



A STUDY ON KUTTANAD PADDY FIELDS THE NEED FOR DE-ACIDIFICATION AND NITRIFICATION

Ann Susan Mathew

Research Associate at International Centre for Technological Innovation

ABSTRACT

Climate change and frequent flood in Kuttanad region of Kerala has changed the fertilizer requirement for paddy. In this study for improving the productiveness of paddy, soil was tested in different Padashekarams (polders). This paper reviews the soil testing procedures used and their results and analysis. After the analysis, it was found that the soils in most paddy fields of Kuttanad has become more acidic and deficient in nitrogen and phosphorous.

1. INTRODUCTION

The disruptive rainfall pattern due to climate change has brought about major crop loss in Kuttanad. Untimely rainfall and flooding have given rise to water logging, unable to reap mature crops. Water logging promotes an anaerobic condition creating a barrier for gaseous nutrients to reach atmosphere. It reduces oxygen level in the root level affecting the growth of crops. It further causes nutrient deficiencies due to an imbalance of the chemical equilibrium of elements in their aqueous form.

Nutrient deficiency was further looked into the areas of Kuttanad. As a part, soil testing was done in different areas of Kuttanad. Soil testing is the assessment of soil fertility to determine nutrient deficiencies. An optimum fertilizer application can improve efficiency and further reduce environmental hazards. The main crop of Kuttanad, rice-bowl area of Kerala, is paddy. Soils of different *padashekaram* (paddy polder) were tested. The required nutrient level for paddy is listed below in the table.

Nutrient	Required range
Phosphorus	20 lbs/acre
Potassium	60 lbs/acre
Nitrogen	30 lbs/acre
pH	6.0 - 7.0

Table 1-Required nutrient level for paddy

1.1. Kuttanad and its soil

Kuttanad, low-lying delta region, is the only place in India where sub-sea level farming is practised. The area is stretched across the districts of Kottayam, Alapuzha, Pathanamthitta. Paddy farming are done in polders called *padashekaram*. Soil salinity is higher due to the exposure of salt water from nearby lakes or rivers. The soil is a mixture of mud and clay in different proportions. The soil is highly acidic in nature and contains high level of toxic salts (Neenu, et al., 2020).

2. METHODOLOGY

2.1. Collection of Soil

The soil taken should be the representative of the area. For testing, only small amount of soil is required. To avoid mixing of samples, labelling should be done properly. For proper sample collection is done using the below steps:



1. A clean bag is used for collecting samples.
2. An auger, spade, or sampling tube is used for collecting soil samples from the field.
3. Dig a v-shaped hole, or bore a hole about 6 inches. Paper tags and rubber are used for closing and properly identifying the soil sample.
4. The sample should be properly dried for testing. It should be dried enough to pass through fingers. Remove foreign materials such as stones, roots, etc.,. When clear of unwanted particles, soil is ready for testing.
5. Store the samples in clean containers with proper labelling with full particulars so that rechecking is possible if required.

2.2. Soil Testing Procedures

2.2.1. Determination of Soil pH

1. Take a clean test tube.
2. Pour 5 ml of Distilled Water into the test tube.
3. Add 2 g of soil sample to the test tube.
4. Add 1 g of Barium Sulphate to the test tube.
5. Allow the test tube to stand for 20 minutes with occasional shaking.
6. Add 5 drops of Calcium Chloride solution to the above solution, and shake thoroughly with the contents being closed. Then allow the soil to settle own completely.
7. After it settles down, compare the colour of the upper liquid with the colour *Chart No.1*(Fig 1). Find out the nearest match, correspondingly will indicate the pH.
8. If the colour of the supernatant indicates pH near 6 (acidic), then repeat the whole experiment using calcium hydroxide. It then compared to *Chart No. 2* (Fig 1).

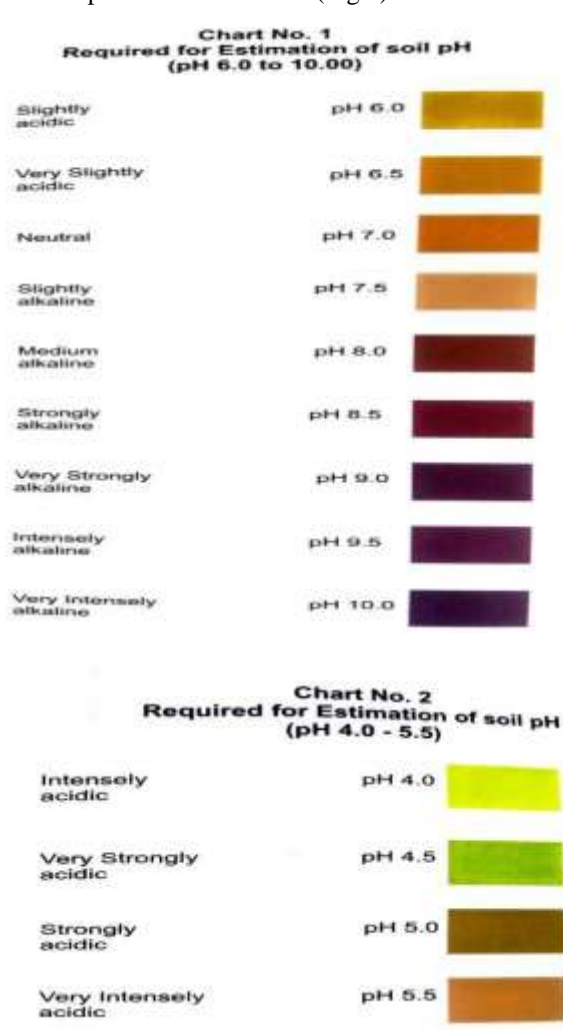


Fig 1- Chart No. 1 and Chart No. 2 for estimating soil pH.

2.2.2. Estimation of available Phosphate (Olsen's Method)

1. Take a clean test tube.
2. Pour 10 ml of Sodium Bicarbonate solution into the test tube.
3. Add pinch of Darco G-60 (activated charcoal) to the above.
4. Add 5 g of soil sample.
5. Close the test tube with rubber stopper. The contents are shaken thoroughly for 3 minutes and filter the solution.
6. Take 2 ml of the filtered solution into a clean test tube.
7. Add 2 ml of Ammonium Molybdate solution into the test containing filtered solution.
8. This solution is kept aside that will be used after the preparation of stannous chloride solution (step 11).
9. Take 66 ml of distilled water in a 100 ml of beaker.
10. To the beaker containing water, add 0.5 ml of stannous chloride.
11. From the stannous chloride solution add 1 ml to the solution prepared in step 8.
12. Shake the contents thoroughly after closing the tube with stopper.
13. Make up the solution to 10 ml using distilled water.
14. Now compare the colour of the solution with *Chart No.3* (Fig 2).

Note: Stannous chloride oxidises or deteriorates if kept unused for more than 3 months. In this case, stannous chloride must be reduced before using it in step 10 (preparation of stannous chloride). For reduction, a small amount of zinc dust is added to 0.5 ml of stannous chloride. Now add 2 to 3 drops of Hydrochloric Acid before step 10.

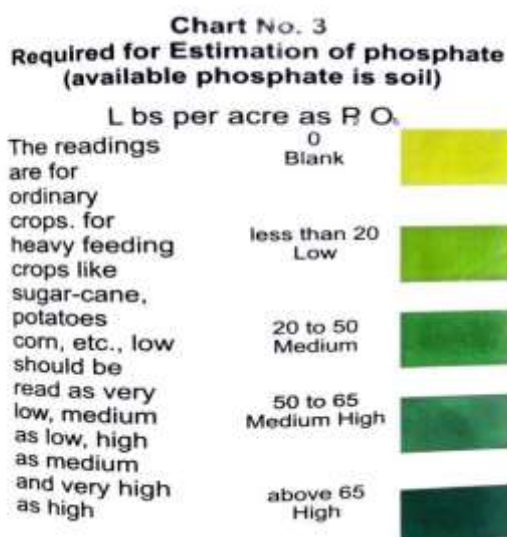


Fig 2- Chart No. 3 for estimating available phosphate

2.2.3. Estimation of available Potassium

1. Take a clean test tube.
2. Add 10 ml of Ammonium Acetate solution.
3. Add 5 g of soil sample.
4. Shake the contents thoroughly 1 minute after it is closed with a stopper. Let the solution be in rest for few minutes and the supernatant is further used in step 8.
5. Take another clean test tube.
6. Add 2 ml of ethanol solution.
7. Add 6 drops of Tetraphenylborate to the above solution without touching the sides of test tube.
8. Add 2 ml of solution made in step 4 using syringe.
9. After injecting the solution from syringe to step 7, turbidity development can be seen after 5 minutes.
10. Turbidity is evaluated using *Chart No. 4* (Fig 3).

Note: For estimating turbidity from chart, the final solution in the test tube is kept over the chart. The visibility of the ark line is observed rather than the intensity of colour.

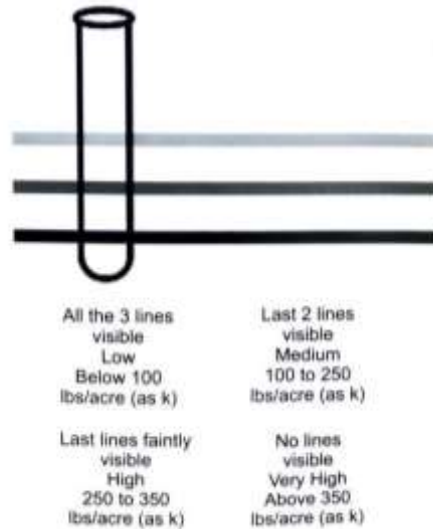


Fig 3- Chart No. 4 for estimating available potassium

2.2.4. Estimation of Nitrogen (Nitrate and Ammoniacal)

1. Take a clean test tube and fill 10 ml distilled water.
2. Add 2 g of soil sample and close the test tube with a clean stopper.
3. Shake the contents thoroughly for 5 minutes and filter.

2.2.4.1. Nitrate Nitrogen

1. Transfer 1 drop of the filtrate from above to a clean inch test tube. Now add 8 drops of Calcium Sulphate. Compare the colour of the solution with *Chart No. 5* (Fig 4).

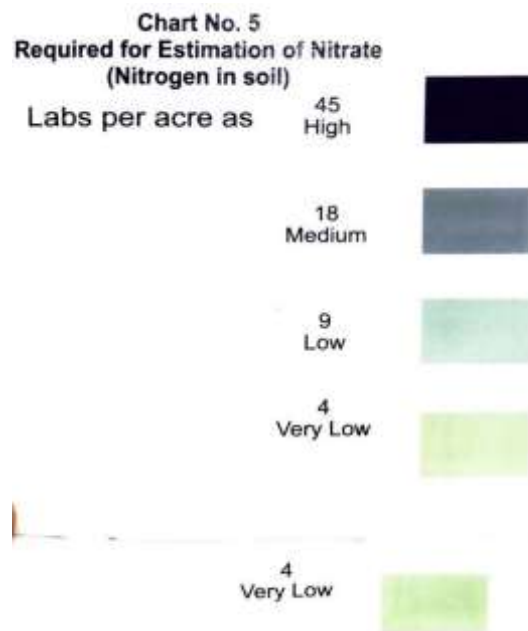


Fig 4- Chart No.5 for estimating nitrate

2.2.4.2. Ammoniacal Nitrogen

1. Transfer 3 drops of filtrate from step 3 to a clean inch test tube. Add 1 drop of Sodium Hydroxide. Compare the colour with *Chart No. 6* (Fig 5).

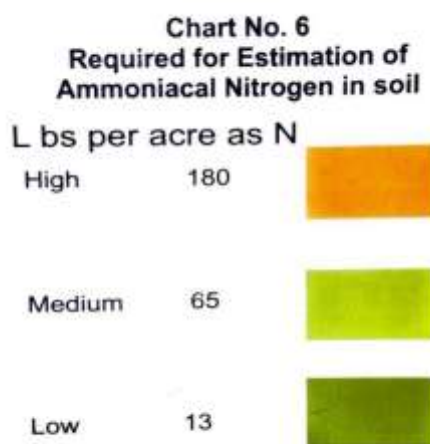


Fig 5- Chart No. 6 for estimating ammoniacal nitrogen.

2.2.5. Estimation of Organic Carbon

1. Take a clean test tube and add 10 ml distilled water.
2. Add 2 g of soil sample and close it with a stopper.
3. Shake the contents thoroughly for 5 minutes. Quickly take out 0.5 ml of clay suspended liquid with a clean graduated dropper.
4. To the clean solution, add 1 ml of Phosphoric acid solution and 2 ml of Potassium Dichromate while swirling the test tube.
5. Keep the test tube for 30 minutes. Compare the colour of the solution with *Chart No. 7* (Fig 6).

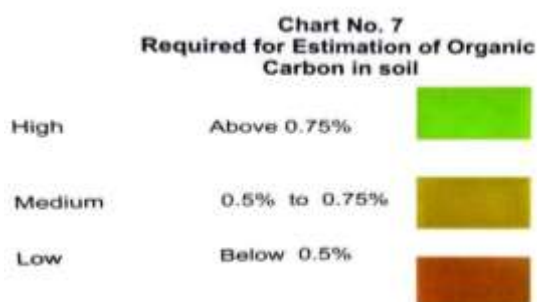


Fig 6- Chart No. 7 for estimating organic carbon

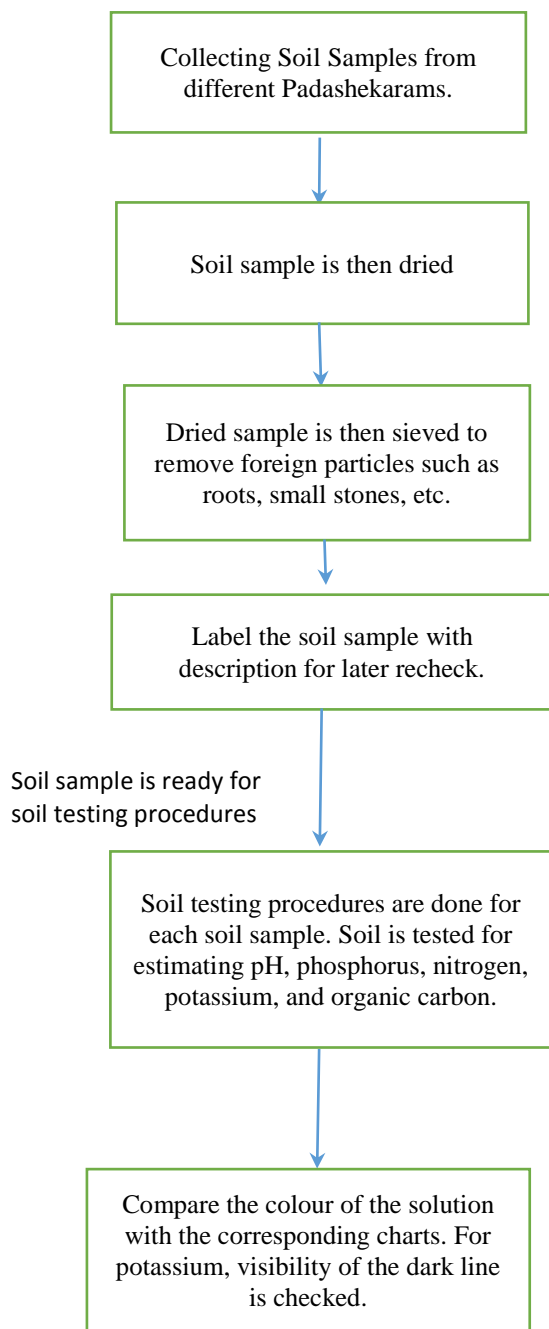


Fig 7- Flowchart for soil testing procedure.

3. RESULTS AND ANALYSIS

3.1. Results

1. Soil Sample 1

Location (Padashekaram 1): Puthankari 600 Padashekaram, Nedumudy

Sample Date: 21-March-2022

Report Date: 30-March-2022



Test	Result	Desirable
Nitrogen (N)	10	40 kg/acre or higher
Phosphorous (P)	25	20-25 kg/acre
Potassium (K)	150	150 kg/acre or higher
pH	4.5	6

2. Soil Sample 2

Location (Padashekaram 2): Edapally, Somathuram, Kainakary

Sample Date: 14-March-2022

Report Date: 30-March-2022

Test	Result	Desirable
Nitrogen (N)	10	40 kg/acre or higher
Phosphorous (P)	15	20-25 kg/acre
Potassium (K)	150	150 kg/acre or higher
pH	4.5	6

3.2. Analysis

The nutrient recommendation for paddy rice grown in wetlands of Kuttanad for high yielding variety during 120-140 days is 90:45:15 kg NPK per hectare. The first spilt must be applied at the time of planting; for an acre 26 kg urea, 100 kg rock phosphate, and 5 kg muriate of potash respectively is to be applied. The second dose should be applied in active tillering stage and the dosage is 26kg urea. The third dose must be applied at panicle initiation stage. The fertilizer dose 26 kg urea and 5.0 kg muriate of potash. Addition of lime is necessary when the pH is lower than 6. Apply lime at 300 kg/acre in two spilt doses, the first dose of 150 kg/acre as basal dressing at the time of first ploughing and the second dose of 150 kg/acre as top dressing about one month after sowing/transplanting. A time lag of one week should be given between application of lime and fertilizers. For top dressing, lime may be applied one week prior to the application of fertilizers.

4. CONCLUSION

From the results of soil testing, it can be seen that nitrogen and pH are lower than the required amount for soil sample of Padashekaram 1. Similarly is the case of Padashekaram 2 wherein Phosphorous is also lesser than the required 20-25 kg/acre. In general, Kuttanad soils are acidic in nature, and de-nitrification is quite common. As a solution liming should be done periodically. Urea and rock phosphate is to be applied for the deficiency of nitrogen and phosphorus respectively.

5. BIBLIOGRAPHY

1. Neenu S, Karthik K. S. Anil Kumar K.S, Nair K.M, (2020) "Kuttanad Soils: The Potential Acid Sulphate Soils of Kerala"
2. Thomas P. M, (2002) "Problems and Prospects of Paddy Cultivation in Kuttanad Region", Thiruvananthapuram
3. UMASS(2022)https://extension.umass.edu/landscape/sites/landscape/files/pdf-doc-ppt/nursery_bmp/NurseryBMP14_pgs24-29.pdf (Accessed: March 2022)