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# Analysis on land evaluation and crop suitability rating of acid sulphate soils of Kerala

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**ABSTRACT**

Kuttanad, a low lying deltaic region 0.5 to 2.2 m below mean sea level lies on the western coast of Kerala. After conducting soil survey and classification, these acid sulphate soils were evaluated qualitatively by Land Capability Classification and quantitatively by Soil Site Suitability Classification. As per Land Capability Classification, five soil series *viz.*, Ambalapuzha, Purakkad, Thotapally, Thuravur, Kallara and Thakazhi covering a area of 13099.60 ha were grouped under the class IV sw *i.e.*, they are fairly good cultivable land with limitations due to soil problems and excessive wetness. Except Thotapally and Thuravur, all series belonged to soil suitability sub class S2xf. While considering suitability for paddy cultivation in the region, these soils were moderately suitable for paddy cultivation with limitations due to fertility and pH. With regard to coconut cultivation, all the soil series except Thuravur were grouped under S2xf. Thuravur series belonged to S3xf. It was marginally suitable for coconut cultivation with limitations due to fertility, pH and salinity. For mango cultivation, Kallara, Thakazhi series were marginally suitable. Considering the socio-economic situations, productivity constraints and potentials, most ideal land use models are found to be rice-fish rotational farming and rice-fish-livestock integrated farming system.

Key words : *Acid sulphate soils, Kuttanad, Land capability classification, Soil site suitability classification.*

## INTRODUCTION

India with a geographical area of 329 million ha is likely to touch 1225 million human population by 2015 necessitating 275 million tones of food grains. Kuttanad, a wetland eco-system known as rice bowl of Kerala is facing several problems like extreme acidity, salinity, iron toxicity, aluminium toxicity etc. As we have to meet challenges of this century, new understandings and new technologies will be needed to protect the environment and at the same time, produce food and biomass to support society (Brady and Weil, 2004). In order to achieve sustainable yields of crops besides maintaining soil health needs, knowledge on morphological, physical and chemical classification of soils is an essential requirement. For solving the problems related to natural resource management, proper planning with the help of qualitative and quantitative land evaluation methods and maintaining soil health is of utmost importance. The increasing demand for intensification of existing cultivation, especially in areas with less favourable conditions as in acid sulphate conditions there is an urgent need to evolve a suitable land use system for this region. An assessment of constraints and limitations due to soil problems is imperative for management and so the present study was carried out.

## MATERIALS AND METHODS

Kuttanad lies on the western coast of Kerala between 9°17' to 9°40' N latitude and 76°19' to 76°33' E longitude. Major crop is paddy. Other crops include coconut, paddy and vegetables. Mixed farming is also practiced. Four rivers drain into the area *viz.*, Pampa, Manimala, Achankoil and Meenachil. All these drain into Vembanad lake forming an extensive lake lagoon system opening into Arabian sea. Analysing climatological data for the past ten years it was revealed that the region enjoyed a humid tropical climate. The average rainfall recorded in the region was 2737.2 mm. Two spells of monsoon was prevalent in the area *viz.*, south west monsoon and north east monsoon. Average maximum and minimum temperatures recorded in the area was 31.9°C and 24.2°C respectively. High rate of evaporation was recorded during the month of March and April. Average relative humidity observed was 85 per cent.

Reconnaissance soil survey of the area was conducted as per methods described in IARI (1970). Areas having acid

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sulphate soils were delineated and classified as per keys to soil taxonomy (Soil survey staff, 1998). Soils collected were subjected to estimation of physical properties (Black *et al.*, 1965) and chemical properties (Page, 1982). Land evaluation is mainly based on land suitability with reference to specific uses. Land capability classification is an interpretative grouping of soils based on inherent soil characteristics, land features and environmental factors that limit land use. Under qualitative approach Land capability classification and under quantitative approach soil site suitability classification (FAO, 1976, Sys. *et al.*, 1993) were carried out. Soil site suitability classification for paddy, banana, coconut and mango have been done. By carrying out resource inventory of area, socio-economic profile, land evaluation and assessment for sustainable agriculture appropriate land use options were developed.

## RESULTS AND DISCUSSION

### Soil survey and mapping

The acid sulphate soils of Kuttanad were delineated and mapped based on land form analysis, field survey, laboratory investigation, cartography and GIS. The total area covered by these soils is 14277.51 ha comprising six soil series *viz.*, Ambalapuzha, Purakkad, Thotapally, Thuravur, Kallara and Thakazhi (Beena *et al.*, 2007). Taxonomically this region came under Typic Sulfaquent. The soils were invariably acidic with pH ranging from 2.7 to 5.6. Organic carbon content varied from 1.99 to 11.6 per cent. Phosphorus content was generally low. Available potassium and sodium content were also high. Other problems were saline water intrusion, Fe and Al toxicity and water logged condition. (Beena and Thampatti, 2012).

**Table 1.** Chemical characteristics of soils

| Series | pH | EC ($dSm^{-1}$) | Avail. S ($mg\ kg^{-1}$) | Fe ($mg\ kg^{-1}$) | Exch. Al ($c\ mol\ kg^{-1}$) |
|---|---|---|---|---|---|
| Ambalappuzha | 3.78 | 0.94 | 1295 | 395.3 | 1.41 |
| Purakkad | 4.03 | 1.12 | 2931 | 452.8 | 2.90 |
| Thotapally | 4.58 | 1.25 | 1966 | 496.5 | 2.03 |
| Thuravur | 3.79 | 3.29 | 3114 | 536.9 | 3.91 |
| Kallara | 3.38 | 1.57 | 2695 | 377.5 | 3.15 |
| Thakazhi | 3.24 | 0.92 | 1776 | 652.1 | 2.32 |

### Land capability classification

As per Land Capability Classification, five soil series *viz.*, Ambalapuzha, Purakkad, Thuravur, Kallara and Thakazhi were grouped under 'IV sw' *i.e.* they are fairly good cultivable land with limitations of soil problems and excessive wetness. These soils were characterized by imperfect drainage, high acidity, slow permeability and infiltration, low base saturation and salinity. While Thotapally series was grouped as 'III sw' which constituted an area of 8.25 per cent of total area. These soils were unsuitable for variety of crops due to poor drainage, salinity and acidity. Growing crops need intensive soil and water management practices. Thotapally series was very deep (> 1 m deep), had high salinity, low base *saturation and high acidity*. Salinity was due to proximity to sea, presence of pyrite deposits in lower layers leading to high acidity and capillary movement of salt along with water which was moved by evaporation (Thampatti and Jose, 2000).

### Soil site suitability classification for paddy

Paddy is the major crop of the region. For all series except Thotapally and Thuravur the soil site suitability sub classes were 'S2xf'. These soils were moderately suitable for paddy cultivation with limitations due to fertility and pH. The Thotapally series came under the suitability class S3xf for paddy with limitations due to salinity, low pH & fertility aspects.

**Table 2.** Land capability grouping, their description/limitation and extent of occurrence of acid sulphate soils in Kuttanad

| Series | Capability subclass | Description (limitation) | Area (ha) | % of total area |
|---|---|---|---|---|
| Ambalapuzha | IV sw | Fairly good cultivable land (soil problems and excess wetness) | 1171.94 | 8.20 |
| Purakkad | IV sw | Fairly good cultivable land (soil problems and excess wetness) | 2522.61 | 17.66 |
| Thotapally | III sw | Moderately good cultivable land (soil problems and excess wetness) | 1177.91 | 8.25 |
| Thuravur | IV sw | Fairly good cultivable land (soil problems and excess wetness) | 1800.21 | 12.6 |
| Kallara | IV sw | Fairly good cultivable land (soil problems and excess wetness) | 6860.17 | 48.04 |
| Thakazhi | IV sw | Fairly good cultivable land (soil problems and excess wetness) | 744.67 | 5.21 |

**Table 3.** Suitability subclasses for paddy

| Series | Suitability subclass | Description (limitation) | Area (ha) | % of area |
|---|---|---|---|---|
| Ambalapuzha | S2 xf | Moderately suitable (low pH and fertility) | 1171.94 | 8.20 |
| Purakkad | S2 xf | Moderately suitable (low pH and fertility) | 2522.61 | 17.66 |
| Thotapally | S3 xf | Marginally suitable (low pH and fertility) | 1177.91 | 8.25 |
| Thuravur | S2 nxf | Moderately suitable (low pH, salinity and fertility limitation) | 1800.21 | 12.6 |
| Kallara | S2 xf | Moderately suitable (low pH and fertility) | 6860.17 | 48.04 |
| Thakazhi | S2 xf | Moderately suitable (low pH and fertility) | 744.67 | 5.21 |

Table 4 Suitability subclasses for coconut

| Series | Suitability subclass | Description (Limitation) | Area (ha) | % of area |
|---|---|---|---|---|
| Ambalapuzha | S2 xf | Moderately suitable (low pH and fertility) | 1171.94 | 8.20 |
| Purakad | S2 xf | Moderately suitable (low pH and fertility) | 2522.61 | 17.66 |
| Thotapally | S2 xf | Moderately suitable (low pH and fertility) | 1177.91 | 8.25 |
| Thuravur | S3 nxf | Marginally suitable (low pH, salinity and fertility limitation) | 1800.21 | 12.6 |
| Kallara | S2 xf | Moderately suitable (low pH and fertility) | 6860.17 | 48.04 |
| Thakazhi | S2 xf | Moderately suitable (low pH and fertility) | 744.67 | 5.21 |

Table 5. Suitability subclasses for mango

| ɔeries | Suitability subclass | Description (Limitation) | Area (ha) | % of area |
|---|---|---|---|---|
| ımbalapuzha | S2 wxf | Moderately suitable (excessive wetness, low pH and fertility) | 1171.94 | 8.20 |
| ³urakkad | S2 wxf | Moderately suitable (excessive wetness, low pH and fertility) | 2522.61 | 17.66 |
| Thotapally | S2 xf | Moderately suitable (excessive wetness, low pH and fertility) | 1177.91 | 8.25 |
| Thuravur | S3 nxf | Marginally suitable (salinity, excessive wetness, low pH and fertility) | 1800.21 | 12.6 |
| Kallara | S3 wxf | Marginally suitable (excessive wetness, low pH and fertility) | 6860.17 | 48.04 |
| Thakazhi | S3 wxf | Marginally suitable (excessive wetness, low pH and fertility) | 744.67 | 5.21 |

Table 6. Suitability subclasses for banana

| ɔeries | Suitability subclass | Description (Limitation) | Area (ha) | % of area |
|---|---|---|---|---|
| ımbalapuzha | S2 cwxf | Moderately suitable (excessive wetness, low pH and fertility) | 1171.94 | 8.20 |
| ³urakkad | S2 cwxf | Moderately suitable (excessive wetness, low pH and fertility) | 2522.61 | 17.66 |
| Thotapally | S2 cwxf | Moderately suitable (excessive wetness, low pH and fertility) | 1177.91 | 8.25 |
| Thuravur | S3 ncwxf | Marginally suitable (salinity, excessive wetness, low pH and fertility) | 1800.21 | 12.6 |
| Kallara | S3 cwxf | Marginally suitable (excessive wetness, low pH and fertility) | 6860.17 | 48.04 |
| Thakazhi | S3 cwxf | Marginally suitable (excessive wetness, low pH and fertility) | 744.67 | 5.21 |

**ɔoil site suitability for coconut**

With regard to coconut cultivation, all the soil series except Thuravur are grouped under S2xf. The Thuravur series is marginally suitable for coconut cultivation with limitations due to fertility, pH and salinity. The suitability subclass for this series is S3 nxf constituting an area of 1800.21 ha. For all the other series the suitability subclass is S2 xf, *i.e.* these soils are moderately suitable for coconut cultivation with limitations due to fertility and pH. The area coming under S2xf constitutes about 12477.30 ha. Assessment of area coming under soil suitability class of moderately suitable region for coconut cultivation reveals an area of 87.4 per cent.

**Soil site suitability for banana**

For banana cultivation, the series Thotapally and Thuravur are marginally suitable which come under the class of S3 cwxf and S3 ncwxf respectively. The limitations for Thotapally series include climate, excess water, pH and

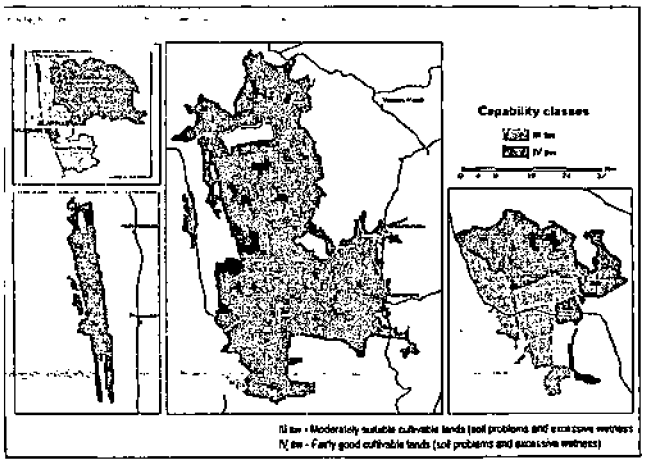


Fig. 1. Land capability classification

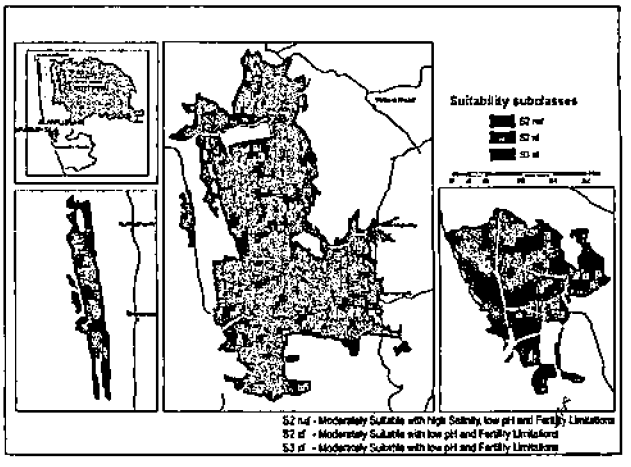


Fig. 2. Soil site suitability for paddy

fertility limitation. The Thuravur series was also marginally suitable with limitations due to salinity, climate, excess water and fertility characteristics. All the other series are moderately suitable with limitations due to fertility, climate, low pH and excess water coming under the class S2 cwxf constituting an area of 11299.39 ha. The Soil Site Suitability evaluation showed that an area of 79.02 per cent is moderately suitable for banana cultivation.

### Soil site suitability for mango

For cultivation of mango, Ambalapuzha, Thotapally and Purakkad series were moderately suitable with limitations due to excess wetness, low pH, fertility limitations. Thuravur, Kallara and Thakazhi series were marginally suitable for mango cultivation occupying an area of 65.85 per cent of total area. Ambalapuzha and Purakkad came under the class of S2 wxf which occupies an area of 3694.55 ha. Kallara and Thakazhi series came under S3 wxf which occupies an area of 7604.84 ha. The Thotapally series came under the class of S2 xf and Thuravur series came under the class of S3 nxf.

### Land use planning

Majority of the farmers were below poverty line. Taking in to consideration, socio-economic details of the area it was observed that majority of farmers were marginal with average holding size less than 0.2 ha. Since this area came under the coastal agro-ecosystem there is high population pressure and waterlogged situation which led to low farm holding size. The areas that are left fallow can be brought under rice-fish rotational farming.

## CONCLUSION

Soil health of the area can be improved. Suitable land use models that can be suggested for the area are a) rotational farming with rice + fish + fodder + duck and b) mixed farming with rice and fish.

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