To Map and Characterized the Sub-Pixel Classification of Soil Properties using Remote Sensing and GIS

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Abstract— A Subpixel spectral analytical process was used to classify the soil in LISS -IV data using thematic mapper imagery in India. The sub-pixel process enabled the detection of soil and geology in mixed pixels. two hundred pixels were field verified for each soil species to independently measure errors of omission and commission. The cypress total accuracy was 89 percent and the geology total accuracy was 91 percent field investigations revealed that both soil and geology were successfully classified when they occurred both as pure stands and when mixed with other soil species and water. In a comparison with traditional classification technique (iso-data maximum likelihood and minimum distance) the Subpixel classification of soil and geology yielded improved results. Large area of wetland where cypress was heavily mixed with other tree species were correctly classified by the Subpixel process and not classified by traditional classifiers.

Key words: Sub-Pixel, GIS, Remote Sensing

I. INTRODUCTION

IMAGINE Soil Classifier is an advanced image exploitation tool designed to detect materials that are smaller than an image pixel, using multispectral imagery. It is also useful for detecting materials that cover larger areas but are mixed with other materials that complicate accurate classification. It is a powerful, low cost alternative to ground surveys, field sampling, and high-resolution imagery.

Behind soil analysis is that, with rare exceptions, image pixels are mixed pixels, containing not only a feature of interest but other features as well. Chemical compositions of the soil influences spectral signature of soils through the absorption processes. In near infrared (NIR) and middle infrared (MIR) domain, absorption feature of soil components in solid.

Soil is defined as upper layer of the earth composed of loose surface material. It is a mixture of many substances including endless variety of minerals, remnants of plants and animals, water and air. It is the end product of continuing interaction between the parent material, local climate, plant and animal organisms and elevation of land. Since each of the elements varies over space, soils also differ from place to place. Soil is an important segment of our ecosystem, as it serves an anchorage for plants and source of nutrients. Thus, soil is the seat, the medium and fundamental raw material for plant growth. Through its relative fertility, it affects man's economic activities and shapes the destiny of our country. When the soil is lost, property and culture are also lost.

A. Remote Sensing Technology for Soil:

Though conventional soil surveys were providing information on soils they are subjective, time consuming and laborious. Remote sensing techniques have significantly contributed speeding up conventional soil survey programmers. In conventional approach approximately 80% of total work requires extensive field traverses in identification of soil types and mapping their boundaries and 20% in studying soil profiles, topographical features and for other works. In the case of soil surveys with aerial photographs or satellite data considerable field work with respect to locating soil types and boundaries I reduced owing to synoptic view. Remote sensing techniques have reduced field work to a considerable extent and soil boundaries are more precisely delineated than in conventional methods. The satellite data were utilized in preparing small scale soil resource maps showing soil subgroups and their association for about three decades. Soil erosion, an important soil degradation process can influence soil spectra. Soil erosion influences indirectly by influencing soil surface roughness and iron content in top soils. So the more is the erosion the more will be soil reflectance (Latz *et al.* 1984) in the longer wave length of visible and NIR region

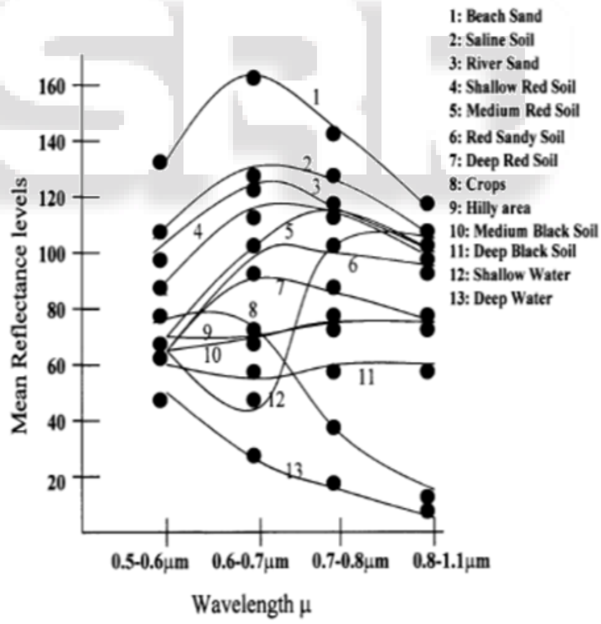

Fig. 1: Spectral behaviour of soil

B. Objective:

- To Map of different physiographic units with the help of LISS-IV satellite data.
- To classify the soil properties, supervised pixel classification approach.
- To estimate Supervised classification soil properties.
- To classify the soil in Subpixel classification in soil properties
- To quantity a posteriori knowledge of study area, To prepare the lineage documentation & mapping

II. STUDY AREA

Krishnagiri is a district in the state of Tamil Nadu, India. The municipal town of Krishnagiri is the district headquarters. The study area covers two taluks: Hosur and Denkanikottai.
The area lies between
Latitude: 12 15' 45" N& 12 46' 20"N
Longitude: 77 47' 2.4" & 77 53' 20" E

A. Description:

The collected Toposheets of study area were scanned, registered and mosaicked using ERDAS Imagine software. Satellite data were collected preprocessed & geo-corrected with respect to registered Toposheet. Secondary data were collected & geo-corrected with respect to registered Toposheet. Contours from Toposheets were digitized and digital elevation model (DEM) for the study area was obtained. Thematic layers on geology, slope, aspect, NDVI, drainage & its density, soil, geomorphology developed for the study area.

B. Software Used:

- ERDAS Imagine 9.2
- Arc GIS 10

C. Flow of Work:

1) Data Processing:

The IRS P6 satellite data were geo-referenced and suitable Image enhancements are applied to facilitate the delineation and interpretation of different thematic information.

2) Data Interpretation:

Visual and digital interpretation methods were used to prepare pre-field interpreted map. The satellite data is interpreted based on photo elements like tone, texture, size, shape, pattern, aspect, association etc. These pre-field interpreted maps and digitally enhanced satellite data are used on the ground to identify different elements of various thems.

3) Field Verification and Data Collection:

Suitable field sampling designs in terms of line transects/ quadrants are used to assess the interpreted elements and relate with satellite data. The field data collections are aided by GPS in order to locate the ground verification points on the image and for further incorporation of details. For the all the sample collection and field points visited attribute information on vegetation, geomorphologic, soil and topographic parameters are also collected. The detailed soil-site study was undertaken in each soil-mapping unit by general traversing and by collecting surface soil, minipit and soil profile observations at intervals depending on soil variability The sample points were decided based on the geological / Geomorphological / soil heterogeneity mapped from the satellite data.

4) Finalization of Maps:

Based on the pre-field interpretation, ground truth verification and available secondary information final maps were prepared in 1: 25000 scales. Towards this both visual and digital approaches are conjunctively used.

III. METHODOLOGY

This method section describes the activities that were carried out to detect single tree felling using remotely sensed data. The first step was pre-processing of the liss iv image. The image was shifted using the main road map and georeferenced using the ground control points collected in the field. The second step was the image classification and the Sub-pixel SP classifier.

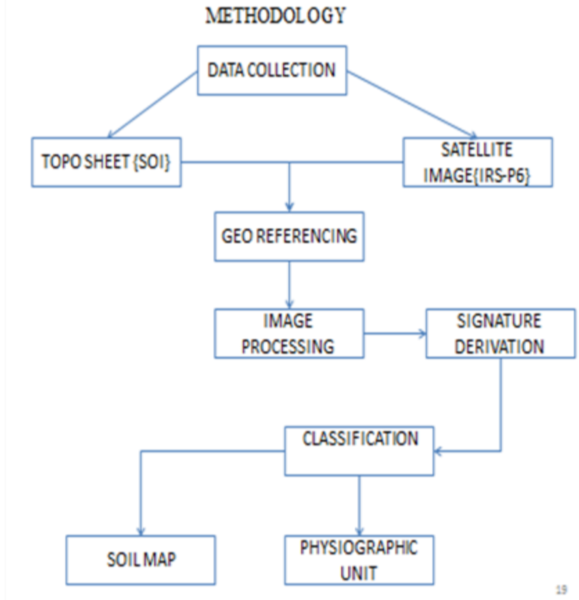

Fig. 2: Methodology map

A. Satellite Map of the Study Area:

The satellite map of the study area. The data was collected from NRSC Hyderabad. The study area covers 5 sub scenes, each sub-scene cover 72.5 Km swath width. It shows different features which are converted in to false color composite to differentiate different features in space. Red soils are seen in Hosur, Shoolagiri, Thally and Kelamangalam. In general, the soil in the district is quite loose and fresh with its colour from Red to dark brown. The soil has low nitrogen and phosphate content with marked variation between different Taluks. The Chief Rivers that flow through the District are Cauvery.

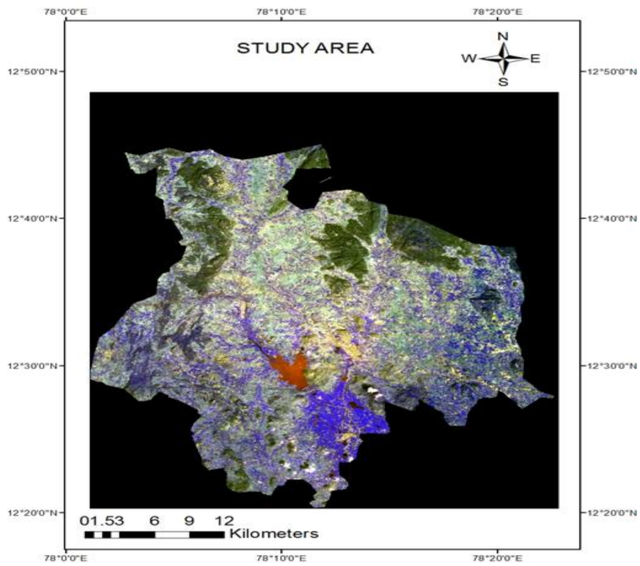

Fig. 3: Satellite map for the study area

IV. RESULT

Remotely sensed image raw-data gathered by a satellite or aircraft needs to be corrected. Even images of seemingly flat areas are distorted by both the curvature of the Earth and the sensor being used. Hence there is a need for geometrically correcting an image. Errors due to earth surface: While covering larger distance of earth's surface (swath width) causes error in pixel size.

A. Geology:

The storage capacity of the rock formations depends on the porosity of the rock. In the rock formation the water moves from areas of recharge to areas of discharge under the influence of hydraulic gradients depending on the hydraulic conductivity or permeability. The study area contains Gneisses, Granites, Charnockite, Granitoid gneiss as major geological structure.

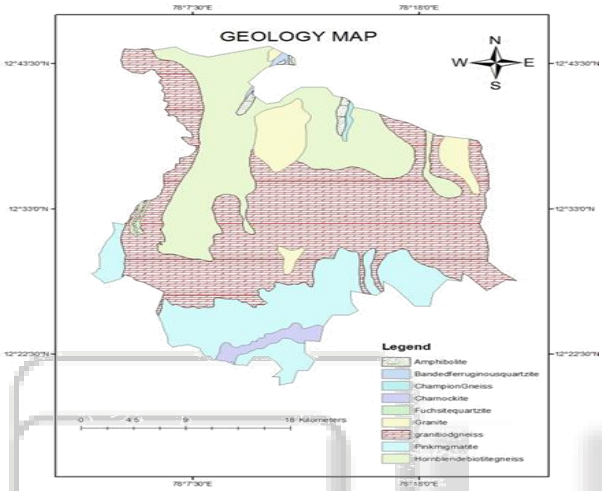

Fig. 4: Geology map for study area

B. Geomorphology:

Climate and geomorphological characteristics of an area affect its response to a considerable extent. There are four different types of landforms present in the study area. It involves the identification and characterization of various landforms and structural features. Many of these features are favorable for the occurrence of groundwater and are classified in terms of groundwater potentiality. The study area has various landforms such as flood plains, pediments, Pedi plains and residual hills.

Fig. 5: Geomorphology map for study area

C. Physiography:

The detailed physiographic unit's interpretation has been done from the IRS-P6 satellite imagery. Such major physiographic units were interpreted on the basis of tone, texture, pattern, size and association references with drainage, relief, slope, etc. The further interpretation of soil mapping over this area has been done by using liss3 imageries which classification of soil types and land use patterns of the different physiographic units.

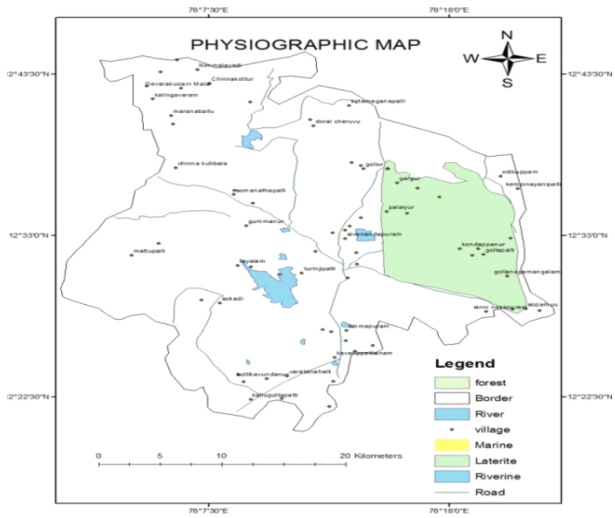

Fig. 6: Physiographic map for study area

D. Soil:

Soil characteristics invariably control penetration of surface water into an aquifer system and they are directly related to rates of infiltration, percolation and permeability. The study area is predominantly controlled by red soil and alluvial soil. It plays an important for delineating the ground water potential zones. Study area also has contains brown and black soil.

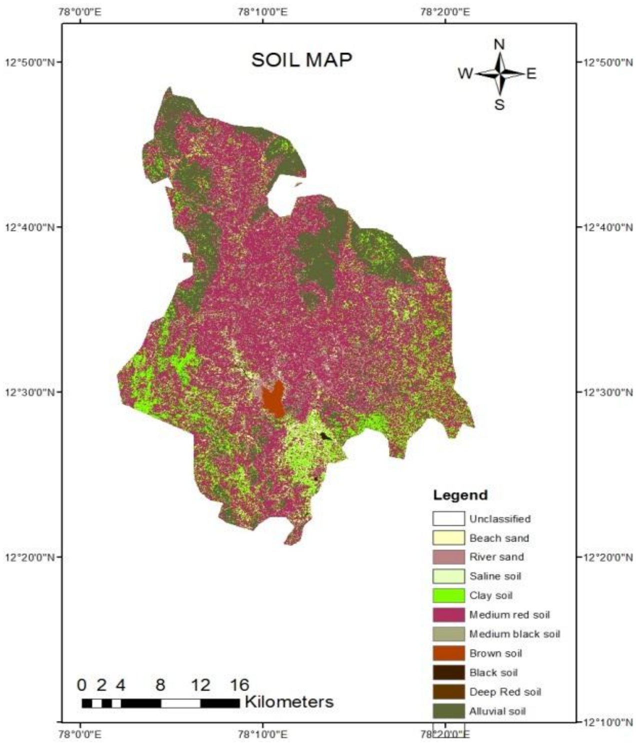

Fig. 7: Soil map for study area

Soils have been classified into Black soil, mixed soil, red loamy soil, gravelly and sandy soils. Red loamy and sandy soils are predominant in krishnagiri taluk. Vast stretches of loam soils and black soils occur in Krishnagiri district. Field observations based on conventional soil survey are tedious and time consuming. The remote sensing data in conjunction with alternative, with a better delineation of soil mapping units. However, there is a need to have an automated method for accurate soil boundary delineation with a Trans disciplinary and integrated approach.

E. Subpixel Classification:

Although the SP classifier requires raw data, a dereferenced image was used because selecting aoi for the training set was not possible using a raw image. Prior to the signature derivation, pre-processing and environmental correction were performed. During the environmental correction cloud pixels were selected and removed.

1) Image Classification:

The classification was run using the selected signature. The default tolerance value was set at one and the number of output classes at eight which will result in eight different MOI fraction classes ranging from 0.20 to 1.0 with increments of 0.1. The eighth class with MOI fraction 0.90-1.0 was considered as the NLP class and the final result was a map with two classes, NLP and other.

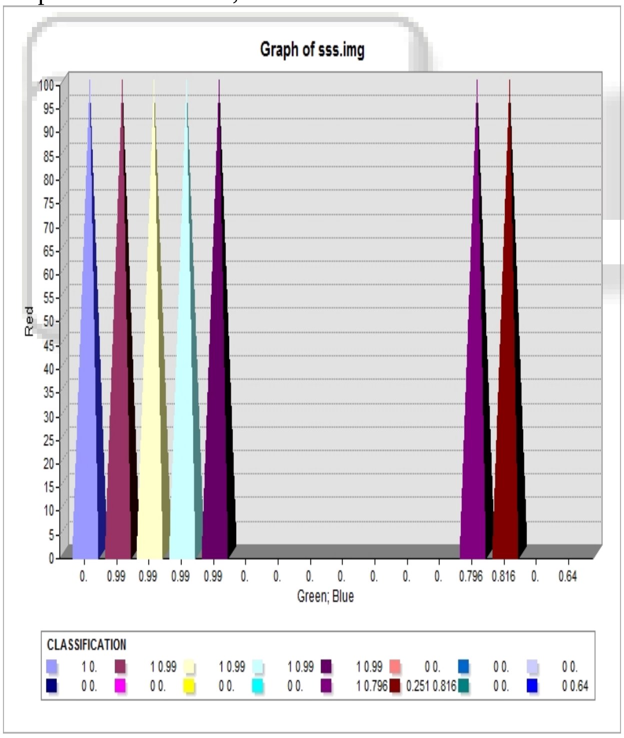

Fig. 8: Crop range in study area

Red soils are seen in Hosur, Shoolagiri, Thally and Kelamangalam. In general, the soil in the district is quite loose and fresh with its colour from Red to dark brown. The soil has low nitrogen and phosphate content with marked variation between different Taluks. The Chief Rivers that flow through the District are Cauvery.

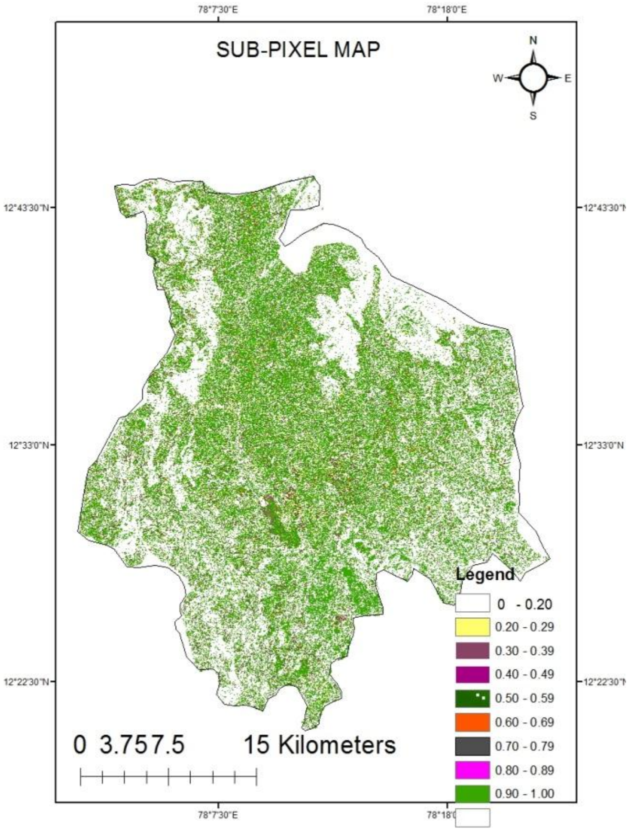

Fig. 9: Subpixel for study area

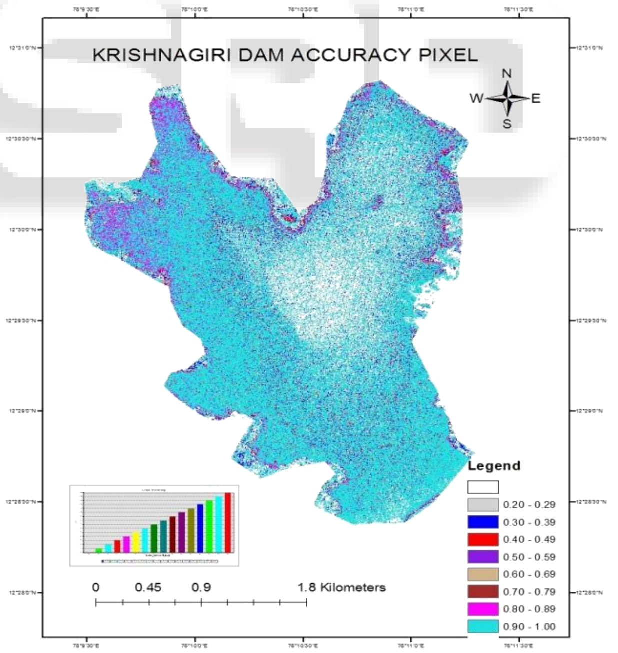

Fig. 10: Krishnagiri dam accuracy pixel

Product	Area	Range
Paddy	20,687 hectares	0.0- 0.20
Ragi	48,944 hectares	0.20-0.29
Other minor crops	11,937 hectares	0.30-0.39
Pulses	48,749 hectares	0.40-0.49
Sugarcane	4,078 hectares	0.50-0.59
Mango	30,017 hectares	0.60-0.69
Coconut	13,192 hectares	0.70-0.79
Tamarind	1,362 hectares	0.80-0.89
other crops	43,199 hectares	0.90-1.00

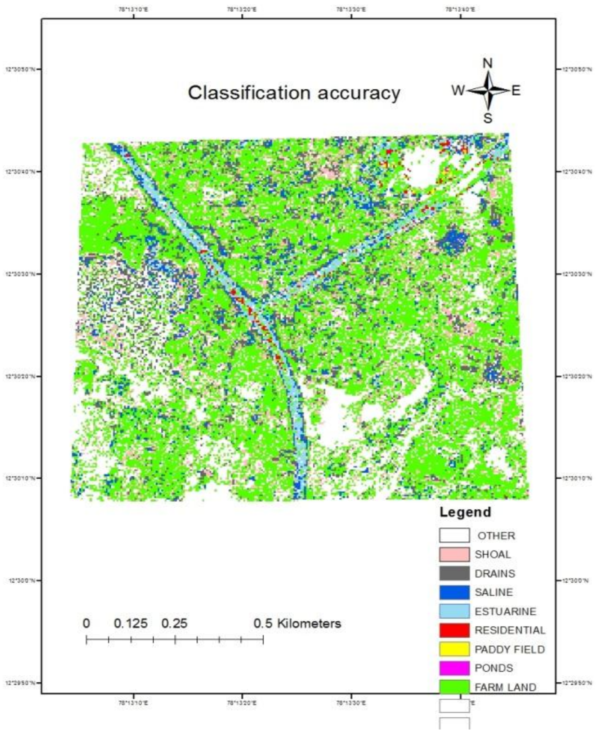

Fig. 11: Road accuracy pixel

V. CONCLUSION

The various literature reviews were reviewed regarding the subpixel classification in soil approach using RS & GIS. This study of Ranges of soil variability can be quantitatively established. The use of remote sensing for soil science can certainly be further advanced by enhanced understanding of the process of interaction of electromagnetic spectrum with soil. identify spectral characteristics of various soil grain sizes and textures. The study highlight is mainly for the soil types and land use patterns. The soils are suitable for agricultural activities.

A. Future Scope:

The study can be benefited to future by

- To develop agricultural area.
- To sub-pixel classification method can give the proper high classification accuracy and more accurate results to identify the minor features.
- To Investigate and apply various strategies for classification of these data in extracting earth resources information such as geology, land use and land cover, soil, geomorphology, vegetation etc.

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