



Status of Soil Testing and Fertilizer Recommendations by the Farmers of Tamil Nadu

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ABSTRACT

Background: Fertilizers are one of the major inputs of agriculture to increase crop production. In India, fertilizer consumption had increased over a period of four decades. There is an increase in demand for food and this in turn increases the demand for fertilizers. The increase in food production is due to use of proper inputs like fertilizers, quality seeds and pesticides. The fertilizer consumption in India increased from 65.6 thousand metric tons in 1950-51 to 26,593.4 MT in 2017-18. However, the fertilizer use in India has many problems. Firstly, it is imbalanced in terms of NPK. Secondly, there is a wide variation in the amount of fertilizer in different state.

Methods: Primary data were collected from two districts namely Thiruvannamalai and Thanjavur of Tamil Nadu. In each of the two districts, two representative blocks namely, Cheyyar, Kalasapakkam in Thiruvannamalai district and Thanjavur and Orrathanadu in Thanjavur district were taken for the study. In each district, 120 farmers (60 in each block) from the list of soil tested farmers were drawn at purposive farmers from households with different land sizes. In addition, 60 control (non-soil tested) farmers (30 in each block) were selected in each purposive farmer from households amongst general rice and groundnut growing cultivators.

Result: Nearly three-fourths (72 per cent) of the farmers getting their soils tested in the present study belonged to the small (47 per cent) and medium (25 per cent) categories of landholdings. All farmers have to travel long distance for soil test incurring sizable transportation cost. Generally, in Thanjavur district, soil test farmers have been travelling long distance from their farm to Aduthurai, where the soil test laboratory is located at a distance of 50-60 kms. There is no soil test laboratory in Thiruvannamalai district, hence, the farmers have to travel to the neighbouring district of Trichirapalli. The soil tested farmers travel from Vembakkam and Mamandur to Thiruvannamalai where the laboratory is located and the average distance is about 80-100 km. Nearly half of the paddy farmers and nearly, two-thirds of the groundnut growers expressed the view that the soil test has an important role in increasing crop yield. Almost half of the paddy farmers and one-third of the groundnut farmers did not how to take a soil sample from their farm land, whereas, another half of paddy farmers and one-third of groundnut growers reported that they did not know whom to approach in this regard. These are the major reasons cited for non-participation in the soil test process.

Key words: Farmer's livelihood, Fertilizers, Nitrogen, NPK balanced fertilizer, Phosphorus, Potassium, Recommended doses, Soil fertility/health, Soil testing, Sulphur.

INTRODUCTION

Fertilizers are one of the major inputs of agriculture to increase crop production. In India, fertilizer consumption had increased over a period of four decades. There is an increase in demand for food and this in turn increases the demand for fertilizers. The increase in food production is due to use of proper inputs like fertilizers, quality seeds and pesticides. The fertilizer consumption in India increased from 65.6 thousand metric tons in 1950-51 to 26,593.4 MT in 2017-18. The factors responsible for this increase in fertilizers were: (1) rapid expansion of irrigation, (2) introduction of HYV seeds, (3) introduction of Retention Price Scheme, distribution of fertilizers to farmers at an affordable price, (4) expansion of dealers network, (5) improvement in fertilizer availability and (6) virtually no change in farm gate fertilizer (Department of Agriculture and Cooperation, Government of India, 2018). However, the fertilizer use in India has many problems. Firstly it is imbalanced in terms of NPK. Secondly, there is a wide variation in the amount of fertilizer in different state.

The variation in the Amount of Fertilizer in Different States in India is given in Table 1. Punjab (250.2 kg/ha.), Bihar (212.2 kg/ha), Haryana (207.6 kg/ha), Andhra Pradesh (189.3 kg/ha), Uttar Pradesh (183.2 kg/ha), Tamil Nadu

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(164.6 kg/ha), West Bengal (163.2 kg/ha), Jharkhand (158.2 kg/ha), Uttarakhand (130.4 kg/ha) Arunachal Pradesh (2.05 kg/ha), Nagaland (4.8 kg/ha), Mizoram (13.2 kg/ha) and Meghalaya (14.4 kg/ha) DOA-In, 2012-13).

In Tamil Nadu, average consumption of fertilizer is 197 kg/ha. Out of that, nitrogen consumption is 109 kg/ha. Phosphate consumption is 54 kg/ha and potash consumption is 34 kg/ha. as per projected value (DOA-TN, 2015). As regards NPK use pattern, Thanjavur, Nagapattinam, Villupuram, Tiruchirapalli and Tirunelveli districts have the highest consumption of Nitrogen fertilizer, Cuddalore, Thanjavur,

Villupuram, Tiruchirapalli and Dindigul districts have the highest level of consumption of phosphate fertilizers and Tirunelveli, Villupuram, Tiruchirapalli and Salem are the highest consumption districts of potash fertilizers (DOA-TN, 2015). The major reason for higher consumption of NPK fertilizers among different districts of Tamil Nadu is soil fertility conditions. Nutrient deficiency is a major problem in the agricultural sector.

Chauhan and Misra (1989) pointed out that application of nitrogenous fertilizers is a key factor in the overall fertilizer programme of India as there is widespread nitrogen deficiency in soils in India and adequate nitrogen fertilizer is the key for HYV rice and wheat. Dey *et al.* (2017) reported that 90 per cent of Indian soils are low in phosphorus, while Khera *et al.* (1990) observed that the one-fifth of the Indian districts fall under the low-potash category in India. Motsara (2006) observed that there is a positive correlation between the applications of NPK balanced fertilization and crop yield. Generally, soil is deficient not only in NPK, but also it has inadequate secondary nutrients like sulphur, calcium and magnesium and micro nutrients like zinc, copper and iron in most of the Indian states. Tandon (2007) has stressed upon the need for the need for a nutrient balance sheet for soils. The deficiency of soil varies from one region to another.

Tamil Nadu Agricultural University (EARD-TN, 2014) has estimated deficiency in micronutrients in soil test samples in selected villages during 2006-14. They collected 32,151 samples from different blocks covering 19 districts in Tamil Nadu namely, Thiruvannamalai, Coimbatore, Theni, Thirunelveli, Virudhunagar, Nagapattinam Cuddalore, Vilupuram, Krishnagiri, Kanyakumari, Thoothukudi, Ramanathapuram, Sivagangi, Namakkal, Madurai, Pudukottai, Salem, Vellore and Erode districts. The average zinc deficiency slightly increased from 56.5 per cent to 63 per cent, copper deficiency increased from 5.4 per cent to 30 per cent and boron deficiency from 8 per cent to 19 per cent and sulphur deficiency from 3.5 to 10 per cent over the period. D'Arcy and Frost (2001) indicated that 36 per cent of the farmers who have conducted their soil tests are willing to apply fertilizers based on recommendations, but are not convinced of the benefits from applied fertilizer. The results of the soil tests conducted by Tamil Nadu Agricultural University have revealed that fertilizers used based on soil tests and as recommended as increased soil fertility and crop production.

The objective of this paper is to examine the level of adoption and constraints in the application of recommended doses of fertilizers based on soil test reports by the farmers in Tamil Nadu.

MATERIALS AND METHODS

Primary data were collected from two districts namely Thiruvannamalai and Thanjavur of Tamil Nadu. In each of the two districts, two representative blocks namely, Cheyyar, Kalasapakkam in Thiruvannamalai district and Thanjavur and Orrathanadu in Thanjavur district were taken for the study. In each district, 120 farmers (60 in each block) from

the list of soil tested farmers were drawn at purposive farmers from households with different land sizes. In addition, 60 control (non-soil tested) farmers (30 in each block) were selected in each purposive farmers from households amongst general rice and groundnut growing cultivators.

Sample distribution of Thiruvannamalai and Thanjavur Districts of Tamil Nadu is presented in Table 2. For the primary survey, the reference year is 2013-14. Accordingly, *kharif*, *rabi* and summer seasons for the rice and groundnut crops were covered. From each village, 15 and 7 sample farmers were selected based on the soil tested farmers and the control farmer's basis, respectively based on the official list in a particular village. The list of farmers who got their soil tested were collected from the State Department of Agriculture for the year 2012-13 to assess the adoption of recommended doses of fertilizers.

RESULTS AND DISCUSSION

Level of adoption of soil test and constraints Distance to soil testing laboratory and cost of soil analysis: The sample distribution of soil tested farmers for paddy crop is shown in Table 3. The average cost incurred for soil test by the farmers is Rs. 21. The farmers have to travel 33.4-36.7 km (mean 35.5) to reach a soil testing laboratory, which is fairly long. In Thanjavur district, soil test laboratory is located near Aduthurai. In Thiruvannamalai district, the laboratory is located in Thiruvannamalai town. Mobile soil test laboratories are also available in the district. They cover a distance of 80-100 km. The soil testing process is not an easy task; In

Table 1: Variation in the amount of fertilizer in different states in India (kg/ha).

States	Fertilizers	States	Fertilizers
Punjab	250.2	Jharkhand	158.2
Bihar	212.2	Uttarahand	130.4
Haryana	207.6	Meghalaya	14.4
Andhra Pradesh	189.3	Mizoram	13.2
Uttar Pradesh	183.2	Nagaland	4.8
Tamil Nadu	164.6	Arunachal Pradesh	2.05
West Bengal	163.2		

Source: Directorate of Agriculture, Government of India, New Delhi.

Table 2: Sample distribution of Thiruvannamalai and Thanjavur districts of Tamil Nadu.

Block level	Soil tested farmers	Control farmers	Total farmers
Thiruvannamalai district			
Cheyyar	60	30	90
Kalasapakkam	60	30	90
Thanjavur district			
Thanjavur	60	30	90
Orathanadu	60	30	90
Total sample size	240	120	360

Source: Primary survey data.

addition since limited facilities are available in the laboratory, only a few soil samples are analyzed. The soil tested farmers travel from Vembakkam and Mamandur to Thiruvannamalai where the laboratory is located and the average distance is about 80-100 km; the cost of transport incurred by the farmers is Rs. 500. Thus getting a soil tested is a Herculean task.

Area covered in soil sampling

The large and the medium farmers covered an area of 17.17 acres and 7.87 acres respectively. The marginal farmers covered an area of 1.56 acres. The mean area covered for soil testing by a farmer is 7.6 acres reported in Table 4.

Reasons for adopting soil testing

The farmers have been using fertilizers continuously for getting more yield for the past four decades. As a consequence, the fertility of the soil has deteriorated resulting in low yields. Also the farmers are convinced that indiscriminate and imbalanced use of fertilizers results in determination of the natural resources like soil and water. Therefore, the farmers have changed their attitude and would like to avail advice on soil test. Data on their response to various factors leading to the need of soil testing are reported in Table 5.

Table 3: Distance to travel for getting the soil tested by paddy (rice) farmers in Tamil Nadu.

Particulars	Marginal	Small	Medium	Large	Total
Percentage of farmers tested their soil in last three years	23	47	25	5	100
Average cost of soil testing (Rs/sample)	20.6	20.7	20.7	20.8	20.7
Average distance from field to soil testing lab (KMs)	35.9	33.4	35.9	36.7	35.5
Average number of soil samples taken per plot	4.87	5.36	4.86	4.46	4.90
Average no. of plots considered for soil testing	1.45	1.40	1.48	1.52	1.50
Average area covered under soil test (Acre)	1.56	3.94	7.87	17.17	7.60

Table 4: Area covered by a soil test by different range of groundnut farmers in Tamil Nadu.

Particulars	Marginal	Small	Medium	Large	Total
Percentage of farmers tested their soil in the last three years	38	46	14	2	100
Average cost of soil testing (Rs/Sample)	20.0	21.1	20.3	22.5	21.0
Average distance from field to soil testing lab (KMs)	33.6	32.0	32.7	37.0	33.8
Average number of soil samples taken per plot	5.42	5.8	5.7	4.6	5.4
Average no. of plots considered for soil testing	1.4	1.3	1.3	1.5	1.4
Average area covered under soil test (Acre)	1.65	4.03	6.83	14.0	6.63
Percent of soil sample collected by the dept. officials	100	100	100	100	100

Source: Primary survey data.

Table 5: Response of farmers to various factors leading to soil testing.

Reasons for adopting soil testing	Paddy crop				Ground nut crop			
	Most important	Important	Least important	Total	Most important	Important	Least important	Total
For availing benefits under subsidy schemes	5.0	12.0	-	17.0	4.0	14.0	-	18.0
For increasing crop yield	13.0	52.0	-	65.0	11.0	58.0	-	69.0
Motivation from demonstration/training/ exposure visits to places with best farming		5.0	-	5.0	-	4.0	-	4.0
Peer farmers' group pressure		8.0		8.0		3.0		3.0
Adopt new tech. practices		5.0		5.0	1.0	5.0		6.0

Source: Primary survey data.

Table 6: Reasons for not adopting soil testing.

Reasons for not adopting soil testing	Paddy crop				Ground nut crop			
	Most important	Important	Least important	Total	Most important	Important	Least important	Total
Do not know how to take soil samples	20.0	27.0	-	47.0	-	34.0	-	34.0
Do not know whom to contact for details on testing	-	45.0	-	45.0	-	39.0	-	39.0
Soil testing laboratories are located far away	-	8.0	-	8.0	-	27.0	-	27.0

Source: Primary survey data.

Fifty two per cent of the paddy growing farmers and 58 percent of the groundnut growing expressed their view that the soil test has an important role in increasing crop yield. The main intention of the soil test for a majority of the farmers in the paddy crop is increasing crop yield. Twelve percent of the paddy farmers and 14 per cent of the groundnut farmers said that the soil test was useful and important for availing benefits under subsidy scheme. A majority of the farmers in the study area looked at soil testing as important.

Reasons for not adopting soil testing

The majority of the farmers in rural areas are partially ignorant about the soil testing scheme, as they are illiterate about the government schemes relating to agricultural sector. A majority of the farmers have uneconomic holdings and are engaged in farming without any institutional and government support. A majority of the farmers perceived that such a scheme would benefit only large and rich farmers.

Reasons for not adopting soil testing is given in Table 6. Nearly half of the paddy cultivators informed that they did not how to take soil samples from their farm land, whereas, many others reported that they did not know whom to approach in this regard. A few farmers (8 per cent) felt that soil testing laboratories were located far away from their farms.

One-third of the control farmers among groundnut cultivators did not know how to take soil samples and more than

one-third of them (39 per cent) did not know whom to contact for details on testing. 27 per cent of them expressed the view that soil testing laboratories were far away from their farms.

In rural areas, the farmers did not know much about the soil test. For instance, they do not know about location of the laboratory, officials involved with it and how to take soil samples from the farm land. The soil testing laboratories are located far away from their farms. These are the major reasons cited for non-participation in the soil test process. No one seems to be guiding the farmers for conducting the soil test in the village in a proper manner.

The negative attitude of the farmer's mindset in the rural areas could be another reason. The adverse weather conditions restricted them to follow traditional farming methods instead of experimenting with new methods of cultivation. Unawareness was also a reason for non-adoption of recommended doses of fertilizer on the basis of soil tests.

Status of soil health of the soil samples tested

About 45 per cent of the paddy cultivating farmers reported that their soil health status was low in the case of nitrogen components (Table 7), while 34 per cent of the farmers said it was medium. Only 10 per cent reported that the soil status was at normal level with regard to nitrogen. Among the paddy cultivating sample tested farmers, 42 per cent reported that the nitrogen content of their soil was high. In the case of phosphorus, 37 per cent reported that it was medium and 9 per cent indicated low soil status in the study area. It implies that phosphorus level is higher in paddy farms. Nearly half of the paddy growing farmers said that their soil had high potassium content and one-third of them reported that their soil had medium level of potassium. Only 6 per cent of farmers reported that there was normal level of potassium in their soil. High content of phosphorus and potassium is recorded in the soil health status cards among the paddy growing farmers and 45 percent of them said nitrogen content in the soil was low. Only a few cards reported that the soil status was normal in the case of NPK.

Table 7: Status of NPK in soils tested on the farmers' field in the present study.

Crop/ Nutrient	Normal	High	Medium	Low
Paddy				
Nitrogen	10.0	11.0	34.0	45.0
Phosphorus	9.0	42.0	37.0	12.0
Potassium	6.0	48.0	31.0	15.0
Groundnut				
Nitrogen	13.0	28.0	29.0	30.0
Phosphorus	28.0	37.0	23.0	12.0
Potassium	5.0	65.0	17.0	13.0

Source: Primary survey data.

Table 8: Average quantity (Kg/Acre) of fertilizers recommended at different growth stages of crops by soil testing.

Particulars	Basal application	After inter-cultivation	Vegetative growth	Flowering	Grain formation	Total
Paddy						
Urea	41.02	29.58	28.78	27.60	27.28	150
DAP	50.12	23.45	-	-	-	75
SSP	-	-	-	-	-	-
Potash	43.18	30.39	33.68	34.56	-	142
Groundnut						
Urea	24.05	34.80	38.16	27.78	-	125
DAP	50.32	-	-	-	-	50
SSP	-	-	51.85	-	-	52
Potash	44.01	32.66	33.71	35.16	-	146
Gypsum	-	-	52.20	50.80	-	103

Source: Primary Survey Data.

About 30 per cent and 29 per cent of groundnut cultivators reported that the soil status was low and medium, respectively in the case of nitrogen. Only 13 per cent reported that it was normal. 37 per cent of cultivators said that there was high level of phosphorus component in their soil. About 28 per cent of farmers expressed that it was normal. About 12 per cent of farmers indicated that phosphorous was at low level. 65 per cent of groundnut cultivators reported that there was high level of potassium in their soil in the study area. Only 5 per cent of farmers expressed the view their soil status was normal with regard to potassium component.

Recommended doses of fertilizers on soil test basis

Recommended doses of fertilizer recommended on the basis of fertilizers at different growth stages of crops is given in Table 8.

The average quantity of total and split doses of fertilizers recommended by stage of crop growth by soil test farmers is presented in Table 8. Generally soil tested farmers adopt split doses of fertilizers; basal application, after inter-cultivation, vegetative growth, flowering and grain formation. For the paddy cultivators, split doses of urea recommended are 29.6 kg/acre, 29.8 kg/acre, 27.6 kg/acre and 27.3 kg/acre for basal application, inter-cultivation, vegetative growth and flowering stages, respectively. The government officials recommended doses DAP of 52.12 kg/acre for basal application of paddy crop. The average dose of potash recommended is 43.2 kg/acre, 30.4 kg/acre, 33.7 kg/acre and 34.6 kg/acre for basal to flowering stages, respectively. During basal application, they applied large quantities of urea and potash. For the remaining three stages, the officials recommended more or less same quantity of urea and potash for the paddy crop.

For the groundnut crop, the officials recommended 24.1 kg/acre, 34.8 kg/acre, 38.2 kg/acre and 27.8 kg/acre of urea from the first stage to the fourth stage. The Government officials recommended 50.3 kg/acre of DAP for basal application and 51.9 kg/acre of SSP during vegetative growth stage. Split doses of potash recommended per acre are 44 kg/acre, 32.7 kg/acre, 33.7 kg/acre and 35.2 kg/acre from basal application to flowering. Gypsum doses recommended for vegetative growth and flowering stage are 52.2 kg/acre and 50.8 kg/acre.

The split dose of urea recommended by the officials for paddy crop is larger in quantity than for the groundnut crop during basal application. The average quantity of split dose of urea recommended for groundnut crop per acre is larger than the doses for paddy during inter-cultivation, vegetative growth and flowering stage. The average doses of DAP recommended are more or less the same for both categories of farmers. The dose of potash recommended is larger for groundnut than the paddy crop during basal application. The doses of potash recommended for groundnut crop is larger in quantity than for paddy during inter-cultivation to flowering stage.

CONCLUSION

Nearly three-fourths (72 per cent) of the farmers getting their soils tested in the present study belonged to the small (47 per cent) and medium (25 per cent) categories of landholdings. All farmers have to travel long distance for soil test incurring sizable transportation cost. Generally, in Thanjavur district, soil test farmers have been travelling long distance from their farm to Aduthurai, where the soil test laboratory is located at a distance of 50-60 kms. There is no soil test laboratory in Thiruvannamalai district, hence, the farmers have to travel to the neighbouring district of Trichirapalli. The soil tested farmers travel from Vembakkam and Mamandur to Thiruvannamalai where the laboratory is located and the average distance is about 80-100 km.

The Agricultural Department of the Government of Tamil Nadu gives valuable information about the soil test uses and how to collect the sample soil from the field. But, still a majority farmers could not be informed about the purpose of soil tests. Some of them in the village are not interested to get information about soil tests. Only educated and knowledgeable farmers use this kind of information.

Nearly half of the paddy farmers and nearly, two-thirds of the groundnut growers expressed the view that the soil test has an important role in increasing crop yield.

Almost half of the paddy farmers and one-third of the groundnut farmers did not how to take a soil sample from their farm land, whereas, another half of paddy farmers and one-third of groundnut growers reported that they did not know whom to approach in this regard. These are the major reasons cited for non-participation in the soil test process. No one seems to be guiding the farmers for conducting the soil test in the village in a proper manner. Among the paddy farmers, nearly half of them said that the nitrogen content in the soil was at a low level and only a few cards reported that the soil status was normal for NPK. Only a small proportion of paddy farmers followed recommended doses of fertilizers. The doses of fertilizers used can be accessed through soil health card alone and not through the doses of fertilizers used by the farmers. They perceive that whenever they used more fertilizers, they got more production and they did not pay much attention to the soil fertility, which is essential for sustainable production.

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