

**RAPID RECONNAISSANCE SOIL & LAND DATABASE OF TAMIL NADU
STATE**



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are in-house data of the organization available in
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PREFACE

Soil is a key part of our natural environment and is a non-renewable resource. Soil loss due to erosion can have major implications not just for soils and the benefits they provide but also for air and water quality as well as our climate, biodiversity and economy. The acquisition of adequate information on soil and land characteristics is thus essential to formulate a viable strategy to check the degradation of soil and land resources. Proper consideration of soils through the planning system is needed to make sure that soils can deliver essential functions vital for the sustainability of Indian environment and economy.

Soil and Land Use survey of India (SLUSI), Department of Agriculture, Cooperation and Farmers' Welfare, Ministry of Agriculture and Farmers' Welfare carried out Rapid Reconnaissance Survey (RRS) to identify & demarcate the potential soil erosion in river catchment of different river basins using extensive ground truthing. The details on various facets of soil & land have been assessed to fix sub /micro watershed wise priority in catchments based on the assessed runoff using SYI/RPI index. The work for data acquisition on RRS has been completed by organization in 2010. Subsequently SLUSI took up a national initiative to digitize the RRS maps and data on soils of the country at 1:50, 000 in different states.

With a view to provide details to users in various states, SLUSI took up the initiative to seamlessly compile the digital soil & land character data base acquired on 1:50 scale during the decades. This state-level RRS guide contains agro-climatic sub-zone wise information on various soil parameters such as landscape, physiography, slope, depth, texture and erosion status.

The digital soil database can be vital input as considered in the National Disaster Management Plan and State Disaster Management plan of Tamil Nadu, which recognizes soil as a physical asset and highlight the need to manage our finite soil resource by maintaining and improving its condition.

The spatial database would play an effective role to support the decision makers to achieve the right development in the right place and identifies the need to consider the implications of development on soil quality as one of its guiding principles.

This enormous task is accomplished by officers and officials of Soil and Land Use Survey of India. I hope that the RRS guide may serve as a guiding tool for user's departments /agencies of the state.

Date:
Place: New Delhi

Rajni Taneja
Chief Soil Survey Officer

CONTENT

| Sl. No. | Particulars | Page No. |
|-------------------------------------------------------|----------------------------|----------|
| Overview | | |
| 1. | Prelude | 1 |
| 2. | Introduction | 1 |
| 2.1 | Objective | 2 |
| 2.2 | Background | 2 |
| 2.3 | Data Source | 3 |
| 2.4 | Methodology | 3 |
| 2.5 | Output | 4 |
| Hydrologic Frame Work of Watershed | | 5 |
| Agro climatic Sub zones of Tamil Nadu | | 7 |
| Outcomes of soil and Land Database | | 9 |
| I. | Landscape/ Parent material | 9 |
| II | Soil Erosion | 13 |
| III | Soil Depth | 17 |
| IV | Soil Slope | 19 |
| V | Land Use | 21 |
| VI | Soil Texture | 24 |
| District-wise Categorization of Priority Class | | 26 |

OVERVIEW

1. Prelude

The purpose of planning is to manage the development and use of land in long term public interest. Soil is a key part of our environment and is effectively a non-renewable resource. Soil loss due to erosion can have major implications not just for soils and the benefits they provide but also for air and water quality as well as our climate, biodiversity and economy. Proper consideration of soils through the planning system is needed to make sure that soils can deliver essential functions vital for the sustainability of Indian environment and economy.

The National disaster management plan (NPF) and Disaster Management plan of Tamil Nadu state recognize soil as a physical asset and highlight the need to manage our finite soil resource by maintaining and improving its condition.

The acquisition of adequate information on soil and land characteristics is thus essential to formulate a viable strategy to check the degradation of soil and land resources. To combat the situation development of spatial database would play an effective role to support the decision makers to achieve the right development in the right place and identifies the need to consider the implications of development on soil quality as one of its guiding principles.

2. Introduction

Soil and Land are important natural resources on the surface of the earth. The biomass covers the surface and act as natural protector of soil in the area. But due to variety of reasons the vegetative cover distribution varies at various location in the state. The area in state suffers from a variety of problems of soil erosion, soil salinity, sodicity/ alkalinity, shallow depth, unfavorable texture responsible for increased land degradation. Tamil Nadu homes over 16% of countries population in an area, which is 3.96% of TGA of the country. Per Capita arable land in state is around 0.15 ha at present.

There is ever growing need to new Watersheds technology in an integrated watershed management-tool for climate smart solution in the entire river basin to treat the abiotic or physical component of a river basin including soil and water, and mineral deposits and other compounds bound up with them. Water is a dynamic resource variable in time and space from season to season in year, as the status of surface and ground water in a basin area follows a cyclic mode for replenishment and losses. But in contrast to water, soils formation and development –take place from the physical weathering of parent material (rocks) to chemical decomposition and biological transformation – is a drawn-out process that may take hundreds or thousands of years [Jenny, 1994]; and taking into account of time required in the soil development, once formed, soils may be fairly durable if not conserve it, once it protect from runoff due to precipitation and reduce the severity of related erosion. Thus, changes in a basin's water resource status is relatively fast and easily identified, while the soils those changes naturally slow and unnoticed with significant human activity in many ecosystems (example, in agro-ecosystems and urban ecosystems), and climate change phenomenon the complexity of human-technology-environment systems has increased manifold [Pahl-Wostl, 2006] resulted in drastic change in soil quality status that has under gone degradation drastically. Now a days many land degradation problems are being faced in our country such as salinity / alkalinity and waterlogging in command areas, severe erosion in catchments leading to siltation of reservoirs, decrease in productivity of crops etc. As both soil and water are operating in ecosystem synergistically to one another through many biotic and abiotic processes. Being thus interrelated, degradation of either soil or water has a concurrent effect on the other; hence neither can be considered in isolation

Therefore, in recent years' emphasis is laid on the information on the nature, extent, spatial distribution and magnitude of land degradation which plays a vital role in planning the strategies for reclamation /conservation of degrade soil and land characteristics.

Management of soil and water resources conservation under RVP/FPR catchments is completed by SLUSI to assess the priority sub/ micro watersheds / Hydrologic unit's area under various catchments of the state in last three decades on 1: 50,000 scale. In this context mapping of soil and land features as well as land use/cover information, adequate field visit/survey were carried out for mapping.

2.1 Objective

The basic objective of the Rapid reconnaissance mapping is to calculate the sediment yield of the catchment and determine the status of runoff and soil loss in the country on 1:50,000 scale. Generating priority hydrologic units (sub/micro) level spatial maps based on its assessed erosion through sediment yield potential and generating soil & land information with its spatial distribution components helps to check soil erosion using conservation measures.

2.2 Background

A national policy was adopted to use watersheds for the development of land and water resources for conservation in all possible river basins. The selection of watersheds in catchment areas of different river basin for development of water and soil resources was done on the basis vulnerability assessment of soils for erosion, demographic setting of the area by prioritizing on problem's severity. Each priority watershed was surveyed and studied morphologically and topographically to generate database. The development of Watersheds is applied not only to the geo-physical situation but also to the people's need.

Watersheds are natural hydrological entities that cover a specific areal expanse of land surface from which the rain fall runoff flows to a defined drain of channel, stream or river of any particular point. The size of watershed is governed by the size of the stream/river or the point of intersection on the stream/river like dam/barrage etc. A workable size of watershed is defined by aims and objectives of the development programs. The size of watersheds will also differ with the different stages between macro to micro level of planning and implementation of watershed programs. (AIS&LUS, 1990).

The concept of a watershed as the planning unit for the development of land and water resources has been available for long, but the watershed approach has gained importance since 1974.

The Soil and Land Use Survey of India (SLUSI erstwhile AIS&LUS) has initiated delineation and codification of hydrologic units in the country, since launching of Centrally Sponsored Scheme on Soil and Water Conservation in the catchments of River Valley Project during III Five-Year Plan. The delineation of a hydrologic unit is carried out following hierarchical system of rivers/streams based on drainage network. The codification of hydrologic unit is made to assign a unique code to all hydrologic units following Alfa-numeric Codification System. The drainage network helps in the delineation of a watershed for a particular river system.

In an attempt to acquire soil and land resource information at reconnaissance level survey, SLUSI (1991) has developed and published a methodology to map the potential soil erosion in different river catchment area using extensive ground truthing method. The organization has carried out Rapid Reconnaissance soil survey to map various facets of soil and land to assess sub /micro watershed wise priority in catchments of the states based on the assessed runoff using SYI/RPI index and plan to complete the work of data acquisition by 2012. Subsequently SLUSI (2010) took up a national initiative to digitize the RRS maps and data on soils of the country at 1:50, 000 in different states.

In recent times, SLUSI took up the initiative to seamlessly compile the digital national soil and land character data base acquired on 1:50 scale during last three decades. Mapping of natural resources has been an on-going activity for more than three decades.

2.3 Data Source

2.3.1 Acquisition of soil and land data

The work of mapping of areas in catchment areas was started in 1985 in the state. The initial mapping of soil and land characteristics was carried out using Survey of India topographic maps with extensive field ground truthing involving study of profile/ mini pits and auguring at regular interval.

The digitalization drive was undertaken by SLUSI in 2010 with NIC to place the soil and land character data on SLUSI geo portal with Universal Traverse Mercator 1 (UTM 43 and 44 N) projection. The final outputs were later converted Albers equal area with following parameters.

2.3.2 Specifications Table

Subject: Geographic Information System (GIS), Soil Mapping

Type of data: Image Figure Digital maps (quantitative), Metadata (Attributes)

How data were acquired: GIS digitization, raster to vector conversion ESRI ArcGIS 10.3.1

Data format: Raw Vector shape files (.shp); Soil database, Raster images (Tiff, JPEG)

Data Accessibility: Only the static graphic maps are included in this article. The main digital data are hosted on <https://slusi.dacnet.nic.in>

Projection:

Universal Traverse Mercator Projection

Spheroid: WGS84

Datum: WGS1984

False _Easting: 500000.0

False _Easting: 0.0

Central Meridian: 81.0

Scale _Factor: 0.9996

Linear Unit Meter (1.0 Legacy/ancillary data)

For mapping of soil and land characteristics on 1: 50,000 scale, land use/land cover, wetland and wastelands thematic information's taken from SOI toposheets was used as base map. Besides this, forest cover map generated by Forest Survey of India (FSI) was also referred.

The tabular distribution of area details of Geographic / landscape (parent material) and climate data acquired from district level state government records/ district gazetteer used as reference information while mapping. Apart from this, district boundary taken from Survey of India topographical maps, meteorological data use to assess the soil loss especially while mapping of water erosion categories.

2.4 Methodology

The various steps followed in the methodology for mapping RRS on 1:50,000 scale. First of all, we select the area and estimate the erosion intensity mapping units for Hydrologic unit's delineation up to sub / micro watersheds and codification done using Survey of India toposheets. This information was converted to digital layer using DEM downloaded from BHUVAN. The steps includes were:

- ☐ Delineation of catchment areas / bigger hydrologic unit into small watersheds (hereinafter will be called as Sub watersheds) on 1:50,000 scale topographic maps of Survey of India.
- ☐ Codification of different stages of delineation by using Alpha-numeric symbolic code.
- ☐ Rapid Reconnaissance survey using 1:50,000 scale topo-maps, satellite imagery/aerial photographs and other basic material leading to the generation of a map indicating erosion intensity/ runoff potential mapping units.
- ☐ Assignment of weightage values to various Erosion Intensity Mapping Units (EIMU) or Run-off Potential Mapping Units (RPMU) based on their relative Sediment Yield/ Run-off Potential.

- ❑ Assignment of maximum delivery ratios to various Erosion Intensity Mapping Units and assessment of adjusted delivery ratio for different sub/micro watersheds.
- ❑ Computation of Sediment Yield Index / Run off potential Index for individual sub/micro watersheds.
- ❑ Grading of sub/micro watersheds into very high, high, medium, low and very low Priority categories.

(Steps sourced from: Methodology of Priority Delineation survey manual published by erstwhile AISLUS in 1991)

2.5 Output

SLUSI carried out detailed study of soils and generate soil database for watershed management and other developmental aspects in priority areas. The Rapid Reconnaissance survey helps in categorization of the areas in different classes on priority basis such as very high, high, medium, low and very low. The areas which comes under very high and high priority classes needs to check the runoff water through applying watershed approach.

SLUSI successfully completed development of state-wise Micro Watershed Atlas of India using 1:50 k scale drainage map. The organization has also developed Web-enabled Micro Watershed Information system which is in public domain since December, 2010 (<https://slusi.dacnet.nic.in>). It provides Micro watershed data & information in a national standardized format that allows users to search, access, and visualize data and information for planning development of water resource

The reconnaissance level maps at their original scale showing spatial distribution of site features such as land scape, physiography, slope, land use and soil characteristics namely colour, texture class, soil erosion status for indicating soil loss, surface conditions and management also provided as thematic service available on <https://slusi.dacnet.nic.in>

The Tamil Nadu soil attribute and priority survey maps provide useful background information on the types and properties of soils at regional scales. The more detailed Soil map of area can be accessed from detailed Soil Survey data.

HYDROLOGIC FRAMEWORK OF WATERSHED

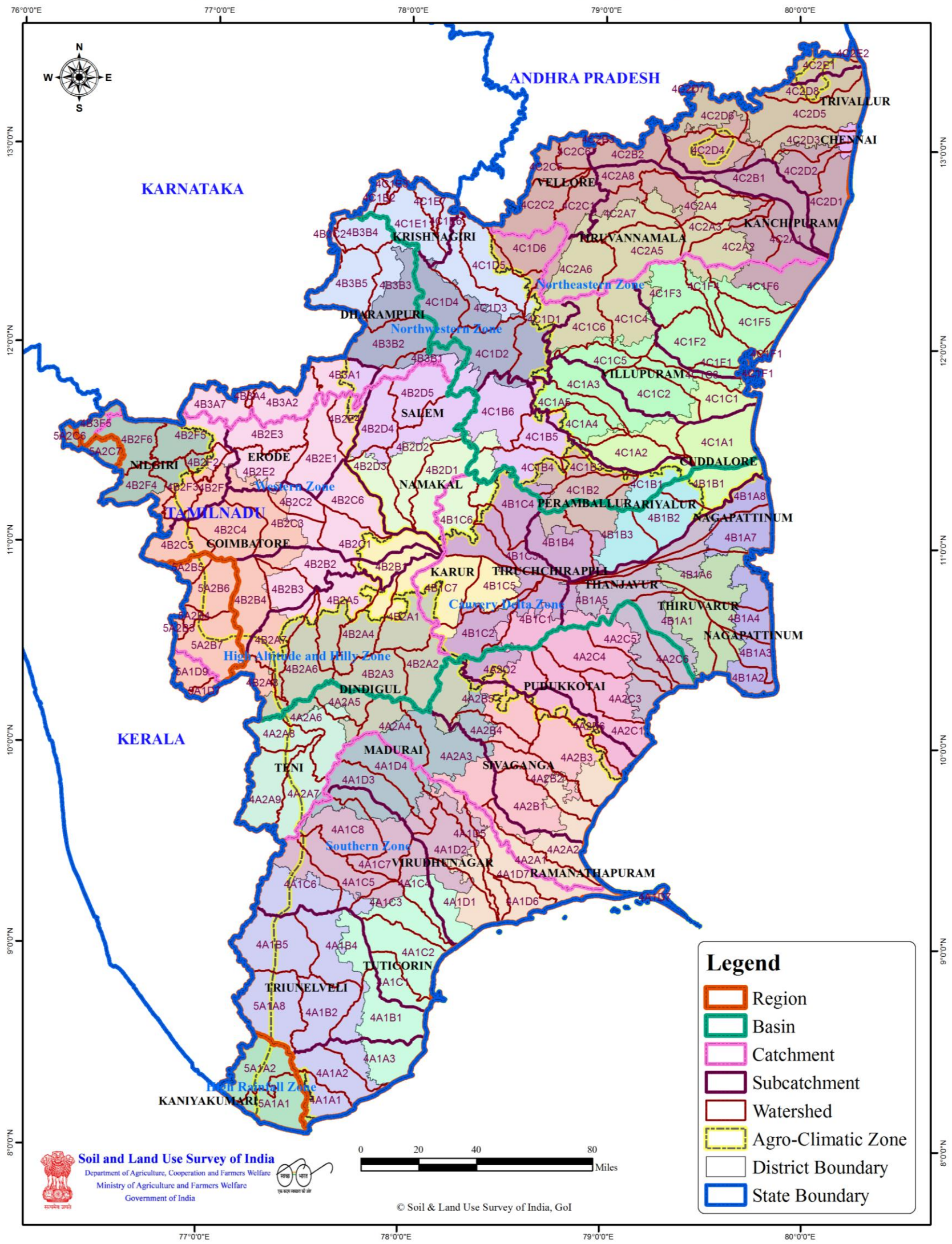
The digital spatial distribution land features such as landscape/parent material, physiography, slope, land use prevalent during the time mapped with soil morphological characteristics such as soil depth, texture, erosion are the most important physical health status indicators required in planning of area, hydrologically or district wise.

SLUSI has developed the model for fixing priority areas based on relative assessment of vulnerability of soils to erosion. This has been done on sub/micro watershed wise in different catchments of the state. The Region, Basin, Catchment and Sub-catchment wise distribution with number of Watersheds, Sub-watersheds and Micro-watersheds and their total area presented in table given below. Catchment wise area of Watershed is given below in the table and in thematic map as **figure no. 1**.

| S.No. | Region | Basin | Catchment | Sub-catchment | Total No. of Watershed | Total No. of Sub-watershed | Total No. of Micro-watershed |
|-------|--------|-------|-----------|---------------|------------------------|----------------------------|------------------------------|
| 1 | 4 | 4A | 4A1 | 4A1A | 3 | 25 | 145 |
| | | | | 4A1B | 5 | 73 | 369 |
| | | | | 4A1C | 8 | 72 | 449 |
| | | | | 4A1D | 7 | 62 | 365 |
| | | | 4A2 | 4A2A | 9 | 84 | 477 |
| | | | | 4A2B | 6 | 77 | 399 |
| | | | | 4A2C | 6 | 65 | 340 |
| | | 4B | 4B1 | 4B1A | 8 | 80 | 488 |
| | | | | 4B1B | 4 | 52 | 264 |
| | | | | 4B1C | 7 | 65 | 392 |
| | | | 4B2 | 4B2A | 8 | 87 | 434 |
| | | | | 4B2B | 4 | 31 | 157 |
| | | | | 4B2C | 6 | 65 | 307 |
| | | | | 4B2D | 5 | 60 | 306 |
| | | | | 4B2E | 4 | 40 | 195 |
| | | | | 4B2F | 6 | 64 | 272 |
| | | | 4B3 | 4B3A | 7 | 43 | 178 |
| | | | | 4B3B | 5 | 56 | 249 |
| | | | | 4B3C | 1 | 6 | 18 |
| | | | | 4B3F | 2 | 10 | 32 |
| | | 4C | 4C1 | 4C1A | 5 | 52 | 281 |
| | | | | 4C1B | 6 | 54 | 301 |
| | | | | 4C1C | 6 | 54 | 289 |
| | | | | 4C1D | 6 | 70 | 394 |
| | | | | 4C1E | 5 | 33 | 143 |
| | | | | 4C1F | 6 | 77 | 339 |
| | | | 4C2 | 4C2A | 8 | 83 | 450 |
| | | | | 4C2B | 3 | 23 | 123 |
| | | | | 4C2C | 6 | 40 | 164 |
| | | | | 4C2D | 8 | 83 | 448 |
| | | | | 4C2E | 2 | 11 | 52 |
| 2 | 5 | 5A | 5A1 | 5A1A | 3 | 24 | 122 |
| | | | | 5A1D | 2 | 12 | 57 |
| | | | 5A2 | 5A2B | 5 | 43 | 180 |
| | | | | 5A2C | 2 | 11 | 32 |
| Total | 2 | 4 | 9 | 35 | 184 | 1787 | 9212 |

The state comes under two water resource regions, i.e. Region no. 4 (All drainage flowing into Bay of Bengal) and Region no. 5 (All drainage flowing into Arabian sea). Further, the state comes under 04 basins, 09 Catchments, 35 Sub catchments, 184 Watersheds, 1,787 Sub watersheds and 9,212 Micro watersheds as depicted in the above table. Out of the total catchment area, maximum area comes under catchment 4C2 having 31,82,332 ha. followed by 4C1 (28,32,543 ha.), 4B2 5,17,782 ha.), 4B3 (22,05,837 ha.), 4A1 (20,28,840 ha.), 4A2 (17,72,416 ha.), 4B1 (17,16,302 ha.), 5A1 (13,17,194 ha.) and 5A2 (10,17,440 ha.).

Fig.1. Spatial Distribution of Watershed in Tamil Nadu



AGRO CLIMATIC SUB-ZONES OF TAMIL NADU

Out of 15 agro climatic zones of country identified by Planning commission of India, two namely ACZ 10-southern plateau and hill region and ACZ 11 east coast and hill region comes under Tamil Nadu state. The specific constraints in those 2 regions are poor water management, poor nutritional status of soils and saline lands. The state under National Agriculture Research Program subdivided under seven agro climatic sub- zone, i.e. Cauvery delta zone, high altitude and hilly zone, high rainfall zone, northeastern zone, northwestern zone, southern zone and western zone. The distribution of districtwise catchment shows the Cauvery delta area forms part of 4A2, 4B1, 4B2, 4C1 catchment area of rivers, covered under Trichirapaloi, Perambalur, Ariyalur, Tanjavur, Pudukotai, Karur, Nagapattanam, Thiruvarur,

The major agro climatic features are:

I. Southern Plateau & Hills Region-X

(1) Features:

- Large rainfed area;
- Large scale cultivation of low value cereals; and
- Tank led irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, sweet sorghum, foxtail millet, maize, horse gram, green gram, sunflower, safflower, cotton & groundnut.

(2.2) Horticulture crops: Tapioca, gherkins, onion, okra, chilies, brinjal, tomato, flowers (Gomphrena, crossandra & Jasmine), garlic, ginger and medicinal & aromatic (Sandal wood, glory, Lilly, Senna, ashok, cinchona).

(2.3) Fruit crops: Mango, banana, grapes, guava, sapota, & citrus.

(2.4) Plantation crops: Rubber, coconut, mulberry, cashew nut, areca nut & cocoa.

(2.5) Livestock & others: Cattle, buffaloes, sheep, goat, poultry, piggery, fishery, beekeeping & Seri-culture.

(3) Farming systems:

- Rice and Coarse cereals based cropping systems;
- Piggery; and Marine fisheries.

(4) Cropping sequences:

(a) Rainfed Areas:

- Sweet sorghum – cotton - groundnut; and
- Sweet sorghum – green gram – fodder;

(b) Irrigated Areas:

- Rice – Rabi maize – green gram; and
- Cotton – Rabi maize – fodder.

(5) Sub-region specific development related priorities (all the 6 sub-regions):

- Creation additional irrigation potential to harness full potential of agriculture;
- In-situ water harvesting/conservation through adoption of cultural practices like ridge and furrow planting, inter-cropping of legumes in uplands, planting against slope in undulating terrain/hilly tract;
- Inter-culture in between rows to create soil mulch and vegetative/bio-mulching;
- Reclamation of saline/alkaline/acidic/water logged/ill drained soils;
- Productive use of barren and un-cultivated lands, cultivation of waste and permanent fallows through afforestation;
- Diversification of crops to high value crops;
- Diversification of sugarcane area by Cotton;
- Adoption of Integrated farming system with a component of crops, livestock, silvipastoral system and agri-horticulture;
- Promotion of Rice hybrids in conjunction with SRI method of cultivation;
- Promotion of hybrids of maize, cotton, sorghum, sunflower; and f Adoption of improved rainfed farming system.

(6) Research priorities:

Development of salt tolerant varieties of rice;
 Delineation & mapping of multi-nutrient deficiency;
 Water harvesting and recycling; and
 Soil & water salinity management.

II. East Coast Plains & Hills Region-XI

(1) Features:

Rich water resources with relatively unfertile land;
 Fragile ecology due to water logging, soil salinity/acidity and soil erosion; and
 Tank led irrigation.

(2) Potential crops, fruits & Livestock:

(2.1) Agriculture crops: Rice, sweet sorghum, maize, sugarcane, black gram, green gram, groundnut, Niger, sunflower, cotton, Jute & Mesta.

(2.2) Horticulture crops: Black pepper, turmeric, brinjal, okra, tapioca, chilies, onion, sweet potato, flowers (Tube rose, Enthuri & Gomphrena), medicinal & aromatics (Coleus & scented geranium).

(2.3) Fruit crops: Cashew nut, mango, sapota, banana, custard apple and pine- apple.

(2.4) Plantation crops: Cashew nut & coconut.

(2.5) Livestock & others: Cattle, buffalo, sheep, goat, poultry, duck & fishery.

(3) Farming systems:

- Rice based cropping systems;
- Fish and Prawn culture;
- Piggery; and
- Poultry.

(4) Cropping sequences:

(a) Rainfed Areas:

Sweet sorghum – cotton - groundnut; and
 Sweet sorghum – green gram – fodder;

(b) Irrigated Areas:

Rice – groundnut - green gram;
 Rice – green gram /black gram;
 Cotton- green gram – green manure; and
 Soybean – sunflower – green gram.

(5) Sub-region specific development related priorities (all the 6 sub-regions):

Productive use of barren and uncultivated lands, cultivable waste and permanent fallows through afforestation;
 Reclamation soil salinity/alkalinity through use of Gypsum/Pyrites;
 Reclamation of acidic soil through liming/mills sludge;
 In-situ water harvesting/conservation through adoption of cultural practices like bed furrow in deep black cotton, uplands and flat sowing and ridging later in red soils;
 Diversification of the area of low value crops to high value crops;
 Promotion of hybrid rice in conjunction with SRI method of cultivation; and
 Development of Tribal agriculture.

(6) Research priorities:

Development of salt tolerant cultivars of rice;
 Delineation & mapping of multi-nutrient deficiency;
 Farming systems and
 Crop management in flood prone areas.

OUTCOMES OF SOIL AND LAND DATABASE

The management of sub/micro watersheds on priority wise in phased manner have been taken up on the analysis of acquired soil and land parameters collected through Rapid Reconnaissance Soil Survey of the state. The outcomes such as Landscape/parent material, Soil erosion, Depth, Slope class, Land use and Soil texture brought out during the survey. These database can be used as a baseline for the development of soil and land quality in the state.

I. Landscape/ Parent Material

The geological formation of India is diverse, ranges from oldest Archean rocks to the recent Alluvium. The major geological formation in the peninsula consists of Archean rocks comprising Gneiss, Schist, Igneous and Metamorphic rocks. Western and Central India are covered by lava flows of the Deccan trap. A close relation exists between soil and physiography, the diversities in physiography, climate and landscapes have enhanced the formation of widely diverse soils in India.

The tabular distribution of landscapes in the state are furnished gives account of landscape in different agro climatic sub zones. These are seven subzones and it is observed that the effect of these zones on the soil development having identical landscape is varying as every zone is having unique climatic features with respect to total rainfall, temperatures, and vegetation which directly governs the soil development. This grouping not only helps in identifying the natures of soil type in different zones under same landscape/parent material but its capacity to grow different crops/orchards etc.

Based on soil conditions, irrigation, cropping pattern, rainfall distribution and other ecological & social characteristics, the state is falling under 7 agro-climatic sub zones exhibiting different geological formations namely, Aeolian, Alluvium, Charnokite, Coastal Alluvium, Granite, Granite Gneiss, Laterite, Limestone and Sandstone. Out of these Seven (07) sub-zones, maximum area of 33,26,724 ha. is under Southern zone covering districts Dindigul, Kanyakumari, Madurai, Ramanathapuram, Sivaganga, Teni, Triunelveli, Tuticorin and Virudhnagar followed by Northeatern zone with an area of 30,77,652 ha covering districts Cuddalore, Kanchipuram, Tiruvannamala, Vellore, Villupuram, Chennai and Trivallur. Third highest area is under Cauvery Delta zone with an area of 23,84,060 ha. covering districts Pudukkottai, Thanjavur, Tiruchchirappalli, Ariyalur, Karur, Nagapattinum, Perambalur and Thiruvarur. Then under Northwestern zone having 18,30,759 ha area covering under Namakal, Salem, Dharampuri and Krishnagiri districts; Western zone with an area of 12,92,614 ha covering districts Coimbatore, Dindigul, Erode and Karur; High altitude and hilly zone with an area of 9,97,039 ha covering districts Kanyakumari, Madurai, Teni, Triunelveli, Virudhnagar, Dindigul, Coimbatore, Niligiri, Trivallur and Vellore. Least area of 1,08,495 ha is under high rainfall area covering only one district Kanyakumari.

Agro-climatic sub-zones/ district wise tabular distribution of area and thematic maps of geology shown in **table: 1** and **figure no. 2**.

Table: 1 Agro-climatic sub-zone/ Catchment wise tabular distribution of area under different landscapes in districts of Tamil Nadu state

| Agro climatic sub-zone | Catchment | District | Landscape | | | | | Miscellaneous | Total Area |
|------------------------|-------------|-------------------|-----------|------------------|---------|----------|-----------|---------------|------------|
| | | | Alluvium | Coastal Alluvium | Granite | Laterite | Limestone | | |
| Cauvery Delta Zone | 4A2 | Pudukkottai | 17253 | 7687 | 284806 | 22635 | | 58586 | 390968 |
| | | Thanjavur | 5573 | 10309 | 93236 | 9515 | | 12080 | 130712 |
| | | Tiruchchirappalli | 78 | | 34662 | | | 2658 | 37398 |
| | Total | | 22904 | 17996 | 412704 | 32149 | | 73325 | 559077 |
| | 4B1 | Ariyalur | 22011 | | 102493 | 20973 | | 10439 | 155917 |
| | | Karur | 127 | | 142642 | | | 7692 | 150461 |
| | | Nagapattinum | 163104 | 49516 | | | | 44010 | 256631 |
| | | Perambalur | 1730 | | 55791 | | | 3289 | 60810 |
| | | Pudukkottai | 2105 | | 48659 | 12787 | | 10632 | 74183 |
| | | Thanjavur | 117871 | 1900 | 39384 | 25206 | | 26395 | 210757 |
| | | Thiruvarur | 126793 | 54550 | 22022 | | | 8264 | 211629 |
| | | Tiruchchirappalli | 25342 | | 320500 | 9034 | | 42240 | 397116 |
| | Total | | 459084 | 105967 | 731490 | 68001 | | 152961 | 1517503 |
| | 4B2 | Karur | 1975 | | 131267 | | | 7043 | 140285 |
| | | Tiruchchirappalli | 429 | | 980 | | | 181 | 1591 |
| | Total | | 2404 | | 132248 | | | 7224 | 141876 |
| | 4C1 | Ariyalur | 616 | | 19417 | 15925 | | 2045 | 38003 |
| | | Perambalur | 1515 | | 106471 | | 337 | 5537 | 113861 |
| | | Tiruchchirappalli | | | 13616 | | | 123 | 13740 |
| | Total | | 2131 | | 139505 | 15925 | 337 | 7706 | 165604 |
| | Grand Total | | 486523 | 123963 | 1415946 | 116075 | 337 | 241216 | 2384060 |

Sub-zone-I:- Cauvery Delta zone : This zone accounts for 2384060 ha in state and five landscape classes such as Alluvium, Coastal Alluvium, Granite, Laterite and Limestone have been identified. Among the landscape mapped major part of

zone comes under Granite landscape (14,15,946 ha) followed by Alluvium landscape (4,86,523 ha) then Coastal alluvium, Laterite and Limestone having 1,23,963 ha, 1,16,075 ha and 337 ha area, respectively.

The depth is main characteristics of soils in this zone where majority of area having shallow to moderately deep soils followed by very shallow soil depth and good soil depth (moderately deep to deep), fine loamy to fine textured having medium to high moisture and nutrient holding capacity and suited for most of crops/orchards. The soils of coastal alluvium are of sandy to coarse textured subject to flooding.

| Agro climatic sub-zone | Catchment | District | Landscape | | | | | | Miscellaneous | Total Area |
|------------------------------|-------------|--------------|-----------|------------|---------|----------------|----------|-----------|---------------|------------|
| | | | Alluvium | Charnokite | Granite | Granite Gneiss | Laterite | Limestone | | |
| High Altitude and Hilly Zone | 4A1 | Kanyakumari | | | 333 | | | | 21 | 354 |
| | | Madurai | | | 68 | 11 | | | | 80 |
| | | Teni | | | | 0 | | | | 0 |
| | | Triunelveli | | | 140967 | | | | 9960 | 150927 |
| | | Virudhunagar | | | 21865 | 17 | | | 620 | 22501 |
| | Total | | | | 163233 | 28 | | | 10601 | 173862 |
| | 4A2 | Dindigul | | | 11 | 346 | | | | 357 |
| | | Madurai | | | | 33 | | | | 33 |
| | | Teni | 6501 | | 1569 | 143282 | | | 2621 | 153973 |
| | | Virudhunagar | | | 9 | 273 | | | 2 | 284 |
| | Total | | 6501 | | 1589 | 143934 | | | 2622 | 154647 |
| | 4B2 | Coimbatore | 1414 | 1132 | 94887 | 15970 | | 731 | 5776 | 119910 |
| | | Dindigul | | | 16421 | 47 | | | 575 | 17043 |
| | | Nilgiri | | 119335 | 36592 | 38677 | | | 4309 | 198913 |
| | | Teni | | | 74 | 24 | | | | 98 |
| | Total | | 1414 | 120467 | 147974 | 54718 | | 731 | 10660 | 335964 |
| | 4B3 | Nilgiri | | 35 | 359 | 23415 | | | 103 | 23912 |
| | Total | | | 35 | 359 | 23415 | | | 103 | 23912 |
| | 4C2 | Trivallur | 7187 | | 5720 | | 11802 | | 3598 | 28307 |
| | | Vellore | 892 | | 21592 | | | | 3615 | 26099 |
| | Total | | 8078 | | 27312 | | 11802 | | 7213 | 54405 |
| | 5A1 | Coimbatore | | | 42984 | | | | 1495 | 44479 |
| | | Kanyakumari | 4714 | | 52149 | | | | 3084 | 59947 |
| | | Triunelveli | | | 0 | | | | | 0 |
| | Total | | 4714 | | 95132 | | | | 4580 | 104426 |
| | 5A2 | Coimbatore | | | 104368 | | | 4383 | 6383 | 115134 |
| | | Nilgiri | | 187 | 34373 | 62 | | | 65 | 34687 |
| | Total | | | 187 | 138741 | 62 | | 4383 | 6448 | 149822 |
| | Grand Total | | 20708 | 120689 | 574341 | 222158 | 11802 | 5114 | 42227 | 997039 |

Sub-zone-II: -High Altitude and Hilly Zone: By and large this zone spreads out in Nilgiri and smaller extent in eastern ghat. The High Altitude and Hilly Zone covers 9,97,039 ha total geographical area of the Tamil Nadu state and six landscapes such as Alluvium, Charnokite, Granite, Granite Gneiss, Laterite and Limestone have been identified and mapped. Granite is the major landscape having 5,74,341 ha area followed by Granite gneiss (2,22,158 ha) then Charnokite (1,20,689 ha), Alluvium (20,708 ha), Laterite (11,802 ha) and Lime stone (5,114 ha).

Maximum area are under shallow to moderately deep soil depth followed by very shallow to shallow soil depth, moderately deep soil depth, shallow soil depth and deep soil depth with medium texture. The soils are distinctively different from that observed in rest of the state. Agriculture and forestry/plantation are the major land use/cover reported.

| Agro climatic sub-zone | Catchment | District | Landscape | | | | Miscellaneous | Total Area |
|------------------------|-------------|-------------|-----------|----------|------------------|---------|---------------|------------|
| | | | Aeolian | Alluvium | Coastal Alluvium | Granite | | |
| High Rainfall Zone | 4A1 | Kanyakumari | 243 | | 24 | 8181 | 1226 | 9675 |
| | Total | | 243 | | 24 | 8181 | 1226 | 9675 |
| | 5A1 | Kanyakumari | | 1482 | 5311 | 83573 | 8455 | 98820 |
| | Total | | | 1482 | 5311 | 83573 | 8455 | 98820 |
| | Grand Total | | 243 | 1482 | 5335 | 91754 | 9681 | 108495 |

Sub-zone-III: -High Rainfall Zone: High Rainfall Zone covers 1,08,495 ha total geographical area of the state in which four landscapes have been identified such as Aeolian, Alluvium, Coastal Alluvium and Granite. Granite is the major landscape covering 91,754 ha area followed by Coastal Alluvium having 5,335 ha, Alluvium and Aeolian landscapes having 1,482 ha and 243 ha area, respectively.

These areas received rains from both south-west to lesser extent and northeast in winter season. These areas are mostly under orchard's plantation. The soils are having shallow to moderately deep soil depth area with medium water & nutrient holding capacity.

| Agro climatic sub-zone | Catchment | District | Landscape | | | | | Miscellaneous | Total Area |
|------------------------|-----------|---------------|-----------|------------------|---------|----------|-----------|---------------|------------|
| | | | Alluvium | Coastal Alluvium | Granite | Laterite | Sandstone | | |
| Northeastern Zone | 4B1 | Cuddalore | 43772 | 1858 | 9379 | 880 | | 6331 | 62220 |
| | Total | | 43772 | 1858 | 9379 | 880 | | 6331 | 62220 |
| | 4C1 | Cuddalore | 19277 | 20643 | 191992 | 45064 | | 32553 | 309529 |
| | | Kanchipuram | 683 | 1694 | 59093 | | 4779 | 10403 | 76652 |
| | | Tiruvannamala | 47 | | 198450 | | | 16716 | 215213 |
| | | Vellore | | | 87859 | | | 2372 | 90232 |
| | | Villupuram | 19608 | 2435 | 602403 | 10944 | 2244 | 91526 | 729160 |
| | Total | | 39616 | 24771 | 1139797 | 56008 | 7023 | 153571 | 1420786 |

| | | | | | | | | | |
|--|-------------|---------------|--------|-------|---------|-------|------|--------|---------|
| | 4C2 | Chennai | | | | | | 17517 | 17517 |
| | | Kanchipuram | 15129 | 20501 | 218844 | 13515 | | 102946 | 370935 |
| | | Tiruvannamala | 7777 | | 348761 | | | 47353 | 403891 |
| | | Trivallur | 24468 | 22009 | 155333 | 28022 | 734 | 80358 | 310925 |
| | | Vellore | 23259 | | 426188 | | | 41821 | 491268 |
| | | Villupuram | | | 110 | | | | 110 |
| | Total | | 70633 | 42510 | 1149236 | 41537 | 734 | 289996 | 1594646 |
| | Grand Total | | 154021 | 69139 | 2298412 | 98425 | 7758 | 449897 | 3077652 |

Sub zone IV: -North eastern zone: North eastern zone covers 30,77,652 ha area of the state which distributed in five landscapes such as Alluvium, Coastal alluvium, Granite, Laterite and Sandstone. Granite is the major landscape identified in the state having 22,98,412 ha area followed by Alluvium covering 1,54,021 ha area, Laterite landscape covering 98,425 ha area, Coastal alluvium and Sandstone having 69,139 ha and 7,758 ha area, respectively.

The soils are distinctively different from sub zone I and utilized for growing different planation /forest etc. The major part of area is having shallow to moderately deep depth soils followed by very shallow to shallow depth soils, deep depth soils and moderately deep depth soils. The soils are fine loamy to coarse loamy texture, low to medium in nutrient and moisture holding capacity.

| Agro climatic sub-zone | Catchment | District | Landscape | | | Miscellaneous | Total Area |
|------------------------|-------------|-------------|-----------|---------|-----------|---------------|------------|
| | | | Alluvium | Granite | Limestone | | |
| Northwestern Zone | 4B1 | Namakal | | 77260 | | 3440 | 80700 |
| | | Salem | | 1224 | | 68 | 1292 |
| | | Total | | 78484 | | 3508 | 81991 |
| | 4B2 | Dharampuri | | 287 | | 19 | 305 |
| | | Namakal | 4295 | 207193 | 3522 | 10546 | 225556 |
| | | Salem | 1231 | 224678 | 2607 | 13916 | 242432 |
| | | Total | 5527 | 432157 | 6129 | 24480 | 468293 |
| | 4B3 | Dharampuri | 2416 | 178540 | | 7492 | 188448 |
| | | Krishnagiri | | 187429 | | 3317 | 190746 |
| | | Salem | 1531 | 46344 | | 10188 | 58063 |
| | | Total | 3946 | 412313 | | 20997 | 437256 |
| | 4C1 | Dharampuri | 3834 | 248984 | 214 | 8376 | 261408 |
| | | Krishnagiri | 955 | 305871 | 298 | 15829 | 322954 |
| | | Namakal | | 35906 | | 267 | 36172 |
| | | Salem | 2532 | 213802 | | 6350 | 222684 |
| | | Total | 7321 | 804563 | 513 | 30822 | 843218 |
| | Grand Total | | 16794 | 1727517 | 6642 | 79807 | 1830759 |

Sub zone V: -North western zone: North western zone covers 18,30,759 ha geographical area of the state. Three landscapes have been identified in the zone where Granite is the major landscape covering 17,25,517 ha area followed by Alluvium and Limestone which covering 16,794 ha and 6,642 ha area, respectively.

Major part of the area covered under shallow to moderately deep depth soils followed by very shallow depth soils and moderately deep depth soils.

| Agro climatic sub-zone | Catchment | District | Landscape | | | | | | | Miscellaneous | Total Area | |
|------------------------|-----------|----------------|-----------|----------|------------------|---------|----------------|----------|-----------|---------------|------------|-----------|
| | | | Aeolian | Alluvium | Coastal Alluvium | Granite | Granite Gneiss | Laterite | Limestone | | | Sandstone |
| Southern Zone | 4A1 | Dindigul | | | | 12 | | | | | | 12 |
| | | Kaniyakumari | | | | 9 | | | | | | 9 |
| | | Madurai | | 284 | | 181368 | 193 | | | | 18461 | 200306 |
| | | Ramanathapuram | | 7497 | 27260 | 147949 | | | | 11153 | 30275 | 224134 |
| | | Sivaganga | | 1118 | | 18278 | | | | | 3822 | 23217 |
| | | Teni | | | | 229 | 3 | | | | | 232 |
| | | Triunelveli | 5870 | 6111 | 297 | 461336 | | | 6367 | | 50872 | 530854 |
| | | Tuticorin | 38657 | 14818 | 32263 | 336142 | | | 903 | 2992 | 37683 | 463459 |
| | | Virudhunagar | | 18091 | | 338840 | | | 13021 | | 32511 | 402463 |
| | Total | | 44527 | 47919 | 59820 | 1484162 | 196 | | 20292 | 14145 | 173624 | 1844686 |
| | 4A2 | Dindigul | | 1406 | | 157284 | | | | | 3579 | 162269 |
| | | Madurai | | 12996 | | 135541 | 3962 | | | | 18462 | 170961 |
| | | Ramanathapuram | | 26104 | 14205 | 125500 | | | | | 35324 | 201132 |
| | | Sivaganga | | 18315 | | 263740 | | 42682 | | | 63139 | 387876 |
| | | Teni | | 3782 | | 62770 | 59040 | | | | 7525 | 133116 |
| | Total | | | 62602 | 14205 | 744835 | 63002 | 42682 | | | 128029 | 1055355 |
| | 4B1 | Dindigul | | | | 18278 | | | | | 787 | 19064 |
| | Total | | | | | 18278 | | | | | 787 | 19064 |
| | 4B2 | Dindigul | | 6816 | | 379768 | | | | | 20793 | 407376 |
| | | Madurai | | | | 222 | | | | | | 222 |
| | | Total | | | 6816 | | 379990 | | | | 20793 | 407598 |
| | 5A1 | Kaniyakumari | | | | 4 | | | | | | 4 |
| | | Triunelveli | | | | 17 | | | | | | 17 |
| | | Total | | | | | 21 | | | | | 21 |
| | | Grand Total | | 44527 | 117337 | 74025 | 2627286 | 63198 | 42682 | 20292 | 14145 | 323234 |

Sub zone VI: -Southern zone: Southern zone covers 33,26,724 ha geographical area of the state wherein eight landscape have been identified and mapped. Granite is the major landscape which covers 26,27,286 ha area followed by Alluvium landscape covering 1,17,337 ha area then Coastal-alluvium covering 74,025 ha area, Granite gneiss covers 63,198 ha area,

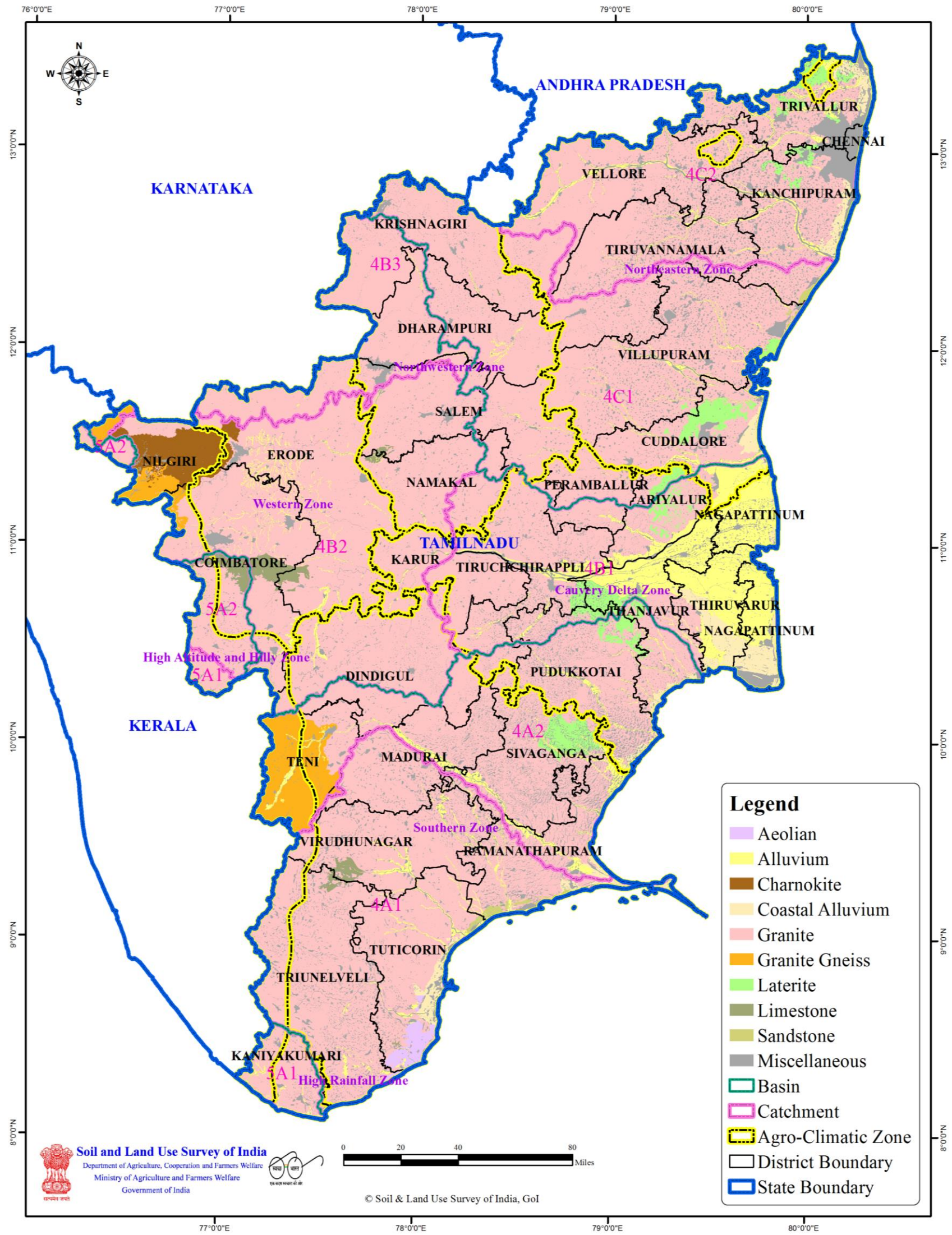
Aeolian covering 44,527 ha area, Laterite covering 42,682 ha area, Limestone covering 20,292 ha area and Sandstone covering 14,145 ha area of the state.

Major part of the area having shallow to moderately deep depth soils followed by very shallow depth soils, moderately deep depth soils and shallow soils depth soils.

| Agro climatic sub-zone | Catchment | District | Landscape | | | | Miscellaneous | Total Area |
|------------------------|-------------|------------|-----------|------------|---------|-----------|---------------|------------|
| | | | Alluvium | Charnokite | Granite | Limestone | | |
| Western Zone | 4B2 | Coimbatore | 18187 | 7254 | 314919 | 25719 | 22117 | 388196 |
| | | Dindigul | | | 21 | | 21 | 42 |
| | | Erode | 32245 | 16163 | 571096 | 11328 | 24483 | 655316 |
| | | Karur | 256 | | | | | 256 |
| | Total | | 50688 | 23417 | 886036 | 37048 | 46620 | 1043809 |
| | 4B3 | Erode | 289 | 50 | 164233 | | 1994 | 166565 |
| | | Total | 289 | 50 | 164233 | | 1994 | 166565 |
| | 5A2 | Coimbatore | | | 53354 | 22314 | 6571 | 82239 |
| | | Total | | | 53354 | 22314 | 6571 | 82239 |
| | Grand Total | | 50977 | 23467 | 1103623 | 59362 | 55185 | 1292614 |

Sub zone VII:-Western Zone: Western Zone covers 12,92,614 ha geographical area of the state in which four landscapes have been identified and mapped wherein Granite is the major land scape which covers 11,03,623 ha area followed by Limestone covering 59,362 ha area then Alluvium and Charnokite having 50,977 ha and 23,467 ha area, respectively. Major part of the zone is having shallow to moderately deep depth soils followed by very shallow soils depth soils and shallow depth soils.

Fig.2. Spatial Distribution of Landscape in Tamil Nadu



II. Soil Erosion

Two types of erosion occur in nature which as follows. Most part of the state suffers from (i) water erosion, whereas (ii) wind erosion noticed in Coastal-Aeolian landscape, Water erosion on agricultural lands takes place through rain water. Intensity of rainfall by rain drops create a pressure and finally make an impact on the surface soil. Soil surface condition and water infiltration depends on the properties of soil surface, part of the water received as precipitation percolate into the soil and remaining water lost by runoff. Evidently surface runoff is negligible wherever water infiltration. On the basis of soil particles disintegration from soil surface water erosion classified as splash, sheet, rill and gully erosion.

The effects of water erosion which are interrelated are briefly as follows (i) loss of surface soil (ii) loss of rain water (iii) loss of soil nutrients and (iv) exposure of less fertile sub soil. A time period an extreme situation create ultimately soil become unproductive.

Wind Erosion is also a serious problem which adversely affect the soil productivity of agricultural lands. It is responsible for removal of the top fertile soil and depletion in the soil water content. There are three types which affect the soil movement viz. saltation surface creep and suspension. Thematic map of spatial distribution of soil erosion and their area shown in **figure no. 3** and **table. 2**.

Table: 2 Agro climatic sub-zone/ Land use class wise tabular distribution of area under different erosion classes in Tamil Nadu state

| Agro climatic sub-zone | Land use | Erosion class | | | | | | Total Area |
|------------------------|------------------------------------------|------------------------|----------------------------|------------------|----------------------------|----------------|-------------------------------|------------|
| | | None to slight erosion | Slight to moderate erosion | Moderate erosion | Moderate to severe erosion | Severe erosion | Severe to very severe erosion | |
| Cauvery delta zone | Deciduous forest (10-40% canopy cover) | 8088 | 4979 | 3731 | | | | 16798 |
| | Plantation-forest | 2798 | 320 | 10538 | | | | 13655 |
| | Forest(teak,eucalyptus,casuarina,etc) | 101 | | 34208 | | | | 34310 |
| | Estates(tea,coffe,rubber,cashew) | | 38 | 39109 | | | | 39147 |
| | Orchards(coconut,citrus,mango,arecanut) | | 79 | | | | | 79 |
| | Single crop cultivation (rf/single crop) | 289467 | 193842 | 409875 | 869 | 2959 | | 897012 |
| | Multiple crop cultivation(ir/multi crop) | 881420 | 1949 | | | | | 883369 |
| | Terraced cultivation (ir/multiple crop) | | 1086 | | | | | 1086 |
| | Grasslands/pasture (<10% canopy) | 281 | 71678 | 105744 | 10404 | 2700 | | 190809 |
| | Unculturable wastelands | 1135 | 199 | 124 | | | | 1457 |
| | Barren lands and scrub lands | 18 | 30290 | 34447 | | | 155 | 64910 |
| | Brick kilns/quarries | | | 71 | | 142 | | 213 |
| | Salt pan | | | | | | | 9155 |
| | Miscellaneous | | | | | | | 232060 |
| | total | 1183308 | 304460 | 637847 | 11273 | 5801 | 155 | 2384060 |

Sub zone I: -Cauvery Delta Zone: Erosion is the process that transforms soil into sediment and its deposited into coastal areas where lands of plain to nearly level slope class are dominant. The severity of erosion got reduced in these plain areas known as River Delta. In Cauvery delta zone, six erosion classes have identified in state. Majority of the area comes under none to slight sheet erosion followed by moderate intensity sheet and rill erosion. Whereas moderate to severe erosion, and severe rills and gully erosion noticed in stream and river banks affecting about 7 % area of zone. It is mainly ascribed to fact that speed of water flux is reduced due to reducing the slope in delta region which increase sediment deposition. The density of forest vegetation also affects the severity of erosion. In deciduous dense forest none to slight erosion covers maximum area followed by slight to moderate and moderate sheet & rill erosion.

| Agro climatic sub-zone | Land use | Erosion Class | | | | | | | Total Area |
|------------------------------|------------------------------------------|------------------------|----------------------------|------------------|----------------------------|----------------|-------------------------------|---------------------------------------------|------------|
| | | None to slight erosion | Slight to moderate erosion | Moderate erosion | Moderate to severe erosion | Severe erosion | Severe to Very severe erosion | Severe water erosion to Severe wind erosion | |
| High Altitude and Hilly Zone | Deciduous forest (10-40% canopy cover) | 162547 | 69715 | 34493 | 13050 | 14546 | | | 294351 |
| | Deciduous forest (>40% canopy cover) | 55544 | 29760 | 16733 | 161 | | 4245 | | 106443 |
| | Plantation-Forest | 3756 | 585 | | 4410 | | | | 8752 |
| | Forest(Teak,Eucalyptus,Casuarina,etc) | 672 | | 6717 | | 970 | | | 8359 |
| | Estates(Tea,Coffe,Rubber,Cashew) | 42689 | 50545 | 25943 | 6917 | 1654 | | | 127748 |
| | Orchards(Coconut,Citrus,Mango,Arecanut) | 46893 | 20350 | 10383 | 1275 | | | | 78901 |
| | Single crop cultivation (RF/Single Crop) | 39412 | 13614 | 27927 | 18000 | 1404 | 19 | | 100376 |
| | Multiple crop cultivation(IR/Multi Crop) | 92018 | 5476 | 3526 | | | | | 101021 |
| | Terraced cultivation (IR/Multiple Crop) | 8631 | 10750 | 3664 | 5835 | 1538 | | | 30418 |
| | Grasslands/Pasture (<10% canopy) | 4324 | 18330 | 44866 | 14792 | 3721 | | 669 | 86701 |
| | Open scrub lands (when canopy is <10 %) | 2833 | | 869 | 1429 | | 133 | | 5264 |
| | Unculturable wastelands | 5368 | | 756 | | | | | 6124 |
| | Culturable wastelands | | | 353 | | | | | 353 |
| | Miscellaneous | | | | | | | | 42227 |
| | Total | 464688 | 219125 | 176231 | 65869 | 23833 | 4397 | 669 | 997039 |

Sub zone II: -High Altitude and hilly zone: Seven erosion classes were found in the area in which none to slight sheet erosion class covers maximum area, followed by slight to moderate sheet and rills erosion, Moderate rills erosion, moderate to severe rills and gully erosion, severe gully erosion, severe to very severe gully and ravines erosion. The area also witnessed severe water erosion to severe wind erosion respectively. Altitude is directly associated with the slope, type of vegetation and depth of soils, if altitude is high the slope also increases and depth of the soil get reduced. This study confirms that deep to very deep soils covers largest area due to tropical climatic conditions. The temperature is very high and the range of annual temperature is minimum. These conditions enhance the weathering of rocks. Type and density of vegetation also controls soil erosion. In Tamil Nadu state mainly broad leaves forest vegetation are observed in the zone, which forms a dense cover on the soil surface and protect soils from erosion hazards. The vegetation reduces the intensity of gravitation force which creates by rain drops.

| Agro climatic sub-zone | Land use | Erosion Class | | | | Total Area |
|------------------------|-----------------------------------------------|------------------------|----------------------------|------------------|----------------------------|------------|
| | | None to slight erosion | Slight to moderate erosion | Moderate erosion | Moderate to severe erosion | |
| High Rainfall Zone | Deciduous forest (10-40% canopy cover) | 4397 | | | 2755 | 7153 |
| | Deciduous forest (>40% canopy cover) | | 2714 | 16194 | | 18908 |
| | Estates(Tea,Coffe,Rubber,Cashew) | | 129 | 4145 | | 4275 |
| | Orchards(Coconut,Citrus,Mango,Arecanut) | 5335 | 24250 | 8336 | | 37921 |
| | Single crop cultivation (RF/Single Crop) | 920 | 1296 | 914 | | 3130 |
| | Multiple crop cultivation(IR/Multi Crop) | 1482 | 13446 | | | 14928 |
| | Grasslands/Pasture (<10% canopy) | | 115 | 47 | | 161 |
| | Open scrub lands (when canopy cover is <10 %) | | | | 12338 | 12338 |
| | Barren lands and Scrub lands | | | 0 | | 0 |
| | Salt Pan | | | | | 9 |
| | Miscellaneous | | | | | 9672 |
| | Total | 12133 | 41951 | 29636 | 15094 | 108495 |

Sub zone III: -High rainfall zone: Intensity and amount of rainfall directly affect to the soil erosion and vegetation, if intensity of rainfall is high the severity of erosion also high. The zone area experiencing high rainfall where amount & intensity of rainfall are more. But due to occurrence of high canopy vegetation and less (Shallow/very shallow) soil depth or thickness on sloping lands, moderate loss of soil through soil erosion reported in the zonal area. Four major erosion classes have been identified in high rainfall zone in which slight to moderate erosion class covers maximum area followed by moderate erosion, moderate to severe erosion and none to slight erosion classes.

| Agro climatic sub-zone | Land use | Erosion Class | | | | | | Total Area |
|------------------------|-----------------------------------------------|------------------------|----------------------------|------------------|----------------------------|----------------|-------------------------------|------------|
| | | None to slight erosion | Slight to moderate erosion | Moderate erosion | Moderate to severe erosion | Severe erosion | Severe to Very severe erosion | |
| Northeastern Zone | Deciduous forest (10-40% canopy cover) | 67100 | 16524 | 126953 | 7893 | | | 218470 |
| | Deciduous forest (>40% canopy cover) | 5893 | | 14189 | | | | 20081 |
| | Plantation-Forest | 23051 | 588 | 1180 | | | | 24818 |
| | Forest(Teak,Eucalyptus,Casuarina,etc) | 15927 | | 35971 | | | 357 | 52255 |
| | Estates(Tea,Coffe,Rubber,Cashew) | | 11 | 85164 | | | | 85175 |
| | Orchards(Coconut,Citrus,Mango,Arecanut) | 5133 | 977 | 22622 | | | | 28733 |
| | Single crop cultivation (RF/Single Crop) | 23539 | 69007 | 311885 | 59606 | 12364 | 1186 | 477587 |
| | Multiple crop cultivation(IR/Multi Crop) | 1404823 | 30409 | 82 | | | | 1435314 |
| | Grasslands/Pasture (<10% canopy) | 4429 | 71689 | 130566 | 20403 | 3074 | 3097 | 233259 |
| | Open scrub lands (when canopy cover is <10 %) | 2338 | | 10378 | 4685 | | 996 | 18398 |
| | Culturable wastelands | | 2187 | 4217 | 1705 | | | 8110 |
| | Unculturable wastelands | 13702 | | | | | | 13702 |
| | Barren lands and Scrub lands | | | 11311 | | | | 11311 |
| | Rock outcrop | | | | | 543 | | 543 |
| | Salt Pan | | | | | | | 1816 |
| | Miscellaneous | | | | | | | 448082 |
| | Total | 1565935 | 191392 | 754518 | 94292 | 15981 | 5636 | 3077652 |

Sub zone IV: -North-eastern Zone: North Eastern zone of Tamil Nadu state are under five type of landscapes, these are Granite, Alluvium, Laterite, Coastal-alluvium and Sandstone. Among the different land uses, none to slight erosion covers major part of the zone whereas moderate erosion is second most dominant erosion class followed by slight to moderate erosion, moderate to severe erosion, severe erosion and severe to very severe erosion class.

| Agro climatic sub-zone | Land use | Erosion Class | | | | | | Total Area |
|------------------------|------------------------------------------|------------------------|----------------------------|------------------|----------------------------|----------------|-------------------------------|------------|
| | | None to slight erosion | Slight to moderate erosion | Moderate erosion | Moderate to severe erosion | Severe erosion | Severe to Very severe erosion | |
| Northwestern Zone | Deciduous forest (10-40% canopy cover) | 103540 | 5034 | 70864 | | | | 179438 |
| | Deciduous forest (>40% canopy cover) | 33007 | | 8153 | | | | 41160 |
| | Plantation-Forest | | 20 | | | | | 20 |
| | Forest(Teak,Eucalyptus,Casuarina,etc) | 6316 | | 134398 | | | 71 | 140785 |
| | Estates(Tea,Coffe,Rubber,Cashew) | 3067 | 6794 | 1363 | 45 | | | 11269 |
| | Orchards(Coconut,Citrus,Mango,Arecanut) | | 658 | 46447 | 602 | | | 47707 |
| | Single crop cultivation (RF/Single Crop) | 114484 | 108178 | 478816 | 32664 | 10357 | | 744498 |
| | Multiple crop cultivation(IR/Multi Crop) | 367148 | 4885 | | | | | 372033 |
| | Grasslands/Pasture (<10% canopy) | | 40512 | 152565 | 14787 | 239 | 457 | 208560 |
| | Unculturable wastelands | | | 204 | | | | 204 |
| | Barren lands and Scrub lands | | 1241 | 3446 | | | | 4686 |
| | Brick kilns/Quarries | | | 245 | | 347 | | 591 |
| | Miscellaneous | | | | | | | 79807 |
| | Total | 627562 | 167321 | 896500 | 48098 | 10943 | 528 | 1830759 |

Sub zone V: -North-western Zone: Amongst the various landscapes, the erosion classes identified and mapped are slight erosion, slight to moderate erosion, moderate erosion, moderate to severe erosion, severe erosion and severe to very severe erosion. Moderate erosion covers maximum area of the zone where as none to slight erosion is second most dominant erosion class followed by slight to moderate erosion, moderate to severe erosion, severe erosion and severe to very severe erosion, respectively.

| Agro climatic sub-zone | Land use | Erosion Class | | | | | Total Area |
|------------------------|-----------------------------------------------|------------------------|----------------------------|------------------|----------------------------|----------------|----------------|
| | | None to slight erosion | Slight to moderate erosion | Moderate erosion | Moderate to severe erosion | Severe erosion | |
| Southern Zone | Deciduous forest (10-40% canopy cover) | 86181 | 90983 | 2578 | 15 | 5690 | 185447 |
| | Deciduous forest (>40% canopy cover) | | 33 | 167 | | | 201 |
| | Plantation-Forest | 2726 | 87 | 12633 | | | 15446 |
| | Forest(Teak,Eucalyptus,Casuarina,etc) | 3266 | | 1370 | | 146 | 4782 |
| | Estates(Tea,Coffe,Rubber,Cashew) | 7660 | 26730 | 8483 | | | 42873 |
| | Orchards(Coconut,Citrus,Mango,Arecanut) | 11081 | 3211 | 7155 | 967 | | 22415 |
| | Single crop cultivation (RF/Single Crop) | 1059177 | 230222 | 458497 | 8023 | 1759 | 1757677 |
| | Multiple crop cultivation(IR/Multi Crop) | 349892 | | 66 | | | 349958 |
| | Terraced cultivation (IR/Multiple Crop) | 2986 | 8974 | | 6796 | 1611 | 20368 |
| | Grasslands/Pasture (<10% canopy) | 71399 | 142344 | 223087 | 2963 | 941 | 440734 |
| | Open scrub lands (when canopy cover is <10 %) | | | | 3 | | 3 |
| | Culturable wastelands | | 1205 | 2531 | 2346 | | 6082 |
| | Unculturable wastelands | 1932 | 2685 | 887 | | | 5504 |
| | Barren lands and Scrub lands | 882 | 37868 | 111763 | | | 150513 |
| | Brick kilns/Quarries | | | 1488 | | | 1488 |
| | Salt Pan | | | | | | 7474 |
| | Miscellaneous | | | | | | 315760 |
| | Total | 1597182 | 544343 | 830706 | 21112 | 10148 | 3326724 |

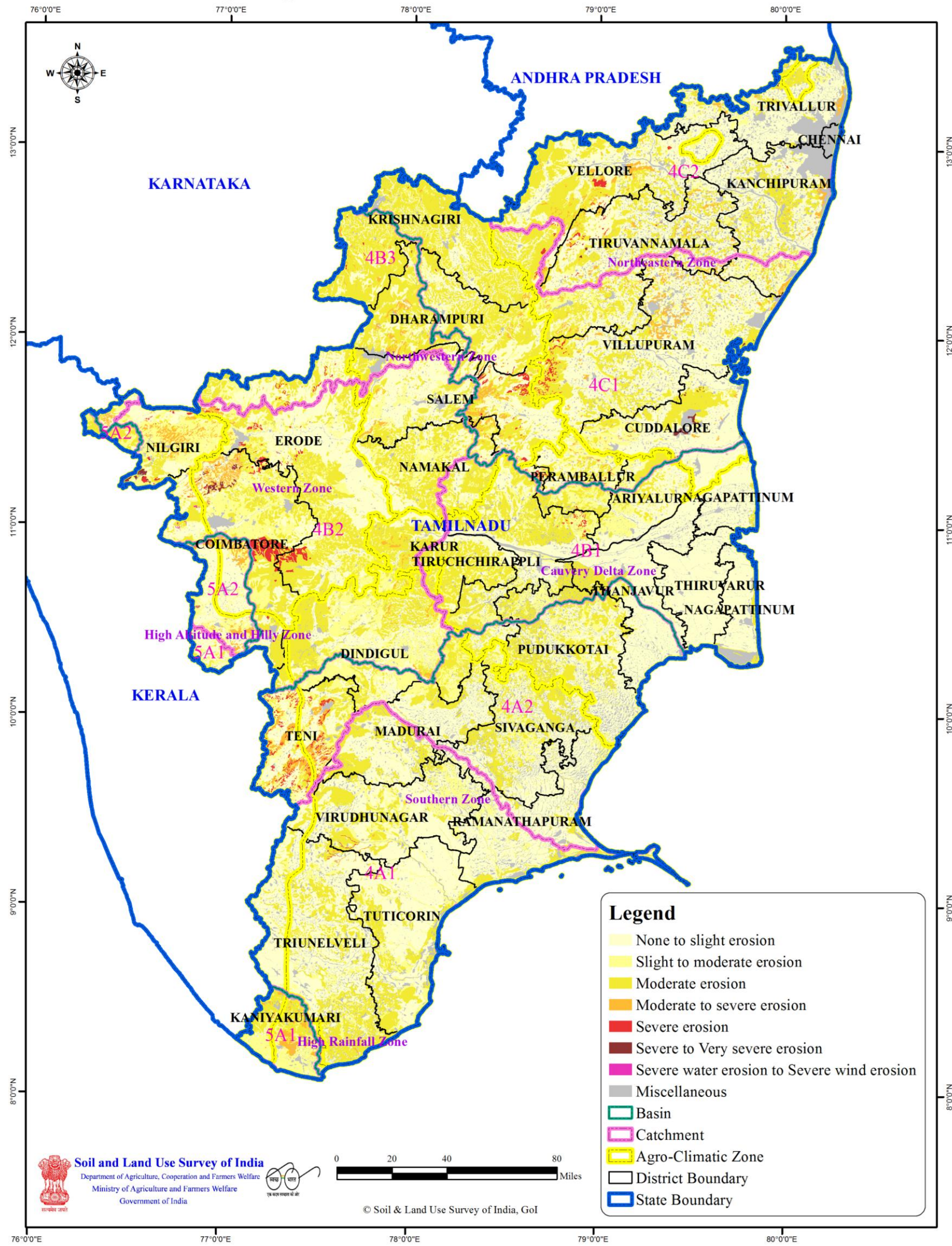
Sub zone VI: -Southern Zone: Southern zone have dominated by laterite landscape, whereas majority of soils comes under deep to very deep soil class followed by moderately deep soils which are moderately fine to moderately coarse in texture. The moderately coarse texture enhances the infiltration rate which reduces the overflow of surface water. Due to decreasing the overflow water flux intensity also slow which reduce the soil erosion. The southern zone affected by none to slight erosion which covers highest area followed by slight to moderate erosion, moderate erosion moderate to severe erosion and severe erosion.

| Agro climatic sub-zone | Land use | Erosion Class | | | | | | | Total Area |
|------------------------|------------------------------------------|------------------------|----------------------------|------------------|----------------------------|----------------|-------------------------------|---------------------------------------------|----------------|
| | | None to slight erosion | Slight to moderate erosion | Moderate erosion | Moderate to severe erosion | Severe erosion | Severe to Very severe erosion | Severe water erosion to Severe wind erosion | |
| Western Zone | Deciduous forest (10-40% canopy cover) | 94788 | 17546 | 30928 | 1514 | | | | 144776 |
| | Deciduous forest (>40% canopy cover) | 16 | | | | | | | 16 |
| | Plantation-Forest | | 3308 | | | | | | 3308 |
| | Forest(Teak,Eucalyptus,Casuarina,etc) | 44646 | | 983 | | | | | 45629 |
| | Estates(Tea,Coffe,Rubber,Cashew) | 9877 | 9983 | 16 | | | | | 19876 |
| | Orchards(Coconut,Citrus,Mango,Arecanut) | 24856 | 4895 | 92 | | | | | 29842 |
| | Single crop cultivation (RF/Single Crop) | 80799 | 167362 | 269720 | 28855 | 35065 | 4410 | | 586211 |
| | Multiple crop cultivation(IR/Multi Crop) | 262037 | 1537 | | | | | | 263575 |
| | Grasslands/Pasture (<10% canopy) | | 49813 | 27758 | 9763 | 2522 | | 132 | 89988 |
| | Culturable wastelands | | | 1414 | | | | | 1414 |
| | Unculturable wastelands | 1193 | | | | | | | 1193 |
| | Barren lands and Scrub lands | | | 51601 | | | | | 51601 |
| | Miscellaneous | | | | | | | | 55185 |
| | Total | 518212 | 254444 | 382511 | 40133 | 37587 | 4410 | 132 | 1292614 |

Sub zone VII: -Western Zone: Six erosion classes have been identified and mapped in the zone. None to slight erosion class covers maximum area followed by slight to moderate erosion, moderate erosion, moderate to severe erosion, severe erosion, Severe to Very severe erosion and Severe water erosion to Severe wind erosion. Western zone of Tamil Nadu state has dominated by Granite landscape which is responsible for coarse textured soils and enhance the infiltration rate & reduce erosion hazards.

The agro-climatic zones are specific combinations of moisture availability zones and temperature zones. Agro-climatic zones show how climate variability shapes agricultural landscape of an area. The main factor that caused the changes in the agro climatic zones is soil erosion which was influenced by climatic factors, i.e. rainfall and temperature. It was observed that out of 7 zones, erosion severity is mainly in Western zone covering an area of 42,129 ha followed by high altitude & hilly zone covering an area of 28,899 ha, Northeastern zone covering an area of 21,618 ha and Northwestern zone covering an area of 11,471 ha. This might be attributed to excessive run-off of soil, higher slopes where vegetation cover is reduced, low soil organic matter. Based on the difference in characteristics of zonal variations, it is quite evident that maximum acreage of severe and very severe erosion is observed under western zone and high altitude & hilly zone. This might be due to the high altitude & rainfall along with rolling & undulating topographical formations. This is followed by northeastern zone, north western zone, southern zone and Cauvery delta zone.

Fig.3. Spatial Distribution of Erosion in Tamil Nadu



III. Soil Depth

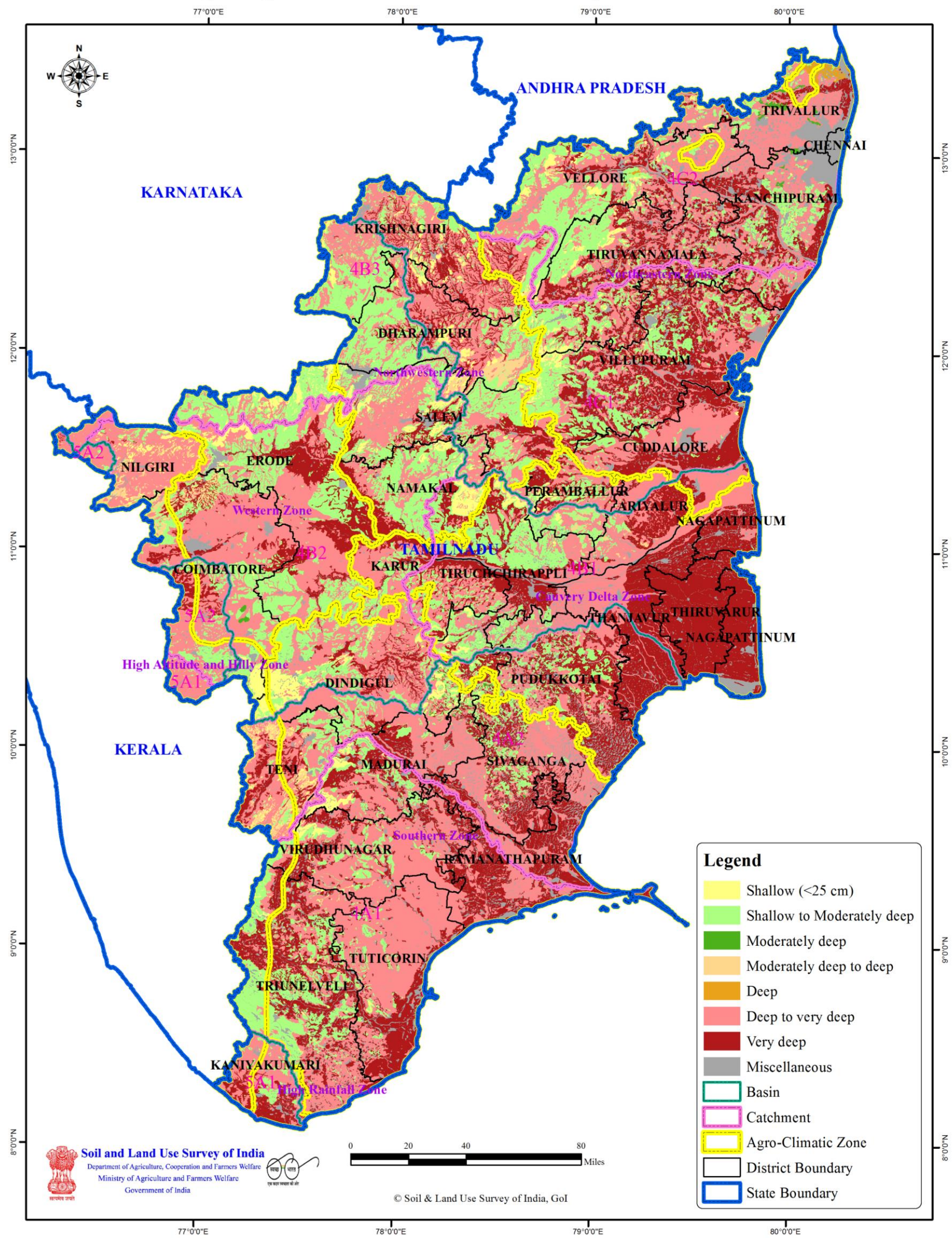
Weathering is a key part of the process of soil formation. Soil forms through accumulation and decay of organic matter and through the mechanical and chemical weathering processes. Soil slope affect to the depth & stability of soil by the way of erosion. In high slope, lands increases water erosion leading to loss of the fertile top soil and at places sub-surface soil expose by erosion the movement of soil and water in catchment area. The silting/ deposition of sediments are irreversible and particularly in the lower part of the catchment. In this way redistribution of soil in various depth categories and soil type takes place, where by some portions of the land losses the soil depth and other portion gain. Along with soil loss in the runoff from catchment area carries the plant nutrients. The quantity of soil particles of a given size lost in runoff varies the fifth power of runoff.

Out of the total area of the state, among different soil depth classes maximum area is reported under deep to very deep class covering an area of 83,66,520 ha. These are the soils that are 50-100 cm and >100 cm deep from the soil surface. Next to this class, an area of 28,36,378 ha is mapped under shallow to moderately deep soils followed by shallow soils covering an area of 4,53,163 ha that area < 25 cm from the soil surface, moderately deep to deep soils covering 1,39,203 ha area and deep soils covering 20,832 ha. Area of the soils under different identified geological formations, Granite and Alluvium shows maximum area under deep to very deep soils. Whereas, very shallow to shallow soils shows maximum acreage under Granite and Charnokite. Spatial distribution of soil depth class and their area are shown in **figure no. 4** and **table 3**.

Table: 3 Landscape/ Agro-climatic sub-zone wise tabular distribution of depth classes in Tamil Nadu state

| Landscape | Agro climatic sub-zone | Depth Class | | | | | | | Miscellaneous | Total Area |
|--------------------|------------------------------|-----------------|----------------------------|-----------------|-------------------------|--------------|-------------------|----------------|----------------|-----------------|
| | | Shallow (<25cm) | Shallow to Moderately deep | Moderately deep | Moderately deep to deep | Deep | Deep to very deep | Very deep | | |
| Aeolian | High Rainfall Zone | | | | | | | 243 | | 243 |
| | Southern Zone | | | | | | | 44527 | | 44527 |
| | Total | | | | | | | 44771 | | 44771 |
| Alluvium | Cauvery Delta Zone | | 8 | | | | 143736 | 342779 | | 486523 |
| | High Altitude and Hilly Zone | | | | | 5368 | 2540 | 12799 | | 20708 |
| | High Rainfall Zone | | | | | | | 1482 | | 1482 |
| | Northeastern Zone | | | | | 2282 | 124368 | 27370 | | 154021 |
| | Northwestern Zone | | | | | | 16146 | 648 | | 16794 |
| | Southern Zone | | | | | | 57813 | 59524 | | 117337 |
| | Western Zone | | | | | | 46178 | 4798 | | 50977 |
| | Total | | 8 | | | 7650 | 390782 | 449400 | | 847840 |
| Charnokite | High Altitude and Hilly Zone | 18925 | 427 | | 841 | | 99845 | 651 | | 120689 |
| | Western Zone | 3622 | 1613 | | | | 18233 | | | 23467 |
| | Total | 22547 | 2040 | | 841 | | 118078 | 651 | | 144156 |
| Coastal Alluvium | Cauvery Delta Zone | | 89 | | | | 83 | 123791 | | 123963 |
| | High Rainfall Zone | | | | | | | 5335 | | 5335 |
| | Northeastern Zone | | | | | 11419 | | 57720 | | 69139 |
| | Southern Zone | | | | | | 1085 | 72940 | | 74025 |
| | Total | | 89 | | | 11419 | 1168 | 259785 | | 272461 |
| Granite | Cauvery Delta Zone | 35884 | 393610 | 79 | 10532 | | 418082 | 557760 | | 1415946 |
| | High Altitude and Hilly Zone | 31212 | 175268 | | 1729 | | 277123 | 89009 | | 574341 |
| | High Rainfall Zone | | 19501 | | | | 44274 | 27979 | | 91754 |
| | Northeastern Zone | 68751 | 638808 | 1443 | 7048 | 1762 | 895012 | 685588 | | 2298412 |
| | Northwestern Zone | 126485 | 637506 | 658 | 39861 | | 679013 | 243994 | | 1727517 |
| | Southern Zone | 97895 | 501697 | 3211 | 411 | | 1368150 | 655922 | | 2627286 |
| | Western Zone | 46902 | 377035 | 2285 | 16795 | | 473967 | 186639 | | 1103623 |
| | Total | 407128 | 2743427 | 7676 | 76375 | 1762 | 4155620 | 2446891 | | 9838879 |
| Granite Gneiss | High Altitude and Hilly Zone | 16866 | 11279 | | 47541 | | 125156 | 21316 | | 222158 |
| | Southern Zone | 4855 | 1363 | | 13317 | | 28214 | 15448 | | 63198 |
| | Total | 21722 | 12642 | | 60858 | | 153370 | 36764 | | 285356 |
| Laterite | Cauvery Delta Zone | | 1843 | | | | 113614 | 619 | | 116075 |
| | High Altitude and Hilly Zone | | 1864 | 869 | 133 | | 8937 | | | 11802 |
| | Northeastern Zone | | 4565 | 10378 | 996 | | 82486 | | | 98425 |
| | Southern Zone | | 986 | | | | 41695 | | | 42682 |
| | Total | | 9257 | 11247 | 1129 | | 246732 | 619 | | 268985 |
| Limestone | Cauvery Delta Zone | | 266 | | | | 71 | | | 337 |
| | High Altitude and Hilly Zone | 353 | 4453 | | | | 308 | | | 5114 |
| | Northwestern Zone | | 441 | | | | 6200 | | | 6642 |
| | Southern Zone | | 1886 | | | | 18406 | | | 20292 |
| | Western Zone | 1414 | 42211 | | | | 15737 | | | 59362 |
| | Total | 1767 | 49258 | | | | 40722 | | | 91747 |
| Sandstone | Northeastern Zone | | 734 | | | | | 7023 | | 7758 |
| | Southern Zone | | | | | | 5446 | 8699 | | 14145 |
| | Total | | 734 | | | | 5446 | 15722 | | 21903 |
| Miscellaneous | Total | | | | | | | | 1201246 | 1201246 |
| Grand Total | | 453163 | 2817455 | 18923 | 139203 | 20832 | 5111917 | 3254603 | 1201246 | 13017343 |

Fig.4. Spatial Distribution of Soil Depth in Tamil Nadu



IV. Soil Slope

Soil can only develop where the rate of soil formation is more than the rate of erosion. The formation of soils are based on the slope gradient & relief of land. Steeper slopes lands having excessive relief develops well drained soils with deep soil depth whereas plain slope having normal to sub-normal relief develops moderately well to well drained soils with very deep soil depth.

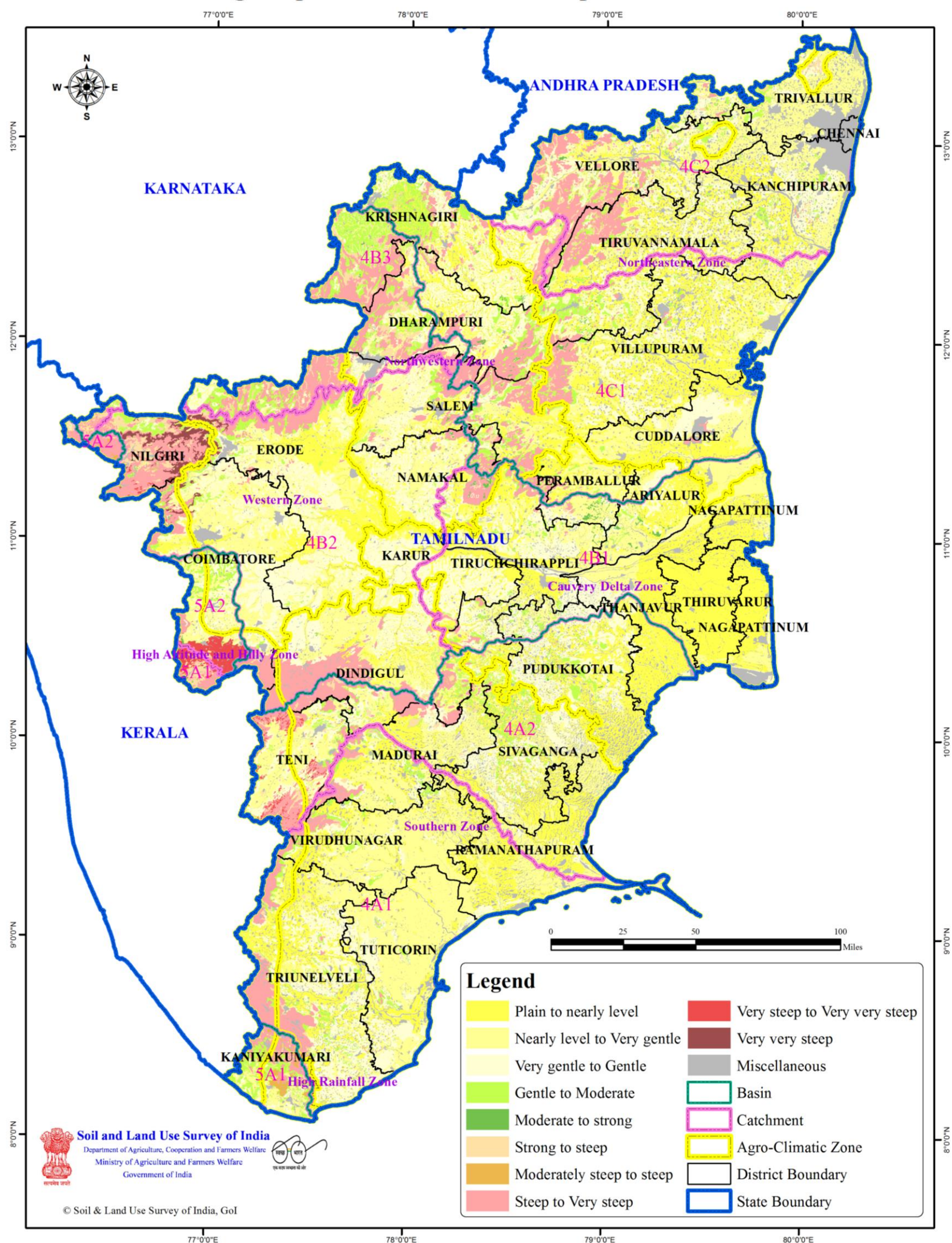
The factors that affect the nature & kind of soil and the rate of formation of soils include the slope of the surface. In the state different slope classes ranging from nearly level to very-very steep slope class identified & mapped in the area. From here, when related to soil depth class identified in the state it is quite evident that maximum area of 89,333,20 ha is mapped under plain-nearly level to gentle slope class having not more than 5% slope gradient.

Slope class between 5-15 % slope gradient, have an area of about 8,45,056 ha. is mapped. Whereas, >15 % slope gradient covering an area of 3,45,649 ha and under >30 % slope gradient area have an area of about 16,92,071 ha. Thematic map of spatial distribution of Slope classes and their area shown in **figure no. 5** and **table 4**.

Table: 4 Landscape/ Agro-climatic sub-zone wise tabular distribution of slope classes in Tamil Nadu state

| Landscape | Agro climatic sub-zone | Slope Class | | | | | | | | | | Miscella neous | Total Area |
|---------------------|---------------------------------|--------------------------------------|-----------------------------------------------|--------------------------------------|--------------------------------|--------------------------------|-----------------------------|---------------------------------------|------------------------------------|----------------------------------------------|-----------------------------|-------------------|-----------------|
| | | Plain to nearly level slope | Nearly level to Very gentle slope | Very gentle to Gentle slope | Gentle to Moderate slope | Moderate to strong slope | Strong to steep slope | Moderately steep to steep slope | Steep to Very steep slope | Very steep to Very very steep slope | Very very steep slope | | |
| Aeolian | High Rainfall Zone | | 198 | 45 | | | | | | | | | 243 |
| | Southern Zone | | 15510 | 29018 | | | | | | | | | 44527 |
| | Total | | 15708 | 29063 | | | | | | | | | 44771 |
| Alluvium | Cauvery Delta Zone | 326869 | 152674 | 6867 | 114 | | | | | | | | 486523 |
| | High Altitude and Hilly Zone | | 20684 | 24 | | | | | | | | | 20708 |
| | High Rainfall Zone | | 1482 | | | | | | | | | | 1482 |
| | Northeastern Zone | 17000 | 136321 | 699 | | | | | | | | | 154021 |
| | Northwestern Zone | | 16590 | 204 | | | | | | | | | 16794 |
| | Southern Zone | 31967 | 82998 | 2372 | | | | | | | | | 117337 |
| | Western Zone | | 47669 | 3308 | | | | | | | | | 50977 |
| | Total | 375836 | 458417 | 13473 | 114 | | | | | | | | 847840 |
| Charnokite | High Altitude and Hilly Zone | | 2104 | | 6016 | | 21537 | | 55673 | | 35359 | | 120689 |
| | Western Zone | | 1 | | 6203 | | 3707 | | 5586 | | 7971 | | 23467 |
| | Total | | 2105 | | 12219 | | 25243 | | 61259 | | 43330 | | 144156 |
| Coastal Alluvium | Cauvery Delta Zone | 82873 | 25681 | 15320 | 89 | | | | | | | | 123963 |
| | High Rainfall Zone | | 5335 | | | | | | | | | | 5335 |
| | Northeastern Zone | 1787 | 66209 | 1142 | | | | | | | | | 69139 |
| | Southern Zone | 13485 | 50871 | 9668 | | | | | | | | | 74025 |
| | Total | 98146 | 148096 | 26130 | 89 | | | | | | | | 272461 |
| Granite | Cauvery Delta Zone | 557521 | 264125 | 455583 | 74931 | 10532 | 10110 | | 43146 | | | | 1415946 |
| | High Altitude and Hilly Zone | 55051 | 79399 | 62219 | 62224 | 1477 | 42571 | 4262 | 211215 | 50905 | 5019 | | 574341 |
| | High Rainfall Zone | 722 | 21526 | 7999 | 18940 | | 3605 | 12338 | 26623 | | | | 91754 |
| | Northeastern Zone | 670515 | 596960 | 539518 | 146751 | 4890 | 52918 | | 286860 | | | | 2298412 |
| | Northwestern Zone | 243835 | 248547 | 461479 | 264940 | 8759 | 93762 | | 406194 | | | | 1727517 |
| | Southern Zone | 649512 | 948786 | 580864 | 138420 | 411 | 45212 | 3 | 264077 | | | | 2627286 |
| | Western Zone | 159423 | 317274 | 377570 | 72391 | 294 | 32049 | | 137302 | 11 | 7308 | | 1103623 |
| | Total | 2336580 | 2476617 | 2485231 | 778598 | 26362 | 280228 | 16603 | 1375418 | 50916 | 12327 | | 9838879 |
| Granite Gneiss | High Altitude and Hilly Zone | | 43342 | 26210 | 8848 | 836 | 13847 | | 113179 | 15285 | 612 | | 222158 |
| | Southern Zone | | 23815 | 15422 | 2413 | | 3737 | | 13101 | 4294 | 415 | | 63198 |
| | Total | | 67156 | 41633 | 11262 | 836 | 17584 | | 126281 | 19579 | 1026 | | 285356 |
| Laterite | Cauvery Delta Zone | 619 | 7002 | 108238 | 217 | | | | | | | | 116075 |
| | High Altitude and Hilly Zone | | 1390 | 5786 | | | 4627 | | | | | | 11802 |
| | Northeastern Zone | | 20159 | 76862 | 39 | | 1365 | | | | | | 98425 |
| | Southern Zone | | 20263 | 22419 | | | | | | | | | 42682 |
| | Total | 619 | 48814 | 213304 | 256 | | 5992 | | | | | | 268985 |
| Limestone | Cauvery Delta Zone | | | 337 | | | | | | | | | 337 |
| | High Altitude and Hilly Zone | | | 1057 | 2121 | | | | 1935 | | | | 5114 |
| | Northwestern Zone | | 987 | 5655 | | | | | | | | | 6642 |
| | Southern Zone | | 17762 | 1886 | 644 | | | | | | | | 20292 |
| | Western Zone | | 5243 | 42296 | 11822 | | | | | | | | 59362 |
| | Total | | 23992 | 51232 | 14587 | | | | 1935 | | | | 91747 |
| Sandstone | Northeastern Zone | | 7023 | | 734 | | | | | | | | 7758 |
| | Southern Zone | | 814 | 13331 | | | | | | | | | 14145 |
| | Total | | 7837 | 13331 | 734 | | | | | | | | 21903 |
| Miscellaneous | Cauvery Delta Zone | | | | | | | | | | | 241216 | 241216 |
| | High Altitude and Hilly Zone | | | | | | | | | | | 42227 | 42227 |
| | High Rainfall Zone | | | | | | | | | | | 9681 | 9681 |
| | Northeastern Zone | | | | | | | | | | | 449897 | 449897 |
| | Northwestern Zone | | | | | | | | | | | 79807 | 79807 |
| | Southern Zone | | | | | | | | | | | 323234 | 323234 |
| | Western Zone | | | | | | | | | | | 55185 | 55185 |
| | Total | | | | | | | | | | | 1201246 | 1201246 |
| Grand Total | | 2811180 | 3248742 | 2873398 | 817858 | 27197 | 329046 | 16603 | 1564893 | 70495 | 56684 | 1201246 | 13017343 |

Fig.5. Spatial Distribution of Slope in Tamil Nadu



V. Land Use

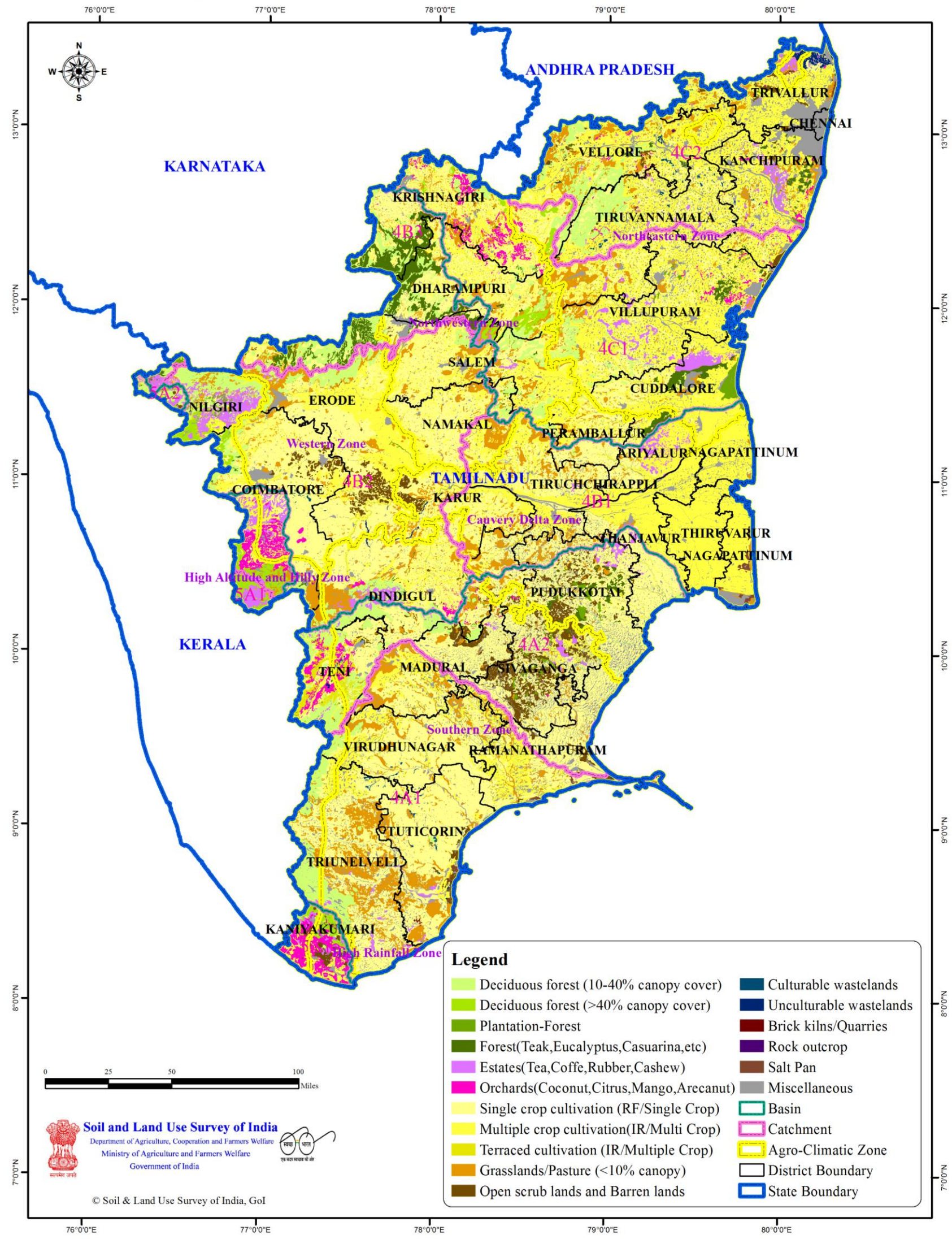
Land use affects to the depth of soils if soil develop under forest vegetation the litter fall is high it affects the temperature and enhance microbial activity and form few acids which enhance the process of weathering. Out of total surveyed area (1,30,17,343 ha.) under different land use classes observed in the state, maximum area is covered under cultivation (single crop/multiple crop) having an area 79,86,667 ha. followed by 12,50,166 ha area is under grassland/pasture having <10% canopy cover. This may be contributed to land degradation and reduce available area under crop production. Next to this is an area of 6,36,905 ha and 4,09,527 ha covered under forest lands, i.e. having 10-20% canopy cover and 20-40% canopy cover, respectively. An area of 3,30,409 ha. is mapped under estate, i.e. tea, coffee, rubber, cashew etc. this depends on the climatic conditions of agro-climatic zone which falling in the state and soil type varies on climatic conditions. Red lateritic slightly acidic soil type is best suited for its production, therefore, Tamil Nadu state is one of the largest cultivator & producer of plantation crops like coffee, tea, rubber etc. whereas 2,86,120.03 Area comes under forest tree plantation like Teak, Eucalyptus, etc. followed by an area of 2,81,236 ha. under barren lands. An area of 1,65,440 ha. is under orchard cultivation like coconut, Mango, Arecanut whereas, an area of 1,38,690 ha is under deciduous forest type having >50 % canopy cover. Remaining area is mapped under cultural/ uncultivable wastelands and scrub lands. Spatial distribution of Land Use classes and their area shown in **figure no. 6** and **table 5**.

Table: 5 Landscape/ Agro-climatic sub-zone wise tabular distribution of land use classes in Tamil Nadu state

| Landscape | Agro climatic sub-zone | Land Use | | | | | | | | | | | | | | | | | | | Misc | Total Area | |
|------------------|------------------------------|--------------|------------------------------|----------------------|-----------------------|--------------------------------------|--------------------------|--------------------------|------------------------|-------------------------------------|------------------------------------------|----------------------------------|-------------------------------------------|---------------------------------------------------------|----------------------------------|-------------------|--------------|------------------------------------------|--------------------------|-------------------------|------|------------|---------|
| | | Barren lands | Barren lands and Scrub lands | Brick kilns/Quarries | Culturable wastelands | Deciduous forest (Double Storey Veg) | | | | Estates(Tea, Coffe, Rubber, Cashew) | Forest (Teak, Eucalyptus, Casuarina etc) | Grasslands/Pasture (<10% canopy) | Multiple crop cultivation (IR/Multi Crop) | (when canopy Orchards(Coconut, Citrus, Mango, Arecanut) | t, Citrus, Mango, Arecanut) with | Plantation-Forest | Rock outcrop | Single crop cultivation (RF/Single Crop) | cultivation (IR/Multiple | Unculturable wastelands | | | |
| | | | | | | F2 (10-20% canopy cover) | F3 (20-40% canopy cover) | F4 (40-60% canopy cover) | F5 (>60% canopy cover) | | | | | | | | | | | | | | |
| Aeolian | High Rainfall Zone | | | | | | | | | | | 45 | | | | | | | 198 | | | | 243 |
| | Southern Zone | | | | | | | | | | | 29018 | | | | | | | 15510 | | | | 44527 |
| | | | | | | | | | | | | 29063 | | | | | | | 15708 | | | | 44771 |
| Alluvium | Cauvery Delta Zone | | | | | 4608 | | | | 741 | | 4723 | 457739 | | | | | 426 | 16952 | | 1334 | | 486523 |
| | High Altitude and Hilly Zone | | | | | | | | | | | 151 | 11951 | | | | 193 | | 484 | | 5368 | | 18147 |
| | High Rainfall Zone | | | | | | | | | | | | 1482 | | | | | | | | | | 1482 |
| | Northeastern Zone | | | | | | | | | | | 682 | 150680 | | | | | | 377 | | 2282 | | 154021 |
| | Northwestern Zone | | | | | | | | | | | 444 | 12516 | | | | | | 3630 | | 204 | | 16794 |
| | Southern Zone | 2745 | | | | 2663 | | | | 8071 | | 13493 | 13074 | | | 637 | | 11 | 75699 | | 943 | | 117337 |
| | Western Zone | | | | | | | | | | | 298 | 11829 | | | | | 3308 | 34349 | | 1193 | | 50977 |
| | | 2745 | | | | 7271 | | | | 8812 | | 19790 | 659270 | | 637 | 193 | 3745 | 131492 | | 11323 | | 845280 | |
| Charnokite | High Altitude and Hilly Zone | | | | | 24829 | 25091 | | | 50155 | | 10349 | 2104 | | | | 4410 | 3750 | | | | | 120689 |
| | Western Zone | | | | | 9564 | 7054 | | | 2248 | | 4599 | 1 | | | | | | | | | | 23467 |
| | Total | | | | | 34393 | 32146 | | | 52403 | | 14948 | 2105 | | | | 4410 | 3750 | | | | | 144156 |
| Coastal Alluvium | Cauvery Delta Zone | 1303 | | | | 1683 | | | | | | 13966 | 87562 | | | | 2490 | 16834 | | 124 | | | 123963 |
| | High Altitude and Hilly Zone | | | | | | | | | | | | | | | | 2557 | | | | | | 2557 |
| | High Rainfall Zone | 0 | | | | | | | | | | | | | | | 5335 | | | | | | 5335 |
| | Northeastern Zone | 383 | | | 813 | | | | | | | 9897 | 16871 | | 5133 | | 22188 | 2437 | | 11419 | | | 69141 |
| | Southern Zone | 22568 | | | | | | | | | | 3490 | 10346 | | | | | 33948 | | 3674 | | | 74026 |
| | Total | 24254 | | | 813 | 1683 | | | | | | 27353 | 114779 | | 5133 | 7892 | 24678 | 53219 | | 15217 | | | 275022 |
| Granite | Cauvery Delta Zone | 61745 | | 142 | | 7679 | 2828 | | | 1036 | 20560 | 164274 | 337038 | | 79 | | 10739 | 808740 | 1086 | | | | 1415946 |
| | High Altitude and Hilly Zone | | | | | 136318 | 33170 | 29010 | 45581 | 48408 | 4751 | 70074 | 75565 | 4262 | 22823 | 30568 | | 73810 | | | | | 574341 |
| | High Rainfall Zone | | | | | 4397 | 2755 | 18908 | | 4275 | | 116 | 13446 | 12338 | | 32587 | | 2932 | | | | | 91754 |
| | Northeastern Zone | 9174 | 1779 | | 7258 | 76713 | 141757 | | 20081 | 51003 | 31251 | 215593 | 1251908 | | 23600 | | 2631 | 543 | 465123 | | | | 2298412 |
| | Northwestern | 4686 | | 347 | | 39010 | 140428 | | 41160 | 11316 | 140785 | 208070 | 359518 | | 47707 | | 20 | 734471 | | | | | 1727517 |

| | | | | | | | | | | | | | | | | | | | | | | | |
|----------------|------------------------------|--------|------|------|-------|--------|--------|-------|--------|--------|--------|---------|---------|-------|--------|-------|-------|--------|---------|-------|-------|---------|----------|
| | Zone | | | | | | | | | | | | | | | | | | | | | | |
| | Southern Zone | 113919 | | | 6082 | 162170 | 1123 | 201 | | 25882 | 4636 | 393642 | 306138 | 3 | 10367 | | 15359 | | 1587353 | 381 | | 31 | 2627286 |
| | Western Zone | 51601 | | | | 74774 | 53384 | | 16 | 8671 | 45629 | 85091 | 250207 | | 20925 | 8917 | | 504408 | | | | | 1103623 |
| | Total | 241125 | 1779 | 489 | 13340 | 501062 | 375445 | 48119 | 106838 | 150590 | 247612 | 1136860 | 2593820 | 16603 | 125501 | 72071 | 28749 | 543 | 4176836 | 1467 | | 31 | 9838879 |
| Granite Gneiss | High Altitude and Hilly Zone | | | | | 72396 | 610 | | 31852 | 22387 | 3608 | 3207 | 10011 | | 22757 | | 4341 | | 19814 | 30418 | 756 | | 222158 |
| | Southern Zone | | | | | 19047 | 444 | | | 494 | 146 | 1092 | 137 | | 11411 | | 76 | | 9477 | 19986 | 887 | | 63198 |
| | Total | | | | | 91443 | 1054 | | 31852 | 22881 | 3754 | 4299 | 10148 | | 34168 | | 4417 | | 29291 | 50405 | 1643 | | 285356 |
| Laterite | Cauvery Delta Zone | 1861 | | | | | | | | 37370 | 13750 | 7845 | 1030 | | | | | | 54219 | | | | 116075 |
| | High Altitude and Hilly Zone | | | | | | | | | 6491 | | 2920 | 1390 | 1002 | | | | | | | | | 11802 |
| | Northeastern Zone | | | | 39 | | | | | 34172 | 21004 | 7087 | 15855 | 11375 | | | | | 8893 | | | | 98425 |
| | Southern Zone | 11250 | | | | | | | | 8426 | | | 20263 | | | | | | 2743 | | | | 42682 |
| | Total | 13112 | | | 39 | | | | | 86459 | 34753 | 17852 | 38537 | 12376 | | | | | 65855 | | | | 268985 |
| Limestone | Cauvery Delta Zone | | | 71 | | | | | | | | | | | | | | | 266 | | | | 337 |
| | High Altitude and Hilly Zone | | | | 353 | 1053 | 882 | | | 308 | | | | | | | | | 2518 | | | | 5114 |
| | Northwestern Zone | | | 245 | | | | | | | | | | | | | | | 6397 | | | | 6642 |
| | Southern Zone | | | 1488 | | | | | | | | | | | | | | | 18803 | | | | 20292 |
| | Western Zone | | | | 1414 | | | | | 8957 | | | 1537 | | | | | | 47455 | | | | 59362 |
| | Total | | | 1804 | 1767 | 1053 | 882 | | | 9264 | | | 1537 | | | | | | 75439 | | | | 91747 |
| Sandstone | Northeastern Zone | | | | | | | | | | | | | 7024 | | | | | 734 | | | | 7758 |
| | Southern Zone | | | | | | | | | | | | | | | | | | 14145 | | | | 14145 |
| | Total | | | | | | | | | | | | | 7024 | | | | | 14879 | | | | 21903 |
| Misc | Cauvery Delta Zone | | | | | | | | | | | | | | | | | | | | | 241216 | 241216 |
| | High Altitude and Hilly Zone | | | | | | | | | | | | | | | | | | | | | 42227 | 42227 |
| | High Rainfall Zone | | | | | | | | | | | | | | | | | | | | | 9681 | 9681 |
| | Northeastern Zone | | | | | | | | | | | | | | | | | | | | | 449900 | 449900 |
| | Northwestern Zone | | | | | | | | | | | | | | | | | | | | | 79807 | 79807 |
| | Southern Zone | | | | | | | | | | | | | | | | | | | | | 323231 | 323231 |
| | Western Zone | | | | | | | | | | | | | | | | | | | | | 55185 | 55185 |
| | Total | | | | | | | | | | | | | | | | | | | | | 1201246 | 1201246 |
| Grand Total | | 281236 | 1779 | 2292 | 15959 | 636905 | 409527 | 48119 | 138691 | 330409 | 286120 | 1250166 | 3420197 | 36003 | 165440 | 80156 | 65999 | 543 | 4566469 | 51872 | 28183 | 1201276 | 13017343 |

Fig.6. Spatial Distribution of Land Use in Tamil Nadu



VI. Soil Texture

Soil parent materials can include all different types of bedrock and any type of unconsolidated sediments. Soils developed on parent material that are coarse grained and composed of minerals resistant to weathering most likely exhibit coarse grain texture. Fine grain soil develops where the parent materials are composed of unstable minerals that readily weather. The severity of erosion and runoff depends on soil texture it influences the rate of percolation of water through the soil and enhance the stability of soil.

It was observed that more area of the state is showing textural class towards more accumulation of clay content in the soils, i.e. fine to fine loamy having 18 to >35 % clay covering an area of 47,50,518 ha under varied landscapes predominantly in Granite and Alluvium.

An area of about 859 ha is also observed under very fine textural class having >60% clay. This clearly indicates that clays area the predominant soils in the state and apart from the rich alluvial soil of the river deltas, Granite is dominant in the area.

An area of 46,10,597 ha is mapped under coarse loamy to fine loamy textural class having clay content ranging between <18% to 35%. An area of 59,439 ha is mapped under sandy to coarse loamy textural class.

Based on the per cent gravels, i.e. 15-25% observed in the soil profile during the survey, the textural class is further categories into gravelly textural classes like gravelly fine to gravelly fine loamy covering an area of 13,92,233 ha and gravelly coarse loamy to gravelly coarse loamy covering an area of 9,40,650 ha.

For gravels percent more than 35 %, textural class like sandy skeletal to loamy skeletal textural class is mapped covering an area of 61,801 ha.

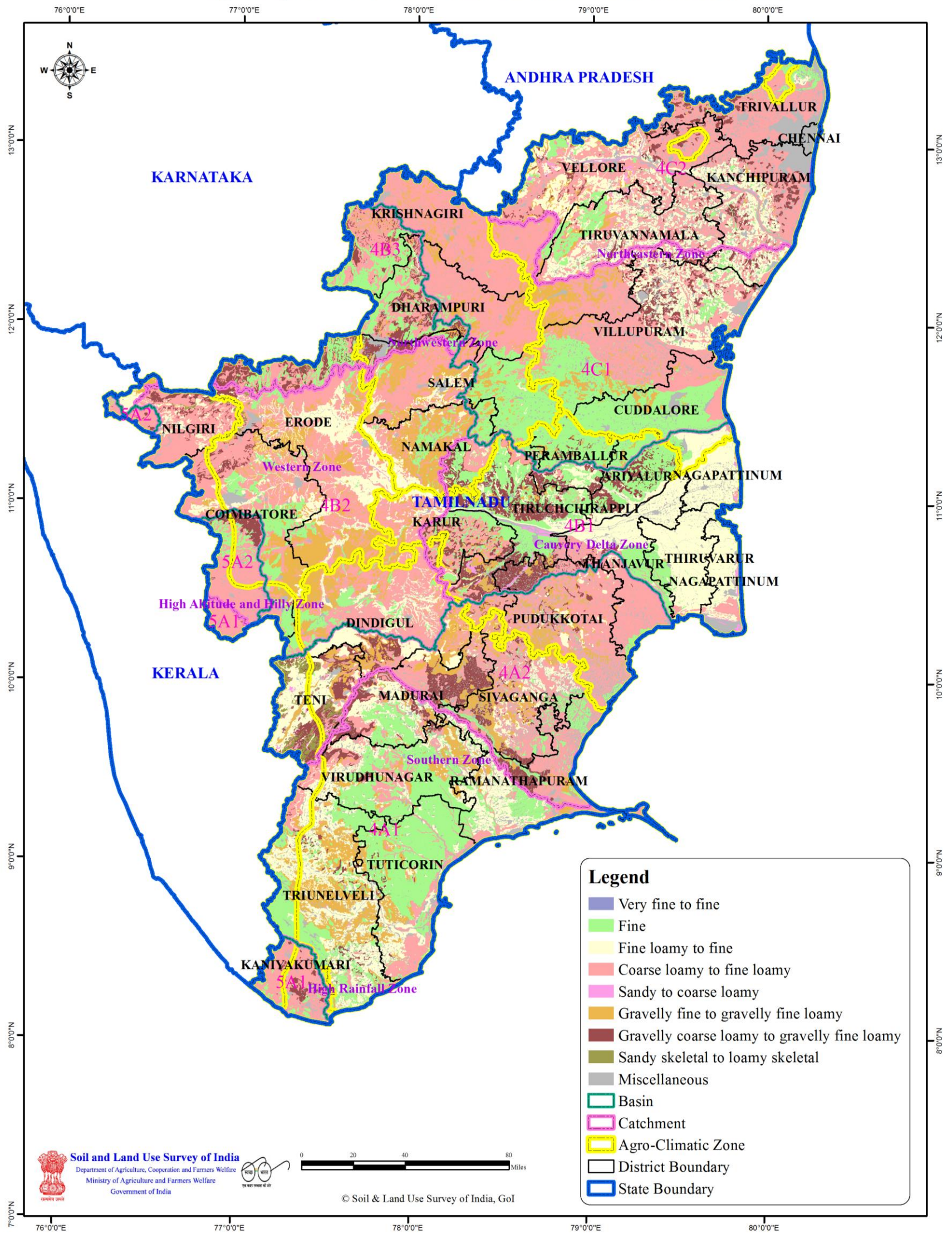
Spatial distribution of textural classes and their area shown in **figure no. 7** and **table 6**.

Table: 6 Landscape/ Agro-climatic sub-zone wise tabular distribution of textural classes in Tamil Nadu state

| Landscape | Agro climatic sub-zone | Textural Class | | | | | | | | Miscella neous | Total Area |
|------------------|------------------------------|-------------------|--------|--------------------|----------------------------|-----------------------|--------------------------------------|----------------------------------------------|----------------------------------|----------------|------------|
| | | Very fine to fine | Fine | Fine loamy to fine | Coarse loamy to fine loamy | Sandy to coarse loamy | Gravelly fine to gravelly fine loamy | Gravelly coarse loamy to gravelly fine loamy | Sandy skeletal to loamy skeletal | | |
| Aeolian | High Rainfall Zone | | | | 243 | | | | | | 243 |
| | Southern Zone | | | | 44527 | | | | | | 44527 |
| | Total | | | | 44771 | | | | | | 44771 |
| Alluvium | Cauvery Delta Zone | | 4676 | 446201 | 25061 | 9702 | 39 | 844 | | | 486523 |
| | High Altitude and Hilly Zone | | 6819 | 1740 | 5997 | | 6151 | | | | 20708 |
| | High Rainfall Zone | | | | 1482 | | | | | | 1482 |
| | Northeastern Zone | | 32721 | 42265 | 72065 | 6969 | | | | | 154021 |
| | Northwestern Zone | | 2532 | 5917 | 7697 | 648 | | | | | 16794 |
| | Southern Zone | | 17347 | 12403 | 79470 | 11 | 3080 | 4388 | 637 | | 117337 |
| | Western Zone | | 1193 | 45889 | 289 | 3606 | | | | | 50977 |
| | Total | | 65288 | 554416 | 192060 | 20937 | 9270 | 5232 | 637 | | 847840 |
| Charnokite | High Altitude and Hilly Zone | | | 26440 | 79129 | | 785 | 10110 | 4225 | | 120689 |
| | Western Zone | | | 3682 | 12948 | | 2491 | 635 | 3711 | | 23467 |
| | Total | | | 30121 | 92076 | | 3277 | 10745 | 7936 | | 144156 |
| Coastal Alluvium | Cauvery Delta Zone | | 18284 | 64626 | 26350 | 14614 | 89 | | | | 123963 |
| | High Rainfall Zone | | | | 5335 | | | | | | 5335 |
| | Northeastern Zone | | 13338 | 997 | 54804 | | | | | | 69139 |
| | Southern Zone | | 12558 | 3884 | 57583 | | | | | | 74025 |
| | Total | | 44180 | 69506 | 144072 | 14614 | 89 | | | | 272461 |
| Granite | Cauvery Delta Zone | | 452915 | 98584 | 484360 | 3414 | 147657 | 229016 | | | 1415946 |
| | High Altitude and Hilly Zone | | 106090 | 61568 | 345839 | | 31301 | 29543 | | | 574341 |
| | High Rainfall Zone | | 11742 | 1389 | 64978 | | 1296 | 12349 | | | 91754 |
| | Northeastern Zone | | 389992 | 527494 | 1053317 | 9160 | 162240 | 156209 | | | 2298412 |
| | Northwestern Zone | 859 | 417534 | 75086 | 821319 | 86 | 316990 | 95643 | | | 1727517 |
| | Southern Zone | | 704904 | 620293 | 590670 | 31 | 492101 | 219286 | | | 2627286 |
| | Western Zone | | 129330 | 162646 | 522041 | | 214828 | 74777 | | | 1103623 |

| | | | | | | | | | | | |
|----------------|------------------------------|-----|---------|---------|---------|-------|---------|--------|-------|---------|----------|
| | Total | 859 | 2212508 | 1547060 | 3882525 | 12690 | 1366413 | 816823 | | | 9838879 |
| Granite Gneiss | High Altitude and Hilly Zone | | 88 | 76661 | 57856 | 5989 | 7546 | 35333 | 38686 | | 222158 |
| | Southern Zone | | 199 | 25025 | 4954 | 5208 | | 13269 | 14542 | | 63198 |
| | Total | | 286 | 101686 | 62810 | 11198 | 7546 | 48602 | 53228 | | 285356 |
| Laterite | Cauvery Delta Zone | | 16222 | 7901 | 60926 | | | 31027 | | | 116075 |
| | High Altitude and Hilly Zone | | 133 | | 11670 | | | | | | 11802 |
| | Northeastern Zone | | 24241 | 3127 | 66332 | | 2381 | 2343 | | | 98425 |
| | Southern Zone | | | 21249 | 21432 | | | | | | 42682 |
| | Total | | 40596 | 32277 | 160360 | | 2381 | 33370 | | | 268985 |
| Limestone | Cauvery Delta Zone | | 266 | | 71 | | | | | | 337 |
| | High Altitude and Hilly Zone | | 397 | | | | 353 | 4364 | | | 5114 |
| | Northwestern Zone | | 987 | | 5655 | | | | | | 6642 |
| | Southern Zone | | 18803 | | | | 1488 | | | | 20292 |
| | Western Zone | | 31326 | | 5843 | | 1414 | 20779 | | | 59362 |
| | Total | | 51779 | | 11569 | | 3255 | 25143 | | | 91747 |
| Sandstone | Northeastern Zone | | | | 7023 | | | 734 | | | 7758 |
| | Southern Zone | | 814 | | 13331 | | | | | | 14145 |
| | Total | | 814 | | 20355 | | | 734 | | | 21903 |
| Miscellaneous | Total | | | | | | | | | 1201246 | 1201246 |
| Grand Total | | 859 | 2415451 | 2335068 | 4610597 | 59439 | 1392233 | 940650 | 61801 | 1201246 | 13017343 |

Fig.7. Spatial Distribution of Texture in Tamil Nadu



DISTRICT-WISE CATEGORIZATION OF PRIORITY CLASS

Identification and demarcation of priority area is based on the assessed Sedimentary Yield Index (SYI) and Runoff Potential Index (RPI) values of hydrologic units have been carried out in state. The state area has been divided in to into five priority classes, i.e. very high, high, medium, low and very low. SLUSI has identified areas of higher runoff and sediment load mostly covering hills/ forests/ scrub lands.

Based on the priority assessment, it was observed that about 5 % of state's total geographical area is identified under very high priority and about 10 % is identified under high priority areas. These area showing degradation due to active soil erosion and can be taken up for conservation measures. Whereas, about 17 % is identified under medium priority area that needs to be protected from further soil loss and requires conservation measures.

Spatial distribution of priority categorization of watersheds and district-wise area are shown in **figure no. 8** and **table 7**. District-wise area covered under very high and high priority area is highlighted in the form of bar-diagram.

Table: 7 District wise tabular distribution of priority classes in Tamil Nadu state

| Distribution of Priority Watersheds in Tamil Nadu | | | | | | |
|---------------------------------------------------|----------------|----------------|----------------|----------------|---------------|--------------------|
| District | Priority | | | | | Total Area (ha) |
| | Very Low | Low | Medium | High | Very High | |
| Ariyalur | 124188 | 43134 | 14093 | 12493 | 12 | 193920 |
| Chennai | 17518 | | | | | 17518 |
| Coimbatore | 268117 | 143504 | 189876 | 95944 | 52518 | 749959 |
| Cuddalore | 294157 | 21927 | 24884 | 21790 | 8989 | 371747 |
| Dharampuri | 62580 | 85865 | 119941 | 103970 | 77805 | 450161 |
| Dindigul | 165214 | 214598 | 99870 | 99064 | 27417 | 606164 |
| Erode | 295175 | 164660 | 172802 | 133418 | 56090 | 822144 |
| Kanchipuram | 394241 | 38221 | 13018 | 2108 | | 447588 |
| Kanyakumari | 140 | 55846 | 36928 | 60326 | 15565 | 168805 |
| Karur | 59955 | 56224 | 89271 | 80601 | 4695 | 290746 |
| Krishnagiri | 60297 | 166581 | 166343 | 59475 | 61004 | 513699 |
| Madurai | 101045 | 114690 | 91601 | 45662 | 18603 | 371602 |
| Nagapattinum | 256631 | | | | | 256631 |
| Namakkal | 59836 | 72551 | 128400 | 62973 | 18668 | 342428 |
| Nilgiri | 85599 | 29539 | 30325 | 39005 | 73045 | 257513 |
| Perambalur | 69448 | 42299 | 29842 | 27951 | 5131 | 174671 |
| Pudukkottai | 219242 | 62902 | 92375 | 68032 | 22608 | 465158 |
| Ramanathapuram | 275122 | 132130 | 15587 | 1169 | 1255 | 425263 |
| Salem | 179977 | 147604 | 98946 | 51498 | 46446 | 524470 |
| Sivaganga | 203210 | 95855 | 55793 | 31328 | 24907 | 411093 |
| Teni | 138908 | 46849 | 61069 | 32315 | 8272 | 287414 |
| Thanjavur | 298772 | 14668 | 23009 | 5017 | | 341466 |
| Thiruvarur | 211631 | | | | | 211631 |
| Tiruchchirappalli | 122695 | 96538 | 120782 | 85918 | 23912 | 449844 |
| Tiruvannamalai | 338242 | 157694 | 64466 | 28521 | 30181 | 619103 |
| Triunelveli | 109027 | 301410 | 228143 | 43021 | 197 | 681797 |
| Trivallur | 335322 | 1882 | 2029 | | | 339233 |
| Tuticorin | 85196 | 286644 | 61743 | 29872 | | 463456 |
| Vellore | 306281 | 112722 | 119123 | 40271 | 29201 | 607598 |
| Villupuram | 522248 | 92337 | 45527 | 19499 | 49659 | 729271 |
| Virudhunagar | 59596 | 259438 | 74563 | 31651 | | 425249 |
| Grand Total | 5719612 | 3058312 | 2270351 | 1312892 | 656177 | 13017343 |

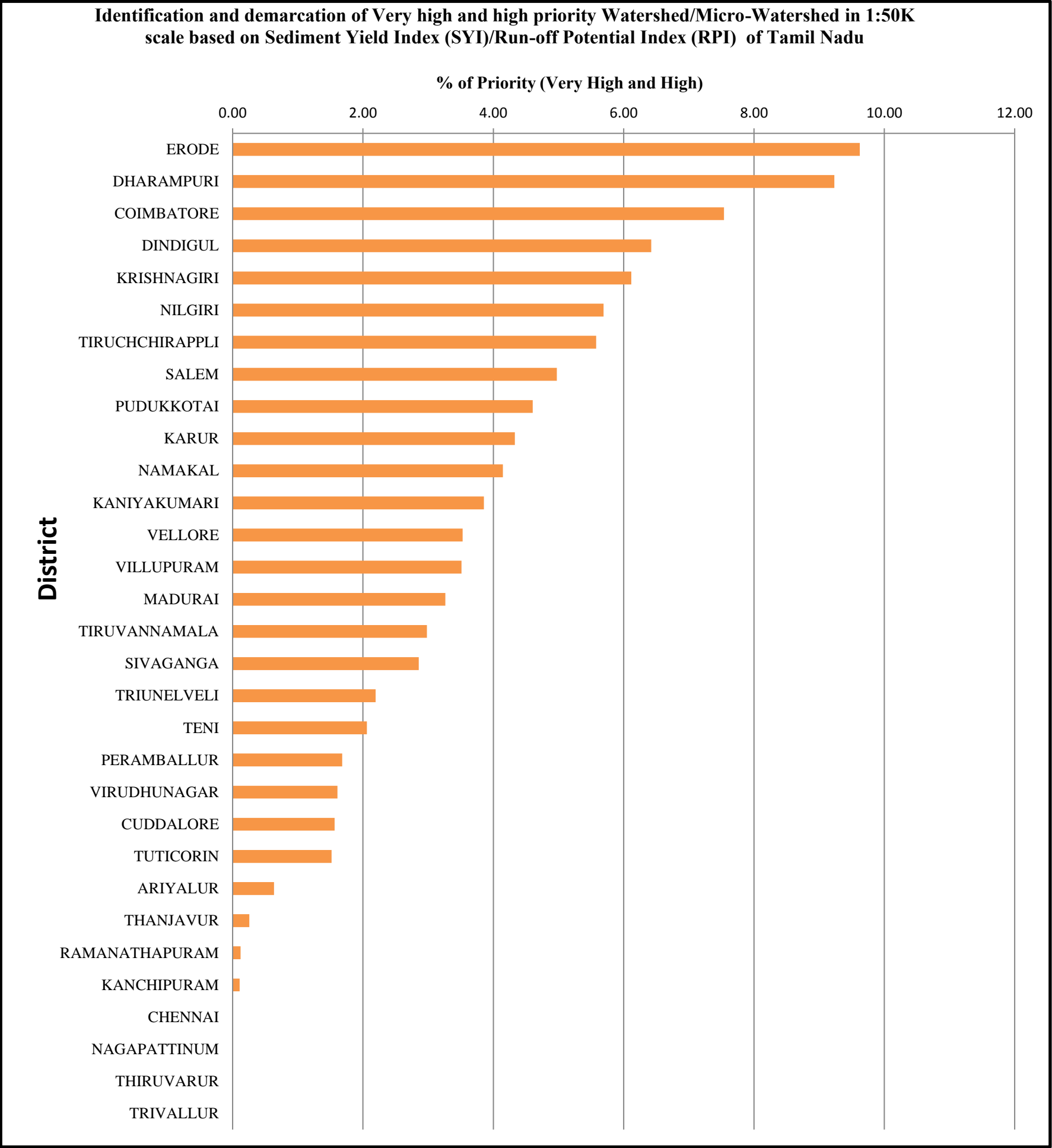


Fig.8 Distribution of Priority Watersheds in Tamil Nadu

