

Study No. 179

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



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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 thank 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.

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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 greater 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).