Advancement of Interpreting and Mapping of terrain features using Remote Sensing and GIS Technique

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Abstract— In this modern era of satellite technology, remote sensing pictures the earth with real 3D effects, so enabling to get the valuable assets of the earth architecture. This leads to analyze the structure of the earth, landform and its features to

restore and manage potential land resources. IRS P6 LISS III precision geocoded data on 1:50,000 scale were used for the preparation of geomorphological and lineament maps for Chennai scene. Here the landforms are delineated using GEOM tool techniques. Research in GIS helps to analyze the real world and their resources. These are useful in various applications such as groundwater exploration, land use planning, disaster management, desertification, geo engineering and so on.

Index Terms— Keywords - Geomorphology, landforms, Lineament, Resource Management

1 INTRODUCTION

Geomorphology studies the architecture of landforms. Geo means "earth", Morpho means "form" and Logy means "discourse" or "science".

A. The Earth - A geomorphological perspective

It is a branch of Earth Science, which has grown after the arrival of aerial photographs and satellite data. These data of its temporal capability are of immense help in understanding the spatial and temporal domain of the landform.

B. GEOM tool

GEOM is developed by National Remote Sensing Centre (NRSC), Hyderabad and published on 18th February, 2010 as a module in ArcGIS. It is used for preparation of National Geomorphological and Lineament Mapping done on 1:50,000 scale. GEOM is a module which runs in ArcGIS as NRSC have set code and default standards in it based on the project standards.
GEOM helps to classify

i. Geomorphological Mapping
ii. Lineament Mapping
iii. Lineament Magnitude

Geomorphology, along with information on soil, water and vegetation has become one of the essential inputs in planning for landuse, landcover changes and various developmental activities.

C. Geological and Geomorphological Interpretation carried out by GSI on 1:50,000 Scale

The classification scheme involved geomorphic unit in the first level and landform unit in the second level. The developed legend scheme followed the genetic classification scheme in project of geomorphology. Regarding lineament mapping, field based structural elements have been rendered in the maps.

D. Data Source

i. Toposheet
ii. Satellite Data- IRS P6 LISS III
iii. Geomorphological Units and maps
iv. District Geological maps by GSI on 1:250,000 scale

i. Toposheet

A topographic map is typically published as a map series, made up of two or more map sheets that combine to form the whole map in the form of grids. A topographic map is a meticulous and accurate graphical representation of cultural and natural features on the ground surface.

ii. Satellite Data- IRS P6 Liss III

IRS P6 LISS III precision geocoded data on 1:50,000 scale were used for the preparation of geomorphological and lineament maps with Sensor: 6 K CCD per band, Spectral bands: 4 bands (0.52 - 0.59, 0.62 - 0.68, 0.77 - 0.86 and 1.5 - 1.7μ), Swath: 140 Km, Ground Resolution: 23.5 meter pixel in all 4 Bands, Radiometric Resolution: 7 bits selected over 10 bits, BBR: < 0.25 pixel, Repetivity: 24 days.

iii. Geomorphological Units

The Geomorphological units are classifications of landforms in to structural and Denudational forms and then sub classified with their type of forms with the standard alphabetical code for each type.

iv. Geological And Geomorphologic Mapping carried out by GSI on 1:50,000 Scale

This was started by Geological Survey of India, GSI as a part of regional geological mapping in early seventies.. Basic objective of the study was to prepare a compiled

Quaternary geological and geomorphologic map of the country, used as reference.

E. Study Area

For geomorphological and Lineament mapping study under GEOM module and to demonstrate the potential of GEOM, two topomap sheets 57L10 and 66D2 are chosen so as to represent the maximum number of classes and almost covering all geomorphic processes.

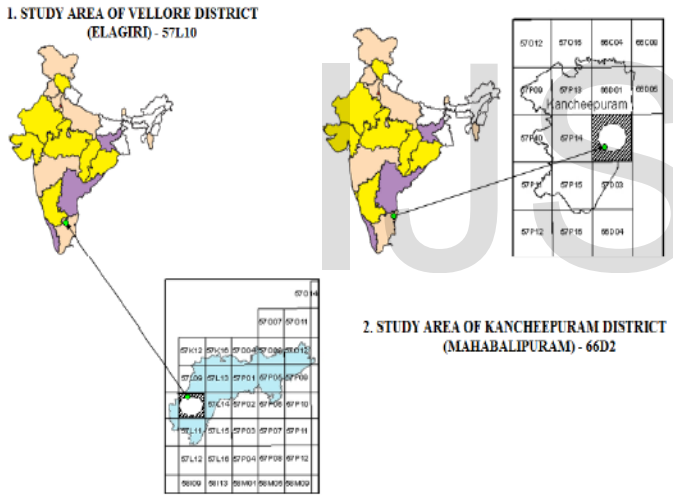

Figure 1. Study Area

1.Elagiri Area

Yelagiri is a hill station in Vellore district of Tamil Nadu, India, situated off the Vaniyambadi-Tirupattur road Located at an altitude of 1,410 metres above Mean Sea Level and spread across 30 km2 area.

57L10 covers Elagiri, aniyambadi, Jolarpettai in Vellore, Dharmapuri District.

2. Mahabalipuram Area

Mahabalipuram, derived from 'Mamallapuram' is a town in Kancheepuram district in the Indian state of Tamil Nadu. It has an average elevation of 12 meters (39 feet) above mean sea level. Mahabalipuram was a 7th century port city of the South Indian era of the Pallavas around 60 km south from the city of Chennai in Tamil Nadu.

66D2 covers Mahabalipuram, Sadras, Kalpakkam, Thiruporur, Muthukadu in Kancheepuram District.

2 GENERAL METHODOLOGY

The geomorphological and lineament mapping is prepared in the following methodology.

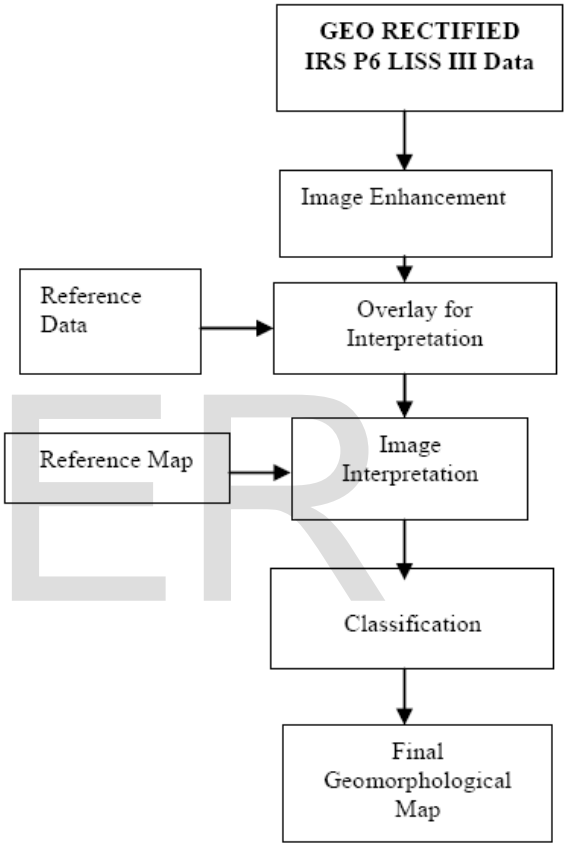

Figure 2. General Methodology for preparation of Geomorphological and Lineament Mapping

A. Data Preparation

In this step, the digitization set up needs to be prepared for onscreen digitization and data base collection for the units falling under geomorphic and lineament. Data preparation can be accomplished by following steps.

B. Image Preparation

The images used for the project is enhanced using image processing techniques and false colour composite (FCC) is prepared and displayed after doing necessary enhancement like contrast stretching, data scaling etc. for the interpretation. High-pass filter can be used to make image appear sharper and emphasize fine details in the data. These filtering algorithms are used for lineament mapping.

C. Image interpretation and database preparation

The map is interpreted based on the geomorphic units within the grid and also checked the geomorphic landform and lineament database.

3 GEOMORPHOLOGICAL CLASSIFICATION

A. Landforms of Structural Origin

Landforms under this origin has genesis related to underlying structure. Structure plays an important role for reducing the resistance of rock which manifests itself in different geomorphic forms. The mega scale structural features like fold and fault depending on its type plays an important role in genesis of structural landform. The influence of geologic structures on the development and appearance of landscapes is prominent ranges from large features to small features.

B. Landforms of Denudational Origin

Landform of denudational origin is formed under the combined effect of mechanical and chemical weathering. Denudation is the process of removal of material by erosion and weathering. The agents are mostly water, ice and wind. All rocks and minerals are attacked by physical and chemical process. As a result weathering and erosion yield number of landforms, which have each typical different shape and forms.

C. Landforms of Fluvial Origin

The fluvial landforms are produced by running water. Running water can either erode material from the earth's landscape, or deposit layers of sediment on the surface. The resulting landforms can thus be grouped as either erosional landforms or depositional landforms.

D. Landforms of Coastal Origin

Coasts are also the loci of a unique formation of erosional and depositional processes. The various landforms of coastal areas are as the result of the action of ocean waves. Wave action creates some of the world's most spectacular erosional landforms. Where wave energy is reduced, depositional landforms like beaches are formed.

4 CLASSIFICATION OF LINEAMENTS

The following two types of lineaments are interpreted from the satellite data.

A. Lineament Mapping

a. Geomorphic Lineaments

b. Structural Lineaments

B. Magnitude of Lineament

All lineaments are to classified based on their length into the following two types.

1. Micro Lineaments

2. Macro Lineaments

1. Micro lineaments- Very small magnitude features observed in the image such as minor faults, fractures, joints and bedding traces of rock and also local depressions/ponds and tonal changes in soil and vegetation. Also, lineament length less than 3 km is classified as micro lineaments.

2. Mega lineaments- Large linear features. Adjacent/ coincides with regional trends/structural features. Lineament length greater than 3 km is classified as mega lineaments.

5 OUTPUT LAYERS

Thus the output layers of Geomorphological and Lineament Mapping for the study area were prepared and shown below.

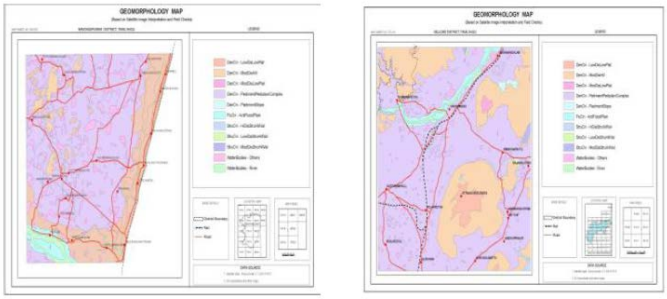

Figure 3. Geomorphological Mapping for (66D02) Kancheepuram District and (57L10) Vellore District

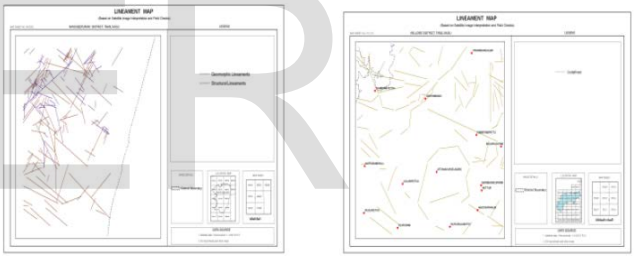

Figure 4. Lineament Mapping for (66D02) Kancheepuram District and (57L10) Vellore District

6 SWOT ANALYSIS OF GEOM

By working in ArcGIS GEOM, the SWOT Analysis is prepared based on the utility and user friendly of GEOM.

A. Strength

1. Unique ID

a. ArcGIS GEOM software is user friendly and helps to give unique identity for the Geomorphological and Lineament units

b. So, the software helps to link all the state works in to single project finally as "National Geomorphological and Lineament Mapping"

2. Topology error correction

The topology errors such as overlap, undershoot etc are which occurs are corrected here in GEOM automatically with single click. We have,

i. Line error
ii. Area error
iii. Point error

3. Upload data

Here in this project, mapping of water bodies in TamilNadu is just loaded here.

B. Weakness

1. This is prepared based on so as to be used only for this project.
2. It cannot be applicable for some other project

C. Oppurtunities

1. GEOM helps to complete the project at a stretch without correction works.
2. It allows to carryon easily and fulfill the project at required time.

D. Threats

1. Readymade or tailor-made program particularly only for this project.

7 Conclusion

GEOM helps in preparation of geomorphology and lineament layers as per the classification scheme. This GEOM ultimately helps to perform the National Geomorphological and Lineament Mapping project successfully with its more added features. 57L10 area is influenced by Denudational and fluvial processes with Structural impact and 66D2 area is influenced by Denudational, fluvial and Coastal processes and Aeolian process is also seen shaping the part of coastal area in the form of sand dumes parallel to the coast.

This is useful for various applications such as groundwater exploration, land use planning, disaster management, desertification, geo-engineering and so on.

Acknowledgment

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