NUTRIENT MANAGEMENT PLAN FOR SOILS OF PALAKKAD

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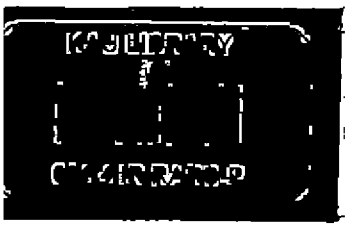

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PREFACE

Agricultural production system in Kerala is passing through a phase of crisis. Escalation in the cost of cultivation, sky rocketing price of land, large scale conversion of rice lands, poor returns from the farming and the like had led the food production scenario in the state to a near collapse. Any meaningful intervention to arrest this should be through administrative as well as technological interventions. Under the Rashtriya Sam Vikas Yojana implemented in Palakkad district using the assistance from central government, management aspects of soil nutrient resources for improving productivity and sustainability of crop production was taken up as an important programme. Soil resource characterisation and soil test based nutrient management recommendations have been generated for 42 selected panchayaths in the district. The National Bureau of Soil Survey and Land Use Planning, Bangalore and Kerala State Soil Survey Organisation and Kerala Agricultural University had worked together to complete the task..

Productivity and profitability of crop enterprises can be enhanced by adopting site specific nutrient management. I hope that this bulletin on nutrient management plan for soils of Palakkad would serve as a guide for farmers, extension workers and researchers.

K.R. VISWAMBHARAN
Vice Chancellor

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Authors

CONTENTS

1. Introduction

A sound resource management strategy is fundamental to ensure sustainability of agricultural production. Soil as a resource is the key determinant that has to be managed in a scientific manner in order to keep it sustainable. Rational use of soil resources, based on its potential is essential for an economically viable and ecologically sound agriculture. Input management decisions at macro and micro level should be based on scientifically evolved database on soil resources so as to make it effective.

Addressing the problems in the agricultural production sector and livelihood opportunities of rural poor formed the basic strategy of the development plan under the *Rashtriya Sam Vikas Yojana* of the Government of India. Palakkad district was included under this programme. Rice being the important food crop grown in the district, programmes were chalked out to improve the productivity of rice and sustainability of rice cultivation system.

Effective interventions in soil resource management and utilisation for augmenting production through scientific resource use were proposed under the project on "Soil Fertility Mapping and Nutrient Management Plan for Rice Soils of Palakkad". This formed a part of the comprehensive project on "Detailed Land Resource Inventory for Precision Agriculture in part of Palakkad District with special Reference to Rice Cultivation and Nutrient Management Plan". The project objective was to give guidance on nutrient management based on authentic soil fertility data. This project envisaged generation of soil fertility data base and their interpretations for the major rice-growing tracts of Palakkad district with a view to assist farmers, planners and research workers.

Participating Institutions

1. National Bureau of Soil Survey and Land Use Planning (ICAR), Regional Centre, Bangalore

2. Kerala State Soil Survey Organisation, Department of Agriculture Government of Kerala

3. Regional Agricultural Research Station (KAU), Pattambi, Palakkad, Kerala

Objectives

1. Analysis of surface soil samples from 42 selected Panchayaths of Palakkad district for plant available macro and micro nutrients and related soil properties.

2. Adaptive trials for validation of recommendations

3. Preparation of soil fertility maps and fertility indices.

4. Development of regional fertilizer recommendations for rice in Palakkad district using the soil fertility data generated under the program.

2. METHODOLOGY

2.1 Selection of Area

Extent of rice cultivation was used as one of the criteria for selection of area under the project. Representative areas from three major agro ecological zones in the district were also included. Thus 42 Panchayaths having more than 25% geographical area under rice representing three agro ecological zones in the district were selected for sampling. Details are provided in Table 1.

2.2 Soil sampling

Detailed soil survey and surface soil sample collection were carried out by NBSS & LUP in 12 Panchayaths and by KSSO in the remaining 30 Panchayaths. Surface soil Samples were collected from plots under each survey number. Collected samples were handed over by these agencies to RARS, Pattambi for processing and estimation of available nutrients.

Table 1. Region wise grouping of panchayaths and details of soil sampling

1. a. Eastern Agro ecological zone

Sl. No	Name of Panchayath	Total geographical area (ha)	No.of samples analysed
1	Kozhinjampara	4384	1464
2	Pattanchery	3030	1099
3	Vadakarapathy	4951	1721
4	Muthalamada	7460	1720
5	Elappulli –Para	4907	2124
6	Polpully	1996	880
7	Chittur- Thathamangalam	1600	1247
8	Eruthempathy	3693	800
9	Nalleppilly	3987	1634
10	Perumatty	6079	2280

1. b. Central Agro ecological region

Sl.	Name of Panchayath	Total geographical area (ha)	No. of samples analysed
1	Kuthanur	3583	1472
2	Kuzhalmannam	3062	1421
3	Vadavanur	1738	718
4	Kottayi	1996	1278
5	Peruvamba	2049	841
6	Pudunagaram	924	464
7	Alathur	1962	1350
8	Erimayur	1047	2128
9	Kavasseri	3046	1775
10	Pudukode	1629	806
11	Vadakkanchery	3778	1430
12	Tarur	3427	1305
13	Kannambra	2972	1343

14	Kollengode	4149	797
15	Koduvayur	2061	1206
16	Mathur	2554	1422
17	Peringottukurissi	3145	1211
18	Thenkurissi	2992	1438
19	Kannadi	1980	1536
20	Puthupariyaram	2958	521
21	Marutharode	1968	717
22	Ayilur	4094	1963
23	Melarkode	2552	1173
24	Elavanchery	3218	999
25	Nemmara	3684	2376
26	Pallassana	2933	1446
27	Pirayiri	1750	815

1. c. Western Agro ecological region

Sl. No	Name of Panchayath	Total geographical area (Ha)	No.of samples analysed
1	Thirumittakkode	3231	1201
2	Chalavara	2790	803
3	Pookkottukavu	2021	533
4	Cherpulasseri	2460	622
5	Sreekrishnapuram	2956	982

2.3 Processing of samples

The surface samples were air-dried; clods were crushed using wooden pestle and mortar and sieved through 2 mm sieve. Plant residues, gravel and other foreign matter retained on the sieve were discarded. For certain type of analysis (e.g. organic carbon) it was necessary to grind the soil further so as to pass it through sieves of finer mesh size (0.5 mm).

From each sample weighed sub-samples were drawn for analysis of individual nutrients. 10g sub-samples were used for estimation

of pH and Electrical Conductivity. For estimation of available Phosphorus and Potassium, separate 5g sub-samples were drawn. Based on the pH, 2 or 10 g sub-samples were used for micronutrient analysis (2 g for acidic soils and 10 g for neutral-alkaline soils). For organic carbon estimation, 1 g of sample sieved through 0.5 mm sieve was used. 53,000 samples were analysed through more than 5,30,000 estimations on pH, Electrical conductivity (EC), Organic carbon (OC), available Phosphorus (P), available Potassium (K), and available micro nutrients i.e. Iron (Fe), Manganese (Mn), Zinc (Zn) and Copper (Cu). Selected samples were analysed for Boron (B) and Sulphur (S).

The sample processing, sub-sampling and analysis of pH, EC and Organic carbon were done at Regional Agricultural Research Station, Pattambi. Analysis of P, K, and micro nutrients were completed at Radiotracer Laboratory, College of Horticulture, Vellanikkara.

2.4 Laboratory Analysis

Estimation of pH and Electrical Conductivity

The pH of soil provides an indication of nature of soil reaction and nutrient availability. The Electrical Conductivity (EC) indicates total salt concentration and hence indicates problems due to salinity. Depending on the soil pH, reclamation measures can be recommended to ensure ideal soil environment for optimum crop growth.

Soil pH was measured in a soil water suspension of 1: 2.5 ratio using pH meter.

The EC of soil was measured in a soil water suspension in the ratio of 1:2.5 using a conductivity meter.

Estimation of organic carbon in soil

Organic carbon was estimated by oxidation of soil by acidified Potassium dichromate and by back titrating the excess un-reacted dichromate using Ferrous ammonium sulphate as detailed in the method proposed by Walkley and Black (Walkley, 1947).

Estimation of available phosphorus

Available P in acid soil was extracted by Bray No.1 (0.03 N

NH_4F and 0.025 N HCl) (Bray and Kurtz, 1945) and estimated by reduced molybdate blue colour method (Watanabe and Olsen, 1965).

In alkaline soil available P was extracted using Olsen's reagent (0.5 M $NaHCO_3$) (Olsen et al 1954) and estimated by reduced molybdate blue colour method.

Estimation of available potassium

Exchangeable plus water soluble K contributes to the plant available pool of potassium in the soil. Available potassium was extracted using neutral normal ammonium acetate solution (CH_3COONH_4) and estimated using Flame photometer.

Estimation of iron, manganese, zinc and copper

In acid soils, plant available Fe, Cu, Mn and Zn were extracted using 0.1 M HCl (Sims and Johnson, 1991). In alkaline soils DTPA extractant comprising 0.005 M DTPA and 0.01 M $CaCl_2.2H_2O$, buffered at pH 7.3 by 0.1 M triethanolamine (TEA) (Lindsay and Norvell, 1978) was used. Estimations were made using atomic absorption spectrophotometry.

2.5 Data presentation

The data generated through chemical analysis was tabulated and organised as a spreadsheet. From the primary data on these parameters, fertility ratings (low, medium and high) and recommendations based on these ratings, nutrient index values (NIV), classification of soils based on pH etc have been derived. Panchayath wise fertility maps have been generated by overlay of the spread sheets with spatial (map) data for the panchayath using a GIS by NBSS and LUP, Bangalore.

2.6 Criteria used for soil fertility evaluation

The soils have been categorised into low, medium and high fertility classes with respect to major nutrients (N, P and K) and as deficient and adequate pertaining to micronutrients status. Based on the pH, the soils have been grouped into 11 classes ranging from ultra acid to very strongly alkaline.

(1) Available Nitrogen

Low	< 0.76% Organic Carbon
Medium	0.76-1.50% OC
High	>1.50% OC

(2) Available P

Low	< 10.0 kg P/ha
Medium	10.0 – 24.0 kg P/ha
High	> 24.0 kg P/ha

(3) Available K

Low	< 115 kg K/ha
Medium	115 – 275 kg K/ha
High	> 275 kg K/ha
Zn – HCl (for acid soils)	< 1.00 ppm Deficient
	> 1.00 ppm Adequate
Zn – DTPA (for neutral	< 0.61 ppm Deficient
to alkaline soils)	> 0.60 ppm Adequate
Cu – HCl (for acid soils)	< 1.00 ppm Deficient
	> 1.00 ppm Adequate
Cu – DTPA (for neutral	< 0.12 ppm Deficient
to alkaline soils)	> 0.12 ppm Adequate

(4) pH

1.	Ultra Acid	–	< 3.5
2.	Extremely acid	–	3.5-4.4
3.	Very strongly acid	–	4.5-5.0
4.	strongly acid	–	5.1-5.5
5.	5.6-6.0	–	Moderately acid
6.	6.1-6.5	–	Slightly acid
7.	6.6-7.3	–	Neutral
8.	7.4-7.8	–	Slightly alkaline
9.	7.9-8.4	–	Moderately alkaline
10.	8.5-9.0	–	Strongly alkaline
11.	> 9.0	–	Very strongly alkaline

Regional nutrient management recommendations have been generated after regrouping these classes as 1. Extremely acidic group (pH <3.5 to 5.0), Acidic group (pH 5.1 to 6.5) and Near neutral to alkaline group (pH >6.5).

(5) Soil fertility indices (Nutrient index value)

Based on the fertility ratings, Nutrient Index Value (NIV) with respect to all the major nutrients (N, P and K) was calculated for soils of each Panchayath. NIV indicates overall fertility status of the soils.

Nutrient Index Value was calculated as

$$NIV = \frac{Nl + 2Nm + 3Nh}{Nl + Nm + Nh}$$

where, Nl is the number of samples coming under low fertility class
Nm is the number of samples coming under medium fertility class
Nh is the number of samples coming under high fertility class

Based on the NIV calculated, soils nutrient status was classified as High, Medium or Low

NIV > 2.50 – High

NIV 1.5 – 2.5 – Medium

NIV< 1.5 – Low

In the case of micronutrients, the range between sufficiency and deficiency level is very narrow and soils have been categorised either as deficient or sufficient.

For the agro ecological regions, NIV have been arrived considering the nutrient status of the soils coming under each region together.

2.7 Formulation of Recommendations

Based on the data generated, nutrient management recommendations for each land parcel of agro ecological region have been formulated as detailed below.

(1) Lime requirement

Lime requirement based on pH level of the soil

Lime (t of $CaCO_3$ per ha) = Ä pH x 0.3375

(Where, Ä pH = Desired pH level (6.5) – Measured pH of the soil)

(2) Major Nutrients N, P and K

Recommendations for nutrient supplements with major nutrients have been arrived as indicated in Table 2

Table 2. Recommendations for Major Nutrients N, P and K

Range of Nutrient Levels in the soil

Soil fertility class	% of organic carbon	Available P ($kg\ ha^{-1}$)	Available K ($kg\ ha^{-1}$)	Recommendation as % of general recommendations
Low	0.00 – 0.76	0.00 – 10	0 – 115	125
Medium	0.76 – 1.5	10 – 24	115 – 275	100
High	> 1.5	> 24	> 275	75

(3) Recommendations for Micronutrients

1. Deficiency of Zn: Application of Zinc sulphate @ 20 kg per hectare. Application of 3 kg $ZnSO_4$ dissolved in 187 litres of water per hectare as foliar spray 20-25 days after planting (as 1.65% $ZnSO_4$ solution to give 0.7 kg Zn/ha) can be adopted for rice

2. Deficiency of Cu: Use recommended quantities of organic manure. Seedling dip in 1% copper sulphate solution can be adopted for rice.

2.8 Validation of soil test results – Adaptive trials

Field evaluation studies were conducted to generate information on the impact of soil test based nutrient management in rice yield and to demonstrate it to the farmers. Preliminary trials were taken up during 2005-06 first crop season (June – September). Experiment plots were selected in each of the following rice growing tracts under different agro climatic zones.

1. Eastern Zone (Near neutral/Slightly alkaline soils)
2. Central zone (Acid loams)
3. Western zone (Acid laterite soils)

The nutrient management treatments were selected based on the analysis of soil samples collected from the selected padasekharam. Field trials were taken up in ten locations during second crop season 2005-06. The following treatments were included

T1: 90:45:45 kg NPK /ha

T2 : Soil test based application of NPK fertilisers - 2% $ZnSO_4$ as foliar spray

T3 : T2 with double dose of potassium + silica @200kg/ha

T4 : T2 + silica @200kg/ha

T5 : Farmers Practice (details in Table 3)

Note: Organic manure @ 5t/ha used in treatments T1 to T4. Lime applied as per requirements in acidic soils. Powdered silica or sodium silicate was used as an ameliorant to reduce toxic effects of iron.

Out of the ten locations two locations came under western agro ecological zone (Thirumittakode and Chalavara), six under central zone (Ayilur, Peruvemba, Elavacherry, Kavasseri, Koyalmannam and Kottayi) and two under eastern zone (Nallepilly and Kozhinjampara).

Table 3. Soil test based recommendations for major nutrients for the selected padasekharams in different Panchayaths

Name of panchayath	Soil test based recommendation for NPK	Farmers practice	
		NPK	FYM
Thirumittakode	75:37:43 kg/ha	57:17:41 kg/ha	3t/ha
Chalavara	96:46:54 „	40:40:45 „	2t/ha
Ayilur	93:27:40 „	89:29:40 „	3t/ha
Peruvemba	92:30:39 „	181:92:75 „	3t/ha
Elavanchery	94:37:57 „	71:22:47 „	3t/ha
Kavassery	98:45:45 „	115:58:29 „	3.5t/ha
Koyalmannam	90:45:57 „	87:41:43 „	3t/ha
Kottayi	99:45:57 „	89:36:50 „	2.5t/ha
Kozhinjampara	85:52:52 „	137:50:61 „	4t/ha
Nalleppilly	85:51:54 „	154:46:86 „	4t/ha

3. RESULTS AND INTERPRETATION

1. Soil Fertility Information

a. Agro-ecologic region level Information

Major agricultural tracts in the district come under three agro ecological zones, *viz.* the Eastern semi arid tracts with low rainfall, Western per humid tropical with high rainfall and Central region with moderate rainfall. Soil sampling and analysis was performed in ten panchayaths under eastern zone, 27 panchayaths under central zone and five panchayaths under western zone.

Soil samples analysed from each zone was grouped based on soil reaction into three groups (Table 4). More than 50 % of the samples analysed from eastern region came under near neutral to alkaline range. In these tracts management practices especially liming, for modifying soil reaction, is not required.

In the central region, almost 90% of the samples were acidic/ extremely acidic in reaction. In the western region 95% of the samples were acidic with 31% coming under extremely acidic group. In these two regions liming is essential to manage soil reaction.

Table 4. Percentage of soil samples under different groups based as soil reaction

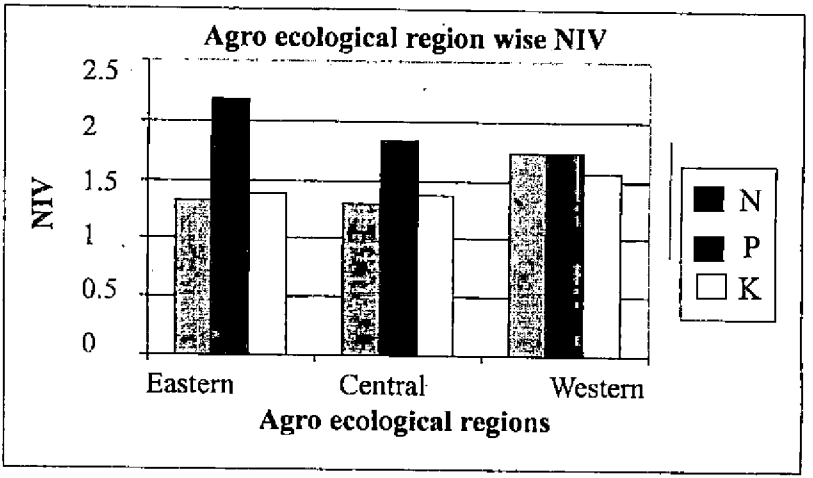
Sl. No	Name of Agro ecologic region	Group I Extremely acidic	Group II Acidic	Group II Neutral alkaline
1	Eastern	2.44	46.02	51.53
2	Central	23.55	67.16	9.29
3	Western	30.96	64.86	4.18

Regional recommendations for nutrient management have been arrived based on the NIV calculated considering analytical results of all the samples collected from the region together. The NIVs for three agro-ecologic regions are shown in Table 5.

Table 5. Soil fertility indices for agro-climatic regions

Name of Agro-ecologic region	Nutrient Index Value			% deficiency	
	N	P	K	Zn	Cu
Eastern	1.32 (L)	2.18 (M)	1.39 (L)	52% deficient	14% deficient
Central	1.31 (L)	1.85 (M)	1.37 (L)	33% deficient	10% deficient
Western	1.75 (M)	1.75 (M)	1.57 (M)	27% deficient	7 % deficient

L: Low, M: Medium, H: High



Soils in the Eastern and Central regions are low in organic carbon status indicating poor nitrogen levels. In these regions application of organic manures @ 5t per hectare and nitrogen supplement @

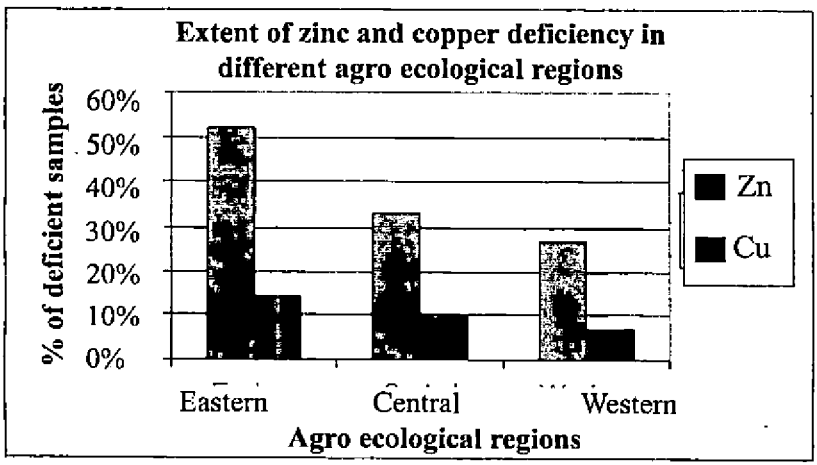
125% of the recommended dose have to be adopted. (Recommended dose for N is 90 kg/ha for high yielding medium duration varieties and 70 kg/ha for high yielding short duration varieties of rice).

In the Western region, soils have medium organic carbon status and the recommended doses of nitrogen will be sufficient. Organic manures @ 5t per hectare should be applied.

Available phosphorus status is medium in all the regions. Recommended doses of phosphorus can be applied for crops in all regions. In the case of rice, recommended levels of 45 kg P per hectare for high yielding medium duration varieties and 35 kg P per hectare for high yielding short duration varieties is sufficient. In Western region where the soil is extremely acidic, rock phosphate can be recommended for upland crops.

Low levels of potassium are indicated in all regions. Supplementary nutrition by providing 125% of the recommended dose of potassium has to be adopted in all regions.

Zinc deficiency is widespread in all the zones. 52% of the samples from eastern region, 33% from central and 27% from western region indicated deficiency of zinc. Foliar spray with 1.65% $ZnSO_4$ solution to give 0.7 kg Zn/ha (3 kg $ZnSO_4$ dissolved in 187litres of water per ha) is recommended for rice. Application of zinc sulphate can be recommended for other crops.



Deficiency of copper is also indicated in some regions. Application of sufficient quantities of organic manures can take care of this. Seedling dip in 1% $CuSO_4$ solution can be recommended for rice, before transplanting.

Sulphur deficiency is indicated in the eastern zone. Sulphur containing fertilizers like ammonium sulphate, Ammonium phosphate sulphate etc can be used to correct sulphur deficiency.

Boron deficiency is common in all the zones but to a lesser extent. Less than 10% of the samples analysed indicated deficiency. Borax @ 18kg per hectare to supply boron @ 2 kg per ha can be applied as corrective measure.

b. Panchayath level soil information

Grouping of soil samples according to soil reaction in different Panchayaths is indicated in Table 6.

Table 6. Percentage samples under different pH ranges

Name of Panchayath	Extremely acidic	Acidic	Neutral to alkaline
Eastern region			
Kozhinjampara	0.34	20.14	79.51
Pattanchery	6.46	68.62	24.93
Vadakarapathy	0.47	27.95	71.59
Muthalamada	5.64	53.21	41.17
Elappulli -Para	0.66	34.94	64.41
Polpully	4.32	30.11	65.56
Chittur-Thathamangalam	3.45	83.73	12.83
Eruthempathy	0	18	82.01
Nalleppilly	2.2	55.2	42.59
Perumatty	2.37	59.08	38.55

Central region			
Kuthanur	32.41	66.31	1.29
Kuzhalmannam	25.41	74.58	0
Vadavanur	1.11	61.57	37.32
Kottayi	40.23	58.61	1.17
Peruvamba	1.19	92.03	6.78
Pudunagaram	0.22	56.68	43
Alathur	13.78	70.89	15.34
Erimayur	30.64	55.79	13.58
Kavasseri	19.84	74.14	6.03
Pudukode	40.2	53.6	6.21
Vadakkanchery	36.51	63	0.49
Tarur	38.63	58.62	2.77
Kannambra	29.71	64.86	5.44
Kollengode	8.65	81.3	10.05
Koduvayur	18.25	80.6	1.16
Mathur	33.47	63.58	2.95
Peringottukurissi	16.11	77.04	6.85
Thenkurissi	25.46	62.73	11.82
Kannadi	26.17	57.89	15.97
Puthupariyaram	9.78	55.86	34.36
Marutharode	12.14	75.59	12.28
Ayilur	27.96	67.03	4.99
Melarkode	17.74	71.02	11.26
Elavanchery	18.82	71.67	9.51
Nemmara	27.44	69.4	3.16
Pallassana	14.59	74.13	11.27
Pirayiri	26.38	69.82	3.81

Western region			
Thirumittakkode	44.05	55.29	0.66
Chalavara	23.04	73.48	3.49
Pookkottukavu	30.2	68.66	1.13
Cherpulasseri	16.56	68.96	14.46
Sreekrishnapuram	74.24	25.56	0.2

Lime should be used to modify soil reaction in all panchayaths under central and western regions. Liming is required in the acid soils in Pattanchery, Muthalamada, Chittur-Thathamangalam, Nalleppilly and Perumatty panchayaths also. Quantity of lime can vary according to the pH level. Liming is not required in major parts of Vadakarapathy, Kozhinjampara, Elapully-Para, Eruthempathy and Polpully panchayaths.

Nutrient Index values and status of Zn and Cu for each panchayath are shown in Table 7.

Table 7. Soil fertility information for Panchayaths

Name of Panchayath	pH	Nutrient Index Value			% deficiency	
		N	P	K	Zn	Cu
Eastern Region						
Kozhinjampara	Near neutral to alkaline	1.24 (L)	2.39 (M)	1.22 (L)	71% deficient	30% deficient
Pattanchery	Acidic	1.29 (L)	1.96 (M)	1.11 (L)	38% deficient	5% deficient
Vadakarapathy	Near Neutral to Alkaline	1.29 (L)	2.42 (M)	1.54 (M)	49% deficient	5% deficient
Muthalamada	Acidic	1.19 (L)	1.75 (M)	1.12 (L)	77% deficient	29% deficient
Elappulli-Para	Near Neutral to Alkaline	1.14 (L)	2.06 (M)	1.28 (L)	70% deficient	8% deficient
Polpully	Near Neutral to Alkaline	1.06 (L)	2.23 (M)	1.10 (L)	73% deficient	1% deficient
Chittur-Thathamangalam	Acidic	1.26 (L)	2.49 (M)	2.08 (M)	24% deficient	5% deficient

Eruthempathy	Near Neutral to Alkaline	1.62 (M)	2.56 (H)	1.66 (M)	40% deficient	3% deficient
Nalleppilly	Acidic	1.55 (M)	1.91 (M)	1.42 (L)	36% deficient	21% deficient
Perumatty	Acidic	1.58 (M)	2.03 (M)	1.33 (L)	45% deficient	31% deficient
Central Region						
Kuthanur	Acidic	1.13 (L)	1.49 (L)	1.09 (L)	63% deficient	8% deficient
Kuzhalmannam	Acidic	1.25 (L)	2.00 (M)	1.08 (L)	51% deficient	1% deficient
Vadavanur	Acidic	1.12 (L)	1.75 (M)	1.11 (L)	35% deficient	5% deficient
Kottayi	Acidic	1.23 (L)	1.75 (M)	1.12 (L)	39% deficient	9% deficient
Peruvamba	Acidic	1.04 (L)	1.69 (M)	1.07 (L)	36% deficient	1% deficient
Pudunagaram	Acidic	1.02 (L)	2.22 (M)	1.00 (L)	25% deficient	6% deficient
Alathur	Acidic	1.31 (L)	1.86 (M)	1.31 (L)	23% deficient	3% deficient
Erimayur	Acidic	1.30 (L)	1.71 (M)	1.26 (L)	27% deficient	5% deficient
Kavasseri	Acidic	1.59 (M)	1.77 (M)	1.59 (M)	13% deficient	11% deficient
Pudukode	Acidic	1.40 (L)	1.87 (M)	1.46 (L)	19% deficient	7% deficient
Vadakkanchery	Acidic	1.20 (L)	1.42 (L)	1.20 (L)	57% deficient	22% deficient
Tarur	Acidic	1.39 (L)	1.68 (M)	1.45 (L)	17% deficient	15% deficient
Kannambra	Acidic	1.89 (M)	1.82 (M)	1.86 (M)	37% deficient	28% deficient
Kollengode	Acidic	1.54 (M)	2.22 (M)	2.03 (M)	45% deficient	38% deficient
Koduvayur	Acidic	1.38 (L)	2.01 (M)	1.58 (M)	13% deficient	5% deficient

Mathur	Acidic	1.30 (L)	1.67 (M)	1.39 (L)	46% deficient	6% deficient
Peringottukurissi	Acidic	1.44 (L)	1.86 (M)	1.52 (M)	23% deficient	7% deficient
Thenkurissi	Acidic	1.75 (M)	1.95 (M)	1.74 (M)	17% deficient	17% deficient
Kannadi	Acidic	1.13 (L)	1.49 (L)	1.09 (L)	63% deficient	8% deficient
Puthupariyaram	Acidic	1.63 (M)	2.01 (M)	1.39 (L)	10% deficient	2% deficient
Marutharode	Acidic	1.13 (L)	1.76 (M)	1.15 (L)	23% deficient	16% deficient
Ayilur	Acidic	1.31 (L)	1.95 (M)	1.63 (M)	34% deficient	8% deficient
Melarkode	Acidic	1.33 (L)	1.89 (M)	1.28 (L)	36% deficient	6% deficient
Elavanchery	Acidic	1.21 (L)	2.13 (M)	1.40 (L)	39% deficient	13% deficient
Nemmara	Acidic	1.43 (L)	1.82 (M)	1.42 (L)	50% deficient	20% deficient
Pallassana	Acidic	1.35 (L)	2.25 (M)	1.74 (M)	28% deficient	10% deficient
Pirayiri	Acidic	1.22 (L)	1.75 (M)	1.69 (M)	42% deficient	31% deficient
Western Regiom						
Thirumittakkode	Acidic	1.51 (M)	1.73 (M)	1.61 (M)	39% deficient	5% deficient
Chalavara	Acidic	1.52 (M)	1.61 (M)	1.26 (L)	38% deficient	7% deficient
Pookkottukavu	Acidic	2.04 (M)	1.52 (M)	1.61 (M)	13% deficient	6% deficient
Cherpulasseri	Acidic	1.93 (M)	2.13 (M)	1.79 (M)	18% deficient	11% deficient
Sreekrishnapuram	Extremely Acidic	1.46 (L)	2.52 (H)	1.86 (M)	17% deficient	11% deficient

Organic carbon status of soils in most of the Panchayaths is low, except for Nallepilly, Kollengode, Chalavara, Thirumittacode, Pookkottukavu and Cherpulasseri. In the Panchayaths where the organic carbon is low, organic matter in the form of Cattle manure/ FYM/Green manure should be supplied to maintain soil health as well as to meet the requirement of nitrogen. Along with the addition of organic manures at the rate of 5 t/ha, nitrogen in the form of chemical fertilizers @ 125% of the recommended dose also must be applied.

In sulphur deficient tracts nitrogen in the form of sulphur containing fertilizers like Ammonium phosphate sulphate have to be used.

Available phosphorus levels are high in Eruthempathy and Sreekrishnapuram Panchayaths, low in Kuthanur and Vadakkumchery and medium in all the remaining tracts. In Eruthempathy and Sreekrishnapuram, 75% of the recommended dose of phosphhatic fertiliser is sufficient. In Kuthanur and Vadakkenchery 125% of the recommendation is to be applied. In all the other Panchayaths the recommended dose is sufficient. In near neutral to alkaline tracts, soluble sources of phosphorus should be used. Rock phosphate can be used in acidic areas.

Potassium levels are low in 23 Panchayaths and medium in the remaining 19 Panchayaths. Supplementary nutrition @125% of the recommended dose of potassium is required in 23 Panchayaths and 100% of the recommended dose is sufficient in the remaining areas.

Level of copper in the soils is adequate in all the Panchayaths. Application of sufficient quantity of organic manures can ensure the maintenance of required levels of copper.

Zinc deficiency is seen in Vadakkenchery, Kozhinjampara, Muthalamada, Kuthanur, Koyalmannam, Elappulli – Para and Polpully Panchayaths. Application of zinc sulphate is recommended in these areas.

Boron deficiency was observed in about 10 % of the total soil samples analysed. Boron @ 2 kg per ha can be applied as Borax (18 kg Borax per ha) especially when deficiency symptoms are observed.

Eastern Region

Kozhinjampara

Soils in Kozhinjampara are near neutral or alkaline in reaction. Organic carbon levels are generally low. Phosphorus availability is medium. Potassium levels are also low. Copper deficiency is observed in 30% of the samples. Zinc deficiency widespread with 71 % of the samples indicating deficiency.

Since acidity is low, liming is not required in this tract. Organic matter in the form of green leaf manure/cattle manure/other manures @ 5t/hectare should be supplied to maintain soil health. Nitrogen in the form of chemical fertilizers @ 125% of the recommended dose is also to be used for all crops. (Recommended dose for rice is 90 kg for high yielding medium duration varieties and 70 kg for high yielding short duration varieties). Since the soil is alkaline, nitrogen in the form of ammonium sulphate or similar types is recommended instead of urea.

Phosphatic fertilisers need be applied at the recommended dose. (Recommended dose for rice 45kg/ha for high yielding medium duration varieties and 35 kg/ha for high yielding short duration varieties). Since the tract is near neutral to alkaline, soluble sources of phosphorus should be used.

Potassium fertilisers are recommended at 125% of recommended dose. (Recommended dose for rice is 45kg/ha for high yielding medium duration varieties and 35 kg/ha for high yielding short duration varieties).

Application of organic manures in sufficient quantities will ensure the maintenance of copper status. In deficient soils, seedling dip in 1% $CuSO_4$ solution can also be recommended for rice. Zinc sulphate @ 20kg per ha have to be used in deficient soils. Application of zinc as foliar spray can be recommended for rice at tillering stage (3 kg Zinc sulphate dissolved in 187 litres of water per ha).

Pattanchery

More than 75% of the soils in Pattanchery are acidic to near neutral. Organic carbon status is low. Phosphorus availability is

dium and potassium availability is low. Deficiency of copper is marginal. Zinc deficiency is noted in 38% of the samples analysed.

Liming is recommended for areas with acidic soils. Organic manures should be applied at the rate of 5 t/ha. Nitrogenous fertilizers @ 125% of the prescribed dose are also recommended.

Recommended doses of phosphate fertilisers should be applied. Soluble sources of phosphorus are recommended in neutral tracts.

Potassium fertilisers are recommended at 125% of the standard recommendation.

In areas where zinc deficiency is noted, supplementary nutrition is recommended.

Vadakarapathy

More than 90% of the soils in Vadakarapathy Panchayath fall under near neutral to alkaline category. The organic carbon status of these soils is low. Phosphorus availability is medium and potassium levels are also satisfactory. Copper deficiency is marginal with 5% samples indicating low levels. Zinc deficiency is common with 49% samples grouped as deficient.

To meet the requirement of nitrogen for better crop yields, organic manures at the rate of 5 t/ha and nitrogen fertilizers @ 125% of the prescribed rate have to be applied. Ammoniacal form of nitrogen should be preferred to urea.

To sustain the phosphorus status, the standard recommendation can be adopted. Soluble sources of phosphorus like Diammonium phosphate or Ammonium phosphate sulphate can be used in neutral tracts.

Potassium fertilisers at recommended dose have to be applied. Supplementary nutrition with zinc sulphate is also recommended.

Muthalamada

About 50% of the soils in Muthalamada are acidic in reaction. Soils are generally low in organic carbon, medium in available phosphorus and low in available potassium. Copper deficiency is seen in

29% of the samples. Zinc deficiency is widespread with 77% soil samples indicating low levels.

Liming is required in the acidic tracts. Organic manures at the rate of 5 t/ha and chemical fertilizers @ 125% of the recommended dose have to be applied.

To sustain the phosphorus status the standard recommendation can be adopted. Potassium at 125% of the recommended dose is prescribed.

Copper deficiency is seen in 29% of the area, while zinc deficiency extends to 77% of the area. Foliar application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Elappulli-para

Elapully – Para has nearly 82% near neutral to alkaline soils. Organic carbon levels are low. Phosphorus availability is medium and potassium availability is low. Copper deficiency is seen in limited number of samples but zinc deficiency is noted in 70% of the samples.

Liming is not necessary in this tract. Organic matter at 5t/ha and chemical forms of nitrogen @ 125% of the recommended dose are required. Nitrogen in ammonium form is preferable to urea.

Recommended dose phosphorus is sufficient and should be given preferably as soluble phosphorus.

Potassium @ 125% of the recommended dose has to be applied.

Foliar application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Polpully

Soils in Polpully Panchayath are neutral to alkaline in 85% of the area. Organic carbon levels are low. Phosphorus availability is medium and potassium availability is low. Copper deficiency is marginal. Zinc deficiency is widespread with 73% soils indicating deficiency.

Liming is not required. Organic matter at 5 t/ha and chemical forms of nitrogen @ 125% of the recommended dose are required. Nitrogen in ammonium form is preferable to urea.

Recommended dose phosphorus is sufficient and should be given preferably in soluble form.

Potassium @ 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Chittur-Thathamangalam

Soil reaction in majority of the area in Chittur-Thathamangalam is acidic to neutral.

The soils are low in organic carbon, medium in available phosphorus and potassium. Copper deficiency is marginal. Zinc deficiency is seen in 24 % samples.

Liming is required in the acidic tracts alone. Organic matter at 5t/ha and chemical forms of nitrogen @ 125% of the recommended dose are required. Nitrogen in ammonium form is preferable to urea.

Recommended dose phosphorus is sufficient and should be given preferably in soluble form.

Potassium has to be applied at the recommended dose.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Eruthempathy

Eruthempathy has almost 94% soils in the near neutral to alkaline range.

Organic carbon and available potassium status are medium. Availability of phosphorus is high. About 40% samples had shown zinc deficiency. Copper deficiency is marginal.

Liming is not required. Addition of organic matter @5t/ha and standard recommendations for nitrogen and potassium can be

followed. Ammoniacal forms of nitrogen should be preferred. Phosphorus need be supplied at 75% of the recommended dose preferably in soluble forms.

Foliar application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Nalleppilly

Soils in Nalleppilly are near neutral to alkaline in reaction in 77% of the area. Organic carbon and available phosphorus status are medium. Available potassium is low. Copper deficiency is seen in 21% of the samples and zinc deficiency is noted in 36% of the samples.

Liming is not required. Addition of organic matter @5t/ha and standard recommendations for nitrogen can be followed. Ammoniacal forms of nitrogen should be preferred.

Recommended dose phosphorus has to be applied. Soluble phosphorus fertilisers have to be preferred.

Potassium @ 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Perumatty

72% of the soils in this Panchayath come under near neutral to alkaline category. These soils have medium organic carbon status and available phosphorus. Potassium availability is low. Copper deficiency is seen in 31% of the samples. Zinc deficiency has been recorded 45% of the samples.

Liming is not required. Addition of organic matter @5t/ha and standard recommendations for nitrogen can be followed. Ammoniacal forms of nitrogen should be preferred.

Recommended dose phosphorus is sufficient and shall be given preferably as soluble phosphorus fertilisers.

Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Central Region

Kuthanur

Kuthanur soils are acidic. The area is poor in organic carbon, available phosphorus and potassium. Copper deficiency is marginal but zinc deficiency is widespread.

Liming is recommended (600 to 800 kg burnt lime per hectare for rice). Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Phosphate fertilisers as well as potassium fertilisers are also recommended at 125% level. Since the tract is acidic, rock phosphate can be used as the source of phosphorus.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Koyalmannam

Soils in Koyalmannam Panchayath are acidic. Organic carbon and potassium contents are low in this area. Phosphorus availability is medium. Copper deficiency is marginal. Zinc deficiency has been recorded in 51% of the samples.

Liming is recommended (600 to 800 kg burnt lime per hectare for rice). Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended.

Vadavannur

In Vadavannur 63% of the soils are acidic in reaction. Organic carbon and available potassium levels are low. Phosphorus availl

ability is medium. Copper deficiency is marginal. Zinc deficiency is seen in 35 % samples.

Liming is required @ 300-500 kg/ha. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium @ 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Kottayi

98% of the soils are acidic in reaction. Organic carbon and potassium levels are low in this area. Phosphorus availability is medium. Copper deficiency is marginal. Zinc is deficient in 39% of the samples.

Liming is required @ 700-800 kg/ha. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Peruvemba

Soils are acidic and have low organic carbon and available potassium. Phosphorus status is medium. 36% samples have indicated zinc deficiency.

Liming @ 400-600 kg/ha is recommended.

Organic manures at the rate of 5 t/ha and nitrogen fertilizers @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended.

Pudunagaram

More than 56% area in Pudunagaram panchayath has acidic soils.

Organic carbon and available potassium levels are low. Phosphorus status is medium. Copper deficiency is marginal. Zinc deficiency seen in 25% samples.

Liming @ 300-600 kg/ha is recommended in acidic tracts. Organic manures at the rate of 5 t/ha and nitrogen @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended.

Alathur

85% of the soils are acidic in Alathur. These soils have low organic carbon levels and low potassium levels. Available phosphorus status is medium. There is marginal deficiency of copper. Zinc deficiency is recorded in 23% samples.

Liming @ 300-600 kg/ha is recommended in acidic tracts. Organic manures at the rate of 5 t/ha and nitrogen @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended.

Erimayur

86% of the soils are acidic with low organic carbon, available potassium and medium phosphorus levels. Zinc deficiency is recorded in 27% of the samples.

Liming @ 300-600 kg/ha is recommended in acidic tracts. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended.

Kavasseri

Almost 94% of soils have acidic reaction. The levels of organic carbon, available phosphorus and available potassium are medium in the Panchayath. Copper and zinc deficiency is seen in few areas.

Liming @ 600-800 kg/ha is recommended. Standard recommendations can be adopted for manuring including application of organic manure @ 5t/ha.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Pudukode

Pudukode panchayath has acidic soils in 94% of the area. Nitrogen and potassium availability is low. Phosphorus availability is medium. About 19% samples have indicated zinc deficiency. Copper deficiency is marginal.

Lime application is to be adopted @ 600-800 kg/ha in Pudukode. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended.

Vadakkanchery

Soils are acidic in about 99% of the areas and more than 70% comes under the pH range of 5-6. These soils have low levels of all major nutrients. Copper deficiency is seen in 22% area and Zinc deficiency in 57% area.

Lime application @ 450-600 kg $CaCO_3$ per hectare is necessary.

Organic manures at the rate of 5 t/ha and chemical fertilizers containing nitrogen, phosphorus and potassium @ 125% of the recommended dose have to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Tarur

More than 97% samples have indicated acidic reaction. Organic carbon and available potassium levels are low. Phosphorus availability is medium. Deficiency of copper and zinc are noted in few areas.

Lime application @450-600 kg $CaCO_3$ per hectare is essential. Organic manures at the rate of 5 t/ha and nitrogen @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Kannambra

More than 90% of the soils are acidic with medium levels of organic carbon, available phosphorus and available potassium. Copper deficiency is seen in 28% samples and zinc deficiency in 37%.

Lime @ 600-800 kg $CaCO_3$ per hectare is recommended. Standard recommendations can be adopted for manuring including application of organic manure @ 5t/ha.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Kollengode

Majority of the soils in this Panchayath are acidic with medium levels of organic carbon, available phosphorus and available potassium. Copper deficiency is seen in 38% samples and zinc deficiency in45%.

Lime @ 600-800 kg $CaCO_3$ per hectare is recommended. Standard recommendations can be followed for manuring including application of organic manure @ 5t/ha.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Koduvayur

99 per cent of the area has acidic soils which are low in organic carbon. Available P and K status is medium. Copper deficiency is negligible. Zinc is low in some parts of the Panchayath.

Lime should be applied @600-800 kg/ha. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at the recommended dose also has to be applied.

Application of zinc sulphate is recommended.

Mathur

Soils are acidic in reaction. Organic carbon status is low. There is medium availability of P and low availability of K. Copper deficiency is marginal while zinc deficiency is widespread.

Lime should be applied @600-800 kg/ha. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Application of 25% additional dose of Potassium is recommended.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Peringottukurissi

93 per cent of the area has acidic soils which are low in organic carbon. Available P and K status is medium. Copper deficiency is marginal. Zinc is low in some parts of the Panchayath.

Lime should be applied @600-800 kg/ha. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at the recommended dose also has to be applied.

Foliar application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Thenkurissi

Soils in major part of the area in Thenkurussi have near neutral to acidic reaction (88%) with medium levels of organic carbon, available phosphorus and available potassium. Copper and zinc deficiency is seen in 17% samples.

Lime @ 450-600 kg $CaCO_3$ per hectare is recommended. Standard recommendations can be adopted for manuring including application of organic manure @ 5t/ha.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Kannadi

Most of the soils are acidic. Statuses of all major nutrients are low. Marginal deficiency of copper and widespread deficiency of zinc is seen.

Lime application @ 450-600 kg $CaCO_3$ per hectare is necessary.

Organic manures at the rate of 5 t/ha and chemical fertilizers containing nitrogen, phosphorus and potassium @ 125% of the recommended dose have to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Puthupariyaram

Pudupariyaram has 65% area with near neutral to acidic reaction. Organic carbon and available P level is medium. Available potassium content is low. Copper deficiency is negligible and zinc deficiency is marginal.

Lime application @ 300-600 kg $CaCO_3$ per hectare is recommended

Organic manures at the rate of 5 t/ha and chemical fertilizers containing nitrogen and phosphorus at the recommended dose have to be applied.

Application of 25% additional dose of Potassium is recommended

Application of zinc sulphate is recommended in areas where deficiency is seen.

Marutharode

Soils in Marutharode Panchayath are near neutral to acidic in reaction. Soil organic carbon status is low. Phosphorus availability is medium and potassium availability low. 16% soils show copper deficiency and 23% show zinc deficiency.

Lime application @300-600 kg $CaCO_3$ per hectare is essential. Organic manures at the rate of 5 t/ha and nitrogen @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Foliar application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Ayilur

The soils of the Panchayath are acidic or extremely acidic. Low in organic carbon status and medium in available P and K; these soils show marginal deficiency of copper. Zinc deficiency is recorded in 34% samples.

Lime application @300-600 kg $CaCO_3$ per hectare is essential. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended dose of phosphorus have to be applied. Potassium at the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Melarkode

89% of the samples indicated acidic reaction. Nitrogen and potassium status are low. Available phosphorus status is medium. Copper deficiency marginal and zinc deficiency widespread.

Liming is recommended for Melarkode @ 450-600 kg $CaCO_3$/ha. Organic manures at the rate of 5 t/ha and nitrogen @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended.

Elavanchery

About 91% of the soils are acidic. Low organic carbon, medium available phosphorus and low available potassium levels have been recorded. 13% samples indicated copper deficiency and 39% indicated zinc deficiency.

Liming is recommended @ 450-600 kg $CaCO_3$/ha. Organic manures at the rate of 5 t/ha and nitrogen @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Nemmara

Nearly 97% of the tract is near neutral to acidic. These soils are low organic carbon, medium in available phosphorus and low in available potassium levels. 20% samples indicated copper deficiency and 50% indicated zinc deficiency

Liming is recommended for Nemmara @ 300-500 kg $CaCO_3$/ha. Organic manures at the rate of 5 t/ha and nitrogen @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Pallassana

89% of the soils are acidic. Low organic carbon, medium available phosphorus and available potassium levels have been

recorded. 10% samples indicated copper deficiency and 28% indicated zinc deficiency.

Liming is recommended @ 300-500 kg $CaCO_3$/ha. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus have to be applied. Potassium at the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Pirayiri

Majority of the soils are acidic to neutral (94%) in the Pirayiri. Low organic carbon, medium available phosphorus and potassium levels have been recorded. 31% samples indicated copper deficiency and 42% indicated zinc deficiency.

Liming is recommended @ 300-500 kg $CaCO_3$/ha. Organic manures at the rate of 5 t/ha and nitrogen containing @ 125% of the recommended dose have to be applied.

Recommended doses of phosphorus can be applied. Potassium at the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Western Region

Thirumittakkode

Majority of the area in Thirumittakode Panchayath are acidic (96%). The organic carbon, available phosphorus and available potassium status of the soil in this area are medium. Copper deficiency is marginal. 39% samples show zinc deficiency

Liming @ 700-800 kg $CaCO_3$/ha is recommended in these tracts to correct the acidity. Organic manures at the rate of 5 t/ha and chemical fertilizers containing nitrogen, phosphorus and potassium, at the recommended doses have to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Chalavara

Soils in this Panchayath are mostly acidic (94%). Organic carbon and available phosphorus status of the soil in this area are medium. Available potassium level is low. Copper deficiency is marginal. 38% samples have indicated zinc deficiency.

Liming @ 700-800 kg $CaCO_3$/ha is recommended in these tracts to correct the acidity. Organic manures at the rate of 5 t/ha and chemical fertilizers containing nitrogen, phosphorus at the recommended doses have to be applied.

Potassium at 125% of the recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Pookkottukavu

Soils are acidic in reaction. Organic carbon, available phosphorus and available potassium statuses are medium. Copper deficiency is marginal. 13 % samples had shown zinc deficiency.

Liming @ 300-600 kg/ha in recommended. Organic manures at the rate of 5 t/ha and chemical fertilizers containing nitrogen, phosphorus and potassium at the recommended doses have to be applied.

Need based application of zinc sulphate is recommended.

Cherpulassery

About 85% of the area is acidic in reaction. Organic carbon and available potassium status is low. Available P is medium. There is marginal copper deficiency. Zinc deficiency is seen in 18% samples.

Liming @ 300-600 kg/ha in recommended. Organic manures at the rate of 5 t/ha have to be applied.

Recommended dose of nitrogen, phosphorus and potassium have to be supplied through fertilisers.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Sreekrishnapuram

Soils are acidic, low in organic carbon, high in available phosphorus and low in potassium. Deficiency of copper is seen in 11% samples. Zinc deficiency noted in 17% samples.

Liming @ 300-600 kg/ha in recommended. Organic manures at the rate of 5 t/ha and nitrogen containing chemical fertilizers like urea @ 125% of the recommended dose have to be applied.

Phosphate fertilisers need be applied only @75% of recommended dose and rock phosphate can be used. Potassium at recommended dose has to be applied.

Application of zinc sulphate is recommended. Need based supplements with copper sulphate is also recommended.

Table 8. Modified fertiliser recommendations for rice in different Panchayaths

Name of the Panchayath	Soil test based recommendations for major nutrients as percentage of general recommendation		
	N	P	K
EASTERN REGION			
Kozhinjampara	125	100	125
Pattanchery	125	100	125
Vadakarapathy	125	100	100
Muthalamada	125	100	125
Elappulli-Para	125	100	125
Polpully	125	100	125
Chittur-Thathamangalam	125	100	100
Eruthempathy	100	75	100
Nallepally	100	100	125
Perumatty	100	100	125
CENTRAL REGION			
Kuthanur	125	125	125
Kuzhalmannam	125	100	125

Vadavanur	125	100	125
Kottayi	125	100	125
Peruvamba	125	100	125
Pudunagaram	125	100	125
Alathur	125	100	125
Erimayur	125	100	125
Kavassery	100	100	100
Pudukode	125	100	125
Vadakkanchery	125	125	125
Tarur	125	100	125
Kannambra	100	100	100
Kollengode	100	100	100
Koduvayur	125	100	100
Mathur	125	100	125
Peringottukurissi	125	100	100
Thenkurissi	100	100	100
Kannadi	125	125	125
Puthupariyaram	100	100	125
Marutharode	125	100	125
Avilur	125	100	100
Melarkode	125	100	125
Elevanchery	125	100	125
Nenmmara	125	100	125
Pallassana	125	100	100
Pirayiri	125	100	100
WESTERN REGION			
Thirumittakode	100	100	100
Chalavara	100	100	125
Pookkottukavu	100	100	100
Cheplassery	100	100	100
Sreekrishnapuram	125	75	100

c. Information at farm level

Soil test information based on samples collected from land parcels under each survey number and the modified nutrient

management practices are provided as soil fertility cards for each farmer. Consolidated information is also made available at the respective Krishibhavans. The fertility card essentially gives information on soil organic carbon, available P, available K and available micronutrients. Recommendations for liming, if required, and nutrient supplements in terms of quantity of fertilisers required for rice and coconut are indicated in the fertility cards. Management of micronutrient deficiencies and general tips for increasing efficiency of applied nutrients are also provided.

2. Adaptive trials

Field trials in different regions were taken up to test the modified recommendations for rice as a part of the project. These activities were done in a participatory mode involving more than 60 farmers in ten selected Panchayaths. Trials were laid out in each agro ecologic zone to generate comprehensive data on the impact of modified management practices. The treatments for comparison was finalised considering the soil test information by the technical committee and the experiments were laid with sufficient number of replications for minimising experimental error.

Treatments

T1: 90:45:45 kg NPK /ha

T2 : Soil test based application of NPK fertilisers + 2% $ZnSo_4$ as foliar spray

T3 : T2 with double dose of potassium + silica @200kg/ha

T4 : T2 + silica @200kg/ha

T5 : Farmers Practice (details in Table 3)

Note: Organic manure @ 5t/ha used in treatments T1 to T4. Lime applied as per requirements in acidic soils

The mean yield data from the experiment plots in each selected Panchayath is indicated in Table 9.

Table 9. Mean grain yield from experiment plots in different Panchayaths (t/ha)

Nutrient status/ Treatment	Locations									
	Thirumittakode	Chalavara	Kottayi	Ayilur	Kavassery	Koyalmannam	Elevanchery	Peruvemba	Nalleppilly	Kozhinjampara
T1	3.00	3.62	5.65	5.71	4.85	4.35	4.52	5.21	6.82	6.44
T2	3.65	3.76	6.20	5.83	4.75	4.50	4.50	4.49	7.30	6.91
T3	3.15	3.65	6.35	6.04	5.00	4.43	4.30	5.39	7.09	6.81
T4	2.94	3.78	5.85	6.19	4.60	4.50	4.12	5.24	7.17	7.07
T5	2.60	3.65	5.05	6.11	4.50	4.35	3.76	4.65	6.80	5.89
CD	0.135	NS	NS	NS	NS	NS	0.26	NS	NS	0.362

In the eastern zone two panchayaths were included in the field trials. In both the areas, modified treatments gave higher yields compared to farmer's practice as well as standard recommendations. In Kozhinjampara yield difference between treatments was statistically significant. Cost benefit analysis indicated that soil test based modified nutrient management practices gives higher returns (Table. 10).

In the central region, six panchayaths were included in the field trials. In *Elavanchery,* adoption of standard recommendation gave significantly high yield

In other areas high yields were recorded for T2, T3 or T4 compared to farmers' practice, but was statistically insignificant. Cost benefit analysis indicated that in four panchayaths, soil test based management practices provided higher returns. In Koyalmannam, farmers practice gave better cost benefit ratio. In Peruvemba standard recommendation was best in terms of cost benefit ratio.

In western region, significant yield difference was recorded in Thirumittakode, where soil test based nutrient application gave the highest yield. This had better cost benefit ratio as well. In the similar tract at Chalavara, there was no marked difference in crop performance between treatments.

The results also indicated response for additional dose of potassium and applied silica but did not provide significant increase in yield. The cost involved in administering these additional inputs makes it uneconomic.

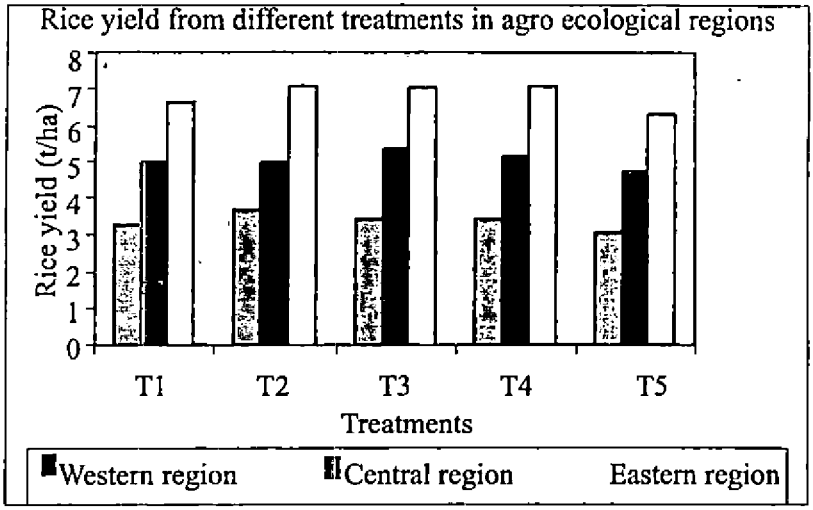


Table 10. Cost benefit analysis of treatments at different locations

Locations	C:B: ratio				
	T1	T2	T3	T4	T5
Thirumittakode	1.39	1.65	1.15	1.10	1.45
Chalavara	1.68	1.65	1.27	1.34	1.99
Kottayi	2.45	2.69	2.67	2.64	2.65
Ayilur	2.65	2.68	2.25	2.35	2.41
Kavassery	2.25	2.27	2.10	1.98	2.24
Koyalmannam	1.88	1.79	1.47	1.53	2.26
Elevanchery	2.11	2.29	1.74	1.70	2.08
Peruvemba	2.42	2.03	1.98	1.96	2.05
Nalleppilly	3.52	3.75	3.14	3.27	3.23
Kozhinjampara	3.32	3.51	2.98	3.19	2.86

4. Recommendations

1. This database can be used as an effective tool for nutrient management at micro level and resource management at macro level.
2. The eastern tracts which are generally fertile, do not require cor-

rective measures for soil reaction through liming. Application of zinc, boron, and sulphur forms an essential component of the recommendations for these areas.

3. At regional level, 125% of the present recommendation for nitrogen should be adopted in eastern and central region. Stand ard recommendation can be continued in western region
4. Phosphorus levels can be maintained by continuing the standard recommendations in all the regions.
5. Rate of potassium application should be enhanced to 125% of the present recommendation in all the regions
6. Organic manure @ 5 t/ha must be applied in all the regions
7. Results of the adaptive trials endorse the validity of soil test based nutrient management practices. However a critical evaluation of the results of adaptive trials points to the inherent soil related inhibitory factors in the lateritic belt (western region) which prevent the farmers from realizing the potential yields especially in rice. Detailed studies are required on the nutrient dynamics, its relation with soil characters, moisture regimes and soil plant inter actions.
8. This database has to be updated at periodic intervals for continuous monitoring and modification of management strategies.

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