Sold	
	Rs/household	Rs/acre	Rs/household	Rs/acre
Soil Test Farmers				
Marginal	66047.00	28791.91	34324.39	14318.67
Small	132247.10	27821.98	69466.80	10299.85
Medium	252737.30	26810.44	167963.40	14179.68
Large	512902.70	25225.29	297740.40	28276.99
Total	129086.90	28111.24	72483.29	13914.52
Control Farmers				
Marginal	47008.44	25657.43	21096.17	14632.49
Small	95724.09	23307.28	57076.62	14273.41
Medium	200882.40	27218.05	109618.00	20046.00
Large	627690.00	31384.50	467040.00	28891.43
Total	77499.79	25347.72	42225.78	15153.24

Let us first discuss the case of soil test farmers. Here we can see that for marginal farmers value of output is Rs.66047.00 per household, for the small farmers it is Rs.132247.10 per household, for medium farmers it is Rs.252737.30 and for large farmers, it is Rs.512902.70 per household. Again, if we consider the value of output per acre, then for marginal farmers it is Rs.28791.91 per acre, for small farmers it is Rs.27821.98 per acre, for medium farmers Rs.26810.44 and for large farmer it is Rs.25225.29 per acre.

Next, we discuss the value of output sold across farm size groups. For marginal farmers, the average value of output sold is Rs.34324.39 per household, for small it is Rs.69466.80, for medium and large farmers the average value of output sold are Rs.167963.40 and 297740.40 per household respectively. Value of output sold per acre for marginal farmer is Rs.14318.67, for small it is Rs.10299.85, for medium and large the value of output sold per acre are Rs.14179.68 and 28276.99 per acre respectively.

Now we consider the control farmers. We can see here that for marginal farmers value of output is Rs.47008.44 per household, for the small farmers it is Rs.95724.09 per household, for medium farmers Rs.200882.40 per household and for large farmer it is Rs.627690 per household. Again, for marginal farmers the value of output is Rs.25657.43 per acre, for the small farmers it is Rs.23307.28 per acre, for medium farmers it is Rs.27218.05 and for large farmer it is Rs.31384.50 per acre.

Next, we discuss the issue of value of output sold across farm size groups for the control farmers cultivating Paddy. For marginal farmers the average value of output sold is Rs.21096.17 per household, for small it is Rs.57076.62, for medium and large farmers the average values of output sold are Rs.109618.00 and 467040.00 per household respectively. On the other hand, value of output sold per acre for marginal farmers is Rs.14632.49, for small it is Rs.14273.41, for medium and large farmers the value of output sold per acre are Rs.20046 and 28891.43 respectively.

Value of Output (Reference crop: Jute)

We will discuss about the value of output and value of output sold for jute. The value of output and the value of output sold across farm size category are considered in this section. The present case is simpler than that of Paddy, as Jute is cultivated only once in a year. The corresponding table is shown as below (3.12):-

Table 3.12: Aggregate Value of Crop Output- Jute

Particulars	Value of Output		Value of Output Sold	
	Rs/household	Rs/acre	Rs/household	Rs/acre
Soil Test Farmers				
Marginal	13578.68	23372.34	13578.68	23372.34
Small	32430.69	24157.02	32430.69	24157.02
Medium	54858.33	29137.88	54858.33	29137.88
Large	0.00	0.00	0.00	0.00
Total	20198.56	23850.25	20198.56	23850.25
Control Farmers				
Marginal	12683.64	26854.86	12683.64	26854.86
Small	27741.33	24422.20	25394.67	23008.55
Medium	40000.00	24096.38	40000.00	24096.38
Large	0.00	0.00	0.00	0.00
Total	16903.33	26200.72	16316.67	25847.31

Let us first discuss the case of soil test farmers. Here, we find that the marginal farmers' average value of output is Rs.13578.68 per household; for the small farmers, it is Rs.32430.69, for medium farmers it is Rs.54858.33 per household and there is no large farmer in case of Jute. Again, if we consider the value of output produced per acre, then for marginal farmers this value is Rs.23372.34 per acre; for the small farmers it is Rs.24157.02 and for medium farmers it is Rs.29137.88 per acre.

Next, we discuss the value of output sold across different farm size groups. For marginal farmers, the average value of output sold is Rs.13578.68 per household; for small farmers it is Rs.32430.69 and for medium farmers the average value of output sold is Rs.54858.33 per household. On the other hand, the value of output sold per acre of the marginal farmers is Rs.23372.34; for small farmers it is Rs.24157.02 and for medium farmers, the value of output sold per acre is Rs.29137.88.

In case of control farmers, marginal farmers' average value of output is Rs.12683.64 per household; for the small farmers it is Rs.27741.33 and for medium farmers Rs.40000.00 per household. Again, considering the value of output produced per acre, for marginal farmers it is Rs.26854.86; for the small farmers Rs.24422.20 and for the medium farmers it is Rs.24096.38 per acre.

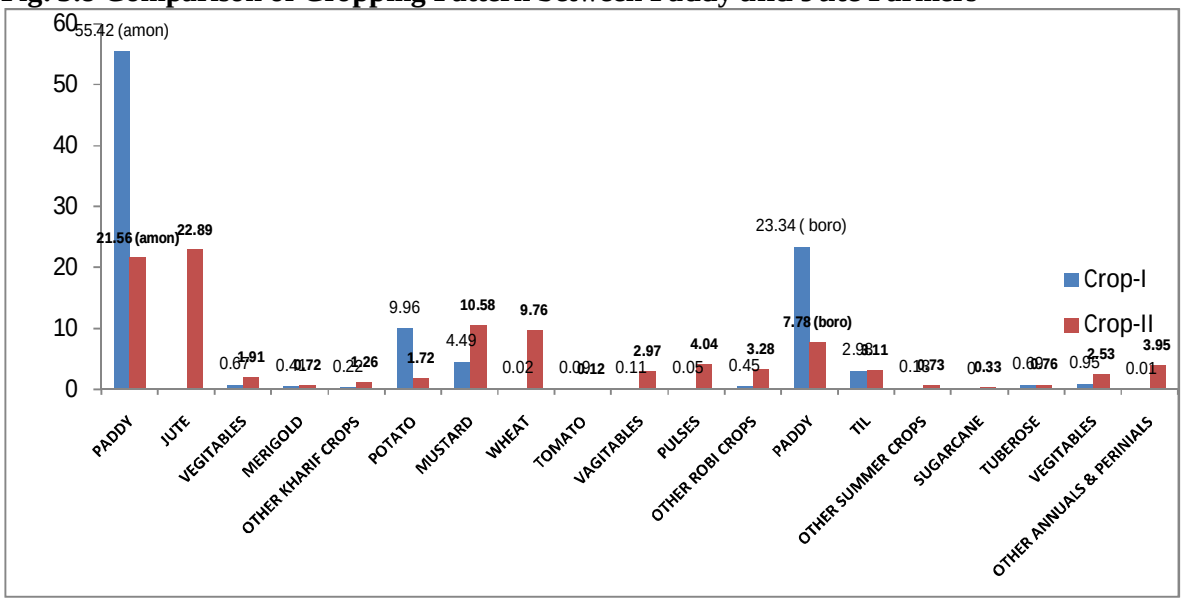
The value of output sold for Jute should be just the same as the value of output produced, as a cash-crop the whole produce is sold in the market. There should not be any question of retention, in this case. But for the small farmer group, we see that the average value of output sold is Rs.25394.67 per household and the corresponding per acre value of output sold is Rs.23008.55.

3.6. c Comparison between Paddy and Jute in terms of Cropping Pattern and Value of Output

Comparison for Cropping Pattern between the Two Reference Crops:

First, we will try to discuss the overall cropping pattern of both the reference crops from the tables 3.8 & 3.9 For better understanding, we will compare the two by using the bar diagram that is shown below (figure 3.8):

Fig. 3.8 Comparison of Cropping Pattern between Paddy and Jute Farmers



We derive the clustered column diagrams with the data for both Paddy and Jute sample farmers focusing only on the issue of overall cropping pattern (keeping aside the farm size groups). Amon Paddy (on the extreme left in the diagram above) is found to occupy much higher area for the farmers chosen for Paddy compared to those selected for the reference Jute. Again for Paddy farmers, percentage of cropping area devoted to potato is more than that for the Jute farmers. However, if we consider mustard seed, it is clear that for the Paddy farmers the area is lesser than that for the Jute farmers. Again in case of Boro Paddy (the Paddy column towards the right axis of the diagram), much higher area is devoted by Paddy farmers in comparison to the Jute sample households.

3.7. Farm assets holdings

3.7.a. Farm asset holdings for Paddy farmers

Here we see the distribution of farm assets per sample household. Let us consider the following table (3.13).

Table 3.13: Distribution of Farm Assets - Paddy Farmers

Particulars	Soil Test Farmers		Control Farmers	
	Number/Household	Value/household (Rs)	Number/household	Value/Household (Rs)
Tractor, trailer/trolley	0.16	30141.67	0.10	28033.33
Harrow and cultivator	0.11	75.00	0.10	61.67
Electric motor/ Diesel Engine	0.53	4640.00	0.33	2570.83
Thresher	0.89	2487.50	0.65	1884.17
Planker	0.00	0.00	0.00	0.00
Manual/power sprayer	0.89	629.58	0.75	462.17
Fodder chopper	0.02	23.33	0.02	5.00
Bullock cart	0.10	966.67	0.05	433.33
Drip/sprinkler system	0.00	0.00	0.00	0.00
Small tools (spade, hoe, sickle etc.)	5.01	454.25	5.45	506.50
Animal shed/pump house	0.72	11337.50	.70	8833.33
Others	0.03	593.33	.02	2000.00
Total	8.45	51348.83	8.17	44790.33

For the soil test farmers (of Paddy) we highlight some crucial points as below:

- Average number of Tractor, trailer/trolley per household is 0.16, whereas its value is Rs.30141.67 per household. Average number of Harrow and cultivator is only 0.11 per household whereas the value per household is Rs. 75.00.
- Average number of Electric motor/ Diesel Engine is 0.53 per household with an average value of Rs. 4640. That means, more than 50% of households have their own the irrigation implements.
- Average number of Thresher is 0.89 per household with an average value of Rs.2487.50. That means, almost 90% of the households have a thresher.
- On an average, every household has small tools like spade, hoe, sickle etc.. with an average value of 454.25/-
- More than 70% farmers have own animal shed with an average value of Rs.11337.5

Now we look at the control farmers:

- Average number of Tractor, trailer/trolley per household is 0.10, whereas the value per household is Rs.28033.33. Average number of Harrow and cultivator is only 0.10 per household, whereas the value per household is Rs. 61.67.
- Average number of Electric motor/ Diesel Engine is 0.33 per household with an average value of Rs.2570.83. That means, only 1/3 of the households have their own the irrigation implements.
- Average number of Thresher is 0.65 per household with an average value Rs. 1884.17. That means, almost 65% of the sample households own a thresher.
- On an average, every household has small tools like spade, hoe, sickle etc. with an average value of Rs.506.50
- 70% farmers have their own animal shed with an average value of Rs.8833.33.

3.7.b. Farm assets holdings for Jute farmers

Now we discuss the case of those farmers who belong to the reference group of Jute. Lets us consider Table 3.14.

Table 3.14: Distribution of Farm Assets - Jute Farmers

Particulars	Soil Test Farmers		Control Farmers	
	Number/Household	Value/household (Rs)	Number/household	Value/Household (Rs)
Tractor, trailer/trolley	0.05	15958.33	0.03	4166.67
Harrow and cultivator	0.02	24.17	0.00	0.00
Electric motor/ Diesel Engine	0.67	5060.42	0.52	3775.00
Thresher	0.38	1056.67	0.33	891.67
Planker	0.00	0.00	0.00	0.00
Manual/power sprayer	0.68	538.71	0.68	779.17
Fodder chopper	0.00	0.00	0.02	6.67
Bullock cart	0.03	458.33	0.00	0.00
Drip/sprinkler system	0.00	0.00	0.00	0.00
Small tools (spade, hoe, sickle etc.)	6.39	878.67	5.88	634.67
Animal shed/pump house	0.55	7008.33	0.58	7866.67
Others	0.00	0.00	0.00	0.00
Total	8.78	30983.63	8.05	18120.5

For the soil test farmers we highlight the following points as below:

- Average number of tractor, trailer/trolley per household is 0.05, whereas the value per household is Rs.15958.33.
- Average number of harrow and cultivator is only 0.02 per household, whereas the value per household is Rs. 24.17.
- Average number of electric motor/diesel engine is 0.67 per household, with an average value of Rs.5060.42. That means, more than 2/3 households have their own irrigation implements.
- Average number of thresher is 0.38 per household with an average value of Rs.1056.67. That means, less than 40% of sample households have a thresher.
- On an average, every household has small tools like spade, hoe, sickle etc. with an average value of Rs.878.67
- Almost 55% of farmers have their own animal shed whose average value is Rs.7008.33

Now we turn to the control farmers and highlight some points as below:

- Average number of tractor, trailer/trolley per household is 0.03 whereas the value per household is Rs.4166.67.

- Average number of electric motor / diesel engine is 0.52 per household with an average value of RS.3775. That means, 1/2 of the surveyed households have their own the irrigation implements.
- Average number of thresher is 0.33 per household with an average value of Rs.891.67. That means, almost 33% of farmers have a thresher.
- On an average, every household has small tools like spade, hoe, sickle etc. with an average value of Rs.634.67
- Almost 60% of the sample farmers have own animal shed with an average value of Rs.7866.67

3.8. Details of Agricultural Credit Availed

3.8.a Details of Agricultural Credit Availed by the Paddy Farmers

We discuss about the average outstanding loan amount for the entire sample, without going into the farm size groups.

Agricultural Credit: Outstanding amount per household

Let us first discuss the case of soil test farmers.

Table 3.15: Agricultural Credit Outstanding by the Sample Households (Rs/household)- Paddy

Sources	Soil Test Farmers	Control Farmers
Co-operative Credit Societies	3573.52	1796.45
Land development banks	0.00	0.00
Commercial banks	18901.22	14579.08
RRBs	2716.67	3075.00
Money lenders	0.00	0.00
Fiends/Relatives	0.00	0.00
Traders/Commission agents	16.33	0.00
Others	0.00	383.33
Total	25207.73	19833.87

Here we can see that the average credit outstanding per household in co-operative credit societies is Rs.3573.52; in commercial banks is Rs18901.22, in regional rural banks is Rs.2716.6. But credit outstanding to traders/commission agents is Rs.16.33 and in aggregate the average credit outstanding is Rs.25207.73 per household.

For the control farmers, the average credit outstanding in Co-operative Credit Societies is Rs.1796.45; in Commercial bank is Rs.14579.08; in Regional Rural Banks is Rs.3075; in other source is Rs.383.33. and in aggregate the average credit outstanding is Rs.19833.87

3.8.b Details of Agricultural Credit Availed by the Jute farmers

Agricultural Credit: Outstanding amount per household

Here again, we first discuss the case of soil test farmers.

Table 3.16: Agricultural Credit Outstanding by the Sample Households (Rs/household) - Jute

Sources	Soil Test Farmers	Control Farmers
Co-operative Credit Societies	3382.00	2916.67
Land development banks	142.67	0.00
Commercial banks	12079.08	4153.33
RRBs	5228.92	350.00
Money lenders	1046.67	83.33
Fiends/Relatives	0.00	1156.67
Traders/Commission agents	1816.67	0.00
Others	206.67	0.00
Total	23902.67	8690.50

Here we can see that the average credit outstanding in the co-operative credit societies is Rs.3382 per household; in land development bank is Rs.142.67 per household; in commercial banks is Rs.12079.08 per household; in regional rural banks is Rs.5228.92 per household .But credit outstanding to money lenders is Rs.1046.67;to traders/commission agents is Rs.16.33 per household and in other source is Rs.206.67per household. In aggregate, the average credit outstanding is 23902.67/- per households.

For the control farmers, the average credit outstanding in the co-operative credit societies is Rs.2916.67 per households; in commercial banks is Rs.4153.33 per households; in regional rural banks is Rs.350 per household. On the other hand average credit outstanding to money lenders is Rs.83.33 per household and to friends/relatives is Rs.1156.67 per households. In aggregate the average credit outstanding is Rs.8690.50 per households.

Purpose of the loan

We also examine the purpose of taking these loans.

Table 3.17: Purpose of Agricultural Loan Availed (by the farmers) - Paddy

Purpose	Soil Test Farmers (% of farmers)	Control Farmers (% of farmers)
Seasonal crop cultivation	36.11	18.33
Purchase of tractor and other implements	1.11	0.00
Purchase of livestock	0.00	0.00
Land development	0.56	0.00
Consumption expenditure	0.00	0.00
Marriage and social ceremonies	0.00	0.00
Non-farm activities	0.00	0.00
Other expenditures	0.00	0.00

*The percentage is taken from total sample size. So aggregate is not 100%

For the soil test farmers, we find that 36.11% of total sample households have taken loan for seasonal crop cultivation. To purchase tractor and other implements 1.11% of farmers have taken loans and for land development the corresponding value is 0.56% of sample farmers.

If we look at the control farmers, we can find that 18.33% of farmers have taken loans for seasonal crop cultivation.

Table 3.18: Purpose of Agricultural Loan Availed (by the farmers) - Jute

Purpose	Soil Test Farmers	Control Farmers
Seasonal crop cultivation	31.11	12.78
Purchase of tractor and other implements	0.00	0.00
Purchase of livestock	0.00	0.00
Land development	2.78	0.00
Consumption expenditure	0.00	0.00
Marriage and social ceremonies	0.56	0.56
Non-farm activities	1.11	0.00
Other expenditures	0.00	0.00

*The percentage is taken from total sample size. So aggregate is not 100%

From the above table we find that for soil test farmers, 31.11% farmers have taken loan for seasonal crop cultivation. 2.78% farmers have taken loan for land development,

0.56% farmers have taken loan for marriage and social ceremonies and 1.11% farmers have taken loans for non-farm activities.

If we discuss the case of control farmers, we find out that, 12.78% farmers taken the loan facility for seasonal crop cultivation and 0.56% farmers have taken it for marriage and social ceremonies.

3.9. Summary of the chapter

In this chapter, we have seen the overall socio economic scenario of the study area. As per the socio-economic characteristics, it has been found that majority of the respondents are in the middle age group. The educational standards of the respondents are around the secondary level. The average family size of the respondents is more than 5. 90% of the respondents' main occupation is agriculture. That means, most of the family members are dependent on agriculture. It has also been found that more than 2 persons of a family are engaged in agriculture. Majority of the respondents are belonging to the general caste – that is approximately 70%.

As per the characteristics of operational land holdings of the respondents, it has been found that the net operated area varies from 3.19 acres in Paddy to 2.12 acres in Jute. The Gross Cropped area also behaves similarly. It is very interesting to note that the cropping intensity decreases for Jute but increases in Jute. It has been found that Bore Wells dominate the irrigation profile of the selected farmers. More than 60% of the lands are irrigated by that source.

It has been observed that the cropping pattern of the selected farmers spread over Kharif, Rabi and Summer seasons. However, a small portion of the gross cropped area is cultivated for annual and perennial crops like vegetables, flowers, etc. In kahrif season, Aman Paddy dominates the cropping pattern in all the households. The share of Aman Paddy is more than 50 per cent in West Midnapore and Burdwan, but surprisingly it falls in Murshidabad and Nadia. For the latter two districts, Jute is the most important Kharif crop. Similarly, in Rabi season, potato occupies a larger portion than that of other crops viz., wheat, mustard and pulses. The share of summer Paddy in the gross cropped area is also important in the selected districts, but it is much lesser than Aman Paddy. Similarly, it has been observed that HYV seeds have been adopted in almost all crops. Nevertheless, it is also true that due to the lack of knowledge about the seed many farmers failed to report the exact variety of the seed used by them.

The average value of output is more or less Rs. 100,000 for Paddy because Paddy is cultivated twice in a year. So, this value is much higher than Jute, which is nearly Rs. 20,000. Similarly, the average value of output sold for Paddy is higher than that of Jute; it is Rs. 60,000 for paddy and for Jute, it is around Rs.17,000. It has been observed that there is a fair amount of farm assets. Further, commercial bank is the primary source of loan availed by the selected farmers. Most of this loan was taken for mainly seasonal crop cultivation.

CHAPTER IV

Details of Soil Testing and Recommended Doses of Fertilisers

4.1. Background

As the use of chemical fertilizers among the farmers has been increasing, the soil quality, unfortunately, is degrading over time. In the short run, heavy use of chemical fertilizer increases agricultural productivity as well as income of the framers. Therefore, farmers are attracted to these chemical fertilizers. Further, to remain competitive and to have an edge over the fellow farmers each and every cultivator takes resort to increasing doses of fertilizer. However, they sometimes use even lesser amount being constrained by the high price of fertilizer or due to lack of knowledge regarding fertilizer use. In this situation, agricultural fields are fed either extra amount of chemical fertilizer or less. These deficiency and mainly, over dose of chemical fertilizer affect the agricultural land and degrade its fertility characteristics. Consequently, the social urge of soil testing emerges which seeks to examine the extent of chemical fertilizer use needed to increase productivity as well as to maintain the basic characteristics of soil.

In this particular chapter, we will try to find answers to the following questions:

i. What proportion of the farmers is testing their soil across the size group?
ii. From where, those who are testing soil, get information about soil testing?
iii. What are the reasons that the farmers would give soil sample to test in laboratory?
iv. What are the reasons that the control farmers are not testing their soil?
v. What is the status of soil health of both the control and treatment farmers?
vi. Whether the treatment farmers are using the recommended doses of fertilizers on soil test basis or not?

The answers to the above questions can be obtained by explaining the tables given below, which are derived from the primary field survey.

4.2 Details of soil testing

This section of the chapter consists of two tables. These two tables are Table 4.1. (which explains the situation of crop I (paddy)) and Table 4.2, which is for crop II (jute). As instructed in proposal, the Table 4.1 has been derived from primary data collected from

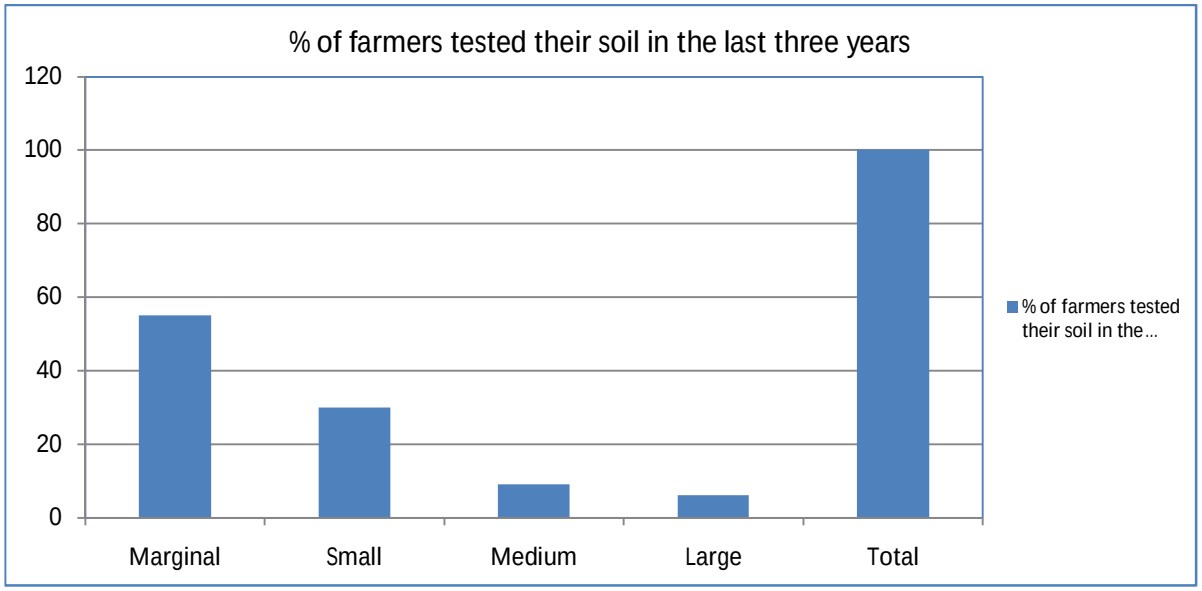
two districts W. Midnapore and Burdwan. Similarly, Table 4.2 has been derived from two districts Murshidabad and Nadia.

For the table below, we have calculated percentage of farmers, who have tested their soil in the last three years. We first categorise the farmers into four groups - marginal, small, medium and large and look at their percentages. Average cost of soil testing has been calculated by taking averages of the costs, incurred for testing soil, only for those who have spent some money for testing. Then to calculate average distance from field to soil testing laboratory, we took the mean distance from farmers' field to soil testing lab corresponding to farmers' categories. Average number of soil sample taken per plot is also derived by taking mean of the soil sample per plot given by the farmers' category. The same process was taken to calculate average number of plot considered for soil testing per household and average area covered under soil testing (acre) per household. Area covered as percentage of net operated area (per HH) was derived through the following process: first, we have calculated percentage of area covered under soil test with NSA as the denominator for each farmer category. Then, we take the mean of these derived percentages. Finally, the last two components of the table were calculated as a percentage of farmers taking all the sample households together.

Table 4.1: Distribution of Sample Soil Test Farmers: Paddy

Particulars	Marginal	Small	Medium	Large	Total
% of farmers tested their soil in the last three years	55.00	30.00	9.00	6.00	100.00
Average cost of soil testing (Rs/sample) only for those who have spent some money for testing	0.00	75.00	0.00	0.00	75.00
Average distance from field to soil testing lab (kms)	22.30	18.78	23.45	24.00	21.47
Average number of soil samples taken per plot	1.04	1.00	1.00	1.00	1.02
Average no. of plots considered for soil testing PER HH	1.90	2.36	2.55	3.86	2.23
Average area covered under soil test (acre) per HH	0.78	1.01	2.07	9.69	1.34
Area covered as % of net operated area(per HH)	50.51	29	30.10	39.71	41.55
% of farmers who collected samples themselves	100.00	100.00	100.00	100.00	100.00
% of soil sample collected by the department officials	0.00	0.00	0.00	0.00	0.00

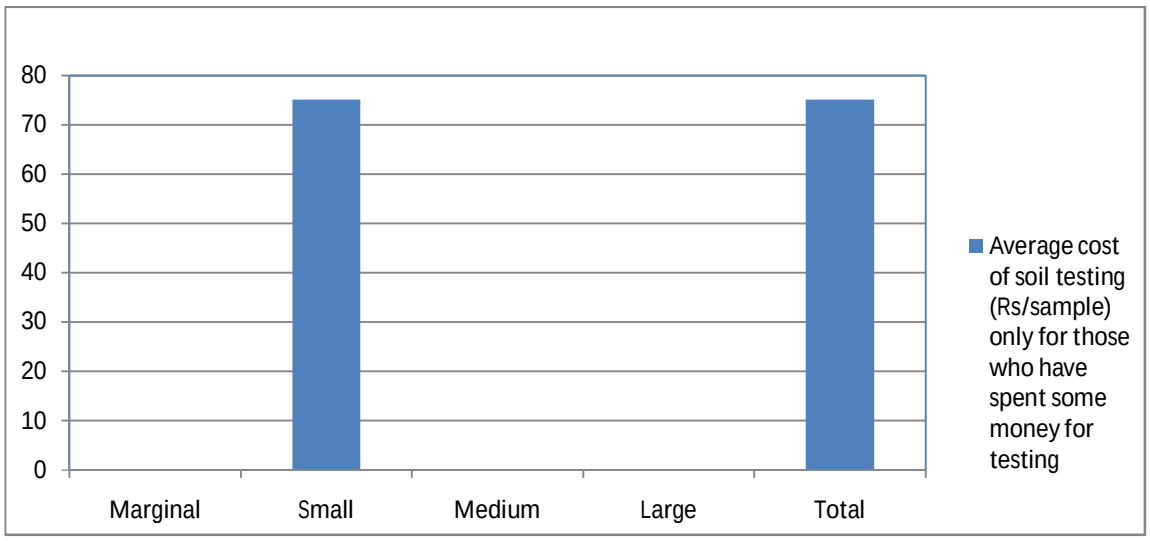
Fig-4.1: % of farmers tested their soil in the last three years (Paddy)



We can see from the above table that, the percentage of marginal farmer is the highest (55%) among those who have tested their soil in the last three years and further, this percentage is declining across the size groups; 30% of small farmers have tested their soil, for the medium farmers this value is 9% and for the large farmers, only 6% have tested their soil. The reason behind this declining trend may be that, the marginal farmers are more concerned with their land because they have to get the maximum in terms of productivity from their tiny pieces.

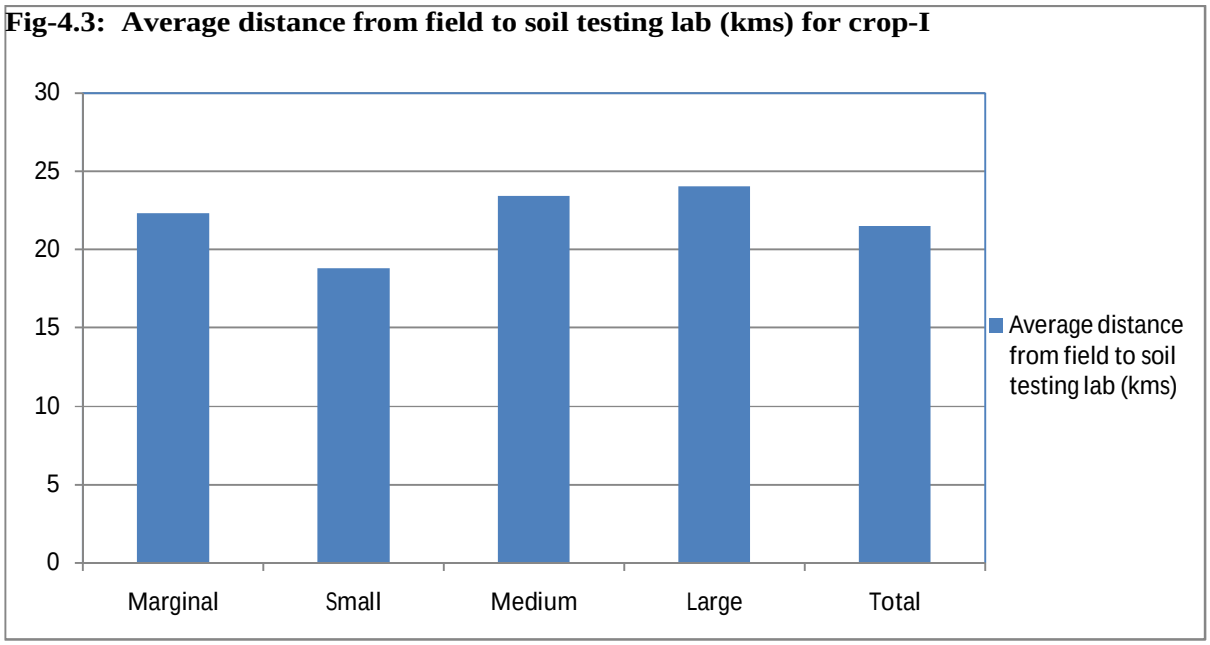
Average cost of soil testing (Rs./sample) is zero for marginal, medium and large farmers. The reason of this is that, most of the farmers have given their soil for testing in the government soil test laboratory. Only some small farmers have an average cost of rupees 75. This average value has been derived from the cost of those who have incurred a cost to test their soil from private companies' soil testing laboratory. They incurred this amount of cost, because they tried to get instant result as well as avoid the long distance travel from field to soil testing laboratory.

Fig-4.2: Average cost of soil testing (Rs/sample) only for those who have spent some money for testing (Paddy)



Average distance from field to soil testing laboratory of marginal, small, medium and large farmers are 22.3km, 18.78km, 23.45km and 24km respectively. We have seen that the distance from field to soil testing laboratory is a vital problem for the farmers, who seriously wanted to test their soil. This problem is more in Midnapore district than Burdwan district for all categories of farmers.

Fig-4.3: Average distance from field to soil testing lab (kms) for crop-I

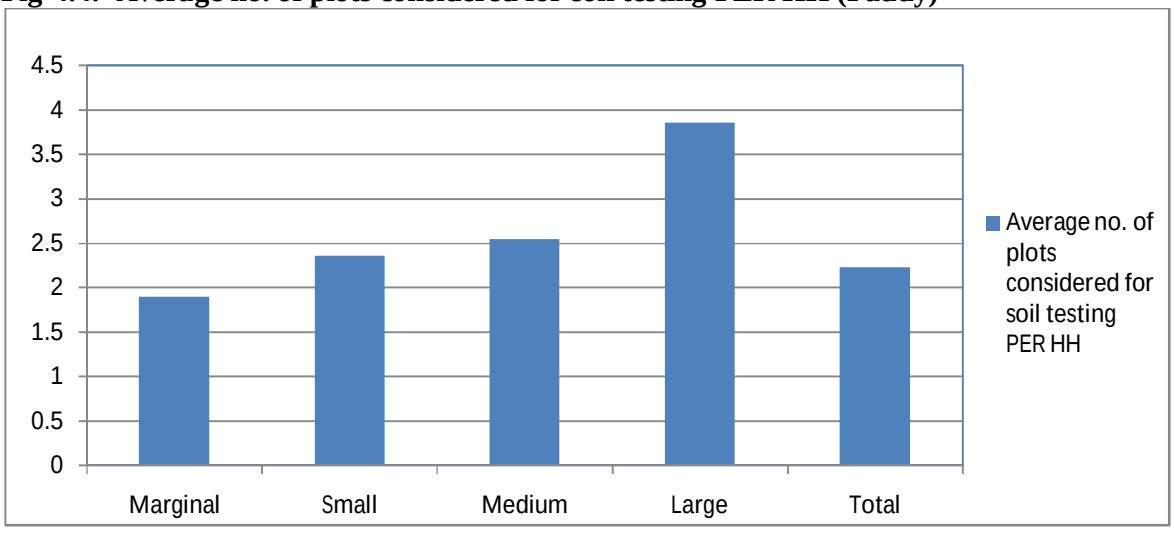


Average number of sample taken per plot is 1 for small, marginal and large farmers as well. Nevertheless, it is slightly above 1 for marginal farmers because they have no trust in

soil testing report. They think soil tests are not done properly in the laboratory. To check this apprehension they had given 2 or more samples for the same plot in the name of the other members of the household. Unfortunately, the Soil-Test results were different corresponding to different samples of the same plot.

Accordingly, average number of plots considered for soil testing per household increases over the size-groups of farmers. This is understandable, as the marginal farmers usually have very tiny pieces of land; naturally, which cannot consist of many plots. As land size increases, plots of land also increase in West Bengal. Hence, it is not unusual that average number of plots considered for soil testing per household increases with increasing farm size.

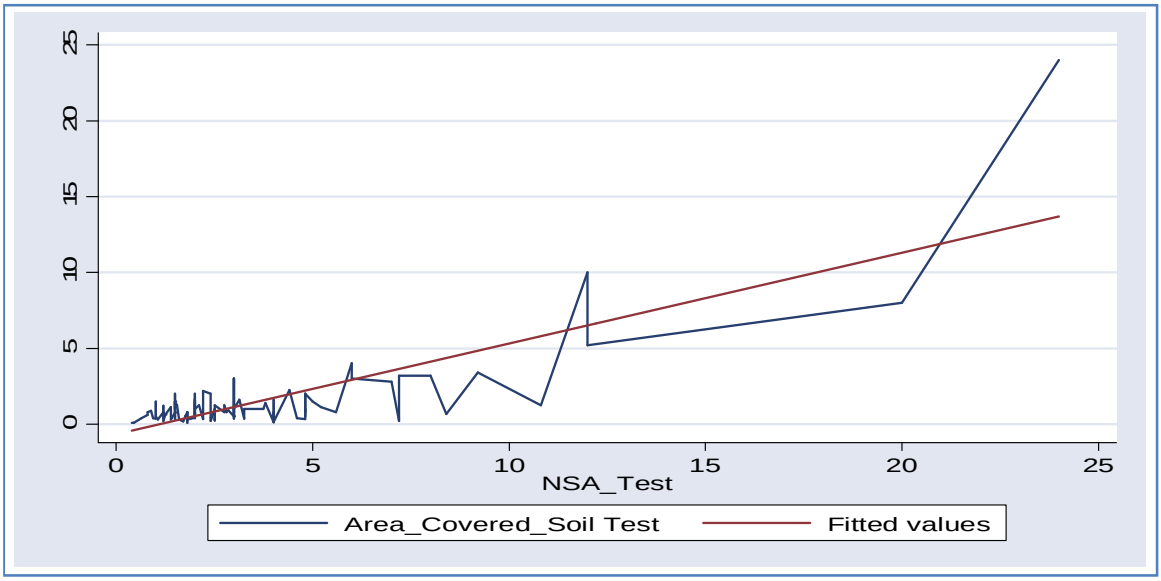
Fig-4.4: Average no. of plots considered for soil testing PER HH (Paddy)



Average area covered under soil test (acre) per household shows an upward rising trend, which is expected. With the farm size, average area covered under soil test increased. Average area covered under soil test (acre) per household are 0.78 acre, 1.01 acre, 2.07 acre and 9.69 acre for the marginal, small, medium and large farmers respectively.

As we know, in West Bengal, most of the farmers are marginal farmers. In addition, these farmers' farms consist of 1 or 2 plots. Thus, if a marginal farmer gives soil sample to test from 1 or 2 plots, then his or her plot of land is mostly covered. In our primary survey, we also observed the same thing. That is why, in the table we can see that 50.51% of land out of net operated area has been covered under soil test for the marginal farmers.

Fig-4.5: Average area covered under soil test (acre) per HH (Paddy)



Percentage of farmers, who collected samples themselves, is 100% in all categories of farmers. There is no provision of KPS collecting the soil from the field. They only inform the farmers. Farmers are compelled to collect soil from field themselves, where the method of collecting may be unscientific. This problem is for two reasons – one, as we had seen there is lack of sufficient number of KPS in the designated areas and secondly, KPS's are not performing their duties appropriately.

The percentage of soil samples collected by the department officials is obviously zero; as we can see in the table, the farmers themselves collect all the samples of soil.

Now we take up Jute

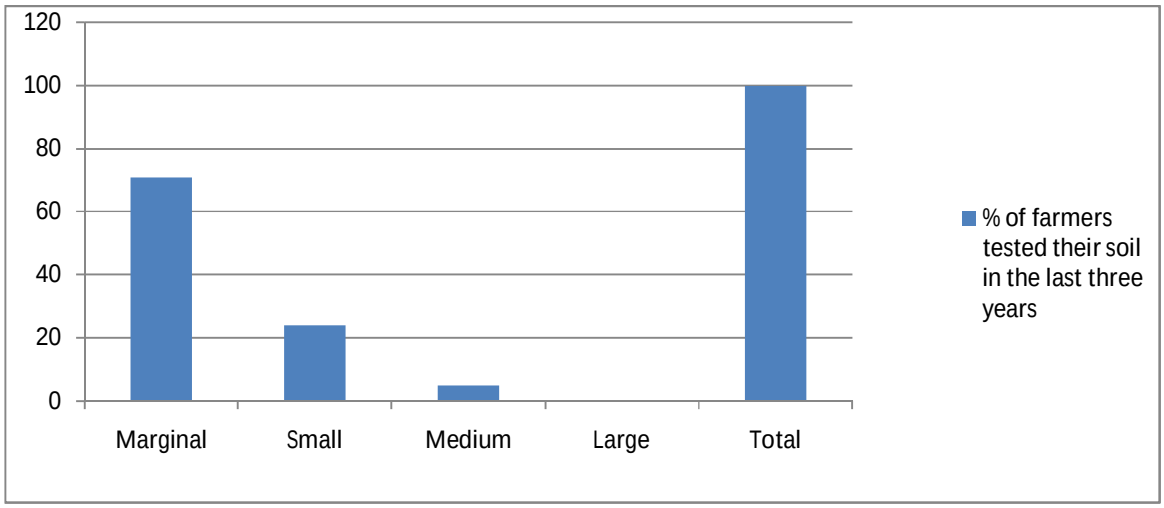
For Jute in Table 4.2 the same methodology has been followed as in table 4.1.

Table 4.2: Distribution of Sample Soil Test Farmers: Jute

Particulars	Marginal	Small	Medium	Large	Total
% of farmers tested their soil in the last three years	71.00	24.00	5.00	0.00	100.00
Average cost of soil testing (Rs/sample) only for those who have spent some money for testing	70.00	62.50	0.00	-	67.86
Average distance from field to soil testing lab (kms)	35.05	28.90	47.00	-	34.16
Average number of soil samples taken per plot	1.03	1.00	1.00	-	1.02
Average no. of plots considered for soil testing PER HH	1.99	2.28	2.00	-	2.06
Average area covered under soil test (acre) per HH	0.71	1.51	1.86	-	0.96
Area covered as % of net operated area(per HH)	54.82	42.86	30.5	-	50.72
% of farmers who collected samples themselves	100	100	100	100	100
% of soil sample collected by the department officials	0.00	0.00	0.00	0.00	0.00

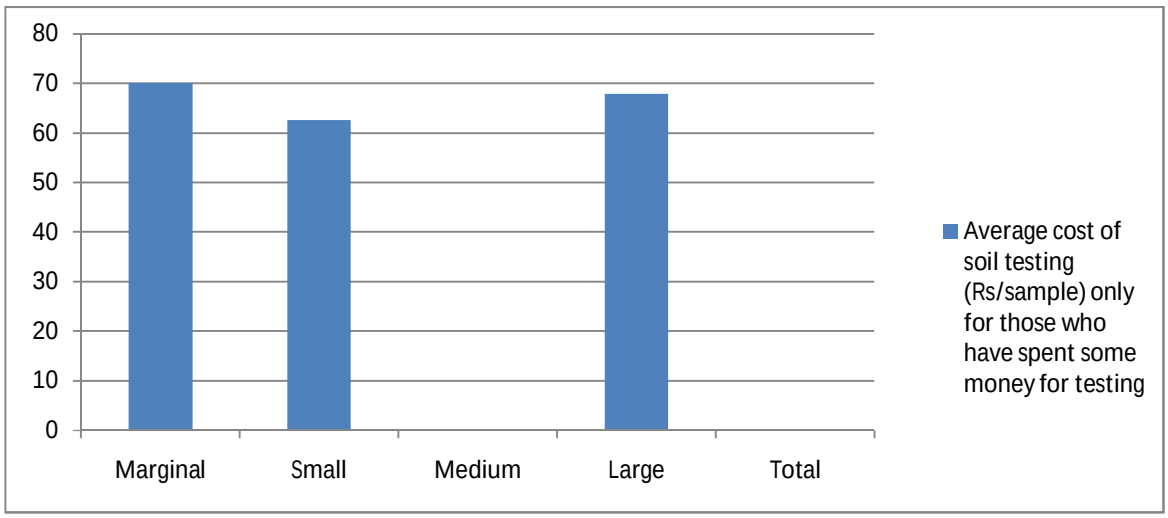
Similar to table-4.1, the first component of table-4.2 reveals a declining trend of soil testing across the size group, though here we do not have a single large farmer. Behind this trend of declining percentage the reason is the same as that shown in Table-4.1. And for Jute , which is basically our reference crop for the two districts – Murshidabad and Nadia, we can see that 71% of soil testing farmers are belonging to marginal farmer class and this proportion is also greater than that of marginal farmers (55%) for Paddy.

Fig-4.6: Percentage of farmers tested their soil in the last three years (Jute)



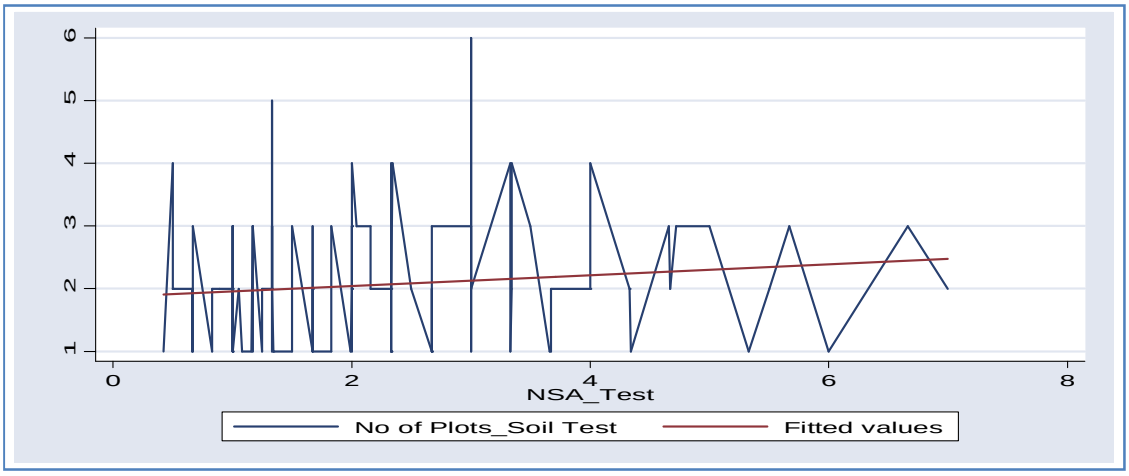
Average cost of soil testing for marginal farmer is rupees 70 and for small farmers is 62.5 rupees. This averages cost is calculated only for those who incurred any cost for testing of soil. Particularly in Nadia, the distance problem is severe. To avoid this access problem as well as to minimise the travel cost some of the farmers, who are poor, had given their soil to test in private company laboratory or to mobile vans. Again, this cost is zero for medium farmers, who are better off financially and hence, could afford to visit the laboratory. For being financially better off and more articulate, their relationships with the KPS seem to be better. Therefore, any kind of scheme related to agriculture or other facilities are easier to get for them. Although we can see the mean distance for medium farmers is greater than small and marginal farmers but the cost of soil testing is nil for them.

Fig-4.7: Average cost of soil testing (Rs/sample) only for those who have spent some money for testing (Jute)



Average number of soil sample taken per plot of land reveals similar trend as in Paddy. It seems that average number of plot considered for soil testing per HH does not show any trend. This issue is examined further with a line diagram

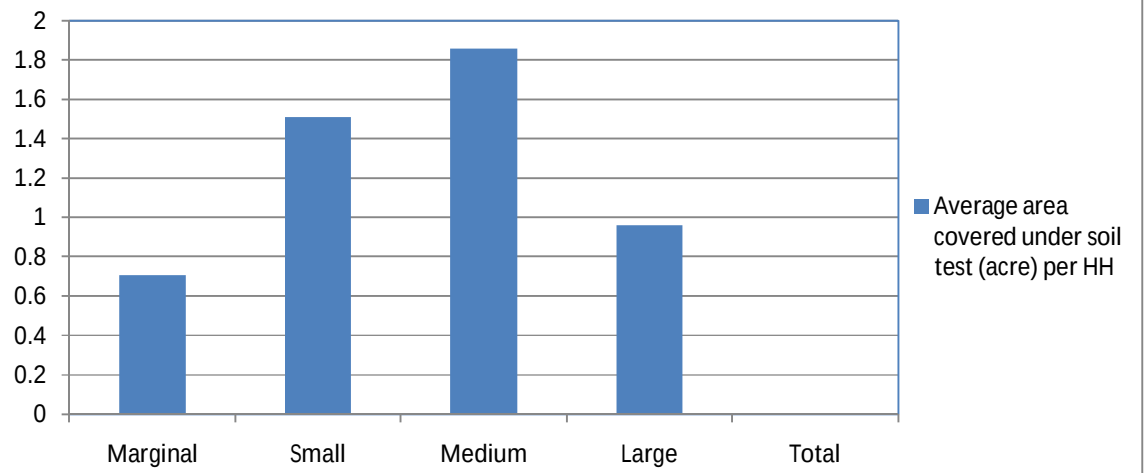
Fig-4.8: Average no. of plots considered for soil testing PER HH (Jute)



Average number of plot considered for soil testing per household, shows an upward rising trend. As we can see, for small farmers, average number of plot for soil testing is 2.28, but for medium farmers their average number of plot decline to 2.00. This unexpectedly greater average for small farmers than medium farmers is because of that, there is an outlier in number of plot considered for soil test in the small farmer group. If we remove the outlier, then we can see an expected upward rising trend in the average number of plot considered for soil testing per household.

In a similar fashion, as we have seen for Paddy, It can be seen here also that, the average area covered under soil test (acre) per household (for Jute) shows an upward rising trend across the farm sizes. Although, we find in the (unreported) graph, this trend for Jute is flatter than that of Paddy. In most of the cases, marginal farmers have tested soil in such a way that 100% of their land is covered. On the contrary, small, medium and large farmers have tested soil for only some parts of their holdings.

Fig-4.9: Average area covered under soil test (acre) per HH (crop-II)



From table-4.2, it is also observed that, 54.82% of net operated area has been covered for soil testing by the marginal farmers. As we move forward along with size groups from marginal to large farmer, we can see this percentage of net operated area is decreasing; for the small farmers and medium farmers, these values are 42.86% and 30.5% respectively.

In a similar fashion as we had seen for Paddy, 100% of the farmers are collecting their soils themselves for Jute also. The same reason is applicable for Jute as for Paddy, as mentioned before, for such a scenario.

4.3 Source of information about soil testing by soil test farmers

The details of source of information about soil testing by the soil test farmers can be obtained from the Table-4.3.

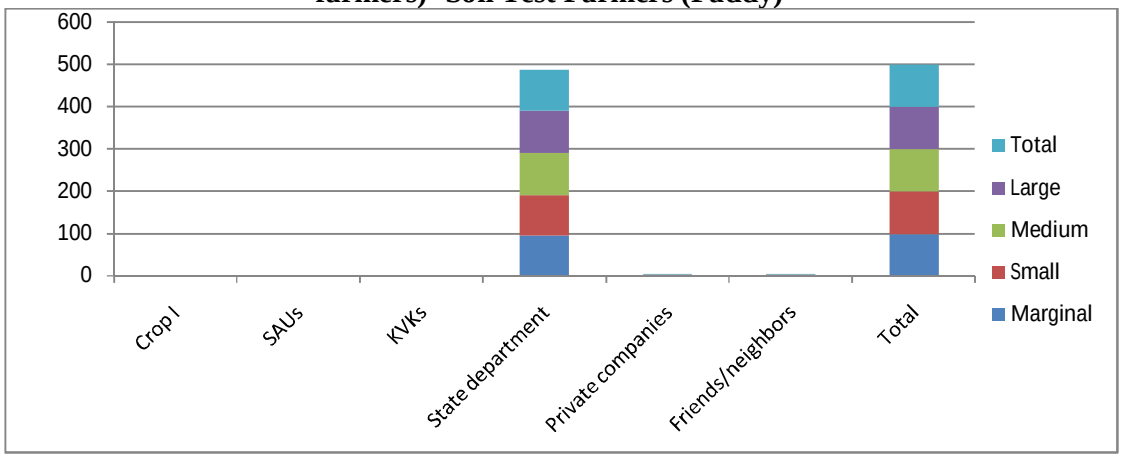
The methodology that is followed to derive the table is the following: First, we sort the soil test farmers into the categories as marginal, small, medium and large and then the percentage of those farmers, who got information of soil testing from different sources are derived – across the farm size-groups.

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

Sources	Marginal	Small	Medium	Large	Total
Crop I (Paddy)					
SAUs	00.00	0.00	0.00	0.00	0.00
KVKs	00.00	0.00	0.00	0.00	0.00
State department	96.96	94.44	100	100	96.66
Private companies	01.52	2.78	0.00	0.00	1.67
Friends/neighbours	1.52	2.78	0.00	0.00	1.67
Total	100.00	100.00	100.00	100.00	100.00
Crop II (Jute)					
SAUs	0.00	0.00	0.00	0.00	0.00
KVKs	0.00	0.00	0.00	0.00	0.00
State department	96.47	93.10	100.00	96.47	95.83
Private companies	1.18	6.90	0.00	1.18	2.50
Friends/neighbours	2.35	0.00	0.00	2.35	1.67
Total	100.00	100.00	100.00	100.00	0.00

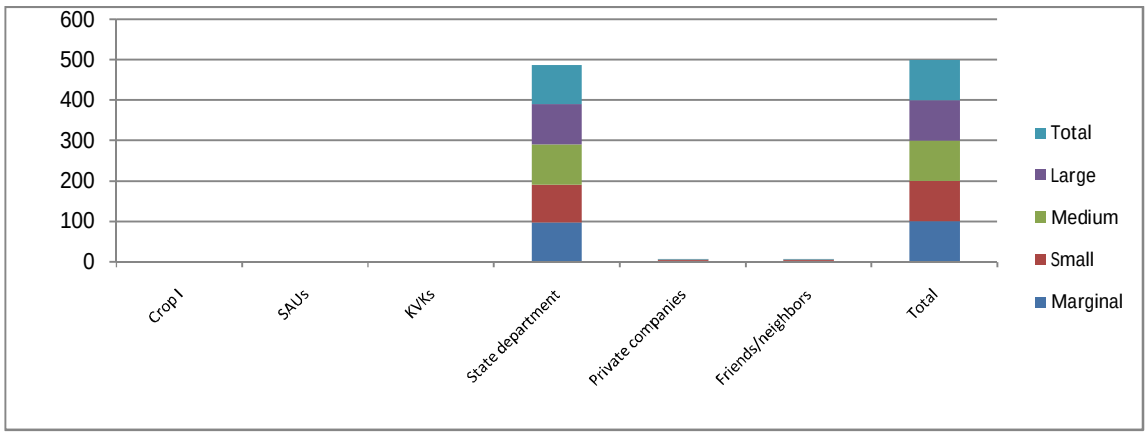
It can be seen in the table that almost all the soil test farmers got information on soil testing from the state department. A few farmers from marginal and small category (i.e. 1.52% and 2.78% respectively) have got the information from private companies; also 1.52% of marginal and 2.78% of small farmers have got the information from friends and neighbours. This is the scenario for Paddy, which can be shown by the following column diagram.

4.10 Sources of Information about Soil Testing by Sample Households (% of farmers)- Soil Test Farmers (Paddy)



A similar scenario we can see for Jute as well. Only 1.18% of marginal, and 6.90% of small and 1.18% of large farmers got the information of soil testing from private companies and 2.35% of marginal and 2.35% of large farmers' source of information about soil testing is friends or neighbours. The rest of the farmers get information from state department.

Fig-4.11: Sources of Information about Soil Testing by Sample Households (% of farmers) - Soil Test Farmers (Jute)



4.4. Reasons for soil testing by soil test farmers

In this section, we discuss the reasons for soil testing by the soil test farmers. Table 4.4 shows the corresponding patters for both the Paddy and Jute (i.e. for 120 soil test households for each crop)

Table 4.4: Reasons for Soil Testing by Sample Households (% of farmers)- Soil Test Farmers

Reasons	Paddy				Jute			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
For availing benefits under subsidy schemes	2.50	14.20	0.00	16.70	8.30	0.00	0.00	8.30
For increasing crop yield	87.50	0.80	0.00	88.30	63.30	2.50	0.00	65.80
Motivation from village demonstration/training/exposure visits to places with best farming practices	2.50	6.70	0.80	10.00	1.70	1.70	0.00	3.30
Peer farmers' group pressure	0.80	0.00	0.00	0.80	0.00	0.00	0.00	0.00
Adopt new technological practices	14.20	2.50	0.00	16.70	10.00	3.30	0.00	13.30
Others	6.70	10.00	1.70	18.30	30.80	7.50	0.00	38.30

The proportion of farmers reporting the second reason as most important, (i.e. for increasing yield) is the highest for both the crops as shown in the table (i.e. 87.5% and 88.3% for crop I and crop II respectively). The second highest proportion of farmers noted the fifth reason as most important for crop-I, while for crop-II, the sixth reason, which is termed as 'other', is reported by 30.8% of farmers as most important. There are many other reasons for which the farmers have tested their soil such as, to decrease the cost of cultivation, to know the actual situation of land, to increase the quality of crop etc. These

reasons have been summarized as “other” as shown in the table above. Only 0.8% of crop-I farmers expressed the reason that they have tested their soil due to peer farmers’ group pressure, while none of the farmers said this for crop-II. A tiny proportion of farmers have tested their soil for the third reason shown in the table for both the crops.

4.5. Reasons for Not Testing Soil by Control Farmers

In this section, we obtain the reasons for not testing the soil by the non-soil test, i.e. the control farmers. Table 4.5. Shows the corresponding results for both the crop I and crop II (i.e. for 60 control non-testing households for each crop).

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

Reasons	Paddy				Jute			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
Do not know how to take soil samples	8.33	6.67	0.00	15	8.33	1.67	0.00	10.00
Do not know whom to contact for details on testing	21.67	13.33	0.00	35	15	6.67	1.67	23.33
Soil testing laboratories are located far away	20.00	11.67	1.67	33.33	13.33	5.00	3.33	21.67
Soil testing not required for my field as crop yield is good	3.33	0.00	0.00	3.33	8.33	0.00	0.00	8.33
Others	23.33	10.00	3.33	38.33	31.67	8.33	1.67	41.67

This section is very interesting because from this section we can obtain a broad overview on the lack of proper functioning of the government institutions and or agents. Also from here, we can derive an observation that farmers are not that concerned about soil testing and not give enough importance to this national program. We can see from the above table that a good proportion of farmers claim that they do not know whom to contact for details on soil testing as a reason for not testing soil. In addition, distance from agricultural field to soil test laboratory is a major problem for the farmers, precisely for the marginal and small farmers. Since the distance is significant with sizeable time and transportation cost and even some (not so visible) transaction cost, the marginal and small farmers cannot afford to avail of this facility. Further, we have already seen earlier that there is a lack of faith in this soil-testing programme due to precarious nature of the test-outcomes (different results from two samples derived from the same plot, as reported and advised by the laboratory officials); this may have contributed in avoiding this grand programme that is even ‘free’. The highest proportion of farmers (i.e. 23.33% and 31.67% for crop-I and

crop-II respectively) does not test their soil because of many other reasons, which we summarize as "other". From the field survey experience, we obtained that there are some farmers who consider their yield as good, that is why they do not need to test their soil. In addition, some of the farmers said they are busy with other 'more' important works. Most interestingly, a good proportion of farmers experienced from their friends and neighbours, who had tested their soil, that the soil health report is fake (as mentioned just above and discussed earlier as well) or does not come in time. Hence, they are reluctant about testing their soil.

4.6 Status of Soil Health for the Sample Soil Test Farms

We got a few soil health reports from the farmers, who have been interviewed for crop-I. The soil health cards that we actually got while surveying (only few even with repeated attempts), from there we derive the percentage of farmers whose soil health reports mark the levels of designated/crucial nutrients. Many of these soil health reports were incomplete in the sense that, the values for the (designated) nutrients as mentioned in the table were not present. We calculate the percentage of farmers for whom the soil-health cards have the mentioned/designated nutrient status.

Table 4.6: Status of Soil Health in terms of Nutrients on the Sample Soil Test Farms (as reported in the soil health card)- Soil Test Farmers (percentage of farmers)

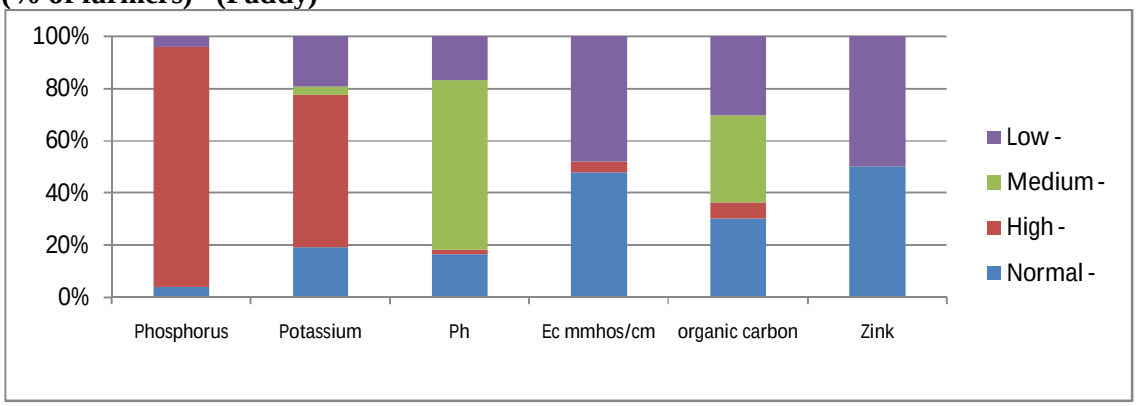
Fertilizers	Normal	High	Medium	Low
Crop I (Paddy)				
Nitrogen	-	-	-	-
Phosphorus	4.440	95.560	0.000	4.440
Potassium	24.000	72.000	4.000	24.000
Ph	20.000	2.000	78.000	20.000
Ecmmhos/cm	91.670	8.330	0.000	91.670
organic carbon	43.750	8.330	47.920	43.750
Zink	100.000	0.000	0.000	100.000
Crop II (Jute)				
Nitrogen	-	-	-	-
Phosphorus	6.060	93.940	0.000	6.060
Potassium	76.470	20.590	2.940	76.470
pH	28.570	62.860	8.570	28.570
Ecmmhos/cm	97.140	2.860	0.000	97.140
organic carbon	57.580	0.000	42.420	57.580
Zink	15.790	0.000	84.210	15.790

Note: These numbers have been calculated by us on the basis of information received only from the official record, which may not have percolated to the farmers.

For Paddy, phosphorus is normal for 4.44% of farmers, high for the 95.56% of the farmers and low for the 4.44% of the farmers. Those who have the potassium status in their soil health reports, among them the percentage calculations show that, for 24%

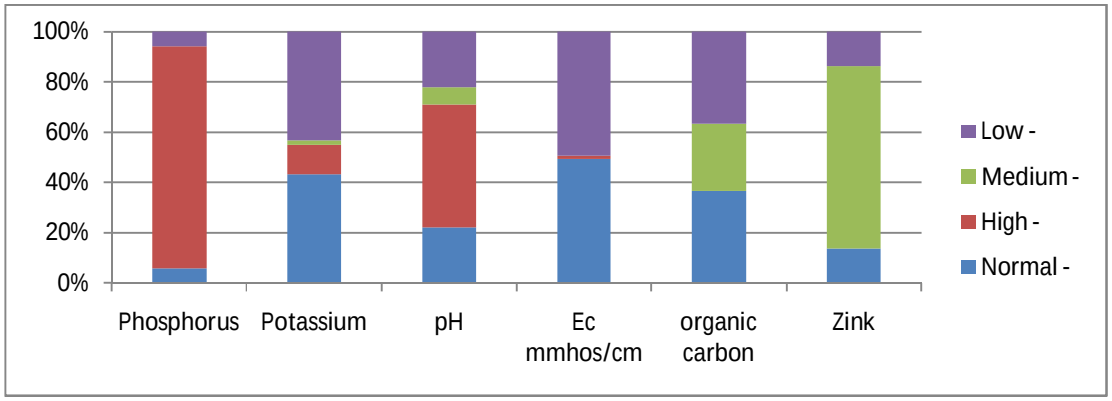
potassium is normal; for 72% potassium is high, for 4% potassium is medium and for 24% it is low. Soil Ph for 20% of the farmers is normal, for 2% ph is high, for 78% it is medium and for 20% ph is low. Ecmmhos/cm, for 91.67% of farmers is normal and for 8.33%, 0% and 91.67% respectively it is high, medium and low. Organic carbon for 43.75% of farmers was normal and again it is high, medium and low for 8.33%, 47.92% and 43.75% of farmers respectively. In most of the soil health reports, there is no status of zinc; for whom (very few though) we were able to collect that status, we found it to be low for Paddy. For Jute, 15.79% farmers have zinc status as normal; and 84.21% and 15.79% of farmers have zinc status as medium and low respectively.

Fig-4.12: Status of Soil Health in terms of Nutrients on the Sample Soil Test Farmers (% of farmers) (Paddy)



Similar kind of explanations is valid for crop-II as well. It is clear from the table above. This has also been shown in the diagram below.

Fig-4.13: Status of Soil Health in terms of Nutrients on the Sample Soil Test Farms (as reported in the soil health card)- Soil Test Farmers (percentage of farmers) (crop-II)



4.7. Recommended Doses of Fertilisers on Soil Test Basis

A negligible number of soil health reports consists recommendation of fertilizer use, that we had collected through field survey. Most of the farmers do not have soil test report as well as the recommendations. The reports which were collected, with recommendation of fertilizer use, by us (though a few, even after repeated attempts and even after contacting the high officials of the district, block etc) show the scenario as given in the table below.

Table 4.7: Average Quantity of Recommended Dose of Fertilisers Given Based on Soil Test

(as reported in the health card)-Soil Test Farmers (Kg/acre)

Crop	Crop I (Paddy)	Crop II (Jute)
Urea	13.20	35.19
DAP	31.19	-
Single Super Phosphate	-	54.80
Potash	26.72	26.98

Note: These averages have been taken only from the farmers who actually have the soil health card with at least some recommendations.

As per recommendation, farmers should use 13.20kg of urea per acre, DAP should be used 31.19kg per acre and potash 26.72kg per acre for paddy on an average. On the other hand, farmers should use 35.19 kg urea, 54.80kg SSP and 26.72kg potash in jute.

Table 4.8: Average Quantity of Split Doses of Fertilizers Recommended by Stage of Crop Growth (Kg/acre)- Soil Test Farmers

Particulars	Basal application	After inter-cultivation (weeding, thinning etc)	Vegetative growth	Flowering	Grain formation
Crop I(Paddy)	NA	NA	NA	NA	NA
Urea	NA	NA	NA	NA	NA
DAP	NA	NA	NA	NA	NA
SSP	NA	NA	NA	NA	NA
Potash	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
Crop II(Jute)	NA	NA	NA	NA	NA
Urea	NA	NA	NA	NA	NA
DAP	NA	NA	NA	NA	NA
SSP	NA	NA	NA	NA	NA
Potash	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA
	NA	NA	NA	NA	NA

Note: no data were available in this respect.

4.8. Summary of the Chapter

First, we can see that most of the farmers have not done soil test. Apparently, they are not sufficiently conscious about the national program on soil test. Hence, our primary survey also was purposive to some extent.

Implementation of this national program seems to be in a poor shape. For this poor performance, government institutions and actors/agents are responsible, to a large extent; farmers are also found to be reluctant. The government actors/agents (e.g. Krishi Prayukti Sahayak – KPS and perhaps, more importantly, the laboratory officials/scientists) may not be performing their duties appropriately; but, the situation is made worse due to a severe lack of proper infrastructure, which we have also observed from our own field experience. There are various reasons because of which the program on soil test is not being implemented fruitfully. The distance between the field and soil test laboratory and minimum technical support from government actors/agents bothered the farmers. Again, if the farmers, who have actually tested their soil, want to apply recommended doses of fertilizer, they cannot do so as the recommendations are either not available or these are difficult to understand for them, because of language problems. In this respect, the scientific recommendations should be supplemented with non-technical advices in the soil health reports.

Overall, what we could see is the following: The standard of laboratories is miserable with severe personnel constraint and lack of infrastructure. There is no proper mechanism of sample collection and dissemination of test results and recommendations. The distance and transportation problems are severe. The KPS pool is painfully understaffed. Only a handful of KPS are given the responsibilities for the blocks/taluks as a whole. Sometimes, it is humanly impossible to cover the farming populations effectively, given the staffing pattern in this programme. The problems are multiplied by a serious lack of professionalism on the part of the ground-level members (and even the medium and lower rank officials, technical staff, scientists etc) of this grand programme.

On the whole, there is a serious lack of concern shown towards this national program on soil test. Neither the government agencies nor the farmers seem to be interested in such a program, in spite of its significant positive potentials.

Chapter – V

Adoption of Recommended Doses of Fertilisers and its Constraints

5.1 Background

Farmers may test their soil and use recommended doses of fertilizer for different reasons. It may vary from crop to crop, place to place, across different farm size groups. In this chapter, we want to see why farmers are testing their soil and apply recommended doses of fertilizer. We also want to find out the constrains for testing soil and applying recommended doses of fertilizer on the basis of soil test. On the other hand, use of chemical fertilizer as well as organic fertilizer may vary from crop to crop, from soil test farmers to non test farmers and also across the different farm size groups. So, we want to compare the use of fertilizers across different farm size groups for paddy and jute. Price of fertilizers, sources of purchase of fertilizer, transport cost of fertilizer, attendant of training programming by different govt. and non-govt. agency may indirectly affect the application of fertilizer. Therefore, we will compare these factors among the soil test farmers and non soil test farmers i.e. control farmers.

5.2 Application of Recommended Doses of Fertilizers by Soil Test Farmers

Keeping in view the objectives, we have tried to find out to what extent the farmers are adopting the recommended doses of fertilizer across different farm size groups for both the crops i.e. paddy and jute. This is shown in Table-5.1.Here, we have divided all the farmers into four groups according to their net operated area .Marginal farmers are the farmers who have net operated area of less than or equal to 2.50 acres. Small farmers have from 2.51 to 5.00 acres, Medium farmers have from 5.01 to 10.00 acres of land and the large farmers have above 10.01 acres.

5.2. a Application of Recommended Doses of Fertilizers in Crop-I (Paddy)

Table-5.1 shows that very few farmers have applied recommended doses of fertilizer, further those who have followed the recommended doses in principal, in fact are not applying actual recommended doses. They have used only oral recommendation of fertilizer given by Krishi-Prayukti-Sahayak – agricultural extension personnel (KPS)

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

Particulars	Marginal	Small	Medium	Large	Total
Crop I (Paddy)					
% of farmers applied recommended doses of fertilizers within each group	6.06	11.11	18.18	14.29	9.17
Average area (acre) of only those farmers who have applied the recommended doses of fertilizer	0.42	.59	2.03	10.00**	1.65
Area covered as % of net operated area (of only those farmers who have applied the recommended doses of fertilizer)	27.62	17.78	22.41	83.33	28.16
Average number of seasons applied (of only those farmers who have applied the recommended doses of fertilizer)	1.00	1.00	1.00	1.00	1.00
% of farmers willing to continue applying recommended doses of fertilizers (of only those farmers who have applied the recommended doses of fertilizer)	100.00	100.00	100.00	100.00	100.00
Crop II (Jute)					
% of farmers applied recommended doses of fertilizers within each group	14.12	3.45	0.00	-	10.83
Average area (acre) of only those farmers who have applied the recommended doses of fertilizer	0.51	1.00	-	-	0.55
Area covered as % of net operated area (of only those farmers who have applied the recommended doses of fertilizer)	24.93	37.45	-	-	25.89
Average number of seasons applied (of only those farmers who have applied the recommended doses of fertilizer)	1.00	1.00	-	-	1.00
% of farmers willing to continue applying recommended doses of fertilizers (of only those farmers who have applied the recommended doses of fertilizer)	100.00	100.00	-	-	100.00

** Only one observation

Among those cultivating paddy, higher number of farmers in the medium and large farming group are applying recommended doses of fertilizers compared to the marginal and small farming. It is also found that 6.06 percent of marginal farmers, 11.11 percent of small farmers, 18.18 percent of medium farmers and 14.29 percent of large farmers have applied recommendation does of fertilizer. Overall, only 9.17 percent of the sample farmers have applied recommended doses of fertilizer. Larger farmers are applying recommended doses of fertilizers in greater area of land because they have tested their soil for higher amount of area compared to the small farmers. It can be found that the marginal farmers who are applying recommended doses of fertilizer are using it on 0.42 acre of land on an average; for small farmers the corresponding value is 0.59 acre, for medium farmers 2.03 acre, for large farmers 10 acre and taking all groups together, it is 1.65 acre. Area covered for application of recommended doses of fertilizer as percentage of net operated area is lower in small farm size-group compared to other size-groups. Area covered for the marginal and small farmers are 27.62 and 17.78 percent respectively; for medium farmers

the corresponding value is 22.41 percent, for large farmers 83.33 percent and taking all groups together, it is 28.16 percent. The farmers who have applied recommended doses of fertilizers are applying it only in one season .Table-5.1 also shows that all the paddy farmers who have applied recommendation doses of fertilizer, want to continue with it.

5.2. b Application of Recommended Doses of Fertilizers in Crop-II (Jute)

Extent of application of recommended doses of fertilizer for jute also has been represented in Table-5.1.It can be seen that higher number of farmers in the marginal farm group is applying recommended doses of fertilizer compared to other farm groups. Thus, 14.12 percent of the marginal farmers are applying recommended doses of fertilizer; for small farmers the corresponding value is 3.45 percent, for medium farmers 0.00 percent and taking all the groups together it is 10.83 percent. In terms of area, small farmers are applying more compared to marginal farmers. Farmers in the small farming group are applying recommended doses on 1.00 acre of land on an average. It is 0.51 acre for marginal farming group and taking all the groups together, it is 0.55 acre per household. Area covered with the application of recommended doses of fertilizers as percentage of net operated area is higher in small farm size group compared to marginal farm size group. It is found that area covered in small farm size group is 37.45%; for marginal farm size group corresponding value is 24.93% and it is 25.89% for overall sample farmers. The farmers of jute who have applied recommended doses of fertilizer are applying it in only one season. All the farmers who have applied recommended doses of fertilizer want to continue with it.

5.2. c Application of Recommended Doses of Fertilizers in Paddy & Jute

It can be seen that higher number of paddy farmers compared to jute farmers in the marginal group has applied recommended doses of fertilizers, and higher number of jute farmers compared to paddy farmers in the small farming group has used it. Overall, number of recommended-dose-applying farmers is higher for jute compared to paddy. Average area for the application recommended doses of fertilizer is higher in paddy compared to jute. Area covered for application of recommendation doses of fertilizer as percentage of net operated area is higher in paddy compared to jute. The farmers who have applied recommended doses in paddy and jute are applying it only in one season. All the

paddy farmers and jute farmers who have applied recommended doses of fertilizers want to continue with it.

5.3 Constraints in Applying Recommended Doses of Fertilisers by Soil Test Farmers

In previous section, we have seen that most of the farmers are not applying recommended doses of fertilizer. Here, we will try to find out the reasons for not applying the recommended doses of fertilizers. We have presupposed some probable factors for not using recommended doses of fertilizer and find out how many persons are not using recommended doses of fertilizer for those factors. We have ranked those factors into three categories: “Most Important”, “Important” and “Least Important”. Many farmers have not got any result of soil test. Therefore, they have no scope for using recommended doses of fertilizer and we have incorporated this factor into ‘other ‘

Table-5.2: Constraints in Applying Recommended Doses of Fertilizers (% of non-applying farmers) - Soil Test Farmers

Reasons	Crop I (Paddy)				Crop II (Jute)			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
Adequate quantity of fertilisers not available	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prices of fertilisers are high	8.26	8.26	0.00	16.51	0.93	1.87	0.00	2.80
Lack of money to purchase fertilisers	6.42	5.50	0.00	11.93	0.93	0.00	0.00	0.93
No technical advice on method and time of fertiliser application	22.94	9.17	1.83	33.94	38.32	4.67	0.00	42.99
Difficult to understand and follow the recommended doses	24.77	9.17	0.00	33.94	4.67	7.48	0.00	12.15
Other	34.86	4.59	0.00	39.45	35.51	6.54	0.00	42.06

- Table-5.2 shows that most important factors for the paddy farmers for not applying recommended doses of fertilizer is difficulty of understanding and following the recommended doses(24.77%) and second important factor is lack of technical advice on method and time of fertiliser application(22.94%). Taking all the rank together, we can see that most of the farmers are not applying recommended doses of fertilizers due to Difficulty of understanding and following the recommended doses and lack of technical advice on method and time of fertiliser application.Further, some farmers are not applying the recommended doses due to

lack of money to purchase fertilizers (total 11.93%) and for high prices of fertilizer (total 16.51%)

- Table-5.2 also shows that most important factor for jute farmers for not applying recommended doses of fertilizers is lack of technical advice on method and time of fertiliser application (38.32%).Further, some farmers are not applying for difficulty of understanding and following the recommended doses(total 12.15%). Few farmers are not applying recommended doses of fertilizer due to high price of fertilizers (total 2.80%)

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

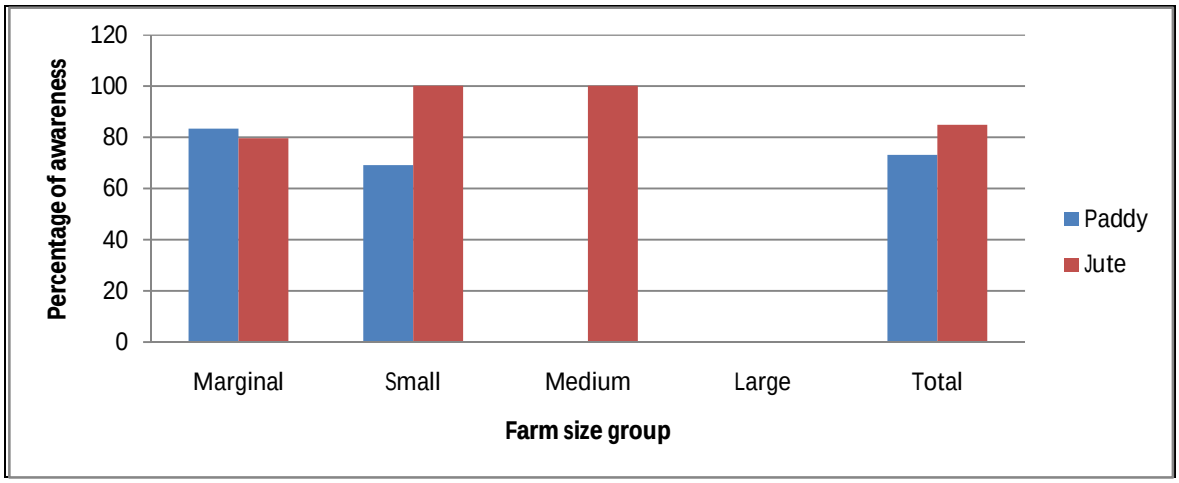
It has been seen that very few farmers are applying recommended doses of fertilizer in the both crops and most of the farmers are not applying it due to lack of technical advice on method and time of fertiliser application. Therefore, it is very important to know the extent of awareness about soil test and recommended doses of fertilizers among the control farmers. Many farmers know about soil test but their understanding is superficial and hazy. On the other hand, Government institutions are not working properly due to various causes like lack of man power. In this background, we want to see how our sample farmers are aware about soil test as well as recommended doses of fertilizers.

Table-5.3: Awareness and Sources of Information about Recommended Doses of Fertilizers by Sample Households (% of farmers) - Control Farmers

Sources	Marginal	Small	Medium	Large	Total
Crop I(Paddy)					
% farmers aware	83.33	69.23	0.00	0.00	73.33
Source of information					
Department of agriculture	0.00	0.00	0.00	0.00	0.00
Agricultural University	0.00	0.00	0.00	0.00	0.00
Cooperatives/Growers' Association	0.00	0.00	0.00	0.00	0.00
Private input dealers	0.00	0.00	0.00	0.00	0.00
Fellow farmers	0.00	0.00	0.00	0.00	0.00
NGO/Others	0.00	0.00	0.00	0.00	0.00
Total	0.00	0.00	0.00	0.00	0.00
Crop II(Jute)					
% farmers aware	79.55	100.00	100.00	-	85.00
Source of information					
Department of agriculture	0.00	0.00	0.00	-	0.00
Agricultural University	0.00	0.00	0.00	-	0.00
Cooperatives/Growers' Association	0.00	0.00	0.00	-	0.00
Private input dealers	0.00	0.00	0.00	-	0.00
Fellow farmers	0.00	0.00	0.00		0.00
NGO/Others	0.00	0.00	0.00	-	0.00
Total	0.00	0.00	0.00	-	0.00

- Table-5.3 shows that among the paddy farmers: 83.33 percent of marginal farmers are aware about the soil test; for small farmers the corresponding value is 69.23 percent. No farmers from the large and medium farm small size groups are aware about the soil test. Overall, 73.33 percent of the control farmers are found to be aware of soil test.
- In case of paddy, no control farmers know about the recommended doses of fertilizer from any of the sources mentioned in Table-5.3.
- Among the jute farmers: 79.55 percent of marginal farmers are aware about the soil test and all the farmers in the small and medium farm size group are aware about soil test. Overall, 85.00 percent of the control farmers are found to be aware of soil test.
- In case of jute, no control farmers from any farming group know about the recommended doses of fertilizer

Diagram-5.1 Awareness about recommended doses of fertilizers of control farmers



Above diagram shows that higher number of paddy farmers compared to jute farmers is aware of soil test in the marginal farming group. On the other hand, higher number of jute farmers compared to paddy farmers in the small and medium farming group is aware of soil test. The large paddy farmers are not aware of soil test. Overall, jute farmers compared to paddy farmers are more aware of soil test. It has been found that, no control farmers know about the recommended doses of fertilizers.

5.5 Application of Actual Quantity of Fertilisers by Sample Households

Farm size group wise applications of different fertilizers in paddy have been represented in table-5.4. Here application of different fertilizers in paddy has been calculated by taking the average of fertilizer-use in Amon paddy and Boro paddy separately.

Table -5.4: Actual Quantity of Fertilizers Applied by the Sample Farmers during the Reference Year (Kg/acre)- Crop I (Paddy)

Crop	Marginal	Small	Medium	Large	Total
Soil Test Farmers					
Urea	38.65	38.44	37.37	44.58	38.81
DAP	36.79	36.31	31.01	42.09	36.42
Single Super Phosphate	8.04	8.44	0.00	7.14	7.37
Potash	23.71	25.57	17.07	28.72	23.95
Complex	17.80	16.46	7.03	0.00	15.37
Micronutrients	0.05	0.05	0.02	0.01	0.04
Other	4.00	3.85	0.03	0.00	3.36
Control Farmers					
Urea	38.43	35.87	45.94	45.63	38.49
DAP	40.08	26.49	45.31	43.75	37.54
Single Super Phosphate	12.46	9.13	6.25	0.00	11.12
Potash	34.75	13.03	19.38	25.00	28.86
Complex	20.07	4.81	0.00	0.00	15.09
Micronutrients	0.78	0.00	0.00	0.00	0.55
Other	1.80	0.38	0.00	0.00	1.35

Note: These has been calculated by Averaging the Boro and Amon Paddy

Diagram-5.2: Use of urea in Paddy by soil test farmers (Kg/acre)

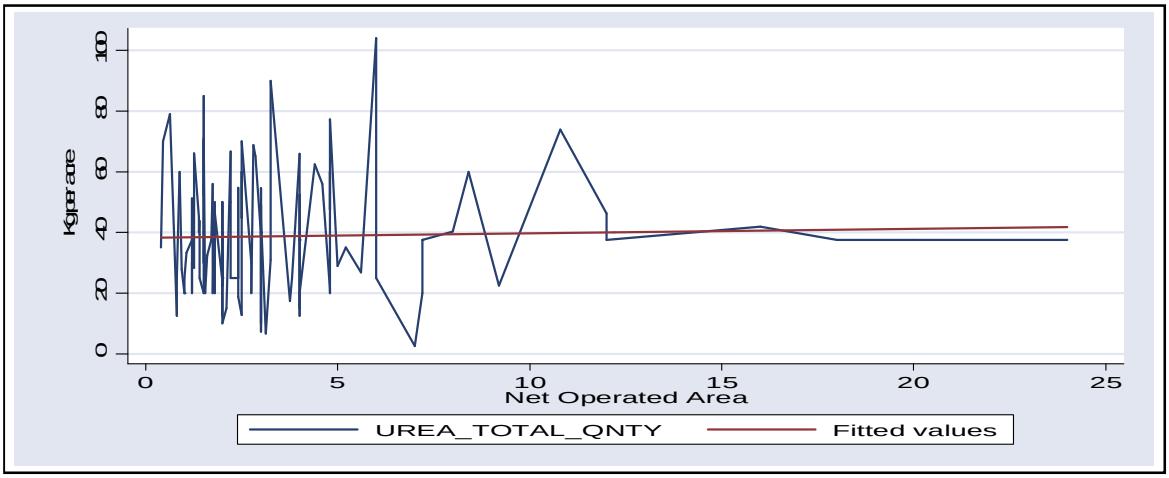
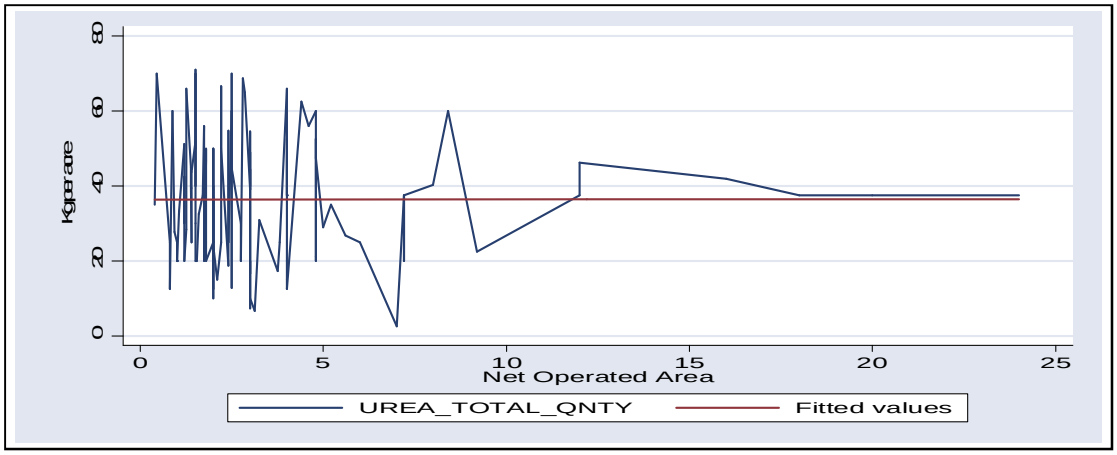


Diagram-5.3: Use of urea in Paddy by soil test farmers (Kg/acre) (Removing outliers)



Note: Considering outlier if kg/acre>=74

Diagram-5.4: Use of urea in Paddy by soil test farmers (Kg/acre) (Up to NOA of 10.1 acre & Removing outliers)

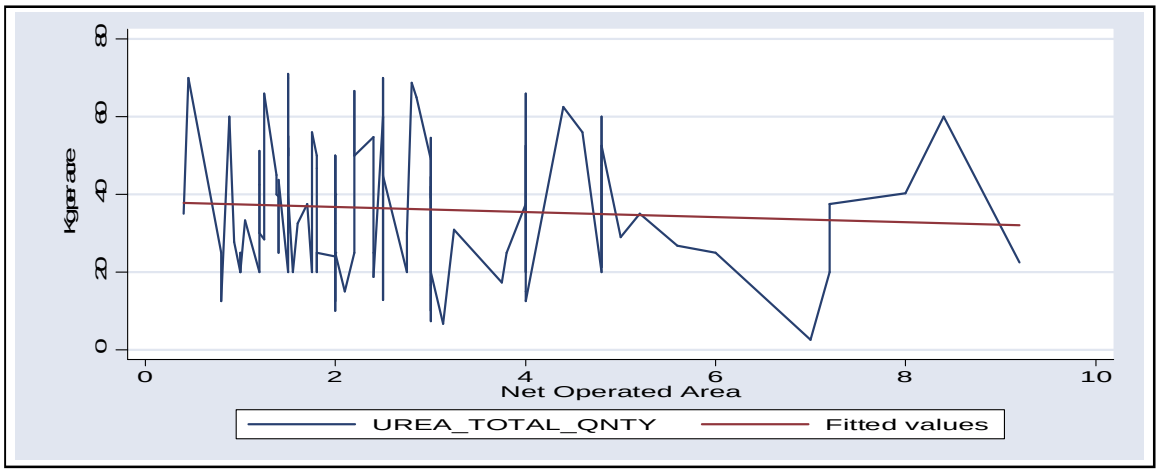
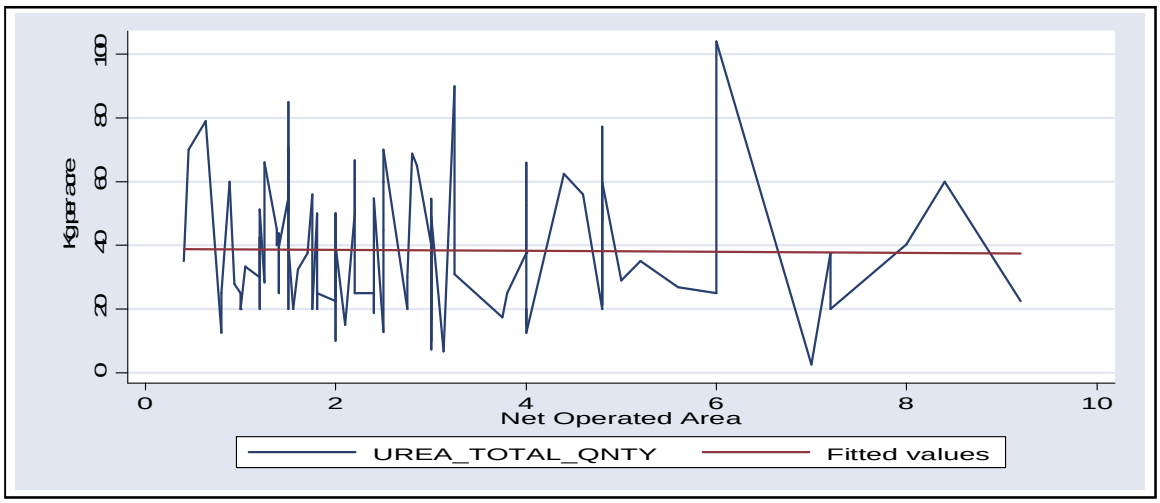


Diagram-5.5: Use of urea in Paddy by soil test farmers (Kg/acre) (Considering NOA<=10.1 & not removing outliers)



Excluding large farm size-group, there is a tendency that smaller farmers are using greater amount of urea compared to large farmers. Farmers in large farm size-group apply more urea compared to others but the sample size in this size group is very low. So it cannot be said confidently that large farmers are using greater amount of urea.

Diagram-5.6: Use of DAP in Paddy by soil test farmers (Kg/acre)(Not removing outlier)

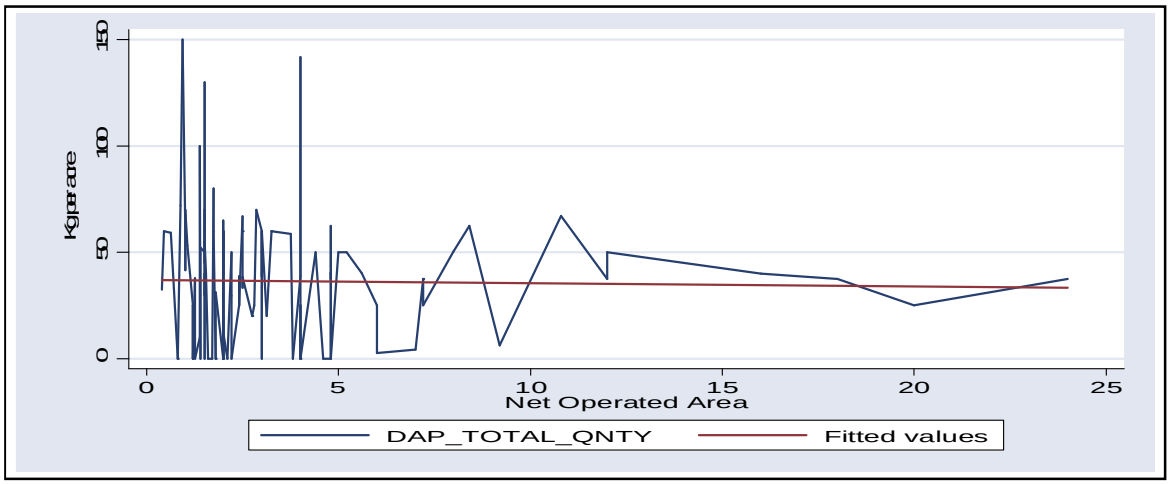
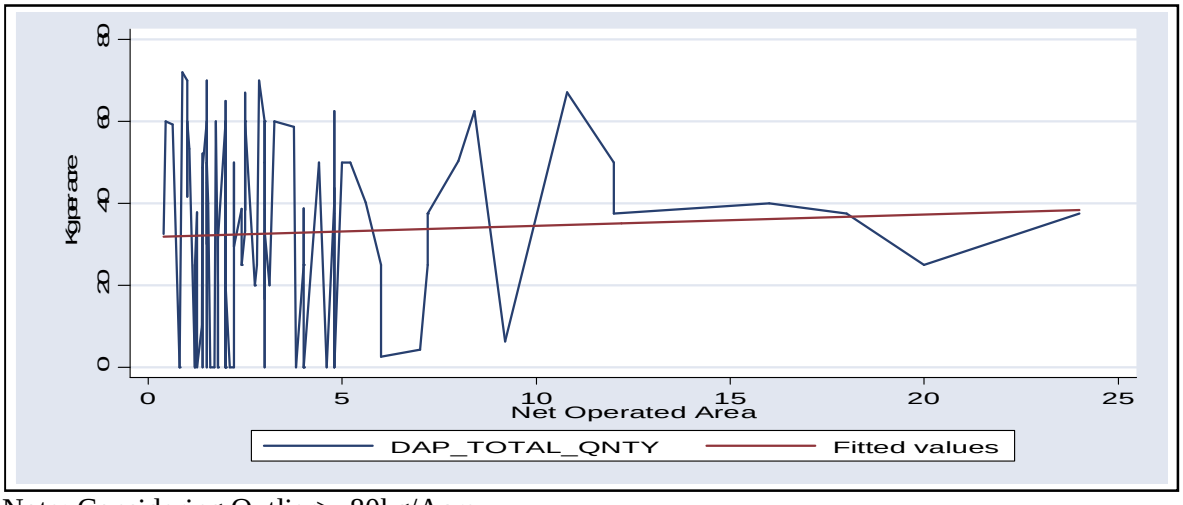


Diagram-5.7: Use of DAP in Paddy by soil test farmers (Kg/acre) (Removing outlier)



Note: Considering Outlier>=80kg/Acre

Diagram-5.8: Use of DAP in Paddy by soil test farmers (Kg/acre) (considering NOA <= 10 acre)

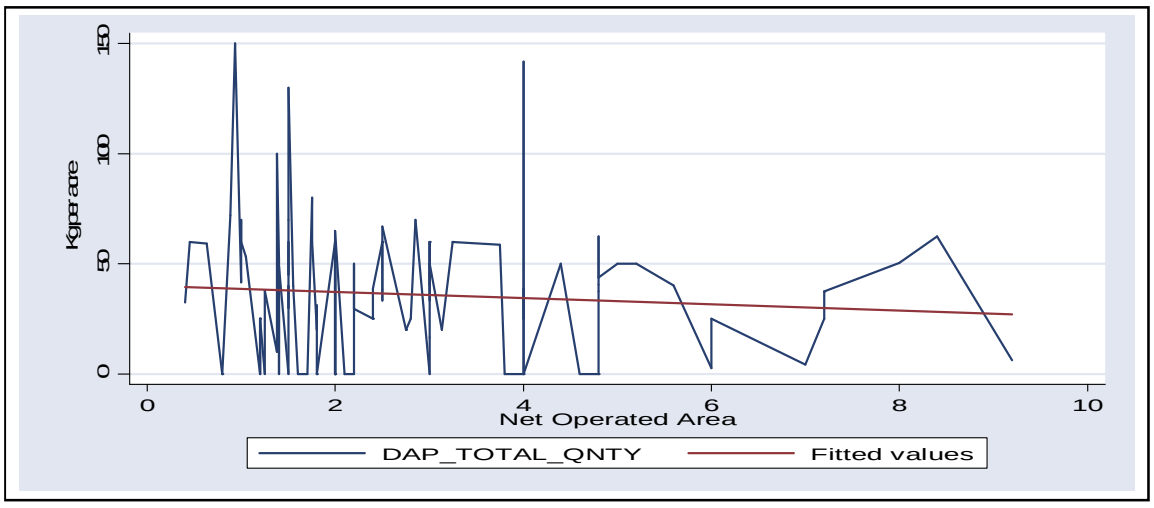
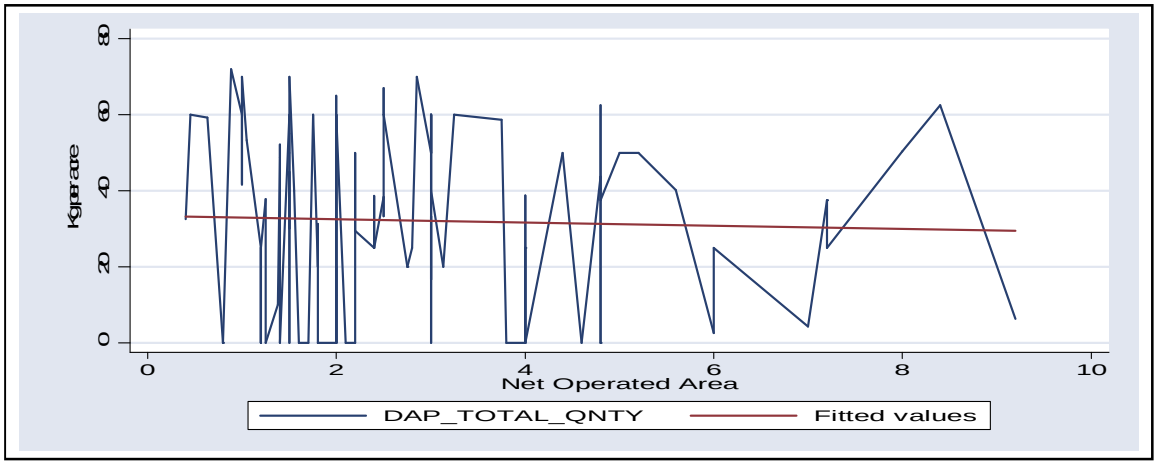


Diagram-5.9: Use of DAP in Paddy by soil test farmers (Kg/acre) (Considering NOA <= 10 acre & removing outliers)



Like urea, excluding large farming group, we can see that smaller farmers are applying greater amount of DAP compared to large farmers. Farmers in the large farming group are applying greater amount of DAP compared to other farming group but the sample size in this group is very low. Therefore, we cannot see confidently that large farmers apply greater amount of DAP compared to others.

Diagram-5.10: Use of MOP in Paddy by soil test farmers (Kg/acre)

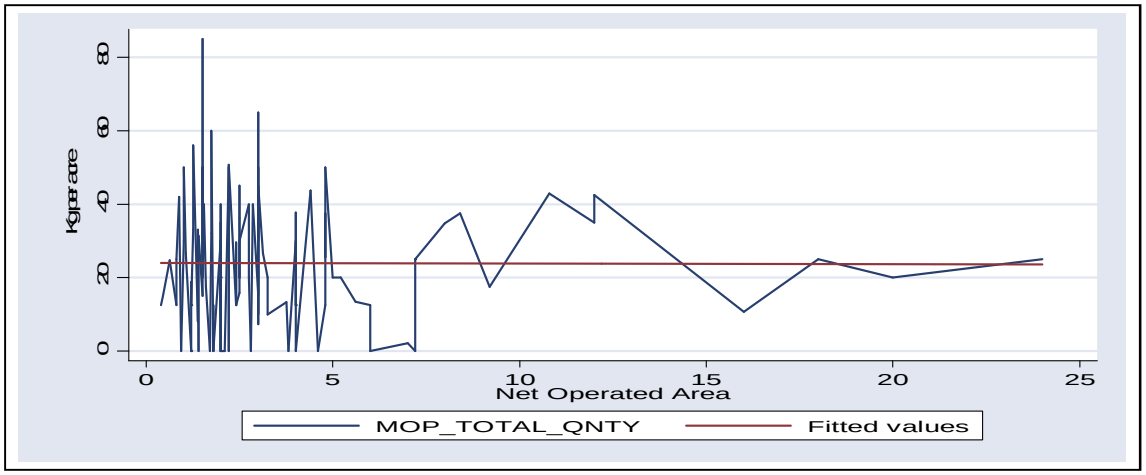


Diagram-5.11: Use of MOP in Paddy by soil test farmers (Kg/acre) (removing outliers)

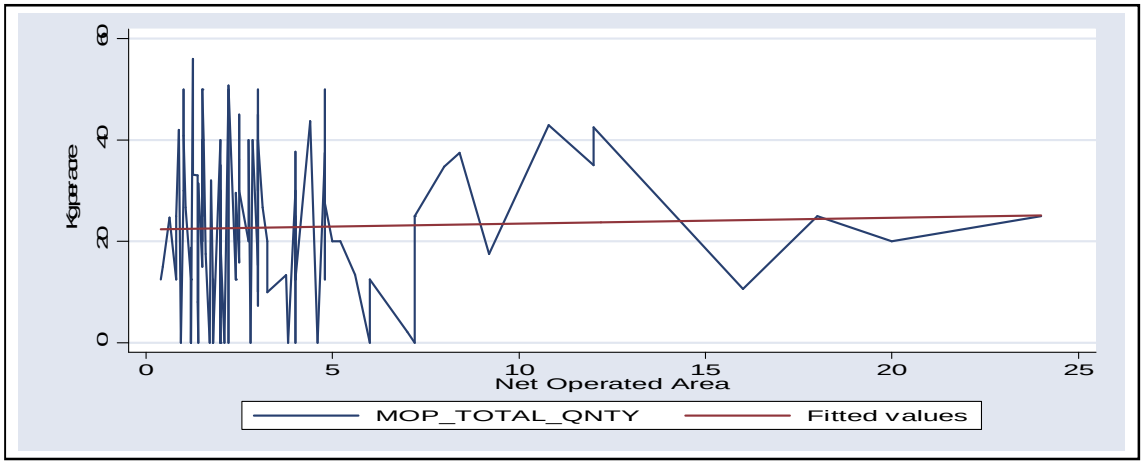


Diagram-5.12: Use of MOP in Paddy by soil test farmers (Kg/acre) (Considering NOA <=10.00 acre)

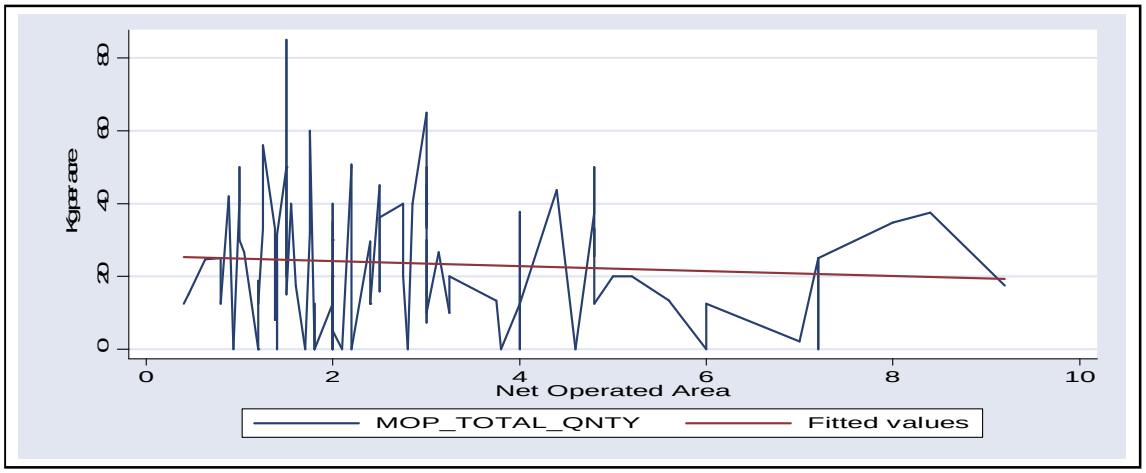


Diagram-5.13: Use of MOP in Paddy by soil test farmers (Kg/acre) (Considering NOA <=10.00 acre & removing outlier)

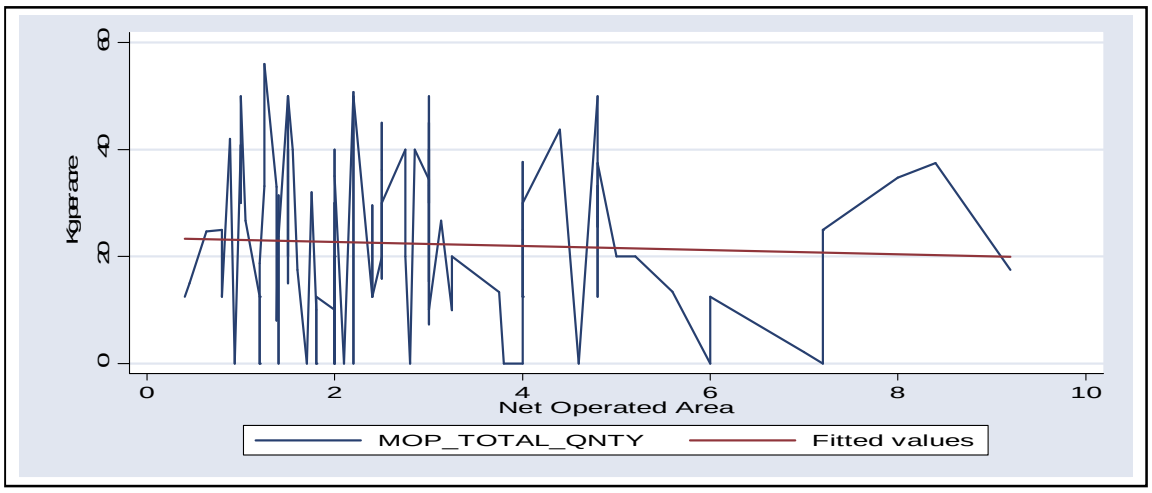
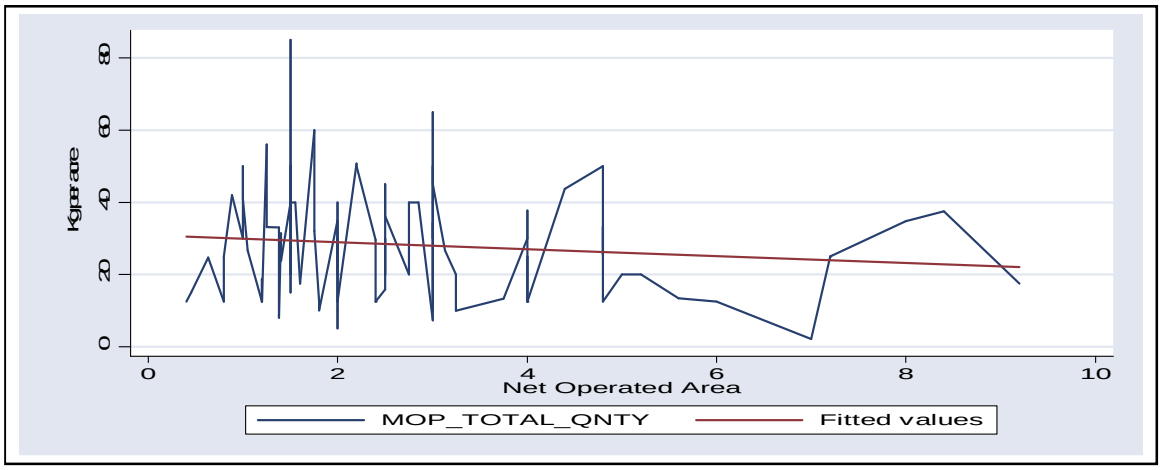


Diagram-5.14: Use of MOP in Paddy by soil test farmers (Kg/acre) (Considering NOA <=10.00 acre)



Excluding the large farming group, there is tendency that smaller farmers are applying greater amount of MOP compared to large farmers. Farmers in the large farming group are applying greater amount of MOP compared to others but sample size in this group is very low. Therefore, it cannot be said confidently that large farmers are applying greater amount of MOP compared to others.

Table -5.4 also indicates that larger farmers compared to small farmers are applying greater amount of complex fertilizer.

Diagram-5.15: Use of urea in paddy by control farmers.

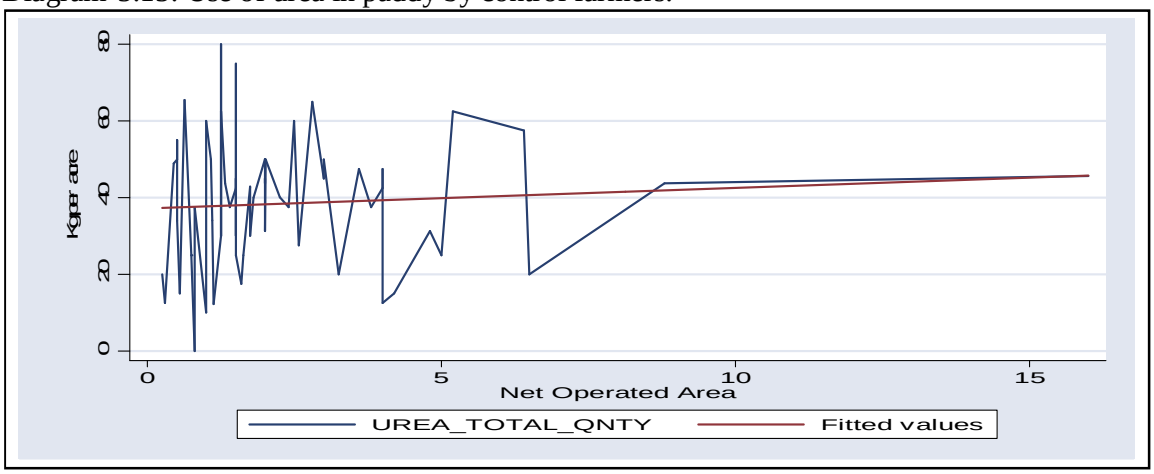
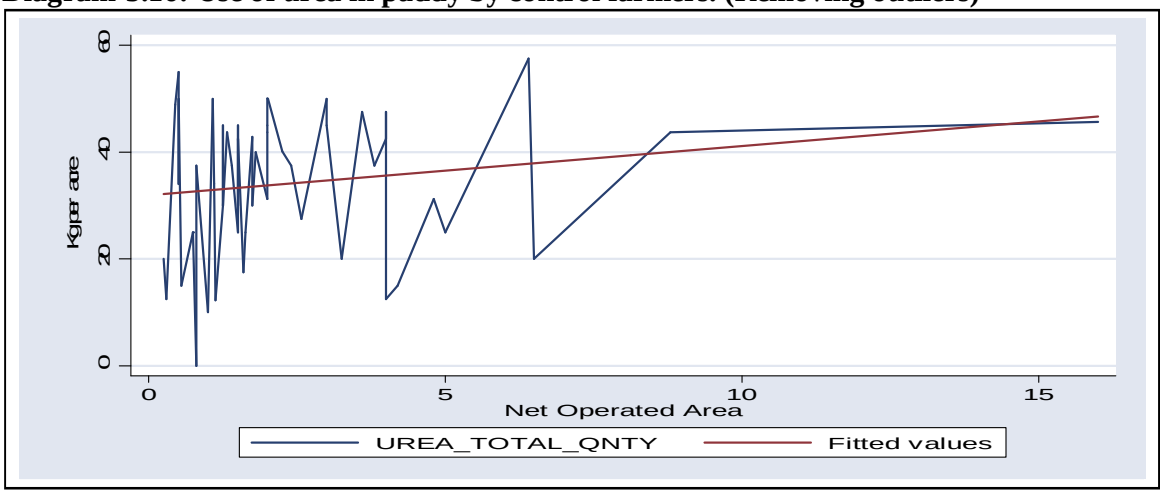


Diagram-5.16: Use of urea in paddy by control farmers. (Removing outliers)



Note: considering outlier if Kg/acre>= 60

Among the control farmers of paddy, larger famers are applying greater amount of urea compared to small farmers.

Diagram-5.17: Use of DAP in paddy by control farmers

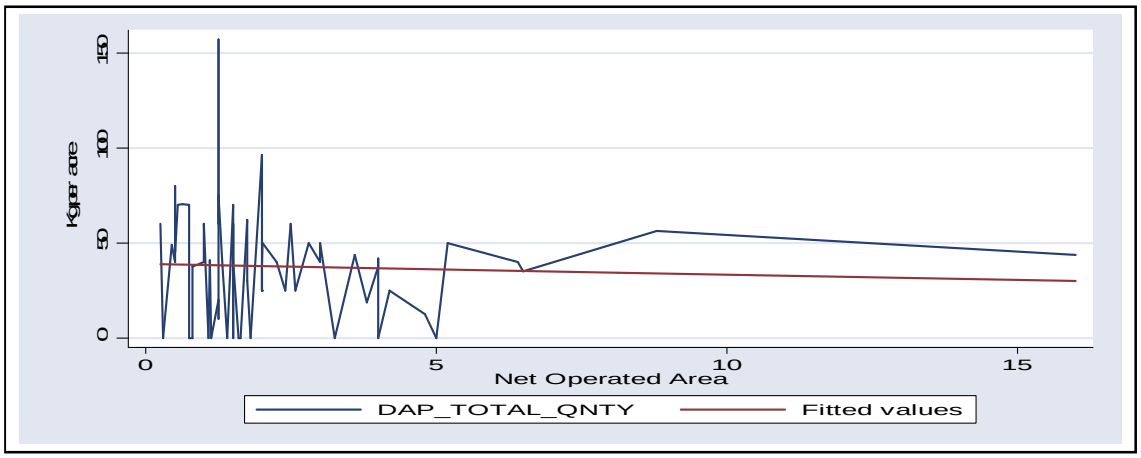
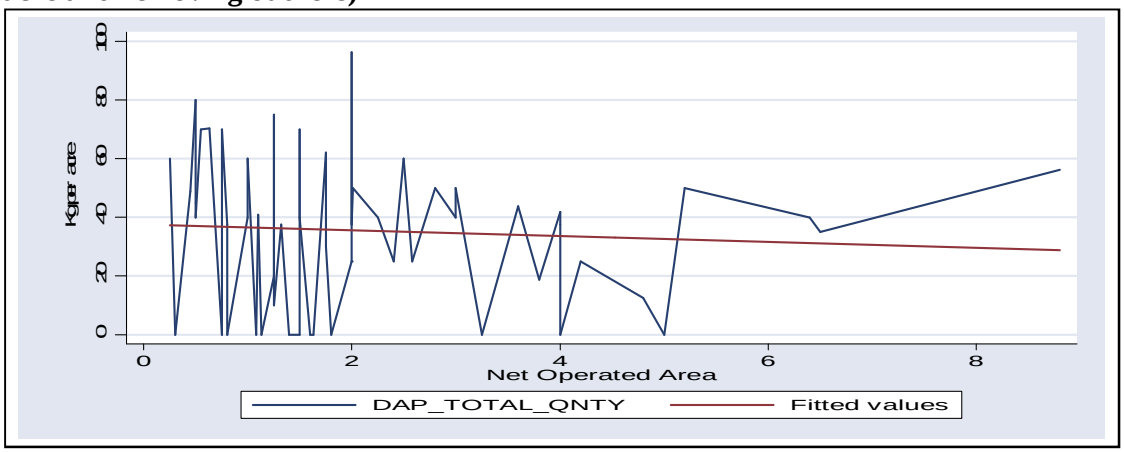
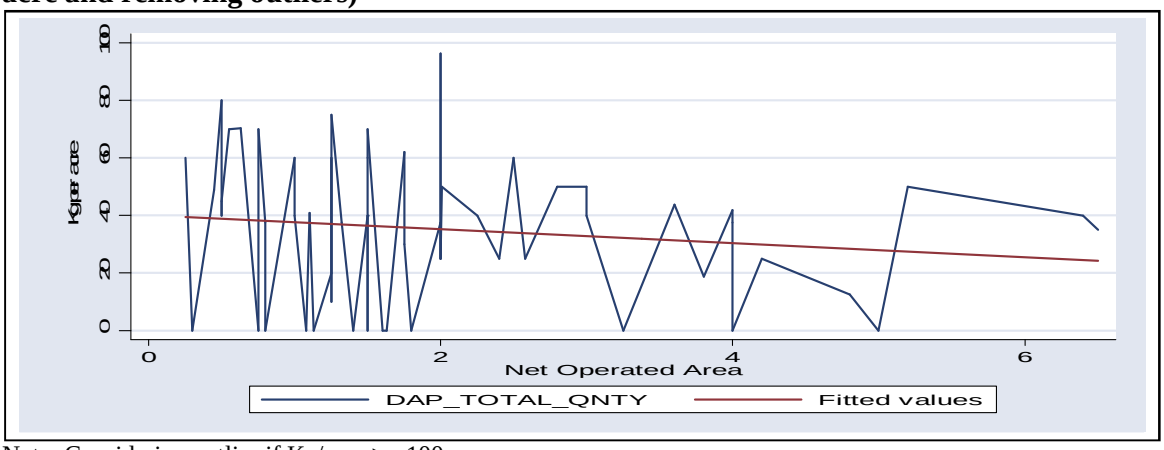


Diagram-5.18: Use of DAP in paddy by control farmers (Considering NOA <=10.00 acre and removing outliers)



Note: Considering outlier if Kg/acre >= 100

Diagram-5.19: Use of DAP in paddy by control farmers (Considering NOA <=8.00 acre and removing outliers)



Note: Considering outlier if Kg/acre >= 100

Among the control farmers of paddy, Smaller farmers are applying greater amount of DAP compared to large farmers. Similarly, smaller farmers are applying greater amount of SSP and Complex fertilizer compared to large farmers

Diagram- 5.20: Use of MOP in paddy by Control farmers

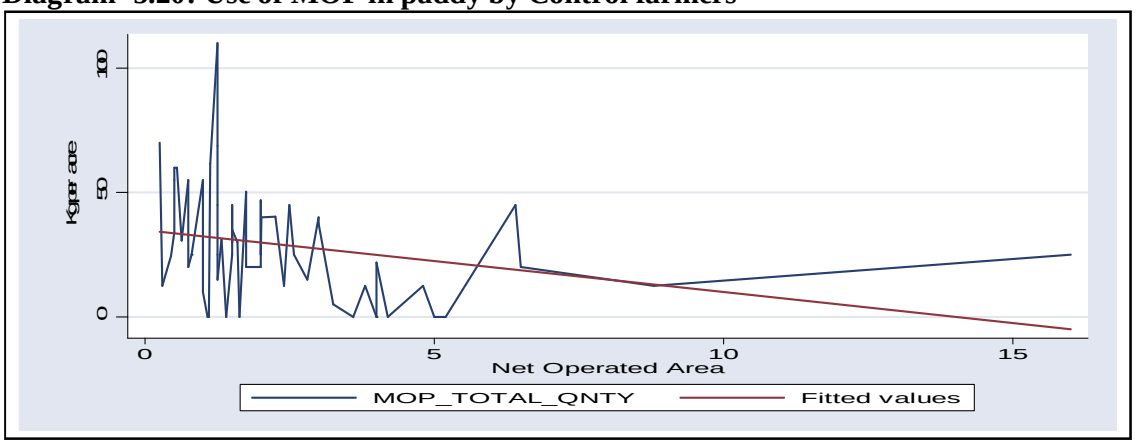


Diagram- 5.21: Use of MOP in paddy by Control farmers (Considering NOA <=10.00 acre)

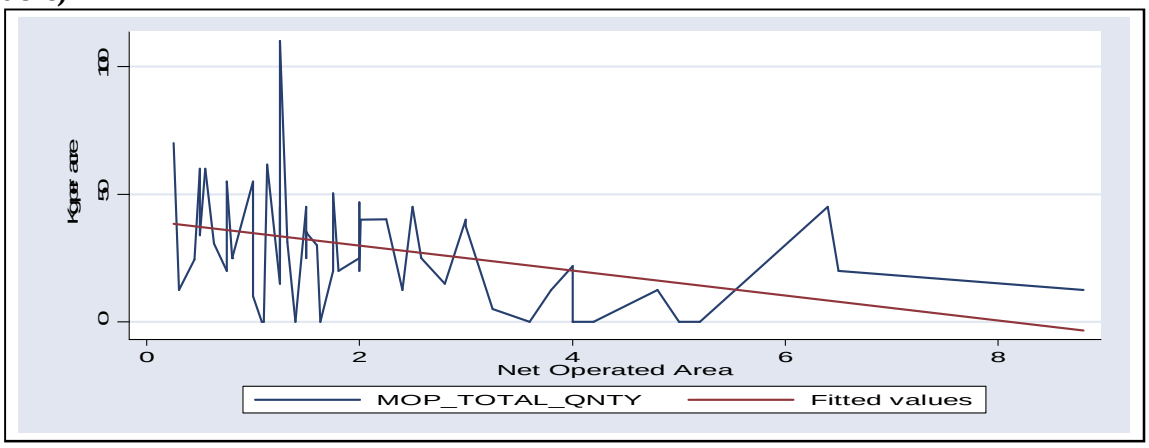


Diagram- 5.22: Use of MOP in paddy by Control farmers (Considering NOA <=6.00 acre)

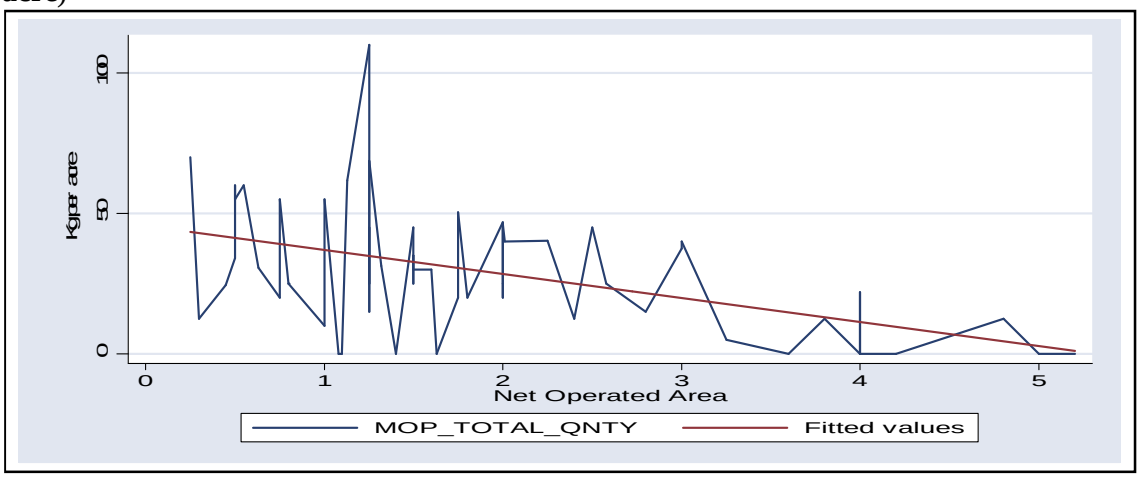
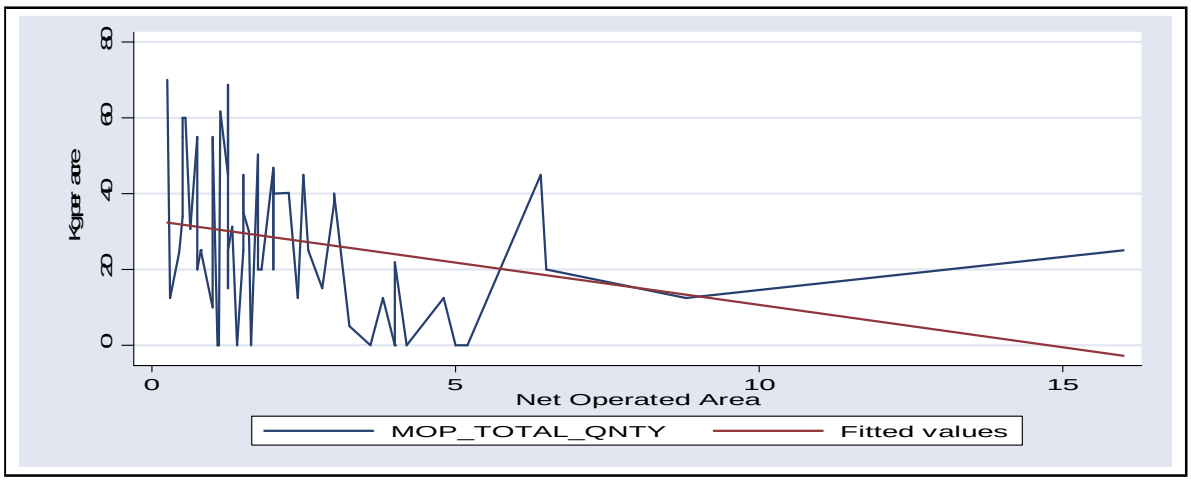
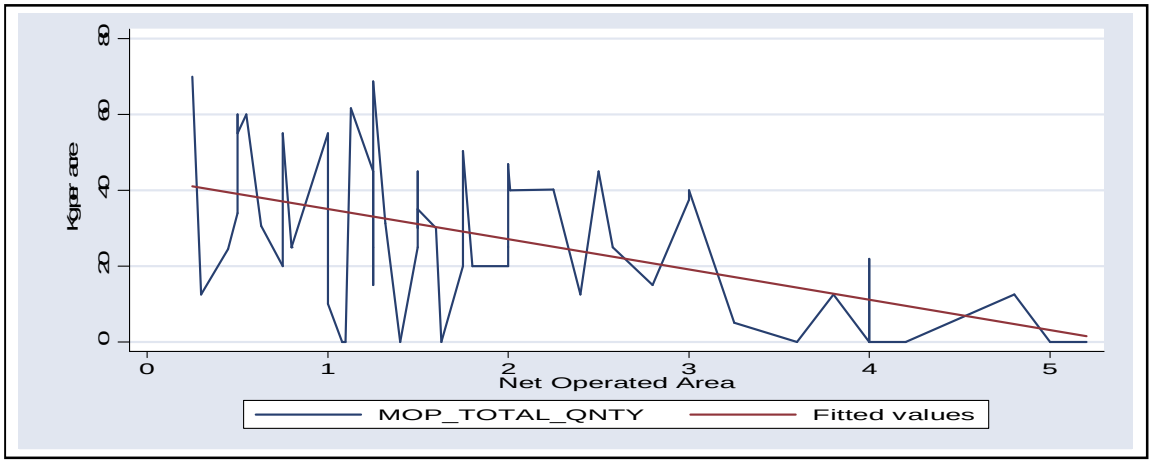


Diagram- 5.23: Use of MOP in paddy by Control farmers (Removing outliers)



Note: Considering outlier if Kg/acre >= 100

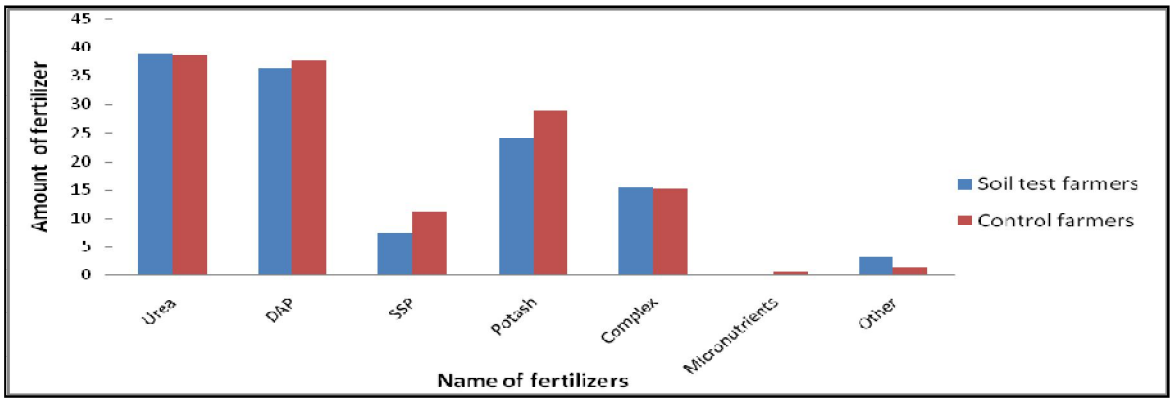
Diagram- 5.24: Use of MOP in paddy by Control farmers (Considering NOA <=6.00 acre and Removing outliers)



Note: Considering outlier if Kg/acre>=100

Among control farmers of paddy, smaller farmers are applying greater amount of MOP compared to large farmers.

Diagram-5.25: Use of fertilizer in Paddy



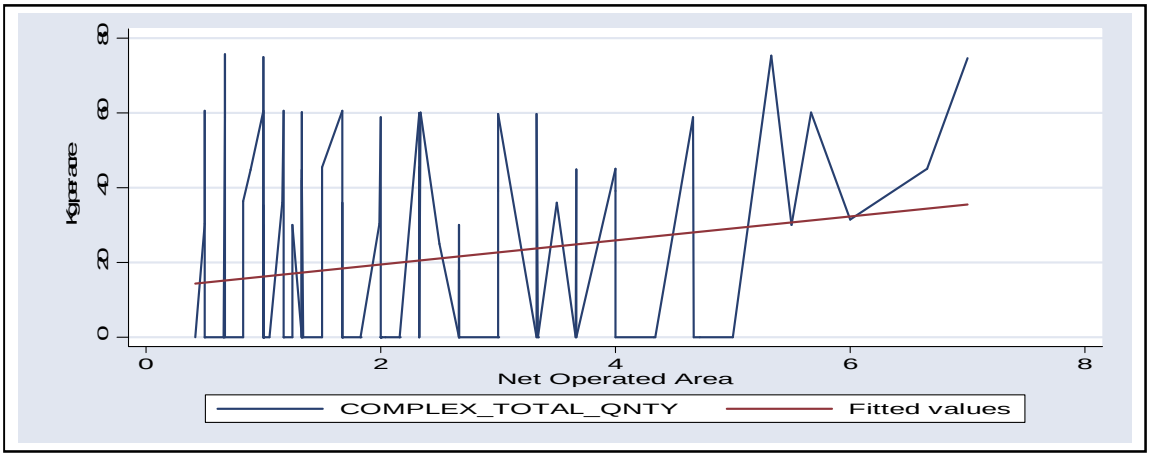
- Soil test farmers as well as control farmers are applying greater amount of Urea compared to other fertilizers in paddy. After urea, application of DAP and MOP are Second and third highest respectively.
- Soil test farmers are using greater amount of urea and complex fertilizers compared to the control farmers. On the contrary, Control farmers are using greater amount DAP, MOP, SSP and micro-nutrients compared to soil test farmers. Soil test farmers are applying very little amount of micro-nutrient.

Table -5.5: Actual Quantity of Fertilizers Applied by the Sample Farmers during the Reference Year (Kg/acre) - Crop II (Jute)

Crop	Marginal	Small	Medium	Large	Total
Soil Test Farmers					
Urea	52.86	51.41	46.72	-	52.20
DAP	32.06	29.10	9.95	-	30.24
Single Super Phosphate	2.64	3.92	0.00	-	2.82
Potash	13.07	17.16	20.00	-	14.40
Complex	35.72(19.70)*	21.03	52.77	-	33.02
Micronutrients	0.00	0.00	0.00	-	0.00
Other	0.25	0.00	0.00	-	0.18
Control Farmers					
Urea	56.38	46.81	0.00	-	53.05
DAP	36.31	27.26	0.00	-	33.45
Single Super Phosphate	8.06	2.01	0.00	-	6.41
Potash	12.44	19.34	0.00	-	13.96
Complex	32.14	43.80	96.39	-	36.12
Micronutrients	0.00	0.00	0.00	-	0.00
Other	0.00	0.00	0.00	-	0.00

*Note: Two outliers (HHID-173 and HHID-178) have been removed from application of complex fertilizers. The value in the parenthesis is calculated excluding these outliers.

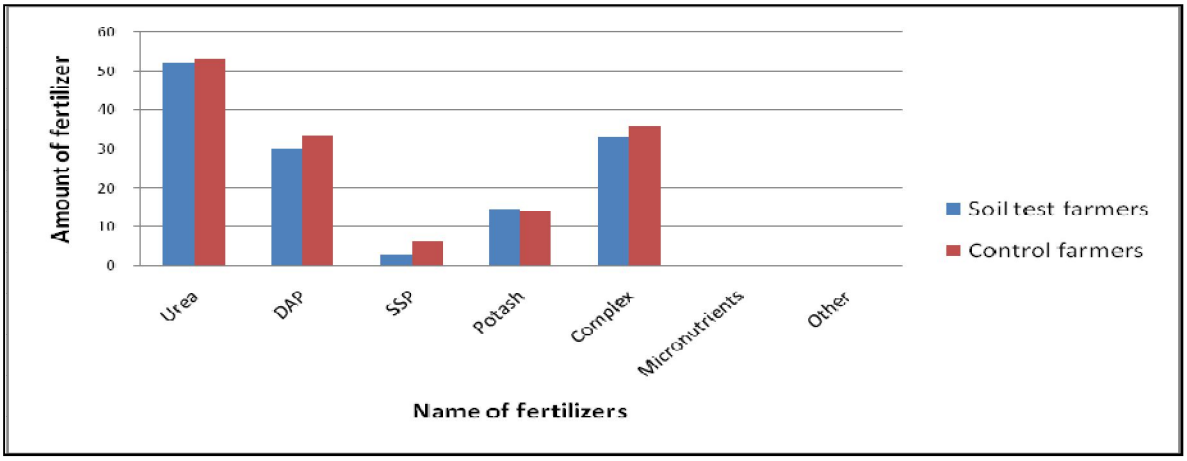
Diagram-5.26: Use of complex fertilizer in Jute by the soil test farmers. (Removing 173 & 178)



- Among the soil test farmers of jute: smaller farmers are applying greater amount of urea and DAP compared to large farmers and larger farmers are applying greater amount of MOP and complex fertilizer compared to small farmers.

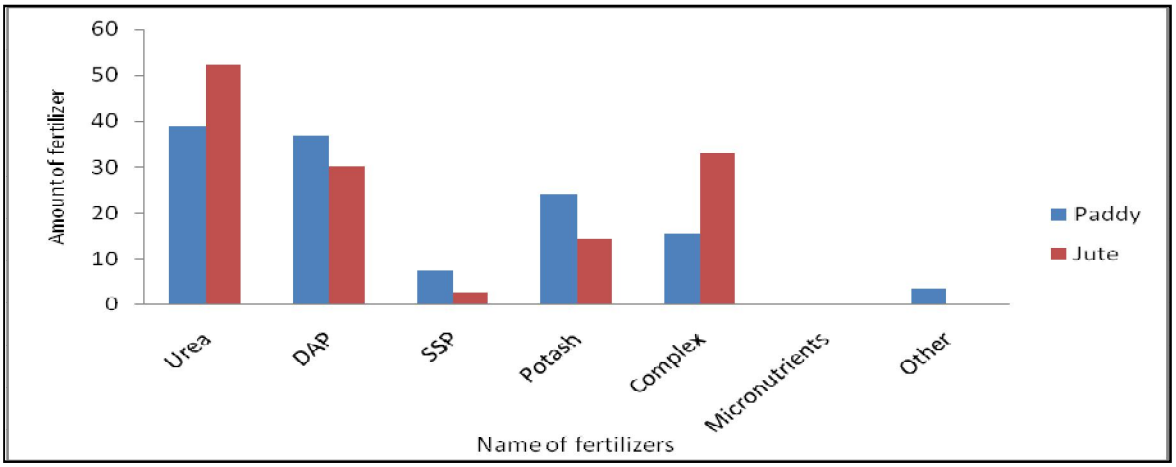
- Among the control farmers: smaller farmers are applying greater amount of Urea, DAP and SSP compared to large farmers and larger farmers are using greater amount of Complex fertilizer compared to small farmers.

Diagram-5.27: Use of fertilizer in Jute by soil test farmers and control farmers.



- Soil test farmers as well as control farmers are applying highest amount of Urea in jute. Second and third highest are Complex and DAP, respectively. No Farmers are using Micro-nutrients in jute.
- Control farmers are applying greater amounts of all types of fertilizers except MOP compared to Soil test farmers.

Diagram-5.28: Use of fertilizers of soil tested farmer in Paddy and Jute



★ Soil test paddy farmers are applying greater amount of Urea and DAP compared to other fertilizers. Soil test jute farmers are applying greater amount of Urea and complex fertilizers compared to other fertilizers

★ Control farmers are applying greater amount of urea and Complex in jute compared to paddy. On the other hand, Soil test farmers are applying higher amount of DAP, MOP and SSP in paddy compared to jute.

Table-5.6: Actual Quantity of Split Doses of Fertilizers Applied by Stage of Crop Growth during the Reference Year (Kg/acre) - Crop I (Paddy)

Particulars	Basal application	After inter-cultivation (weeding, thinning etc)	Vegetative growth	Flowering	Grain formation	Total
Soil Test Farmers						
Urea	6.20	19.58	11.53	1.45	0.00	38.81
DAP	29.60	4.81	1.93	0.08	0.00	36.42
Single Super Phosphate	5.48	1.52	0.37	0.00	0.00	7.37
Potash	12.91	5.79	4.84	0.42	0.00	23.95
Complex	6.74	6.79	1.84	0.00	0.00	15.37
Micronutrients	0.04	0.00	0.00	0.00	0.00	0.04
Other	2.48	0.36	0.39	0.13	0.00	3.36
Control Farmers						
Urea	4.84	21.60	10.95	1.10	0.00	38.49
DAP	26.68	9.76	0.69	0.42	0.00	37.54
Single Super Phosphate	6.70	3.25	1.17	0.00	0.00	11.12
Potash	13.77	7.60	6.74	0.75	0.00	28.86
Complex	6.68	5.51	2.91	0.00	0.00	15.09
Micronutrients	0.39	0.07	0.09	0.00	0.00	0.55
Other	0.92	0.17	0.25	0.00	0.00	1.35

Note: These has been calculated by Averaging the Boro and Amon Paddy

- It is found from Table-5.6 that Soil test paddy farmers are applying highest amount of urea at the 'After inter-cultivation' stage. On an average, this amount is 19.58kg/acre. The next highest amount is applied at the 'vegetative growth'; the amount being 11.53kg/acre. 'Basal application' stage applies 6.20kg/acre and Flowering stage 1.45kg. On the other hand, control farmers are applying maximum amount of urea at the 'After inter-cultivation' stage and this amount is 21.60kg/acre. The second highest amount is applied at 'vegetative growth' stage; the amount being 10.95kg/acre. 'Basal application' stage applies 4.84kg/acre and Flowering 1.10kg
- Soil test farmers and control farmers both are applying highest amount of DAP, MOP and SSP at the 'Basal application' stage. Next highest is applied at the 'After inter-cultivation' stage and then at the 'Vegetative growth' stage.
- Soil test farmers are applying highest amount of complex fertilizers at the 'After inter-cultivation' stage and this amount is 6.90 kg/acre. The second highest amount is applied at the 'Basal application' stage; the amount being 6.74kg/acre. 'Vegetative growth' stage applies 1.84kg/acre. On the other hand, control farmers

are applying highest amount of complex fertilizer at the 'Basal application' stage and next highest is applied at the 'after inter-cultivation' stage.

Table -5.7: Actual Quantity of Split Doses of Fertilizers Applied by Stage of Crop Growth during the Reference Year (Kg/acre)- Crop II (Jute)

Particulars	Basal application	After inter-cultivation (weeding, thinning etc)	Vegetative growth	Flowering	Grain formation	Total
Soil Test Farmers						
Urea	2.25	36.84	12.86	0.25	0.00	52.20
DAP	26.27	2.97	1.00	0.00	0.00	30.24
Single Super Phosphate	1.37	1.33	0.12	0.00	0.00	2.82
Potash	10.06	3.01	1.08	0.25	0.00	14.40
Complex	16.66	14.23	2.13	0.00	0.00	33.02
Micronutrients	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.18	0.00	0.00	0.00	0.18
Control Farmers						
Urea	6.31	29.30	16.93	0.51	0.00	53.05
DAP	28.11	5.34	0.00	0.00	0.00	33.45
Single Super Phosphate	2.50	2.25	1.00	0.00	0.00	6.41
Potash	9.05	2.92	1.98	0.00	0.00	13.96
Complex	19.44	13.68	2.00	1.00	0.00	36.12
Micronutrients	0.00	0.00	0.00	0.00	0.00	0.00
Other	0.00	0.00	0.00	0.00	0.00	0.00

- Table-5.7 shows that Soil test jute farmers as well as control jute farmers are applying highest amount of urea at the 'After inter-cultivation' stage. The next highest is applied at 'vegetative growth' and then at Basal application and Flowering stages.
- Both, Soil test farmers and control farmers are applying highest amount of DAP, MOP, SSP and Complex at the 'Basal application' stage. Next highest is applied at 'After inter-cultivation' stage and then at' Vegetative growth' stage.

Summarizing Table-5.6 and Table-5.7 it can be seen that Soil test farmers are applying highest amount of Urea at the 'After inter-cultivation' stage. Next highest is applied at the 'Vegetative growth' and then at 'Basal application' stages. Soil test farmers are applying highest amount of DAP, MOP, SSP at the 'Basal application' stage. Next highest is applied at 'after inter-cultivation' and then at 'vegetative growth' stage.

5.6 Method of Application of Chemical Fertilizers by Sample Farmers

Requirement of fertilizers may depend on the method of application of fertilizer. It may be a case that paddy requires less fertilizer if farmers apply fertilizer by line application instead of broadcasting. Therefore, it is very important to see the method of application of

different fertilizers in both crops paddy and jute. Here we try to find out percentages of farmers taking different methods of application of fertilizers for both paddy and jute.Table-5.8 and Table-5.9 represent percentages of farmers taking different methods of application of fertilizers by soil test farmers and control farmers.

Table-5.8: Method of Application of Chemical Fertilizers (% of farmers)-Crop I (Paddy)

Method	Urea	DAP	SSP	Potash	Complex	Micronutrients	Others
Soil Test Farmers							
Broadcasting	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Dibbling	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Line application	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spraying	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Control Farmers							
Broadcasting	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Dibbling	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Line application	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spraying	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

- All the soil test paddy farmers are applying all the fertilizers by broadcasting.
- All the control paddy farmers are applying all the fertilizers by broadcasting.

Table-5.9: Method of Application of Chemical Fertilizers (% of farmers)-Crop II (Jute)

Method	Urea	DAP	SSP	Potash	Complex	Micronutrients	Others
Soil Test Farmers							
Broadcasting	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Dibbling	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Line application	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spraying	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Control Farmers							
Broadcasting	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Dibbling	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Fertigation	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Line application	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Spraying	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00

- All the soil test farmers those who are cultivating jute are applying all the fertilizers by broadcasting.
- All the control farmers those who are cultivating jute are applying all the fertilizers by broadcasting.

5.7 Use of Organic Fertilisers by the Sample Households

A comparison of application of organic fertilizers between soil test farmers and control farmers is sown in Table-5.10 and Table-5.11.Here application of organic fertilizer in paddy has been calculated by taking the average of organic fertilizers used in Amon paddy and Boro paddy. Percentage of farmers applied individual organic fertilizers (FYM, Vermi-compost, Bio-fertilizer, Mustard cake) has been calculated taking all the farmers who have applied it in any paddy i.e. Amon paddy and Boro paddy. Percentage of farmers applied any organic fertilizer has been calculated taking all the farmers who have applied any organic fertilizer in any paddy i.e. Amon paddy and Boro paddy. Per acre application of organic fertilizer has been calculated following the steps below:

a. Per acre application is calculated for each type of fertilizer, separately for each type of paddy, i.e. Amon and Boro.
b. Average of these per acre values (for each fertilizer) is calculated, separately for Amon and Boro.
c. Average of these averages for Amon and Boro are calculated.

Table-5.10: Use of Organic Fertilizers by the Sample Farmers- Crop I (Paddy)

Particulars	Farm yard manure	Vermi-compost/Biogas waste	Bio-fertilizer	Green manure	Mustard Oil cake	Total
Soil Test Farmers						
% farmers applied	48.33	1.67	25.83	0.00	35.83	75.00
Quantity applied (Kg/acre)Only for applying farmers	1670.90	71.43	33.73	0.00	34.91	1111.75
Price (Rs/kg)	0.04(0.38)*	7.00	8.5	0.00	21.3	8.50
Area covered (% of net cropped area)	25.94	1.4	11.92	0.00	19.96	22.96
Control Farmers						
% farmers applied	51.67	0.00	6.67	0.00	21.67	66.67
Quantity applied (Kg/acre Only for applying farmers	3802.05	0.00	15.00	0.00	32.19	2958.6
Price (Rs/kg)	0.003(0.17)*	0.00	20.00	0.00	20.69	8.11
Area covered (% of net cropped area)	39.25	0.00	5.00	0.00	17.55	12.36

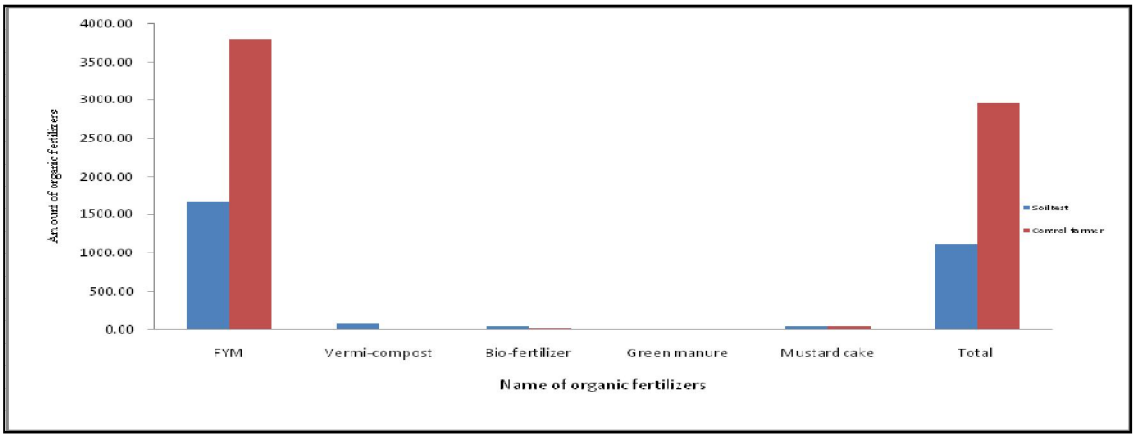
* Note: very few people have to spend for farm-yard manure, as it is a home product. However, few have to buy and considering only these people the average price boils down to the amount in the parenthesis.

- Table-5.10 depicts that among the soil test farmers of paddy: number of farmers applied organic fertilizer is not so high. However, among those farmers who have applied: highest number of farmers is using farm yard manure (48.33%).Next highest is mustard oil cake (35.83%) and then Bio-fertilizer (25.83%). A few soil

test farmers are using vermi-compost and no farmer is applying green manure. Overall, 75.00 percent of the soil test farmers are applying organic fertilizers.

- Among control farmers of paddy :number of farmers applied farm yard manure is so not high .Only 51.67 percent of the control farmers are applying farm yard manure. Some farmers are applying mustard oil cake, very few farmers are using Bio-fertilizer and No farmers are using Green manure and vermi-compost. Overall, 66.67 percent of the control farmers are using organic fertilizer.
- Higher number of control farmers compared to soil test farmers is applying farm yard manure. On the other hand, higher number of soil test farmers compared to control farmers is using bio-fertilizers, mustard oil cake and vermin-compost.

Diagram –5.29: Use of organic fertilizers in paddy by control and soil test farmers



- Control farmers of paddy are applying greater amount of Farm yard manure compared to soil test farmers but soil test farmers are applying greater amount of bio-fertilizers and mustard oil cake compared to control farmers. Overall, Control farmers are applying greater amount of organic fertilizers compared soil test farmers.
- Area covered for application of farm yard manure as percentage of net operated area is higher for control farmers compared to soil test farmers. Area covered for application of bio-fertilizer, verimi-compost, Mustard oil cake as percentage of net operated area are higher for soil test compared to control farmers. Area covered for the application of total organic fertilizer as percentage of net operated area is higher for control farmers compared to soil test farmers. Area covered for soil test and control farmers are 22.96 percent and 12.36 percent respectively.

- Most of the soil test farmers and control farmers are applying own farm yard manure. However, very few soil test farmers and control farmers are purchasing farm yard manure. Price of vermi-compost is Rs 7 per kg for soil test farmers. Price of bio-fertilizer of soil test farmers is lower compared to control farmers.

Table-5.11 describes the application of organic fertilizers in jute. Percentage of farmers applied organic fertilizer has been calculated taking all the farmers who have applied any organic fertilizer in jut. Per acre application of organic fertilizer has been calculated by taking average of per acre fertilizer of all individual organic fertilizers

Table 5.11: Use of Organic Fertilizers by the Sample Farmers- Crop II (Jute)

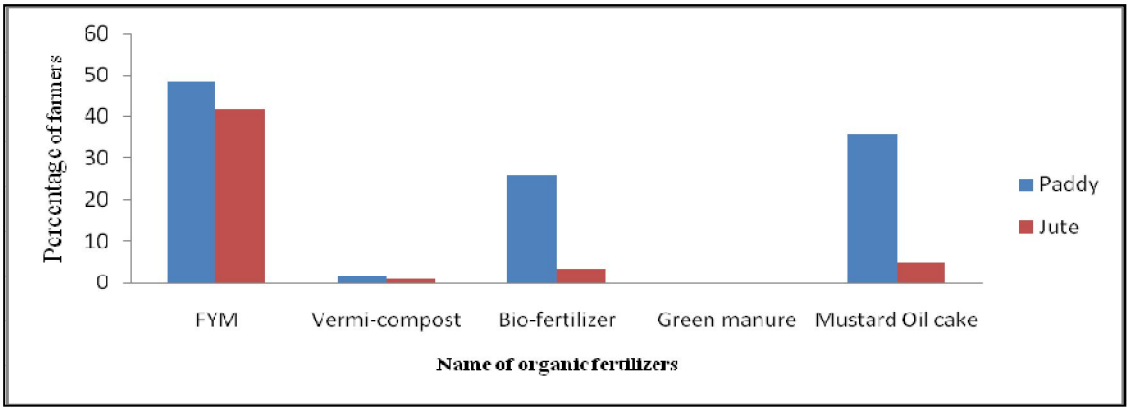
Particulars	Farm yard manure	Vermi-compost/Biogas waste	Bio-fertilizer	Green manure	Mustard Oil cake	Total
Soil Test Farmers						
% farmers applied	41.67	0.83	3.33	0.00	5.00	45.83
Quantity applied (Kg/acre)	8244.3	50.00	39.43	0.00	80.70	7507.430
Price (Rs/kg)	0.09(.32)*	3.50	6.50		18.00	1.76
Area covered (% of net cropped area)	15.16	0.41	1.51	0.00	1.12	3.64
Control Farmers						
% farmers applied	45.00	0.00	1.67	0.00	5.00	48.33
Quantity applied (Kg/acre)	4116.75	0.00	98.51	0.00	3.95	8528.98
Price (Rs/kg)	0.068(.29)*	-	10.00	-	22.5	1.26
Area covered (% of net cropped area)	15.28	0.00	0.56	0.00	0.95	3.36

* Note: very few people have to spend for farm-yard manure, as it is a home product. However, few have to buy and considering only these people the average price boils down to the amount in the parenthesis.

- Higher number of soil test farmers is applying farm yard manure compared to other organic fertilizers. Some farmers are applying bio-fertilizer and mustard oil cake. A few soil test farmers are applying vermi-compost but no control farmers are applying vermi-compost and green manure.
- Soil test farmers are applying greater amount of farm yard manure compared to control farmers. On the other hand, control farmers are applying greater amount of bio-fertilizer compared to soil test farmers.
- Area covered as the percentage of net operated area for soil tested farmers is highest in application of farm yard manure and its area covered is 15.16 percent. The second highest is in bio-fertilizer; the value being 1.51 percent, for mustard oil cake corresponding value is 1.12 percent Similarly, Area covered as the percentage of net operated area for control farmers is highest in application of farm yard manure and its area covered is15.28 percent .For mustard oil cake and bio-fertilizer the values of area covered are 0.95 percent and 0.56 percent respectively.

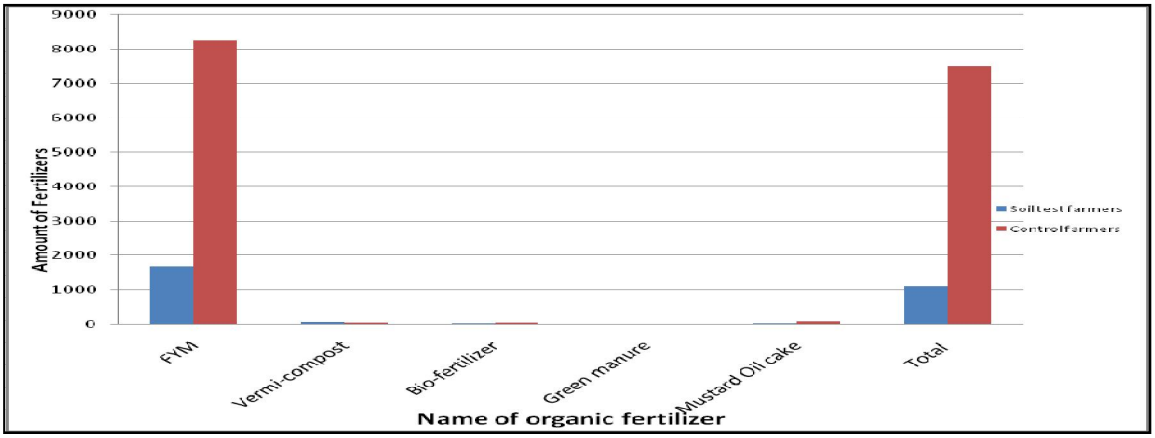
- Area covered with application of farm yard manure as percentage of net operated area is higher for control farmers compared to soil test farmers. But Area covered with applications of vermi-compost, bio-fertilizer and mustard oil cake as percentage of net operated area are higher for soil test farmers compared to control farmers.
- Most of the farmers (soil test and control) are applying own farm yard manure and need not to spend for it. A few farmers purchase farm yard manure from other farmers. Prices of bio-fertilizer and mustard oil cake are higher for control farmers compared to soil test farmers.

Diagram-5.30: comparison of application of Organic Fertilizers between Paddy and Jute by the Soil test Farmers (Percentage of farmers)



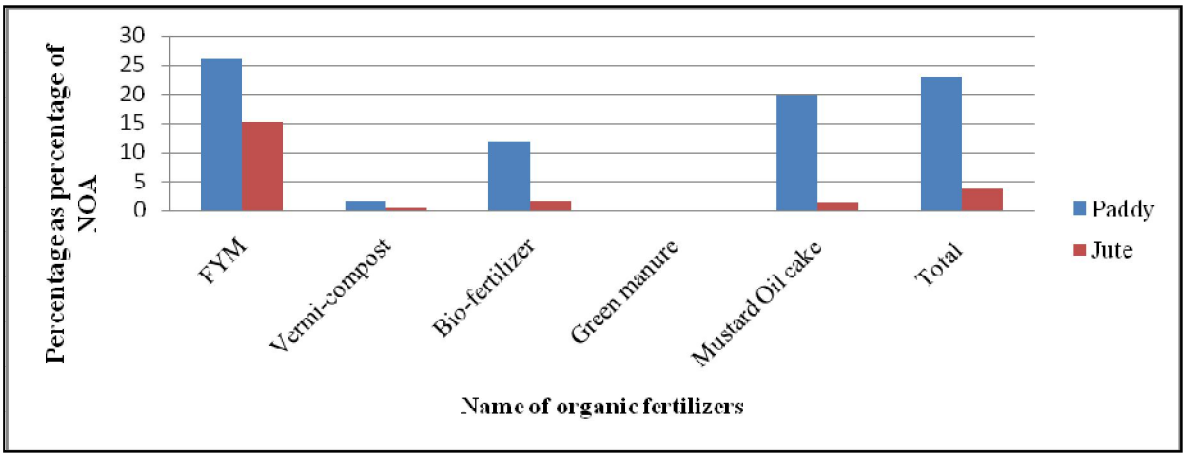
- Higher number of soil test farmers is applying farm yard manure in paddy compared to jute. Similarly, higher number of soil test farmers is applying vermi-compost, bio-fertilizer mustard oil cake in paddy compared to jute.

Diagram-5.31: Comparison of application of Organic Fertilizers between Paddy and Jute by the Soil test Farmers (Kg/acre)



★ Soil test farmers are using greater amount of farm yard manure in jute compared to paddy and the difference between two is very high.Similarly,Use of overall organic fertilizers in jute is higher compared to paddy.Difference between two is very high because of high difference in the use of farm yard manure.

Diagram-5.32: comparison of application of Organic Fertilizers between Paddy and Jute by the Soil test Farmers (Area covered as percentage of NOA)



- Area covered with the application of all organic fertilizers as percentage of net operated are higher in paddy compared to jute. Similarly, area covered with application of total organic fertilizer as percentage of net operated area is higher in paddy compared to jute. No farmers apply green manure in paddy and jute.

As regards the application organic fertilizer, overall analysis indicates that, although some farmers are applying farm yard manure, application of other organic fertilizers is very low in both paddy and jute for soil test farmers as well as control farmers. On the other hand, application of organic fertilizers is higher in paddy compared to jute.

5.8 Details of Fertilisers Purchased by the Sample Households

Most of the farmers in West Bengal purchase fertilizer from private fertilizer because of easy accessibility. Private fertilizer shops are available in many villages in West Bengal. On the other hand, co-operative societies are available in some villages in West Bengal and availability of other sources of purchased mentioned in table-38 are very low. On the other hand private fertilizer companies are spreading their web into villages, even in remote villages by giving incentives to their dealers. Not only that, they are also making arrangement of testing soil and recommend to apply fertilizer to acquire faith of the farmers. Some fertilizer companies have launched some different kinds of chemical

fertilizer giving the name of Organic fertilizer. Some time they arrange some seminars in villages and advice to use their products. In this way, they are capturing whole market of fertilizer in rural area. In this background, it is very important to know the sources of purchase and prices of fertilizers for the sample farmers.

5.8.a Sources of purchase of fertilizers

Table-5.12: Sources of Purchase of Fertilizers (% of farmers)

Sources	Marginal	Small	Medium	Large	Total
Soil Test Farmers					
Private fertilizer shops/dealers	80.79	81.54	82.35	71.43	80.83
Company authorized dealers	0.66	3.08	0.00	0.00	1.25
Co-operative societies	19.87	16.92	17.65	28.57	19.17
Government agency	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00
Total	101.32	101.54	100.0	100.0	101.25
Control Farmers					
Private fertilizer shops/dealers	86.05	85.71	100.00	100.00	86.67
Company authorized dealers	0.00	0.00	0.00	0.00	0.00
Co-operative societies	13.95	14.29	0.00	0.00	13.33
Government agency	0.00	0.00	0.00	0.00	0.00
Others	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00

Note: The aggregate percentage crosses 100 percentages as many farmers are availing of multiple sources

- Table-5.13 shows that among soil test farmers: most of the farmers in all size groups are purchasing fertilizers from private fertilizer shops/dealers. A few farmers in all size groups are purchasing fertilizer from co-operative societies.

- Among soil test farmers: overall, 80.83 percent of the sample farmers are purchasing fertilizers from private fertilizers shop/dealer, 1.25 percent from Company authorized dealers and 19.17 percent from co-operative societies.

★ Among the control farmers: majority of farmers in marginal and small farming groups are purchasing fertilizer from private fertilizer shop/dealer. All the farmers in medium and larger farm size groups are purchasing fertilizers from private fertilizer shops/dealers.

★ Among the control farmers: overall, 86.67 Percent of the sample farmers are purchasing fertilizers from private fertilizer shops/dealers and 13.33 percent from co-operative societies.

★ Higher number of control farmers compared to soil test farmers is purchasing fertilizers from private fertilizers shops/dealers. On the other hand, higher number

of soil test farmers compared to control farmers is purchasing fertilizer from co-operative societies.

Diagram-5.33: Sources of purchase fertilizers of soil test farmers and control farmers

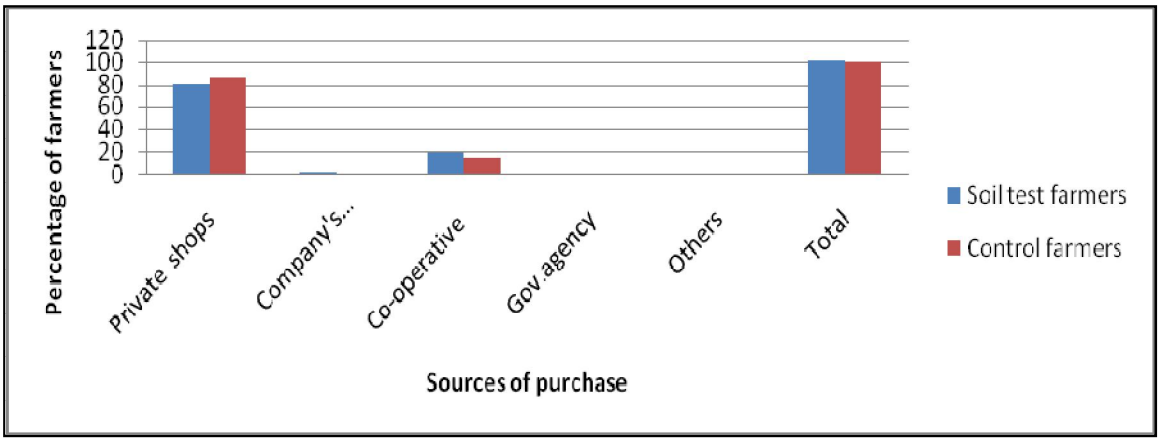


Table-5.13 and Diagram-5.33 indicate that major source of purchase of fertilizers is private fertilizer shops/dealers followed by co-operative societies.

Although Sources of purchase of fertilizer for the soil test farmers and control farmers have been discussed in the table-5.13, product and quantity wise source of purchase of fertilizers have been discussed in Table-5.14. Here, total quantity of each fertilizer used in paddy cultivation has been calculated by taking together the fertilizer used in Amon paddy and in Boro paddy.

Table -5.13: Quantity of Fertilizer Purchased by the Sample Farmers (Per cent)

Sources	Urea	DAP	SSP	Potash	Complex	Micronutrients	Other chemical	Bio-fertiliser	Mustard Oil Cake
Soil Test Farmers									
Private fertilizer shops/dealer	81.56	81.55	79.33	81.19	92.61	100	100	91.08	100
Company authorized dealers	0.74	0.59	0.00	0.87	0.00	0.00	0.00	0.00	0.00
Co-operative societies	17.70	17.86	20.67	17.94	7.39	0.00	0.00	8.89	0.00
Government agency	0.00	0.00	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	0.00	0.00
Total	100.00	100.00	100	100.00	100.00	100	100	100.00	100
Control Farmers									
Private fertilizer shops/dealer	82.00	80.66	100.00	90.76	96.68	90.38	100.00	100.00	100.00
Company authorized dealers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Co-operative societies	18.00	19.34	0.00	9.24	3.32	9.62	0.00	0.00	00.00
Government agency	0.00	0.00	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	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Diagram-5.34: Quantity of Fertilizer Purchased by the soil test Farmers (percent)

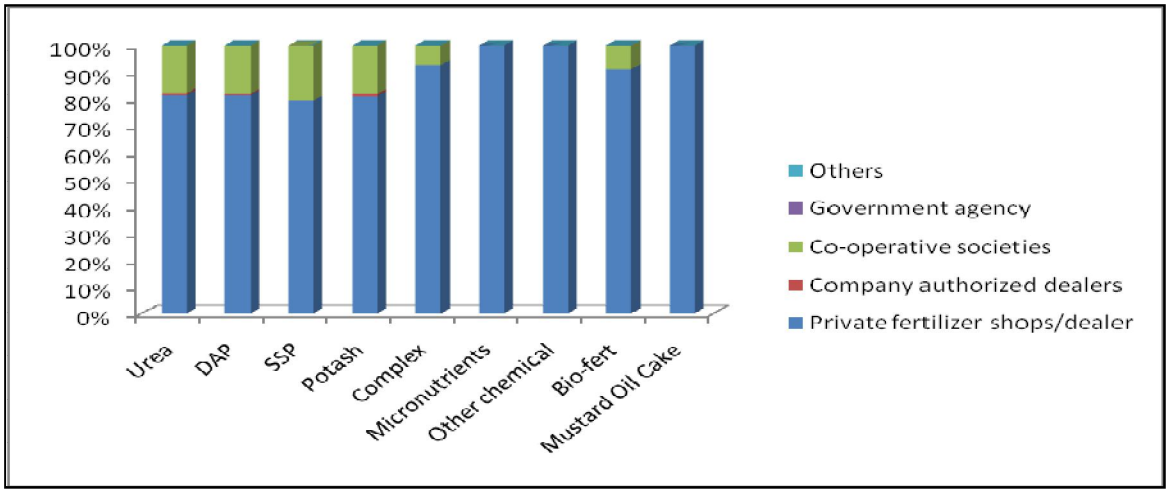
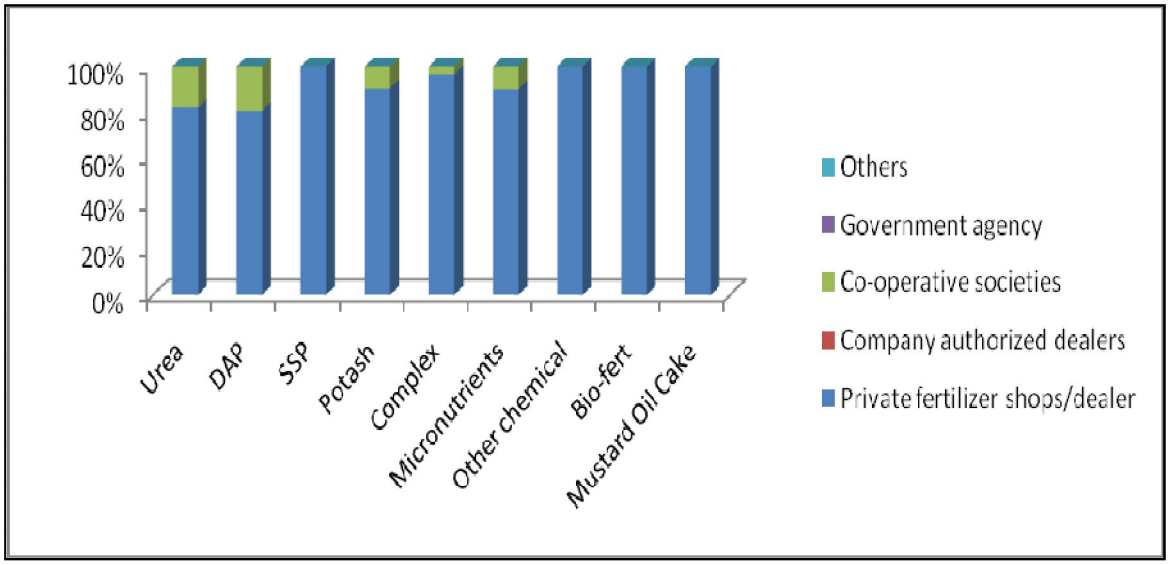


Diagram-5.35: Quantity of Fertilizer Purchased by the control Farmers (percent)



Major source of purchase of fertilizers for the control is private fertilizer shops/dealers followed by co-operative societies. However, for micro-nutrients, SSP, bio-fertilizer and other chemical fertilizers, the sole source is fertilizer shops/dealers; this may be because the sample size in this case is very low.

As regard the source of purchase of fertilizers, Very few farmers are purchasing fertilizers from co-operative societies and no farmers are purchasing fertilizers from government agency. On the other hand, most of the farmers are purchasing fertilizers from private

fertilizer shops/dealers. This is really a striking picture and it indicates the dominance of private fertilizer companies.

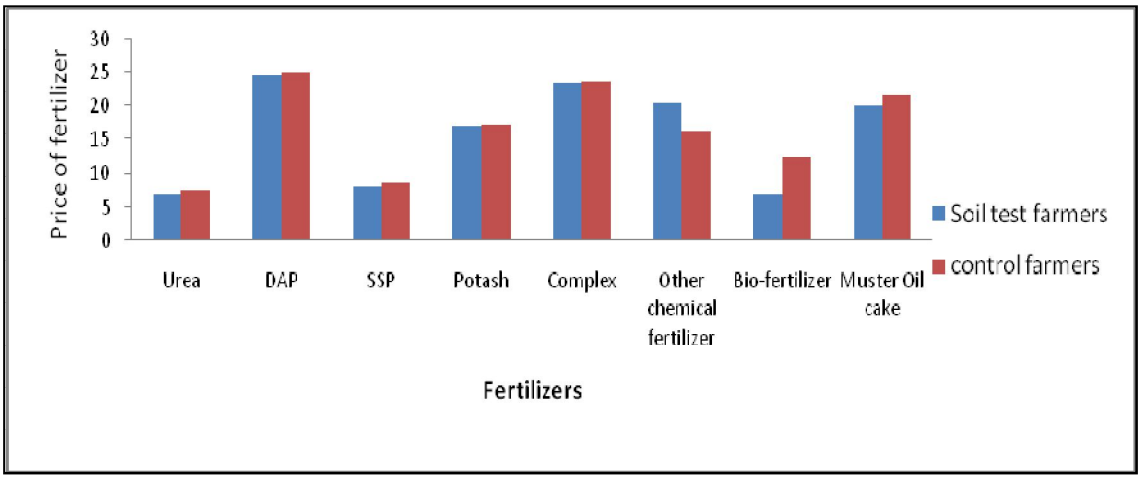
5.8. b Price and transportation cost of fertilizers

As farmers are purchasing fertilizers from different places, therefore price may vary from farmer to farmer. On the other hand, if price and transport cost are high farmers may use less amount of fertilizers and it may be an important determinants of application of fertilizers. Prices and transport cost of different fertilizers have been represented in Table-5.15 and here prices of different fertilizers for paddy have been calculated by taking average price of fertilizer applied in Amon and boro paddy.

Table -5.14: Average Price of Fertilizers and Transport Cost Incurred (Rs/kg)

Fertilizer type	Soil Test farmers		Control farmers	
	Average Price	Transport cost	Average Price	Transport cost
Urea	07.13	.021	07.39	.014
DAP	24.68	.025	24.97	0.00
SSP	08.00	.012	08.79	.04
Potash	16.96	.031	17.14	.012
Complex.....	23.62	.564	23.86	.022
Micronutrients	1424.00	0.00	685.00	0.00
Other chemical fertilizer	20.50	0.00	16.28	0.00
Bio-fertilizer	7.05	0.03	12.50	0.00
Muster Oil cake	20.15	0.02	21.59	.22

Diagram-5.36: Prices of fertilizers of soil test farmers and control farmers (Rs/kg)



Average prices of fertilizers are higher for the control farmers compared to soil test farmers except for micro-nutrients and other fertilizer. It may be due to the fact that

greater number of soil test farmers compared to control farmers is purchasing fertilizers from co-operative societies. On the contrary, higher number of Control farmers compared to soil test farmers is purchasing fertilizers from private fertilizer shops. Average prices of micro-nutrients and other fertilizers are higher for control farmers compared to soil test farmers .Here other fertilizers include lime, ammonium, ammonium-sulphate etc.

Most of the farmers are carrying fertilizers by their bicycle and some farmers are carrying fertilizers by cart. Therefore, those who are carrying fertilizers by their own bicycle or cart do not have any transport cost for carrying fertilizers as such. As a result, if we include such farmers in our calculation, the average transport cost of fertilizers for the pooled data becomes very low and even zero sometimes.

5.9 Attended of Training Programmes

Attendant of training programmes on application of chemical fertilizer is an indication of farmers how much they are aware about the application of chemical fertilizers .It may indirectly influence the farmers for testing soil and applying the recommended doses of fertilizers.

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

Particulars	Crop I (Paddy)	Crop II (Jute)
Soil Test Farmers		
Average number of trainings attended(Only Who have actually attained)	1.13	1.08
% of farmers attended	45	36.67
Average number of days(Only Who have actually attained)	9.73	5.17
Control Farmers		
Average number of trainings attended Only Who have actually attained)	1.07	1.00
% of farmers attended	25.00	21.67
Average number of days Only Who have actually attained)	5.53	3.69

- It has been found from the Table-5.16 that higher number of soil test farmers compared to control farmers has attained training programmes on application of chemical fertilizers for both the crops.
- Greater number of paddy farmers compared to jute farmers (for control and soil test) has attained training programmes on application of chemical fertilizers.

- Average number of training programmes is higher for soil test farmers compared to control farmers for both the crops.
- Average number of training per household is higher for paddy farmers compared to jute farmers (for both soil test and control).
- Average number of days attaining training programmes is higher for soil test farmers compared to control farmers for both the crops.
- Average number of days attaining training programmes is higher for Paddy farmers compared to Jute farmers (for both soil test and control).

  Above discussion indicates that soil test farmers are more aware compared to control farmers. Whereas within the soil test category, Paddy farmers are more aware compared to jute farmers so far as application of chemical fertilizers is concerned.

5.10 Summary of Chapter

Many farmers know about the soil test but their information is superficial and hazy. Farmers think that it will increase the application of fertilizers, their cost of cultivation, destroy soil's health; they cannot follow the recommended doses properly. On the other hand government institutions are not working properly for soil testing. It is observed that some time DDA (Deputy Director of Agriculture) request KPS to collect some soil samples and KPS request some local farmers to collect soil samples. They collect soil sample in any way considering any things. Some time they take the same sample but in different names to increase the number of soil sample. Even some farmers have lack confident on the result of soil test because they have given the same sample but in different names, but they have got the different result. Not only that, some farmers have applied huge amount of organic fertilizers but their soil test result shows that it has lack of organic elements. In many cases, farmers have given soil sample to test but they have not got any results. Sometimes, they have got result after cultivation of crops. On the other hand, number of soil test laboratory is very few. Distance of soil test laboratory is very high. Farmers have to depend on KPS for testing soil. The farmers who have done soil test are doing through KPS. Numbers of KPS are very small in blocks. They cannot guide the farmers properly because they have to cover so many villages at the same time. Not only

that, sometimes they give their responsibilities on some local farmers or political leaders and they became free from their responsibility. Therefore, from the above discussion it has been found that overall performance of testing of soil and application of recommended doses of fertilizers is very poor. However some important observations mentioned as below:

- Very few farmers have applied recommended doses of fertilizers. Those who have applied may not applying actual recommended doses of fertilizers on the basis of soil test. Mostly it is oral recommended doses of fertilizers. More number of jute farmers compared to paddy farmers has applied recommended doses of fertilizers.

- Most of the farmers have not applied recommended doses of fertilizers in paddy due to lack of technical advice on method and time of fertiliser application and difficulty of understanding and following the recommended doses. Most of the farmers have not applied recommended doses of fertilizers in jute due to lack of technical advice on method and time of fertiliser application

- Most of soil test farmer as well as control farmers, have applied fertilizer according their own understanding. They have applied huge amount of fertilizers. Urea is found to be the most important fertilizer for the sample farmers. The second and third preferences are DAP and MOP respectively. Soil test and control farmers have applied almost same amount of urea and complex fertilizer in paddy. But Control farmers have applied greater amount of DAP, MOP, SSP, Micro-nutrients in paddy. Control farmers of jute have applied greater amount of all types of fertilizer compared to soil test farmers except MOP.

- Among soil test farmers: number of farmers applying organic fertilizers in paddy is not so high. The farmers those who have applied, higher number of farmers have used farm yard manure. Higher number of farmers has applied organic fertilizer in paddy compared to jute. Among the paddy farmers: higher number of soil test farmers compared to control farmers has applied organic fertilizer. Among the jute farmers: higher number of control farmers compared to soil test farmers has applied organic fertilizer.

- More number of soil test farmers compared to control farmers has attained training programmes and average number of day attaining training is higher for soil test

farmers compared to control farmers. Paddy farmers have attained more training programmes compared to jute farmers.

- Almost all farmers have applied fertilizers by broadcasting
- Most of the farmers have purchased fertilizers from private fertilizer shops. Few farmers have purchased from co-operative societies. Higher number of soil test farmers has purchased fertilizers from co-operative societies compared to control

Chapter-VI

Impact of Adoption of Recommended Doses of Fertilisers

6.1 Background

Most important objective of the study is to analyze the impact of application of recommended doses of fertilizers on crop productivity and income of the farmers. Therefore, it is important to compare the productivity and value of output between the soil test farmers and control farmers and also the difference of productivity before and after the use of recommended doses of fertilizers.

6.2 Productivity of Reference Crops among the Sample Households

Income of the farmers from reference crops has been represented by value of output of reference crops. Productivity of paddy has been calculated averaging the productivity of Amon paddy and Boro paddy. Similarly, value of output of paddy has been calculated by taking average of value of output of Amon paddy and Boro paddy. Imputed prices have been used for the farmers who have not sold paddy. One average price prevailing in the region has been used to calculate the value of output for the both crops.

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

Particulars	Average yield (Quintal/acre)			Average value of output per acre (Rs/acre)		
	Soil test farmers	Control farmers	% difference in yield	Soil test farmers	Control farmers	% difference in yield
Crop I(Paddy)						
Marginal	19.69	18.92	4.07	28632.29	27512.59	4.07
Small	20.49	16.75	22.33	29795.62	24357.08	22.33
Medium	19.96	18.09	10.34	29024.91	26305.65	10.34
Large	18.08	23.18	-22.00	26291.10	33707.29	-22.00
Total	19.86	18.46	7.56	28879.50	26843.68	7.56
Crop II(Jute)						
Marginal	10.89	11.74	-7.24	24323.99	26222.56	-7.24
Small	10.43	11.06	-5.70	23296.53	24703.70	-5.70
Medium	12.16	12.05	0.91	27160.67	26914.98	0.91
Large	-	-	-	-	-	-
Total	10.85	11.573	-6.25	24234.65	25849.55	-6.25

Note: Only from reference crops

Diagram-6.1: Productivity of paddy (Considering NOA <=16.00 acre)

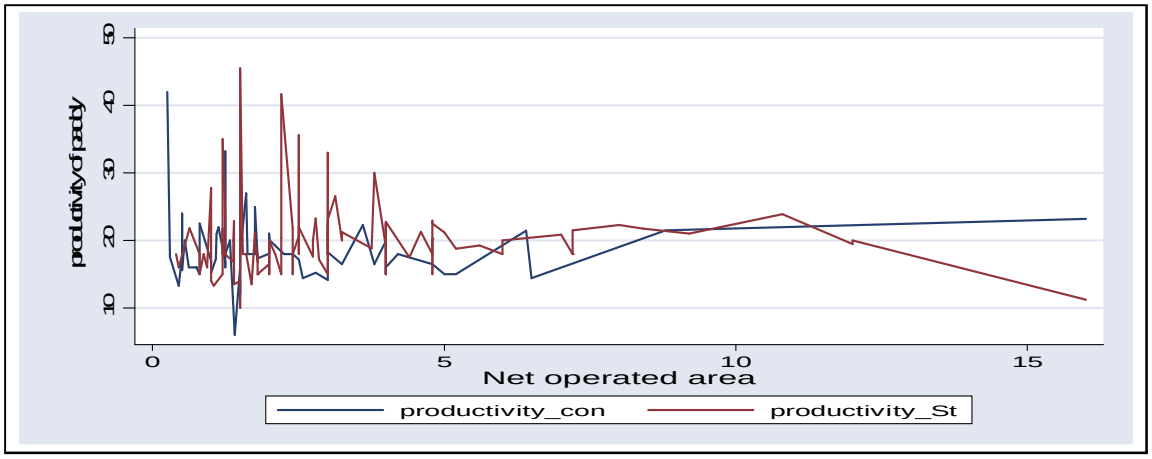


Diagram-6.2: Productivity of Paddy (Considering NOA <=6.00 acre)

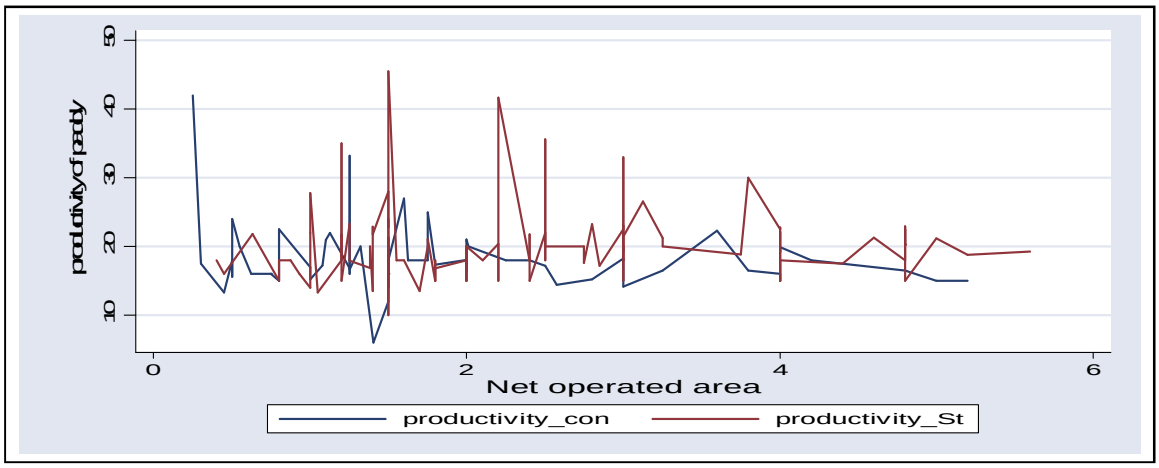
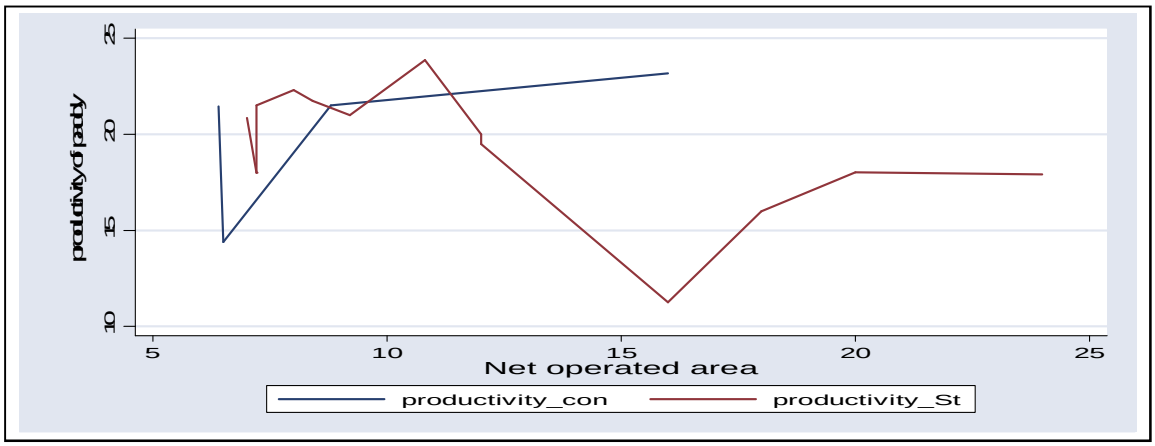


Diagram-6.3: Productivity of paddy (Considering NOA >10.00 acre)



Productivity (Paddy) of soil test farmers is higher compared to control farmers and the difference of productivity between control farmers and soil test farmers is positive in all farming groups except large farm size group, this is due to the presence of outlier in large farm size group.

Diagram-6.4: Productivity of jute (Considering NOA <=6.00 acre)

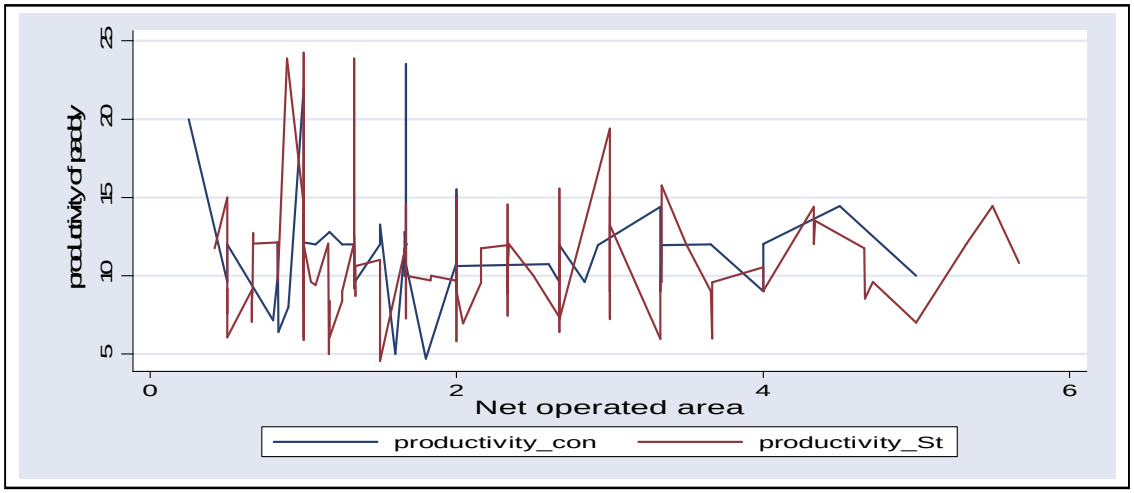
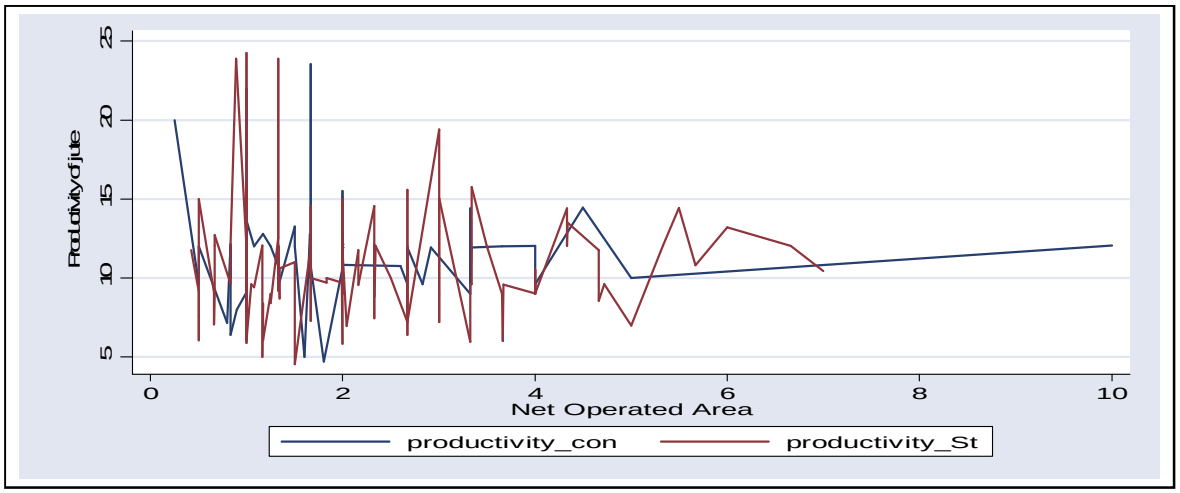


Diagram-6.5: Productivity of jute (Considering NOA <=10.00 acre)



Excluding the medium farming group, Productivity of jute of the control farmers is higher compared to soil test farmers. Productivity of the soil test farmers is higher compared to control farmers in the medium farming group. But number of observation in this group is very small. Therefore, we cannot say confidently that the productivity of soil test farmers is higher compared to control farmers in the medium farming group.

Average value of output in Rs. Per acre from paddy was estimated 28879.50 by soil test farmers against Rs.26843.68 by control farmers. Average value of output was highest in small farming group for soil test farmers. On the other hand, Average value of output

from jute was estimated Rs.24234.65 by soil test farmers against Rs.25849.55 by control farmers. Average value of output of soil test farmers as well as control farmers was highest in medium farming group. In case of paddy, differences in value of output of soil test farmers and control farmers were negative in all the farming groups except large farming group. On the other hand, the difference between control farmers and soil test farmers for jute was positive only in medium farming group. It can be seen that the difference in value of output between control and soil test farmers was same as difference in yield rate. It was due to use of only one average price prevailing in the region for calculating value of output.

6.3 Impact of Application of Recommended Doses of Fertilisers on Reference Crops

It is very difficult to find out farmers who have actually applied recommended doses of fertilizers on the basis of soil test result. Most of the farmers have not got any report of soil test. Some farmers have got report card only with soil health status but no recommendation of fertilizes. Some farmers have got report card but cannot understand the recommended doses of fertilizers. However, sometimes KPS(Krishi-Prayukti-Sahayak – agricultural extension personnel) advise to apply lime, Mustard oil cake, Farm Yard Manures, Micro-nutrients and some chemical fertilizers and they consider it as recommended doses of fertilizers. Very few farmers have used recommended doses of fertilizers. The difference of productivity before and after use of recommendation has been represented in Table-6.2.

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

Particulars	Average yield (Quintal/acre)		% change in yield
	Before	After	
Crop I(Paddy)			
Marginal	14.00	16.00	14.29
Small	19.20	19.80	3.13
Medium	17.50	18.75	7.14
Large	16.75	19.00	13.43
Total	16.78	18.15	8.16
Crop II(Jute)			
Marginal	10.25	11.73	14.44
Small	8.40	9.60	14.29
Medium	-	-	-
Large	-	-	-
Total	10.11	11.57	14.44

Diagram-6.6: Productivity of Paddy after and before application of recommended doses of fertilizers

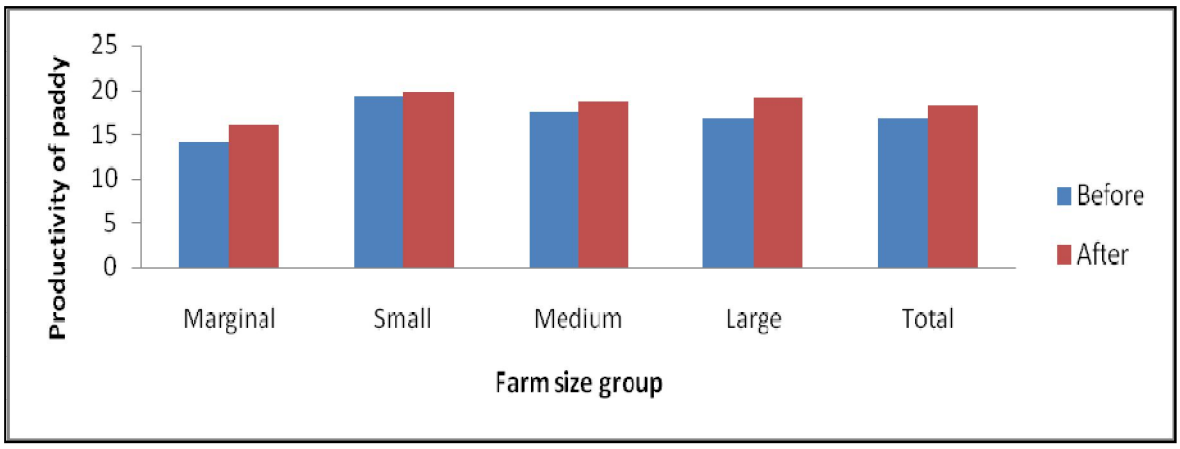
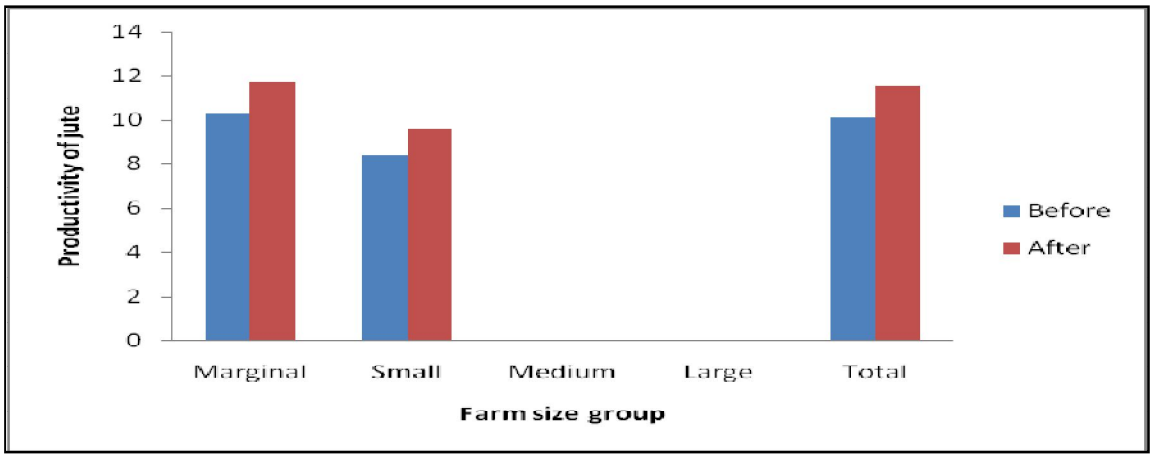


Diagram-6.7: Productivity of Jute after and before application of recommended doses of fertilizers



- Productivity of paddy has increased after application of recommended doses of fertilizers.
- Productivity of jute has increased after application of recommended doses of fertilizers.

Some important changes observed by the famers who have applied recommended doses of fertilizers are represented in Table-6.3

Table -6.3: Changes Observed after the Application of Recommended Doses of Fertilizers on Reference Crops (% of farmers)-Soil Test Farmers

Particulars	Extent of change in Crop I(Paddy)				Extent of change in Crop II (Jute)			
	Most Important	Important	Least Important	Total	Most Important	Important	Least Important	Total
Increase in crop yield	72.73	0.00	9.09	81.82	53.85	0.00	0.00	53.85
Improvement in soil texture	0.00	9.09	9.09	18.18	15.38	38.46	0.00	53.85
Improvement in crop growth	0.00	0.00	0.00	0.00	0.00	15.38	0.00	0.00
Improvement in grain filling	0.00	9.09	9.09	18.18	0.00	0.00	0.00	15.38
Less incidence of pest and diseases	9.09	9.09	0.00	18.18	0.00	0.00	0.00	0.00
Decrease in application of other inputs like seed, labour, pesticide etc.	9.09	9.09	9.09	27.27	0.00	7.69	0.00	7.69
Others	0.00	18.18	0.00	18.18	23.08	0.00	0.00	23.08

Note: Percentage has been taken only for the farmers who have actually used the recommended doses of fertilizer

- It is found from Table- 6.3 that most important change observed by the paddy farmers is ‘increased in crop yield’ (81.81%) and next important is ‘decreased in application of other inputs like seed, labour, pesticide etc’ (27.27%).

- Most important change observed by the jute farmers is ‘increased in crop yield’ (53.85%) and next important is ‘Improvement in soil texture’ (53.85%)

  Although very few farmers have used recommended doses of fertilizer, but for the farmers – in all size groups – who have applied recommended doses of fertilizers, productivity has increased in both paddy and jute. Some other important changes have been observed as a result of application of recommended doses of fertilizers like decreased in application of other inputs like seed, labour, pesticide etc and Improvement in soil texture.

Summary of the Chapter

Most of the farmers have applied fertilizers according to their own choice. Very few farmers have applied recommended doses of fertilizers on the basis of soil test result. It is expected that the difference of productivity between control farmers and soil test farmers should be significantly high. However, some important observations have been described as below:

- In case of paddy, Productivity of the soil test farmers is higher compared to control farmers in all farming groups except large farming group. Overall, productivity of the soil test farmers is higher compared to control farmers. In case of jute, Productivity of the control farmers is higher compared to soil test farmers in the marginal and small farming groups; for the medium farming group productivity of soil test farmers is higher compared to control farmers. Overall, productivity of the control farmers is higher compared to soil test farmers for jute.

- Value of output of paddy is higher for the soil test farmers compared to control farmers in all farming groups except large farming group. Value of output of jute is higher for the control farmers compared to the soil test farmers in small and marginal farming groups.

- Very small number of farmers has applied recommended doses of fertilizers. For the farmers – in all size groups – who have applied recommended doses of fertilizers, productivity has increased in both paddy and jute.

- Important changes by the application of recommended doses of fertilizers in paddy are ‘ increased in crop yield’, ‘Decreased in application of other inputs like seed, labour, pesticide etc’.Important changes by the application of recommended doses of fertilizers in jute are ‘‘increased in crop yield’ and ‘Improvement in soil texture’

Chapter VII

Summary and Conclusions

7.1. Background

Soil health condition plays a very important role in enhancing the quality of crop production as well as the productivity levels in agricultural sector. In order to cater to the growing population with huge population base a recurrent phenomenon of over use of land has in the long run created a negative impact on the very basis of agricultural sector. Such type of preponderant pressure on land has created to a significant extent an unbalanced situation for the soil nutrients further deteriorating health condition of soils. Moreover, in order to enhance agricultural yield – to remain relevant in the contemporary competitive environment–the farmers indiscriminately apply chemical fertilizers and such inappropriate doses of fertilizer application creates a serious impact on environment and sustainability of agricultural sector.

The present study deals with the coherent principles of sustainable development and explicitly divided into two parts: a) soil testing for determining the appropriate dose of fertilizer and other nutrient use; and b) adoption/application of recommended doses of fertilizers etc and its probable impacts. The first one i.e. soil testing deals with Soil Health which is very sensitive and directly related with crop production. Any negligence of Soil Health has serious repercussion on growth and upbringings of plants. Mentioned earlier, continuous use of agricultural land for feeding such an enormous population is inflicting a gradual nutrient mining and to our utter dissatisfaction, such losses are being compensated through over use of fertilizer. Curiously, these compensation/replenishment are being done through purely unscientific processes and in an indiscriminate way. Due to intensive method of cultivation, nutrient mining along with the gradual degradation of micronutrients over the periods has caused irreparable losses to Indian soils. According to a recent estimate of the Fertilizer Association of India (FAI-2014) every year almost 34 million tons of plant nutrient in the form of NPK is being exhausted and in exchange only 26 million tons of NPK are being replenished through application of fertilizer resulting into a deficiency of 8 million tons every year. Besides such a huge NPK deficiency, a careless attitude of the farmers towards the application of fertilizer reduces the percentage of secondary supplements and micronutrient to an abysmal level. The FAI indicates that

‘as a result the deficiency of nutrients and micro nutrients in Indian soil reduces to the tune of 89%(N), 80%(P), 50%(K), 40%(Sulpher), 48%(Zinc), 33%(Boron) respectively’ (ibid.).

The agricultural experts have recommended an appropriate NPK ratio for Indian soil conditions, which is 4:2:1. ‘In 1991-92, the year immediately preceding the decontrol of phosphatic and potassic fertilizers, the NPK ratio was 5.9:2.4:1. Consequent on decontrol of phosphatic and potassic fertilizers, the NPK ratio were distorted to 9.68:2.94:1 in 1993-94. The same has considerably improved to 5.3:2.2:1 in 2005-06. The farmers have to be educated in the matter of nutrient balance as it has a great long-term significance for the Indian agricultural economy and policy measures on balanced use of fertilizers have to be initiated. Apart from the need for increase in the consumption of fertilizers in appropriate ratio, there is a need to be evenly spread the consumption of fertilizers all over the country’ (wg_11fertiliser, …….).

In 1950-51 an estimated amount of 70,0000 tons of fertilizers (NPK) were used for agriculture purposes; it rose manifold and in the year 2012-13 reaches 255lakh ton. The figure for application of plant nutrient in India during the First Five Year Plan was 0.89kg/ha; it rises to128kg/ha in 2012-13. In case of West Bengal, the picture is somewhat different. In 2011-12, the figure of total fertilizer use was 15 lakh 82 thousand ton and it reduces further to 15 lakh 60 thousand ton. During the same period, use of plant nutrient decreases from 169kg/ha to 162kg/ha. The figures of NPK use in India during 2010-11, 2011-12 and 2012-3 were 4.7:2.3:1, 6.7:3.1:1 and 7.9:3.1:1 and as a result, the use of Plant nutrient ($N+P_2O_5+K_2O$)kg/ per hectare, during this period varies between 141.3, 139.7 and 128.6 kg/hect. respectively (FAI-2014).

Considering the importance of soil health management, proper application of recommended doses of fertilizer along with use of bio-nutrient for enhancing and maintaining sustainability in agricultural sector is seriously being taken into consideration. Thus, in order to disseminate proper ideas Government of India has formulated numerous schemes and task force committees with the help of agricultural and environmental experts.

7.2. Need for the study

In the light of increased degradation of natural resources due to intensive cultivation and injudicious use, their sustainable management holds the key for ensuring sustainable food production. Due to a lack of awareness among the farmers, there are wide spread problems

related to the indiscriminate use of chemical fertilizers, mismanagement of surface water and over exploitation of ground water and other resources. The over use of chemical fertilizers in most parts of India in the last few decades has led to several problems affecting soil health, nutrient flow and natural environment. There is a need for promoting, among others, balanced use of fertilizers for increasing productivity of crops and for better absorption of nutrients from the applied fertilizers. It is suggested that, farmers should go for regular soil testing and use recommended doses of fertilizers as advised by the agricultural scientists. There is no systematic study undertaken so far for evaluating the effectiveness of such a programme of soil testing for nutrient deficiency and consequent adoption of recommended doses of fertilizers by farmers based on these soil tests. The present study examines the performance of the soil-test programme, the level of adoption and constraints in the application of recommended doses of fertilizers, impact on crop productivity and relevant institutional problems.

7.3. Objectives of the Study

The objectives of the study are as follows:

To evaluate the soil-test programme and the pattern and determinants of participation/non-participation of the farmers in such a project.

To examine the level of adoption and its constraints in the application of recommended doses of fertilizers based on soil test reports by the farmers.

To analyze the probable impact of adoption of recommended doses of fertilizers on crop productivity and income of farmers.

7.4 Summary and findings

Generally, adoption of recommended technique in agricultural sector is to a significant extent influenced by the socio-economic factors existing in the rural India. Availability of educational facilities along with social taboos make the situation more complex, and hence, a brief discussion about the socio-economic characteristics and demographic composition of the sampled farmers is necessary to have a glimpse on these particular issues.

Here, in the present study, we find that the farm size category of marginal farmers overwhelmingly dominates the farming classes and it is found that, almost 55% of farmers in Paddy and almost 71% farmers in Jute belong to this category. Though a significant

percentage of small farmers (30% in Paddy and 24.17% in Jute) is found in the study, the representative figure in the case of medium and large farmers is negligible and virtually no big farmers are found in jute cultivation due to less interest and non-availability of large farmers in the study area.

Interestingly, in case of paddy it is found that, all of the respondents are middle aged educated male having on an average long 23 years' background in farming sector and 58.33% of them are members of agriculture related association/s. Altogether 92% of the respondents categorically mentioned that agriculture is their primary livelihood; 70% of them belong to General caste category and altogether 14.44% of the respondents represent the OBC group of the social caste system. The picture in case of control farmers cultivating paddy is more or less the same, the only difference is that, 81.6% have identified agriculture as their main occupation and it is found, they have more agricultural experience (in terms of years of involvement) in comparison to soil test farmers, i.e. the treatment group.

In case of Jute, educational standard of the respondents in comparison to the respondents for paddy cultivation is low, though the figure is encouraging in the sense that almost all of them are literate. Among the soil test farmers, 93.33% of them have stated that agriculture is their primary occupation; percentage figure in the case of control farmers is 100%. The control farmers have more agricultural experience, though in terms of membership of any association they are slightly lacking behind their counterpart.

In case of paddy, operational land holding among soil test farmers is marginally higher than that of control farmers. The corresponding figures for both these categories of farmers in Paddy and Jute are 5.86 & 372 and 3.63 & 2.93 (acre/household) respectively. Cropping intensity in Paddy for the soil test farmers (172%) is also higher than that of the control farmers (159%); the corresponding figure for Jute is 184% and 169% respectively.

Needless to mention, cropping intensity to a great extent is influenced by the availability of irrigational facilities. In the present study bore well commands a formidable percentage of total irrigation availabilities. The overall percentages of land irrigated through this system in Paddy and Jute are 63.28 and 84.82 and availability of canal irrigation is very small, the corresponding figures for both the Crops are 28.64 and 0.36 percent respectively.

As far as cropping pattern is concerned, it has been observed that, cultivation of paddy more or less plays a dominant role for all the categories of farmers. Potato and oilseeds including mustard and vegetables are the other important crops grown in the study area. Cultivation of Paddy in Jute areas is visibly higher than Paddy regions. Significantly, adoptions of HYV seeds for all agricultural crops among all categories of farmers reveal a very encouraging picture. Almost all the farmers (both Soil test and Control) use HYV seeds for paddy (both Aman and Boro) cultivation. The Control farmers use more HYV seeds than the soil test farmers for Jute cultivation. It shows that the soil test farmers depend more on traditional variety than the control farmers. In case of Potato, mustard, wheat and vegetables cultivation farmers use HYV seeds though visibly the traditional varieties have significant presence in both Paddy and Jute regions.

Interestingly, the value of output per unit of cropped area (Rs/acre) among soil test farmers for Paddy decreases, with the increase of size of farming and a reverse pattern is found in the case of control farmers. In the case of jute, value of output increases with the increase of size of operational holding and it is true for both the soil test and control farmers. It signifies that in comparison to paddy growers the jute cultivators got better prices of their disposable commodities and have better market facilities in their respective regions. A comparison between the values of crop outputs for both of these two crops signify that the soil test farmers on an average get a better return than the control farmers. Definitely, it indicates that the soil test farmers are progressive in nature. The above fact justifies that, in the case of both paddy and jute, the soil test farmers have definitely an edge over the control farmers in holding and using agricultural machineries. It has been observed, both in terms of quantity and value, the soil test farmers spend more for mechanization in agriculture in order to get a positive return on their farm investments.

Mechanization in agriculture mostly depends upon the economic viability among farmers and such economic endeavors are greatly influenced through availability of credit from different sources. It has been observed that formal credit institutions viz. co-operative credit societies, commercial banks and RRBs play a very important role compared to that by the non-formal banking institutions in the study areas. In case of Paddy, nowhere it is found that the farmers got credit from village money lenders or any such institutions demand exorbitant rate of interest for their lending though such institutions are operating among jute cultivators and outstanding amount to these lenders are negligible. Above facts

clearly indicate that the formal banking sector is doing well but not to that extent of eliminating completely the money lenders in these rural sectors.

With reference to the soil testing and recommended doses of fertilizer, it has been observed that in percentage terms the numbers of farmers decreases with an increase in size class of operational holding. Evidently, number of farmers is higher in the lowest stratum among all the size classes and in comparison to other farmers they have enough scope for soil testing. Besides this, there might be another reason, i.e. greater zeal and aspiration among marginal farmers to enhance their production as they have limited access to other inputs of production, despite the fact that, the farmers are constrained by a lack of easy access to soil testing laboratory. The laboratories are situated in the headquarters, which are far away from the villages; and the farmers consider the distance and cost of transportation as serious obstacles for soil testing.

On an average, one sample per plot for all categories of farmers was submitted for soil testing. In case of marginal farmers, the sample size was two or more with an anticipation of getting appropriate result for the sample submitted to the soil test laboratory. Unfortunately, they were delivered different results corresponding to different samples of the same plot; this has created skepticism among the farmers regarding the very process and validity of the soil-testing programme. Moreover, it is found that, the average number of plots per household considered for soil testing increases with an increase in the size group. Average area covered under soil test (acre) per household for marginal, small, medium and large farmers for Paddy are 0.78, 1.01, 2.07 and 9.69 and for Jute the corresponding values are 0.71, 1.51 and 1.86 respectively. It has also been seen that, the farmers themselves had collected and sent their samples to the laboratories for testing their soil. Method of collection and handling of sample raise a big question about availability of agricultural extension facilities in the study areas. The cost of soil testing is mainly the travelling cost and in many cases, in order to avoid travelling hazards the farmers for both of these two crops prefer private company's laboratory or mobile van for testing their soil. Although the activities of Krishi Prayukti Sahayak (KPS) are not visibly prominent in handling and collection of soil samples from the farmers, interestingly, the farmers got information about the benefits of soil testing mostly from the Government sources (in many a cases, KPS).

While asked the farmers, about the reasons for soil testing most of them categorically mentioned that they expected better yield and wanted to know about the deficiency of the

nutrients of their own land. Moreover, a significant portion of the farmers nodded for adoption of the new technologies and its application for better farming in near future.

A very discouraging picture is obtained from the findings of the reasons for not testing soil from the farmers. The control farmers aspired that they were interested to test their soils but non-availability of the extension officers and availability of the laboratories are major constraints for their non -testing. Another dismal picture about finding of the study, a negligible number of soil health card with the recommended doses of fertilizer were collected only from the farmers engaged in Paddy cultivation. On soil test basis the recommended doses of fertilizers found to be are 13.20, 31.19 and 26.72(kg/acre) for Urea, DAP and Potash for Paddy. No information relating to average quantity of split doses of fertilizers recommended by the stage of crop growth for soil test farmers is available for Paddy and Jute farmers.

In case of recommended doses of fertilizers by soil test farmers the scenario is not as good as expected. In fact, as an aggregate only 9.17% of soil tested farmers applied the recommended doses and most of them depend on the oral recommendation of fertilizer given by Krishi Prayukti Sahayak(Agricultural extension personnel). Moreover it is found that in case of Paddy, as compared to marginal and small farmers the medium and large farmers apply recommended doses of fertilizers while in case of Jute the an opposite picture is seen.. Thus, with reference to both these two Crops a complete opposite picture in terms of the areas covered in case of application of recommended doses of fertilizer is clearly visible. Areas covered under the marginal farmers in Jute are found to be higher than Paddy. Overall; Percentage of applied farmer is higher in Jute and average area for the application of recommended doses of fertilizers is higher in paddy. Area covered as a percentage of the net operated area in comparison to Jute is found to be higher in Paddy.

One constraint analysis for studying the application of recommended doses was done and on that basis again inept performances while dealing with this important matter of the State Agricultural Extension Department can easily be surmised. From this analysis it is found that almost 33.94% of Paddy Growers and almost 43% of Jute cultivators clearly mentioned about the non availability of technical advice on method and timeliness of the application of fertilizers, even the same percentage of farmers in case of paddy complained about the difficulties to understand and follow the recommendations about application of appropriate doses of fertilizers available from the Government Sources. Despite the above facts it should not be pertinent to ponder that the control farmers are not

aware as well as its consequences about soil testing. In our study area it is found a little over 83 % of marginal farmers and 69.23% of small farmers among Paddy cultivators are well aware of the effects of soil testing on crop production. The corresponding figure for control farmers in Jute among the small size class is 100% though the total figure bogged down to 85%. During Paddy cultivation it is found that soil test farmers as well as control farmers generally apply greater amount of Urea followed by DAP and MOP. Soil test farmers use grater amount of Urea and complex compared to control farmers. On the contrary, control farmers use greater amount of DAP, MOP and SSP and micronutrients. In case of jute cultivations, soil test farmers as well as control farmers use more Urea than Complex and DAP. Control farmers except MOP use all types of fertilizers as compared to soil test farmers.

Quantity of fertilizers in different stages of cultivation is different across these two categories of farmers. Soil test paddy farmers apply highest amount of Urea at the 'after-inter-cultivation' stage and DAP&SSP at the 'Basal application stage'. Both soil test farmers and control farmers during Jute cultivation use higher amount of DAP, MOP, SSP and complex at the 'basal application' stage. Next higher dose is applied at 'after-inter-cultivation' stage and then at 'vegetative growth' stage.

Timely application of fertilizer is one of the key factors for enhancing agricultural production and furthermore the timeliness depends on the availability of fertilizers from different sources. It is in the study found among sources; private fertilizer dealers play a very important role in providing fertilizers to the cultivators. As far as data available for sources of purchase of fertilizers is concerned almost 81% among soil test farmers and 87% of the control farmers purchase fertilizers from the private fertilizers shops/dealers. Despite Government interventions functioning of the District/Primary Agricultural Co-operative societies as regard to important sources of supplying fertilizers among farmers are not at all satisfactory. Cost of fertilizers by the control farmers in comparison to soil test farmers is higher because most of them purchase these important inputs of production from the private traders, and eventually the higher price of fertilizers affects their cost of production. The soil test farmers in comparison to control have greater access to Co-operative societies; and price of fertilizers in these societies is definitely lower than private traders.

Besides application of chemical fertilizers both soil test farmers and control farmers during Paddy and Jute cultivation use a formidable amount of organic manure (Bio-

Fertilizers) also. It is in the study found that control farmers during paddy cultivation apply greater amount of organic fertilizers as compared to soil test farmers. The corresponding analyses of application of organic manure for Jute are more or less same.

The soil test farmers for both paddy and Jute have attained training program but as far as number and frequency of training program is concerned the soil test farmers in Paddy have attained more than their Jute counterparts. Training has also imparted to the control farmers for both Paddy and Jute but in case of information regarding average number of per household training they are mostly lacking behind than the soil test farmers.

The above analyses have so far confined in application of recommended doses of fertilizers among soil test and control farmers for Paddy and Jute. However, main objective of this study to assess the impact of adoption of recommended doses of fertilizers on production and productivity and also to have a glimpse on its effect on farm income of the concerned producers. Mentioned earlier, the farmers have applied fertilizers according to their own choices, moreover, lack of extension facilities and conventional method of farming practices make the situation a little obscure. It has also been mentioned that in spite of the above facts some farmers (very few) have applied recommended doses of fertilizers on soil test basis. It has been observed that productivity of Paddy of soil test farmers in comparison to control farmers is higher across all size classes, though in case productivity of Jute the marginal and small size classes among control farmers have an edge over the soil test farmers. Interestingly, in terms of overall productivity in Jute the control farmers hold in advantageous position than the soil test farmers. Moreover, value of output among these categories of farmers is higher than soil test farmers. The reverse is true for Paddy farmers. A small number of farmers who adopted this technology and applied recommended doses of fertilizers got higher production both in Paddy and Jute. The most noteworthy feature of adoption of recommended doses of fertilizers in paddy is increase in crop yield with ‘decrease in application of other inputs like seed, labor, and pesticides’. In case of adoption of this technique in Jute signifies increase in crop yield and ‘improvement in Soil Texture’.

7.5 Conclusions

*Soil testing and adoption of recommended doses of fertilizers among farmers engaged in Paddy and Jute cultivation have enhanced the level of both production and productivity to a significant extent, but number of such farmers are found negligible.

- Most of the farmers after testing their sample did not get any report card.
- A negligible numbers of farmers got report card with soil health status only; recommendation of appropriate doses was not mentioned therein.
- Available extension facilities in soil testing and recommended doses of fertilizers services are found to be poor.
- Most of the Soil testing Laboratories are situated in long distances.
- Sample is collected by the farmers themselves. Scientific and technical knowhow about collection of samples among farmers are very poor.
- Farmers keep little reliance on Soil testing and Health status. It is reported that they got different results for different sample for same plots of land and even for different result for same sample.
- Timely availability of fertilizers is a great concern; source of availability is also a problem to them. Most of the farmers purchase fertilizers from the private fertilizer dealers. PACs or other Agricultural Co-operatives played a limited role.
- Private dealers charge higher price for their inputs.
- Functioning of Commercial and Rural Banks are quite satisfactorily, though operation of money lenders is visible in Jute cultivated regions.
- Even after soil testing, during application of NPK farmers rely more on oral recommendation of the KPSs than recommendation made in their report cards.
- Soil test farmers have attained more training than the control farmers.
- Soil test farmers in terms of value and quantity of farm machineries have definite edge over the control farmers. Cropping Intensity in these categories of farmers is found to be higher than the control farmers.
- During Paddy cultivation both of the soil test farmers and control farmers use more HY Varieties.
- Control farmers use more HYV seeds than soil test farmers during Jute cultivation.
- Bore well is the major source of irrigation for all crops.
- Both soil test farmers and control farmers use farm yard manure and bio-fertilizers during Paddy and Jute cultivation.
-

Whatever miniscule size of number it may be the soil test farmers who adopted recommended doses of fertilizers in Paddy and Jute cultivation got higher production and were capable of diminishing the costs of other factors of production to a

significant extent. It implies if appropriate administrative and extension services are provided to the farmers and if and only if the farmers are pursued with technical efficacy of soil testing with the application of appropriate doses of fertilizers , agricultural sector could get rid of initial inertia and could bounce to an enormous scale resulting food self sufficiency and much needed sustainable development.

7.6 Policy Recommendations

- As the Soil testing Laboratories are situated in the long distances and as the Farmers collect sample on their own, the Extension Personnel in the District Agricultural Offices need to be more careful and attentive during implementation of this important programme and make it more a success. (ATTn: Directorate of Agriculture, Government of West Bengal).
- Supply of Soil Health cards without any recommendation of appropriate doses of fertilizers to the Farmers is considered as serious lapses on part of the Government Officials. Owing to the repercussion of the farmers such type of lackadaisical attitude among the personnel must be checked and a review of providing Health Report Cards to the said farmers draw much needed attention. (ATTn: Directorate of Agriculture, Government of West Bengal).
- Sources and Availability of fertilizers in time is a great concern to the Farmers, Government sources need to provide NPK in time with an adequate amount. . (ATTn: Directorate of Agriculture, Government of West Bengal).
- Continuous mining of nutrients with inadequate doses of replenishment inputs make soil more and more susceptible to infertile, application of recommended doses of fertilizers with an admixture of manure and Bio-nutrient is capable to maintain and regain the soil health. Propagation of Organic Farming among the farmers is essential. (ATTn: Directorate of Agriculture, Government of West Bengal).
- Notwithstanding the existence of Commercial Banking, village money lenders are still operating in some places in rural areas. Panchayat officials should take note of it (ATTn: Ministry of Panchayat and Rural Development. Government of West Bengal).
- One comprehensive and wide program of disseminating the ideas of soil testing and awareness programme for recommendation doses of fertilizer Viz. KrishiMela (Agricultural fare) in every two or three months might be convened in

each Agricultural Blocks and arrangement of instant issuing of Soil Health Card are felt essential for successful implementation of such important Government Programme. (ATTn: Directorate of Agriculture, Ministry of Panchayat and Rural Development. Government of West Bengal).

- Kisan Call Centre should be set up in all Panchayat offices to enable the farmers about the recent modern techniques being prescribed by the experts . (ATTn: Directorate of Agriculture, Government of India, Government of West Bengal).

References

1. Bhattacharya,B.K.(1998).Soil test –Based Fertilizer Recommendation for Principal Crops and Cropping sequences in West Bengal, Department of Agriculture ,Govt. Of West Bengal.
2. Chottopadhyay G.N.,Mazumdar A.,Sulewshi G.D.(2010). Use of village-level soil Fertility Maps as Fertilizer Decision Support tool in the Red-lateritic Soil zone of India- Better Crops-Vol.94(2010,no.3)
3. Chottopadhyay G.N.,Mondal Biswapati,Bhattacharya B.K.,A perspective of Soil Test Programme in West Bengal, Bidhan Chandra Krishi Vidyalaya, West Bengal
4. Bera R., Seal,Bhattacharya P.,Das T.A.,Sarkar D,Kanjoo K.Targeted yield Concept and a framework of Fertilizer recommendation in Irrigated rice Domain of Subtropical India, Http:/www.ncbi.nlm.non.gov/pmc/Articals/PMC 1661667
5. Deyle J.J.(1966).The responses or rice to fertilizer, Food and Agriculture Organisation
6. Mondal B,Kale S.C Jana,Bhattachaya B.K.(2002).Soil test Crop response correlation Studies in West Bengal, Bidhan Chandra Krishi Vidyalaya,West Bengal
7. Tanden HLS,(2013).Soil Health Management ,Fertilizer Development and Consultation Organisation-New Delhi
8. Fertilizer Association of India (1986).Soil of India and Their Management
9. Fertilizer Association of India(Issues-Jul-Sept2010,Jan-Mar 2014,April-Jun 2014)
10. Ministry of Agriculture, Govt. Of India(2013).Krishi Machinery Prasikhan Ebong Parikshan
11. Ministry of Agriculture, Govt. Of India(2011).National Project on Management of Soil Health and Fertility
12. Ministry of Agriculture, Govt. Of India(2012),Compendium of Soil Health
13. Pathak H.(2010).Trend of Fertility stattus of Indian Soils ,Indian Agricultural Research Institute(Jun 2010)
14. Indian Council of Agricultural Research (2011) Vision 2030
15. K.N. Singh, Rathore A, Tripathy A.L., Rao A.S. and Khan S.www.isag.org.in/jisas

ANNEXURE - I

Co-ordinator's Comments on the Draft Report

ADOPTION OF RECOMMENDED DOSES OF FERTILIZERS ON SOIL TEST BASIS BY FARMERS IN WEST BENGAL

AERC, VISVS-BHARATI, SANTINIKETAN

Reviewer Comments:

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

Adoption of Recommended Doses of Fertilizers on Soil Test Basis by Farmers in West Bengal

1. **Date of receipt of the Draft report:** February 20, 2015

2. **Date of dispatch of the comments:** March 31, 2015

3. Comments on the Objectives of the study:

All the objectives of the study have been addressed.

4. 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) **Chapter III**- Please replace the Crop I and Crop II by respective crops name (Paddy and Jute respectively) throughout the report. In case of Jute crop, no large farmers were found, reasons for the same can be quoted in the interpretation.

(ii) Table 3.3 : This table can be removed as it is not suggested in the Table formats.

(iii) Please strictly follow the 'final reference Table format' throughout the report as circulated across AERCs

(iv) Comparison between two crops is made throughout report, but the main focus of the study is to compare between soil test and control farmers. If possible, try to revise the report accordingly.

(v) Table 3.18 and 3.20: The percentage of farmers availing loan from each sources must be mentioned as suggested in the reference table format.

(vi) And also please mention the percentage of farmers' availed loan from any source in the note below for better understanding of the situation.

(vii) Table 3.19 and 3.21: The column total for each category must add up to 100.

(viii) **Chapter IV** Table 4.7: the recommended dose of fertilizer for jute crop is not presented.

(ix) **Chapter V** Sources of fertilizer purchased and quantity of fertilizer purchased must be analysed separately for each crop and presented in different tables.

(x) **Chapter VI** Table 6.1: Different prices have been used among different categories to analyse the present table instead one average price prevailing in the region must be used. The difference in yield must equal to difference in value of output within category in order to capture the impact of soil test technology.

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

(xii) Authors should provide economic explanation of data presented in all the chapters. **It is suggested to copy edit the report before finalizing.**

7. Overall view on acceptability of report

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

ANNEXURE –II

Action Taken Report

ADOPTION OF RECOMMENDED DOSES OF FERTILIZERS ON SOIL TEST BASIS BY FARMERS IN WEST BENGAL

6. Comments on analysis, organization, presentation etc.

(xiii) **Chapter III**- Crop I and Crop II is replaced by respective crops name (Paddy and Jute respectively) throughout the report. In case of Jute crop, no large farmers were found, reasons for the same are quoted in the interpretation.

(xiv) Table 3.3 has been removed as suggested.

(xv) The 'final reference Table format' throughout the report as circulated across AERCs (vide E-mail by Ellumalai Kannan,In-charge, dated 19th August,2014) has been followed.

(xvi) Done as suggested.

(xvii) Table 3.18 and 3.20: It is different as per Final reference table format.

(xviii) Done as suggested.

(xix) Done as suggested.

(xx) **Chapter IV** Table 4.7: the recommended dose of fertilizer for jute crop is presented.

(xxi) **Chapter V** Sources of fertilizer purchased and quantity of fertilizer purchased is analysed following the 'final reference Table format' as circulated across AERCs

(xxii) **Chapter VI** Table 6.1: Corrected by using one average price prevailing in the region .Now, the difference in yield is equal to difference in value of output within category.

(xxiii) **Chapter VII –** Done as suggested.

(xxiv) Done as suggested.