Application of Computer based Techniques in Geomorphology

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Abstract

Geomorphology is a major branch of physical Geography of Earth Science discipline. Geoinformatics techniques and its application form the revolution in the study and research of geomorphology. GIS, Remote Sensing, GPS, photogrammetry, cartographic techniques and its application in Geographical spatial database management could not complete without computer technology. Database management system for the study of surface of the Earth provides precise result of the analysis. This paper is divide into two major section. In the first, an attempt has been made to extract the major applications of computer based techniques and its application in the Geomorphological studies and research. Second portion of the paper highlight a case study of an application of Geographical Information System and Remote Sensing techniques for geomorphological analysis and mapping. Present investigation demonstrate that the significance and necessity of computer based techniques and its application in the Geomorphology.

Key Words: Geomorphology, Geographical Information System, Remote Sensing, DEM

Introduction

Geomorphology is foremost branch of Physical Geography of Earth Science discipline. The subject deals the scientific study of landforms and surface processes of the Earth. The knowledge of Geomorphology is applicable for several applications in the solutions of real time problems. Geoinformatics is a new branch of Geography. It includes GIS, remote sensing, GPS, photogrammetry, cartographic etc. techniques and its application in Geographical spatial database management. Geographical Information System is a computer based spatial information system that use for storage, retrieval, manage, maps and analyze a geographical data.

The GIS word first appeared in 1960's at Canada. Remote sensing is a science of collecting information of Earth surface without being in contact it. Remote sensing provides a database for GIS. GPS system is a Global positioning system which used for spatial reference location on Earth. Hardware, software, data &information, methods and users are the key elements of GIS. Computer system i.e. hardware and software required for scanning, capturing, analyze and mapping of spatial data by the users. GIS application software's develops as the computer system software's modified time to time. Today number of professional and open source GIS software's are available for users for different application.

Objectives of the study

1. To extract the major applications of computer based techniques and its application in the Geomorphological studies and research.
2. To apply the Geographical Information System and Remote Sensing techniques for geomorphological mapping at tehsil level.

Geoinformatics techniques and its application form the revolution in the study and research of Geomorphology. Database management system for the study of surface of the Earth provides particular and accurate result of the analysis. After 2010, in India many researchers apply the techniques of Geoinformatics in Geomorphology research.

SRTM (Satellite Radar Topographic Mission) DEM (Digital Elevation Model) of 90 m resolution, ASTER DEM, CARTOSAT DEM, Aerial photographs, satellite imagery, GPS survey data, total station survey data etc. are the major data source for application and mapping of different Geomorphological parameters using GIS software's. Application of computer based techniques like GIS, RS, GPS in the investigation of Geomorphology perform the qualitative and quickly analysis of voluminous data. Many frequently used indicators of Geomorphology with its GIS application is available on source i.e. http/:gis4geomorphology. com. Raster and Vector analysis and models are precise for number of geomorphic investigation.

Jan-Christoph and others, 2017 reviewed and summarized a detail investigation of application of GIS in the field of Geomorphology by scholars and researchers worldwide. As per the data of webofknowlegde.com which is cited by Jan et al, 2017 the annual publication of number of research papers increases by 2005 after releases of SRTM digital elevation model of 90m resolution. By 2008 with

release of ASTER DEM (30m resolution) the number of research paper publication increased annually at highest level. The common used GIS Software's for the raster as well as vector analysis are Arc- GIS, Global mapper, Arc View, Geomatica, Surfer, Ilwis, Diva GIS, Quantum GIS, Erdas.

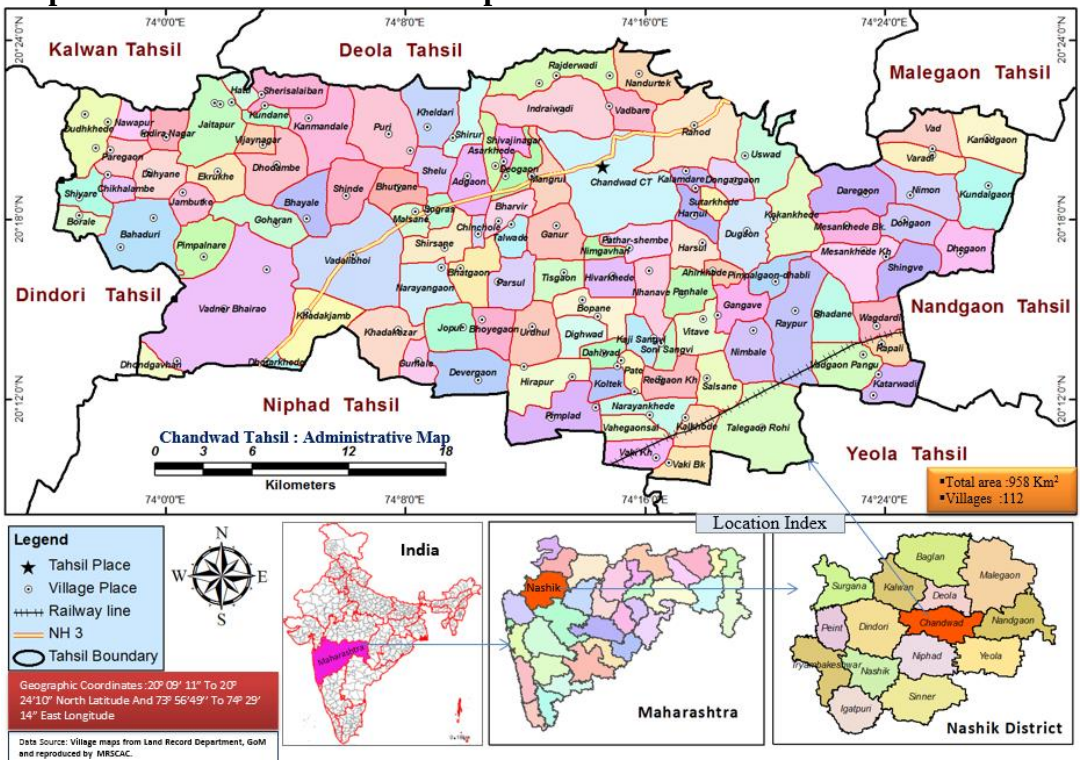
Table No: 1 Major applications of Geoinformatics in the Geomorphology

Geomorphology : Sub branches	**Application areasof Geomorphology of forInvestigation, analysis and mapping using GIS and Remote Sensing**
Pedogeomorphological	Soil properties spatial variation and mapping, Soil loss study, Land evaluation, land capability, land suitability, and land productivity, plant-crop-soil-site suitability study
Digital Terrain Modelling (DTM)	Digital Elevation Model,3d view, automated landform delineation,relief mapping, contours at different interval, digital terrain profiles, slope map, hill shade analysis, Aspect etc.
Fluvial Geomorphology, Hydro-geomorphology and Watershed analysis:	Automated watershed delineation, estimation of aerial, linear and relief properties of watershed or drainage basin. Stream ordering, DEM based drainage generation, measurement of stream length, area, longitudinal profiles, absolute relief, relative relief, dissection index, percentage and or degree slope, shape, relief ratio, ruggedness number, bifurcation ratio, drainage density & frequency, prioritization of watershed, runoff, flood discharge etc.
Land use/ Land cover study	Wasteland delineation, watershed management, landform identification, changes in morphology of rivers, change detection in different landforms, geomorphological features etc.
Coastal & GlacialGeomorphology	Beach morphology, sea level changes,Currents and sea waves, bathymetry, coastline, estuary, Glacier landforms and processes etc.
Structural & Tectonic Geomorphology	Digital Geometry Analysis, Digital Image Processing of terrain data, Geospatial analysis of fractures, lineament, fault, Dykes, Volcano etc.
Applied and Environmental Geomorphology	Geomorphosites mapping, Geotourism mapping, Natural Resource Evaluation and management, Site selection for dam/reservoir, Westland management, Hydrological mapping, Estimation of Surface Runoff, Palaeo-flood mapping, Denudation studies, slope models, Land evaluation, land facets, Geomorphic Hazards and its management etc.

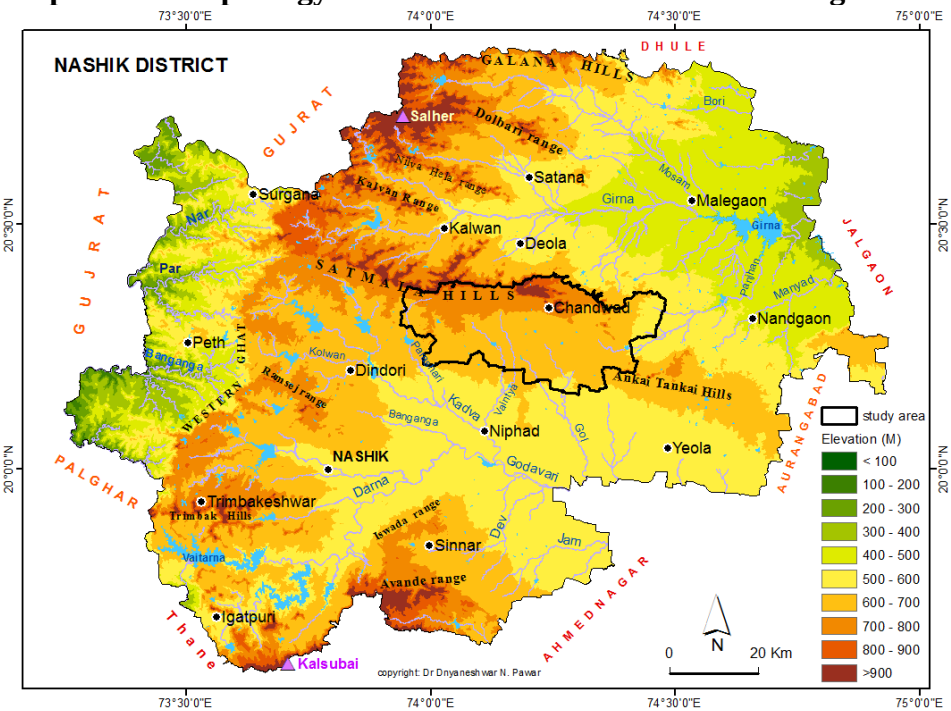
GIS and Remote Sensing techniques for geomorphological analysis and mapping of Chandwad Tahsil of Nashik district, Maharashtra:

The data source used for the study area mapping is ASTER DEM, Toposheets and administrative boundaries of villages from NRCS.Geomorphology map of Nashik district produced using SRTM DEM 90M resolution database. Absolute relief shows the maximum elevation of particular point. The absolute relief map prepared using DEM_{MAX}methods of raster grid operation. Relative relief is difference between maximum height and minimum height. The relative relief map of Chandwad tehsil is prepared using Chandwad DEM_{MAX} –DEM_{MIN} grid operation. Percentage dissected index indicate topography structure and it is prepared using relative relief grid/ DEM_{max} grid*100. Percentage slope calculated using flot grid based on DEM conversion tool. Spatial variation of soil loss up to village level calculated using field survey data and NBSS & LUP, SSD, Nagpur, Maharashtra soil erosion map. Wasteland of the study area delineated using LISS 4 satellite image purchased from NRSC. Supervise image classification carried out for the land use /land cover analysis. SPSS software have been used to find out correlation between all reliefs parameters. Statistical analysis and mapping gives self-explanatory interpretation of an area. (Map No 1 to 9& Table 2)

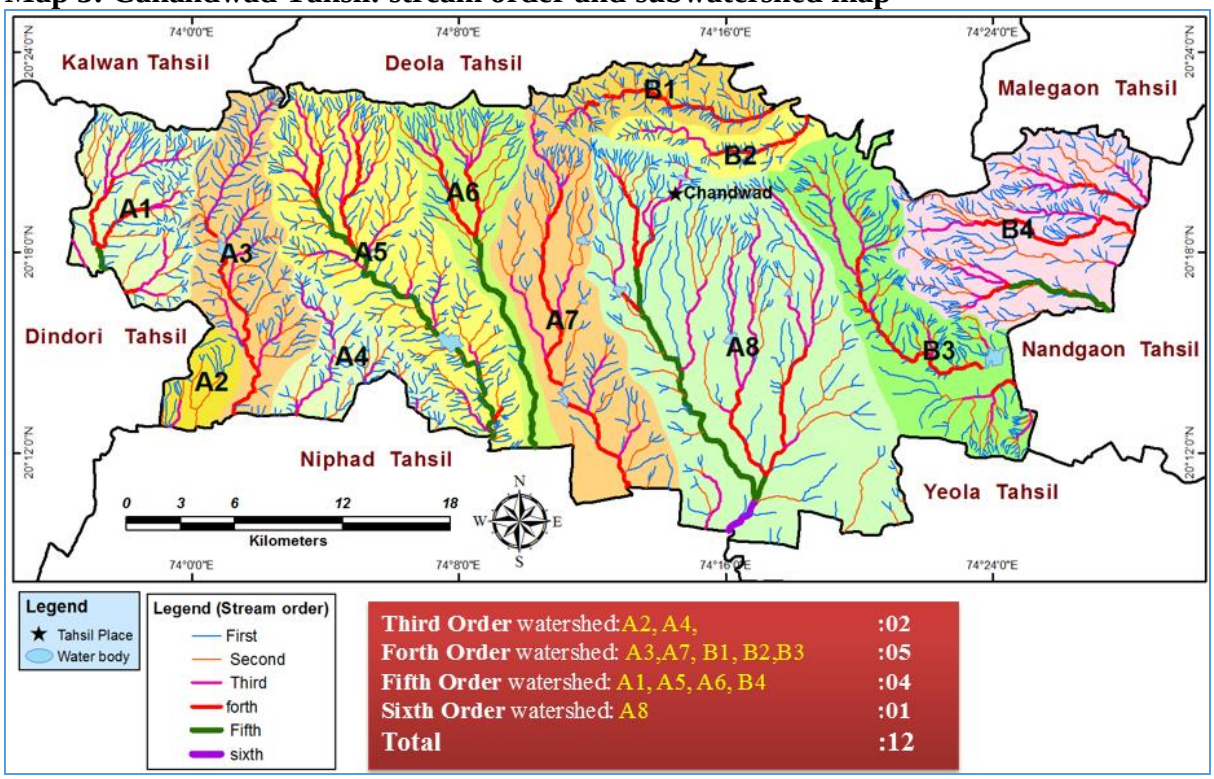
Map1. Administrative Location map of Chandwad Tahsil



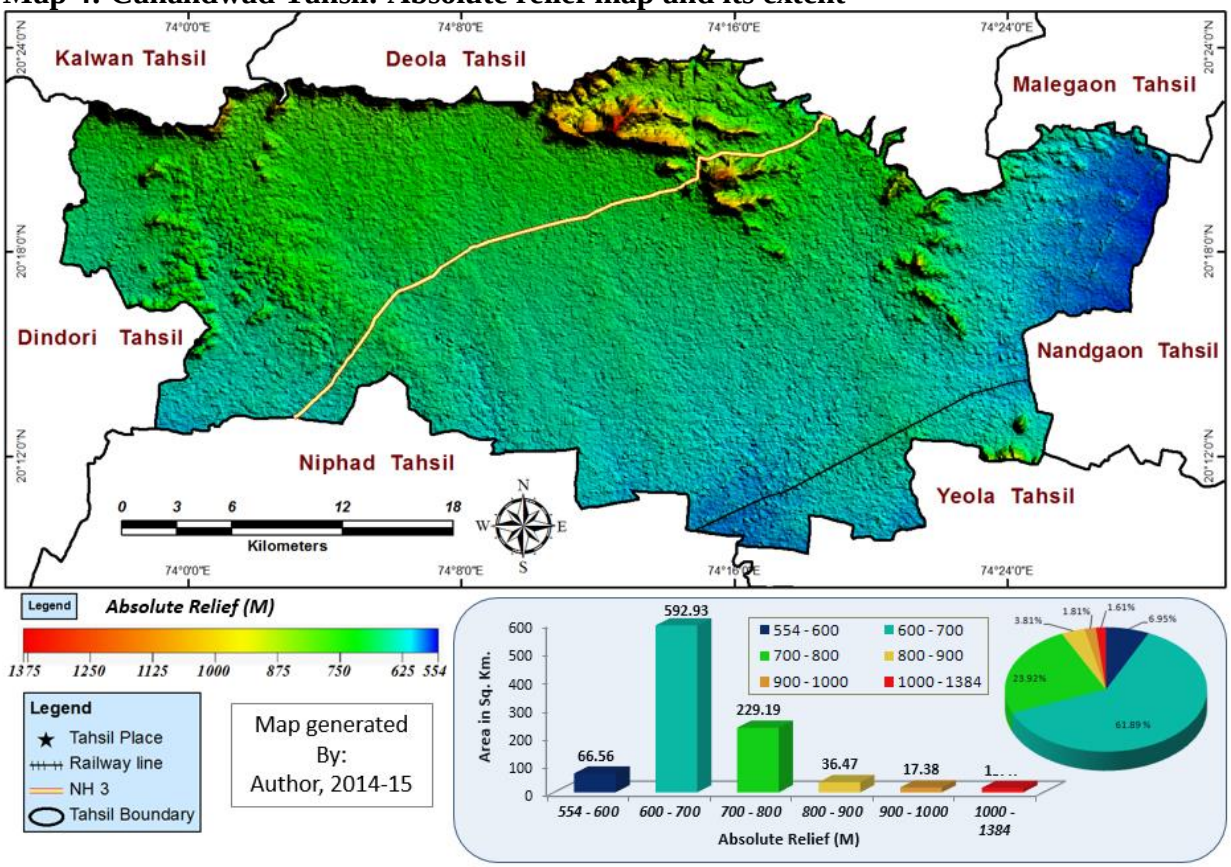
Map 2: Geomorphology of Chandwad tehsil and Surroundings



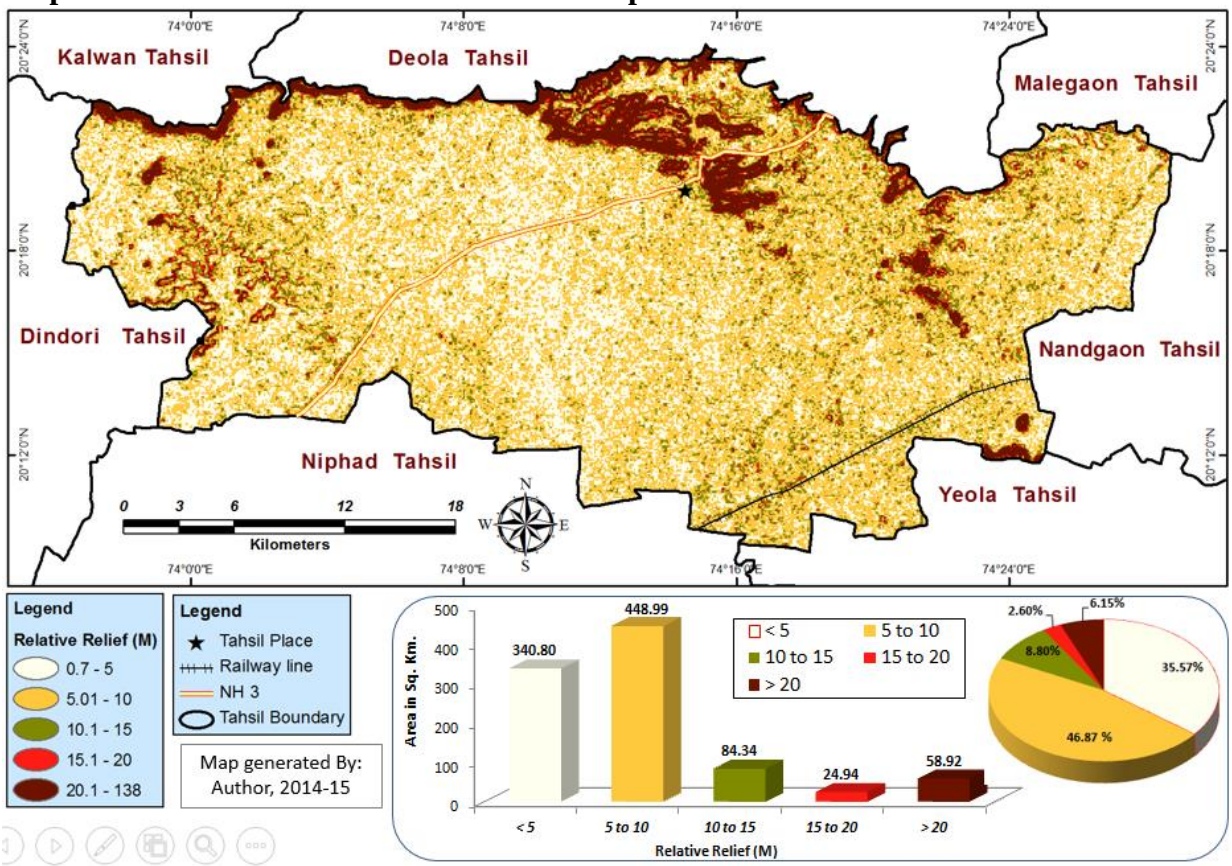
Map 3: Cahandwad Tahsil: stream order and subwatershed map



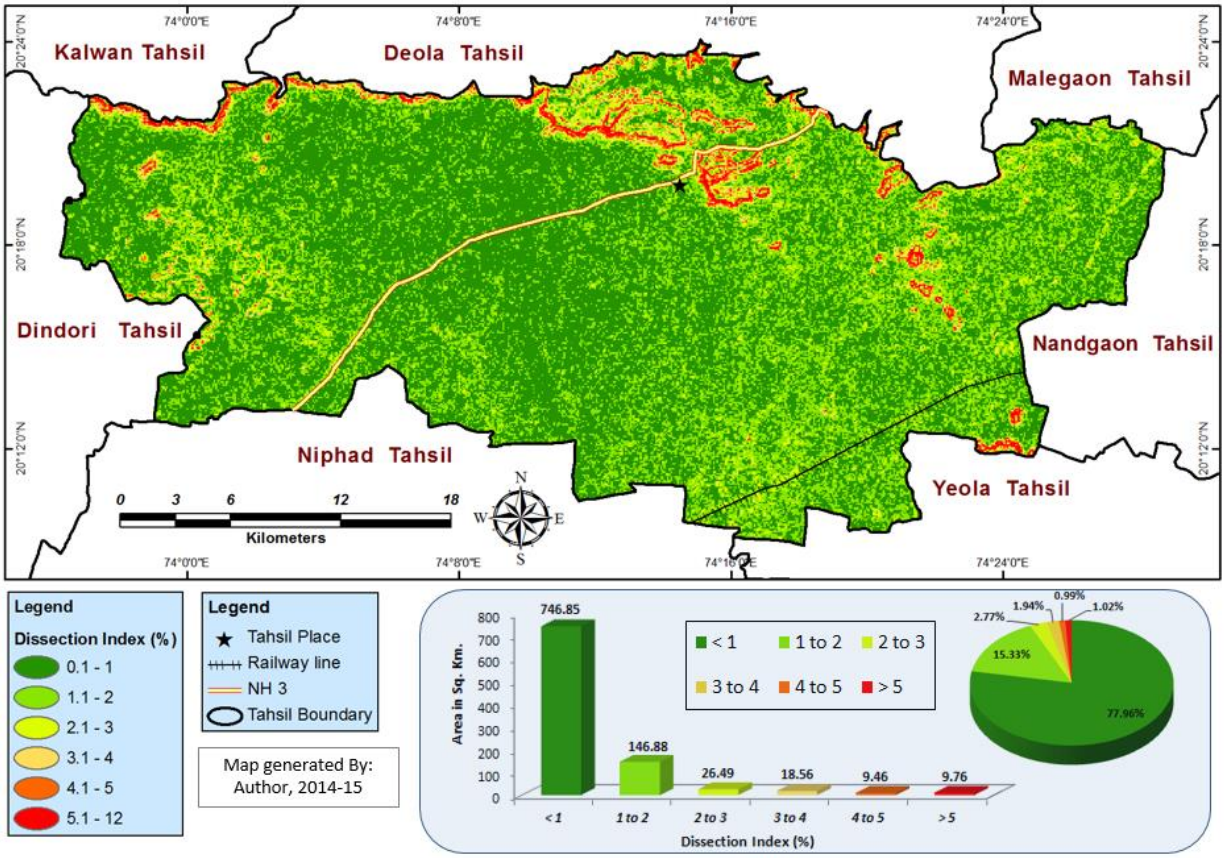
Map 4: Cahandwad Tahsil: Absolute relief map and its extent



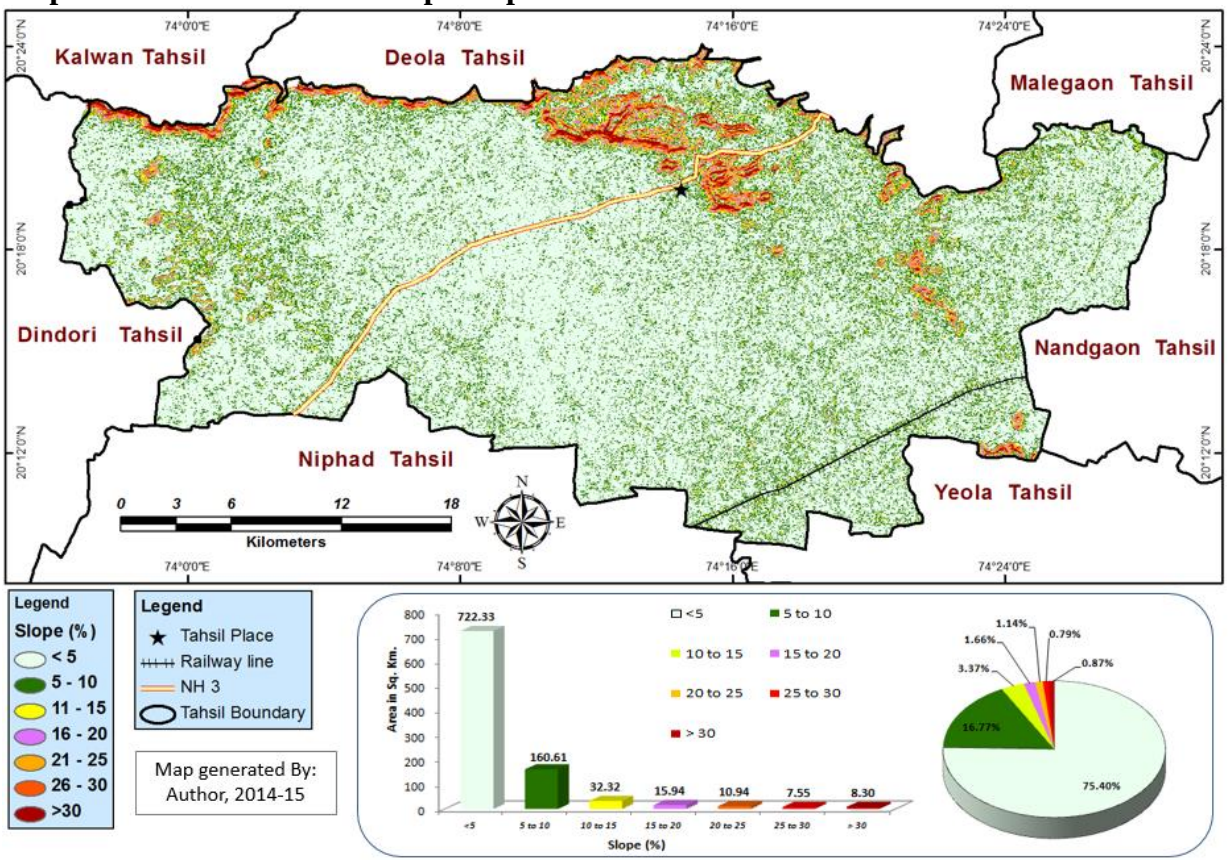
Map 5: Cahandwad Tahsil: Relative relief map and its extent



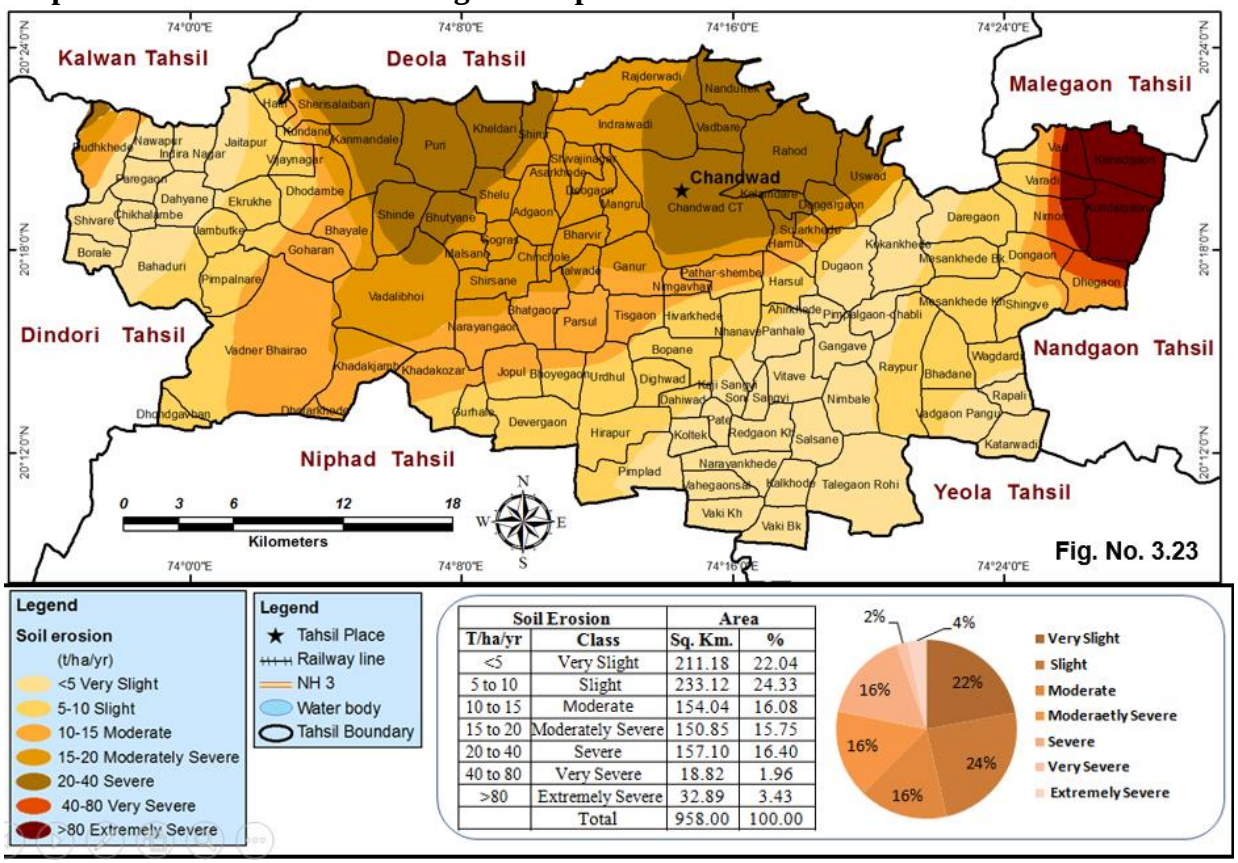
Map 6: Cahandwad Tahsil: percentage dissection index map and its extent



Map 7: Cahandwad Tahsil: slope map and its extent

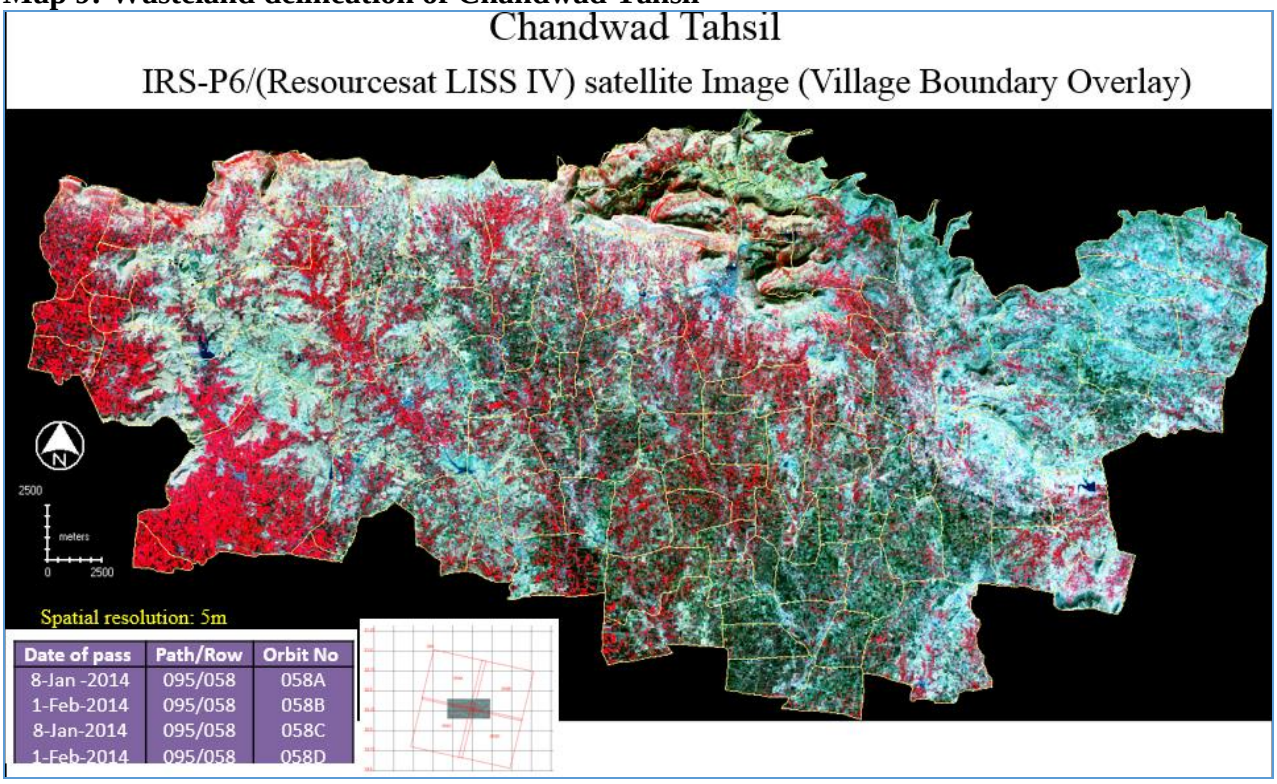


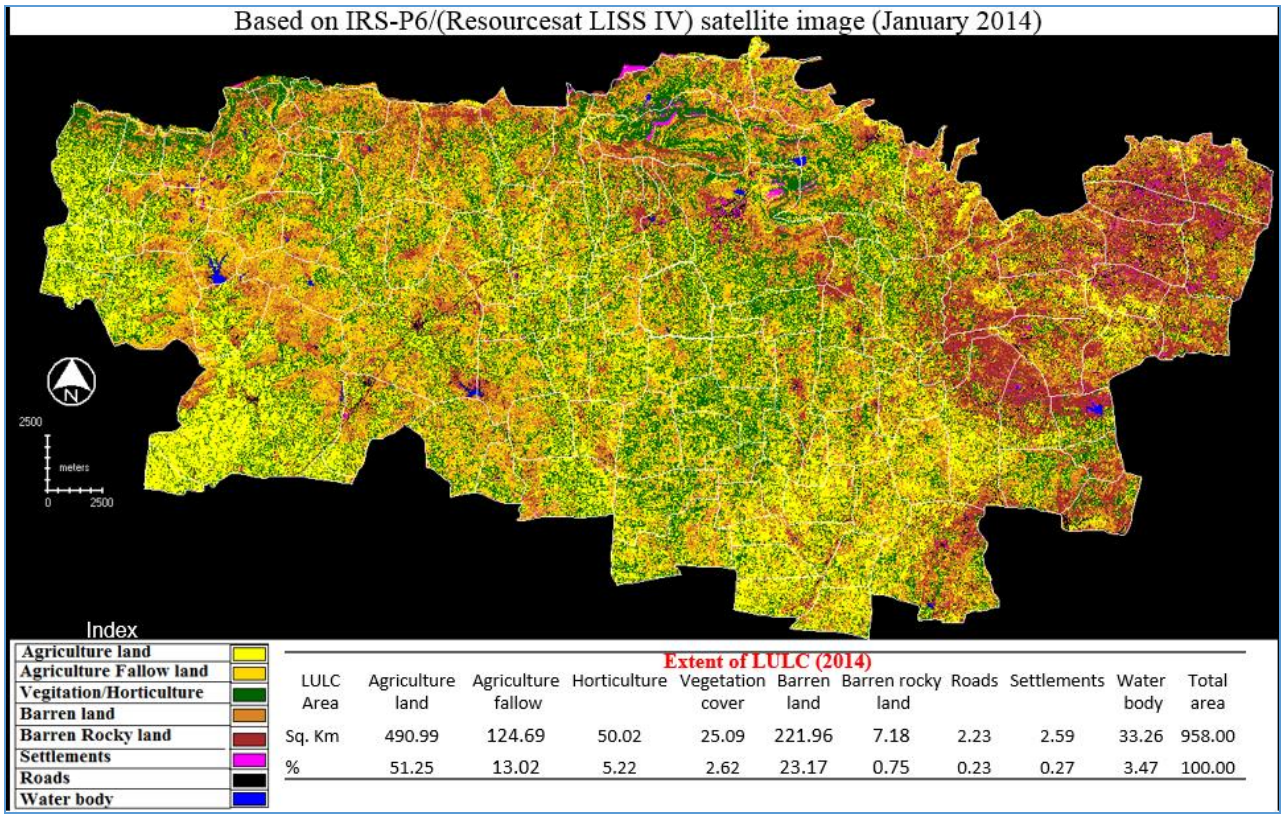
Map 8: Cahandwad Tahsil: Village level spatial variation of soil erosion and its extent



Soil Erosion		Area	
T/ha/yr	Class	Sq. Km.	%
<5	Very Slight	211.18	22.04
5 to 10	Slight	233.12	24.33
10 to 15	Moderate	154.04	16.08
15 to 20	Moderately Severe	150.85	15.75
20 to 40	Severe	157.10	16.40
40 to 80	Very Severe	18.82	1.96
>80	Extremely Severe	32.89	3.43
	Total	958.00	100.00

Map 9: Wasteland delineation of Chandwad Tahsil





Extent of LULC (2014)

LULC Area	Agriculture land	Agriculture fallow	Horticulture	Vegetation cover	Barren land	Barren rocky land	Roads	Settlements	Water body	Total area
Sq. Km	490.99	124.69	50.02	25.09	221.96	7.18	2.23	2.59	33.26	958.00
%	51.25	13.02	5.22	2.62	23.17	0.75	0.23	0.27	3.47	100.00

Table No. 2 Chandwad Tahsil: Correlation matrix of Geomorphological characteristics

Chandwad Tahsil	Elevation	Slope	Absolute relief	Relative relief	Dissection Index	LULC	Soil Types	Erosion
Elevation	1	0.999	.014	.651	0.999	0.908	-.087	.541
Slope		1	-.004	.644	0.999	0.907	-.107	.530
Absolute relief			1	.742	-.027	-.100	0.989	.611
Relative relief				1	.626	.501	.653	.793
Dissection Index					1	.913*	-.131	.520
LULC						1	-.193	.545
Soil types							1	.519
Erosion								1

Conclusion:

The application of computer based techniques viz GIS, remote sensing, cartography in the geomorphological analysis and mapping of any area on the Earth surface forms a very revolution tools. In modern era of Geomorphological research familiarly linked with Geoinformatics techniques. The DEM based studies and its application has widely used by the researchers and this has open many new areas of the research. It increases the research publications of Geomorphology with quality, precise and accuracy in analysis, digital mapping.

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