Soil irrigability mapping for Kannur district, Kerala using Soil parameters in Geographic Information System

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Abstract

Land resource inventory is an important tool to analyse soil health condition and agricultural productivity. There are several methods used for land capability and irrigability analysis. In this paper an attempt is made to map soil irrigabiliy, using soil parameters like, soil depth, soil texture, soil drainage and soil erosion, collected from the Soil Survey Department. Study area chosen is Kannur district in Kerala State. It is situated in the northern part of Kerala. Maps collected from the Soil Survey Department were digitized and rasterised using ArcGIS software. Weighted overlay method is used by giving appropriate weightage to suit the agricultural practices. Derivative soil irrigability map is classified into five classes viz., Moderate limitation, Severe limitation, Severe limitation (topographic), Marginal limitation and not suitable. This analysis will be useful for identifying the main limiting factors for the agricultural development and enables policy makers to develop crop managements able to increase the land quality and agricultural productivity.

KEYWORDS- Soil irrigability, soil parameters, soil texture, agricultural productivity.

Introduction

Land is the base for all human activities in the world. Soil is the most important factor of crop production and productivity of a region. The proper soil management practice determines the levels of agricultural development of a particular area. On the other hand, a systematic soil management practices relayed on a number of factors such as, knowledge about the soil types, characteristics, properties and functions is very important. A detailed information about the soil characteristics, soil types, and soil properties of Kannur district is evaluated to understanding the soil resource characteristics and identifying the limitations for the sustainable agricultural development of the region.

Land irrigability and land evaluation has been defined by FAO (1976). FAO (1975, 1976,1989, 1996) has suggested methods based on physical and soil parameters of various countries in the world. Jakson (1996), Sehgal (1996), Young *et al* (1977), shah *et al* (1988), Satya Priya (1997) and Jyothirmayi (2012), Himabindu *et al* (2018), Mani *et al* (2018), Jyothirmayi et *al* (2019) have also suggested land suitability and land irrigability methods in their studies. In this paper an attempt is made for soil irrigability analysis for understanding and enhancing the levels of agricultural productivity and development based on the soil parameters in Kannur district of Kerala state. Soil related maps like, soil depth, soil texture, soil drainage, and soil erosion, collected from the Soil Survey Department, can be used for soil irrigability analysis to suit the agricultural production.

Objectives of the study

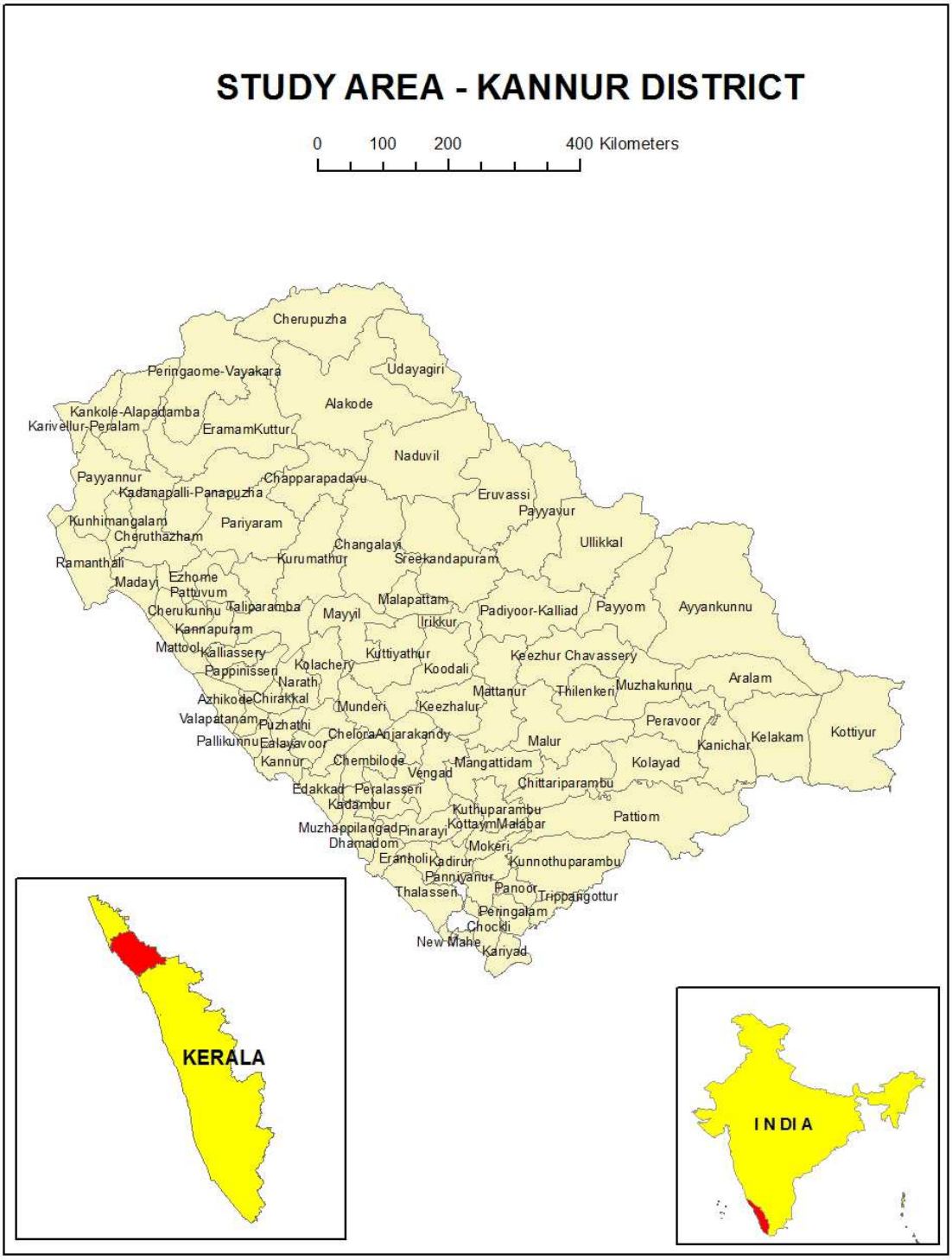
- To analyse the soil irrigability to understand the agricultural development based on different soil parameters
- To prepare soil irrigability Map for Kannur district, using GIS platform

Study Area:

Kannur district is located between latitudes 11^0 40' North to 12^0 48'North latitudes and 74^0 52'East to 75^0 56'East longitude. The district is bound on the north by Hosdurg Taluk of Kasargode district and the south by Mananthavady Taluk of Wayanad district and Vatakara Taluk of Kozhikode district and Mahe of Pondichery. The eastern boundary of the district shares with Koorg district of Karnataka State. The Lakshadweep sea lies in the Western side of the district. The landform of Kannur district undulates from east to west with series of hillocks and valleys dissected by the streams and rivers. The general gradient of the slope is steeper in the eastern part and gentler towards the western side of the district. Based on physiography the district is divided in to three broad physical units., namely, the high land ,the mid land and the coastal plains and low lands. The district experience humid climate with a severe hot season from March to the end of May followed by South West Monsoon season which continuous till the end of September. Retreating Monsoon is from October to November. December to April ,the district has dry season. The average annual rainfall recorded in the district during the year 2014-15 was 3438 mm., of which 70% of rainfall received during the period from June to September. With seven major rivers and about twenty minor streams , Kannur district is endowed with a well developed drainage system. Most of the rivers in the district originate from the Western Ghat in the east and drains in to Lakshadweep sea in the west.

Methodology

To achieve the objectives, soil depth, the soil texture, soil drainage, and soil erosion maps collected from the Soil Survey Department were scanned and digitised using ArcGIS software . Digitised maps were converted into raster format again and reclassified according to the weightages. For this spatial analyst, conversion and analysis tools were used. These maps were overlaid and the cumulative weightages were classified into five classes (limitations) viz., Moderate limitation, Severe limitation, Severe limitation (topographic), Marginal limitation and not suitable, then areas and percentage to the total areas were calculated for each soil irrigability class for the entire district.



Results and Discussion

Soil irrigability evaluation

Soil is one of the important resource which support all the life forms on the earth surface. In Kannur district, the soils in the low lands are very deep and are sandy to loamy sandy in texture. The soils in the midland are alluvial and drained laterite. The soils in the high land are forest soils with clay loam to clayey in texture. In this

paper an attempt is made to map soil irrigability using soil related maps like soil texture, soil depth, and soil erosion.

Soil depth

Soil depth determines the plants effective rooting and water holding capacity of the soil column. Soil depth have greater influence on plant types which can grow in them. If the soil is deeper, it can supply more nutrients and water to the plants and other micro organisms. Soil depth is an important parameter in the soil irrigability classification. Based on its depth from the surface of top soil to the bed rock, it can be classified in to moderately shallow, moderately deep, deep and very deep in the study area. Majority of the portion of the study area comes under deep with 100-150 cm. depth of soil.

Table 1:Soil depth class and weightage

Sl.No	Soil depth class	Map No.	Weightage
1	Very deep	1	5
2	Very deep to deep	2	4
3	Deep to moderately deep	8	2
4	Deep to rocky outcrops	5	4
5	Moderately deep to shallow	9	3
6	Moderately shallow to very Deep	10	1

Source: compiled by author from Soil Survey Map.

Surface soil texture

Soil texture is an important property, which shows the relative proportion of sand, silt and clay particles in the soil. Soil texture is an important factor in land irrigability classification, as it defines the water holding capacity, permeability, drainability and plant rooting depth. The texture of surface soil is an important factor to evaluate the soil irrigability classification. The major soil texture of Kannur district are sandy, loamy, loamy to clay, loamy to rocky outcrops, clay to loamy and clay. Clay to loamy texture are widely distributed over the study area, followed by loam texture which are distributed over Kannur corporation and its neighbouring panchayaths, Ramanthali panchayath in the coastal area and Aralam ,Payam,Muzhakkunnu,Peravoor, Kelakam and Chittariparamba Panchayath in the easat south part of the district. The lateritic duricrust are widely spreaded in the mid land area and it extend up to the north western part of the district. Sandy texture are mainly concentrated in Alakkode, Naduvil, Payyavoor, Malur ,Pattiom and Kottiyoor Panchayath.

Table 2: Soil texture and weightage.

Sl.No	Map No.	Soil Texture	Weightage
1	1	Sandy	2
2	2	Loamy	6
3	3	Loamy to clay	3
4	4	Loamy to rocky outcrops	1

5	5	Clay to loamy	5
6	6	Clay	4

Source: compiled by author from Soil Survey Map

Soil drainage

Soil drainage is a natural process of water moves through, across and out of the soil by the force of gravity, which determines the type of plants in an area. In the drainage classes given are imperfectly to well drained, moderately drained, well drained, fast surface runoff, moderate to excessively drained, well to excessively drained and excessively drained. Most preferred class for cultivation are well drained and moderately to excessively drained. A major portion of the study area spreads in the well drained class.

Table 3: Soil drainage and weightage

Sl.No	Map No.	Soil drainage	Weightage
1	7	Imperfectly to well drained	1
2	8	Moderately drained	5
3	10	Well drained	4
4	12	Fast surface runoff	1
5	13	Moderate to excessively drained	5
6	14	Well to excessively drained	3
7	15	Excessively drained	2

Source: compiled by author from Soil Survey Map

Soil erosion

The level of soil erosion is classified into none to slight, moderate to slight, moderate, moderate to severe and moderate rocky. Among these classes, moderate to slight class is most widely distributed in the study area. The south eastern part of the district comes under moderate erosion classes, where as the midland lateritic zones and north eastern part comes under moderate erosion class.

Table 4: Soil erosion and weightage

Sl.No	Map No.	Soil erosion	Weightage
1	1	None to slight	5
2	3	Moderate to Slight	4
3	4	Moderate	1
4	5	Moderate to severe	1
5	6	Moderate rocky	1

Soil irrigability Classification

Soil irrigability deals with evaluating soil for suitability to irrigation based on its different characteristics. This classification is an interpretative ordering of soils on the basis of its physical parameters in order to understand the lands capability for irrigation for a better agricultural development. In the study area, based on suitability for the application of irrigation lands are classified in to five classes viz., Moderate limitation, Severe limitation, Severe limitation (topographic), Marginal limitation and not suitable. This analysis will be useful for identifying the main limiting factors for the agricultural development and enables policy makers to develop crop managements able to increase the land quality and agricultural productivity.

Table 5: Soil irrigability classes

Soil irrigability class	**Limitations**	**Area in sq. km.**	**Area in percentage**
I	Moderate limitation (soil and drainage)	119	4
II	Severe limitation (soil and drainage)	267	9
III	Severe limitation (topographic)	1394	47
IV	Marginal limitation (soil and drainage)	178	6
V	Not suitable	1008	34
.....	Total	2966	100

Source: compiled by author

Class I

The class I has represent very less limitation with 4 percentage and distributed in the south western corner of the district.

Class II

The class II possess severe limitation with soil and drainage covers 267 sq. km. area and accounts 9 percent and concentrated in the west central area of the district.

Class III

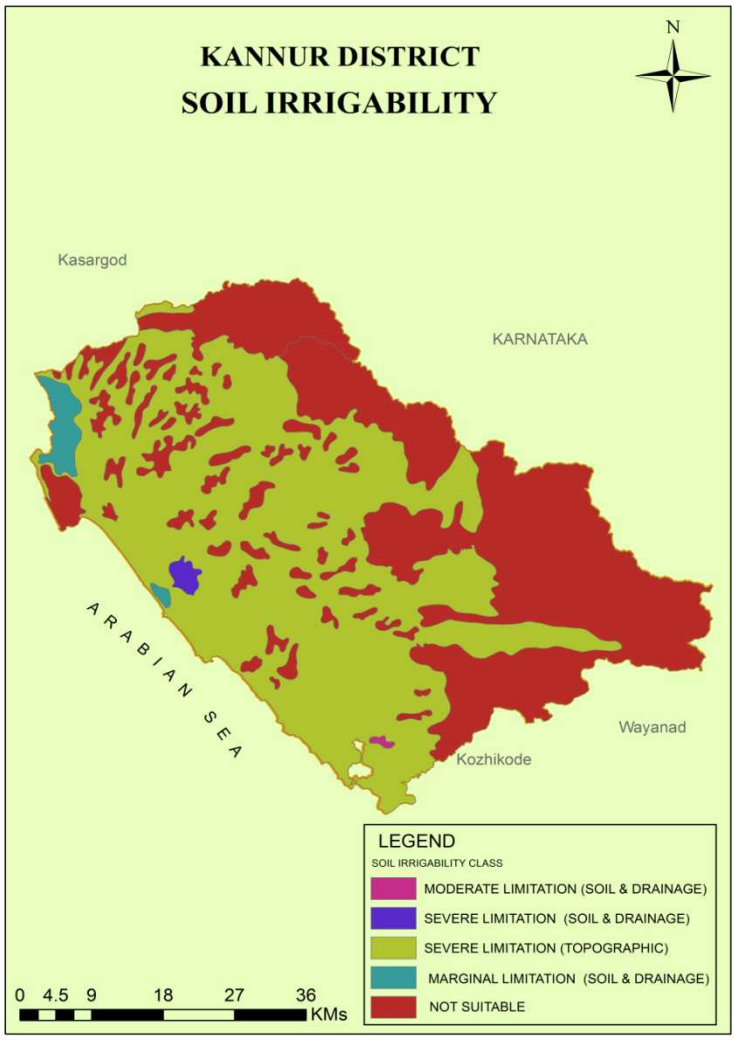
The third class possess severe limitations with topographic issues. A majority area (47%)of the study area lies in this class. This area is mainly confined to western lateritic topography and the central lateritic area of the district.

Class IV

The class represents limitation in the land with marginal limitation accounts 6 percent of the study area, which is mainly distributed in the north western part of the district.

Class V

The class five possess not suitable holds 34 percent of the study area. These land areas are mainly located in the eastern high lands and mid land lateritic durricrust and rocky outcrops area of the district.



Conclusion

The application of GIS technique in land irrigability classification has the greatest potential and capabilities in analysing and preparing soil irrigability maps for the Kannur district. This study selected soil parameters with soil depth, soil texture soil erosion and soil drainage to identify area under soil irrigability class were done and we are getting a picture about the soil irrigibility class of the area. The derivative soil irrigability map is classified into five classes viz., Moderate limitation, Severe limitation, Severe limitation (topographic), Marginal limitation and not suitable. This analysis will be useful for identifying the main limiting factors for the agricultural development and enables policy makers to develop crop managements able to increase the land quality and agricultural productivity.

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