Geomorphological Analysis of Madhyamaheshwar Ganga River Basin Using Remote Sensing and GIS Techniques

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Abstract

Geomorphology is important for the understanding of Earth surface processes, geochronology, natural resources, natural hazards and landscape evolution. It involves the partition of the particular area based on morphology, genetics, composition, structure, land cover, soil, ecology as well as landforms. The present work /study are based on spatial data acquired form of Survey of India topo-sheets and ASTER GDEM (2011). Madhyamaheshwar Ganga River is a major tributary of Mandakini River and drain in near about 378.83 Km² areas from to its source. The origin of Madhyamaheshwar Ganga River is Pandusera and joins to Mandakani in Niwasini. The Remote Sensing and GIS techniques have been used to complete the work on present study. The geo-informatics based study of Geomorphology analysis of river basin characteristics can be used by local people for sustainable development of this area.

Keywords: *Geochronology, Dendritic & Remote Sensing and GIS*

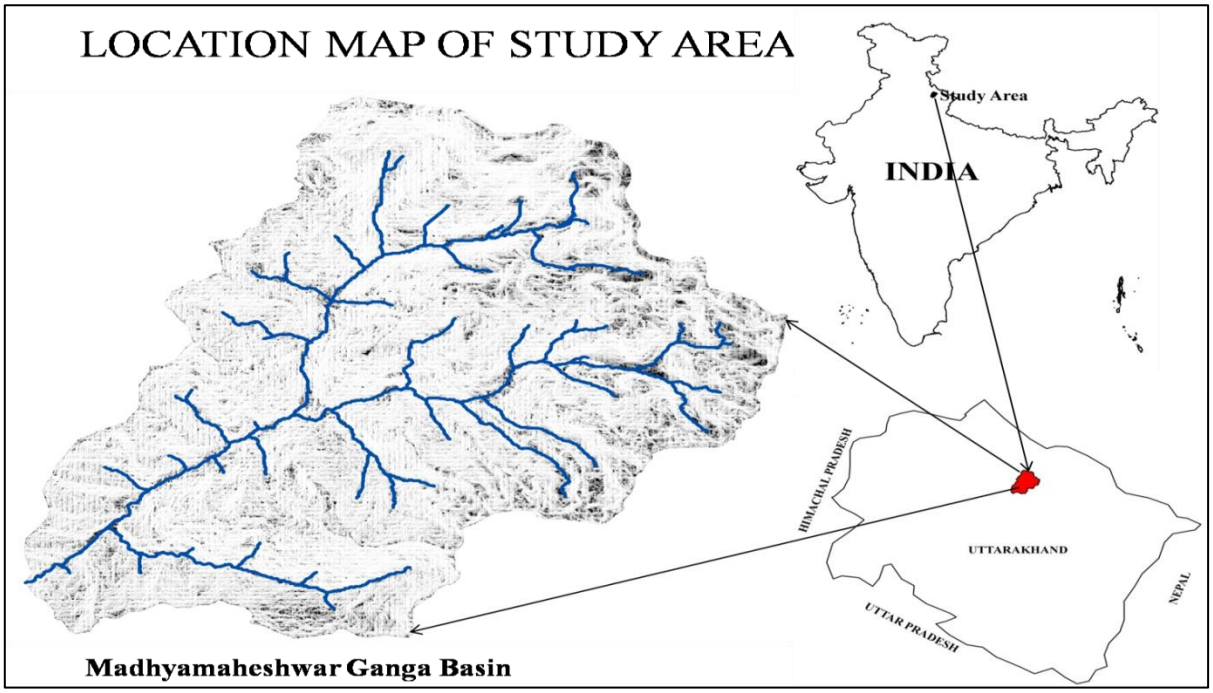
Introduction :

Geomorphology is more than a description of the feature on land such as, mountains, rivers, glaciers or dunes (Kale and Gupta, 2001). An understanding of Geomorphology and its processes are therefore essential in the understanding of Physical Geography. Surface processes comprises the actions of water, air, ice, fire, and living things on the surface of the Earth, along with chemical reactions that form soils and change substance properties, the stability and rate of change of topography under the force of gravity, and factors of the substance, such as human adaptation of the landscape. Fluvial geomorphologists focus on rivers, their transport sediment, migrate across the landscape, cut into bedrock, respond to environmental and tectonic changes, and interact with humans. With growing awareness towards environmental problems the role of the geomorphologists is increasingly recognized as pre-eminently necessary. Geomorphology is being considered as a science contributing towards the natural resource and environmental management.

Physiography of the Study Area :

Madhyamaheshwar Ganga River is a major tributary of Mandakini River which flow in the part of the Rudraprayag District. (Map- 1) The origin of Madhyamaheshwar Ganga River is

Pandusera and joins to Mandakani in Niwasini. The total catchment area of Madhyamaheshwar Ganga River basin is about 378.83 Km². The basin lies between 30º 30' 45" to 30º 44' 31" N latitudes and 79° 5' 38 E to 79° 21' 30" E longitudes. The major tributary of this river is Markanda Ganga, whereas smaller tributaries include; Gundarpong God, Mayall God, Pandokhoia God, Kyar God and Anphal Gad etc.



Map -1

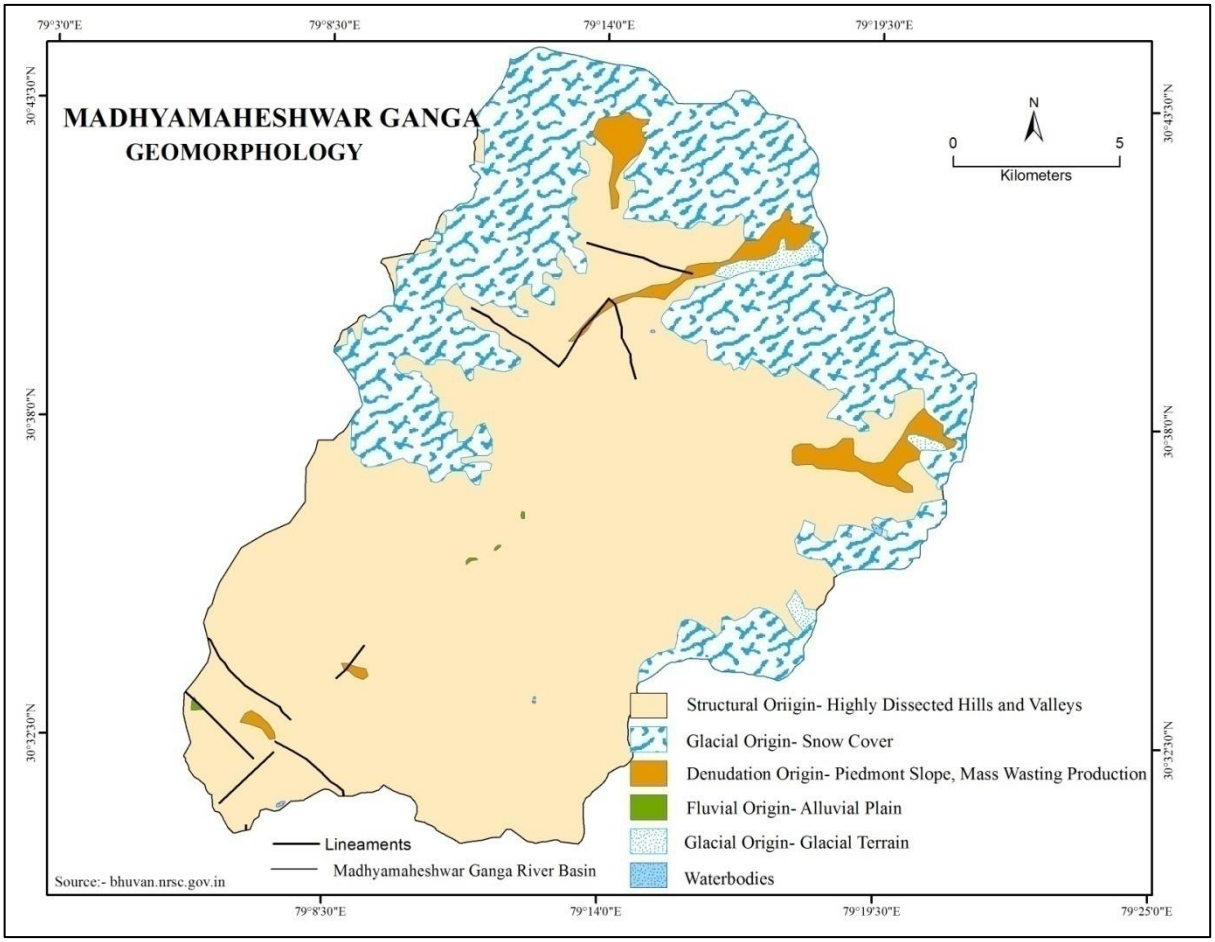
Data Used and Methodology :

The basin boundary has been demarked on the basis of Survey of India Topo-sheet numbers (H44H 2, and 5 open series) on 1:50,000 scale and Digital Elevation Model (DEM) generated from Advanced Space borne Thermal Emission and Reflection Radiometer (ASTER) data 2011. Geomorphological and Lineaments map have been prepared with the help of using BHAVAN portal database (www.bhavan.nrsc.gov.in). Land use land cover map generated form Google Earth image with the help of digitization GIS 9.3 software.

Geomorphology :

The study area is mountainous and this landform has variations and qualities of physical structures and relief due to presence of mountains and valleys. In the upper parts of the region comes under the cold climate. Due to being enveloped with snow cover horn pointing peak, Arate, Nilvi valleys, sans-shaped valleys and various types of glaciers are found in this region of basin. Due to rocks on the banks of river and slope field 'SAKARI VALLIES' are formed Sonprayag, Kali Ganga and Madmaheshwar Ganga rivers get merged into each other and as a result water level gets increased. Geomorphologically, the area of river basin have been divided into six different geomorphic regions characterized by different geomorphic elements and relief characteristics.

These are Structural Origin- Highly Dissected Hills and Valleys, Denudation Origin- Piedmont Slope, Mass Wasting Production, Fluvial Origin- Alluvial Plain, Glacial Origin- Snow Cover, Glacial Origin- Glacial Terrain and Water bodies showing in Map- 2, table- 1 and Fig.1.

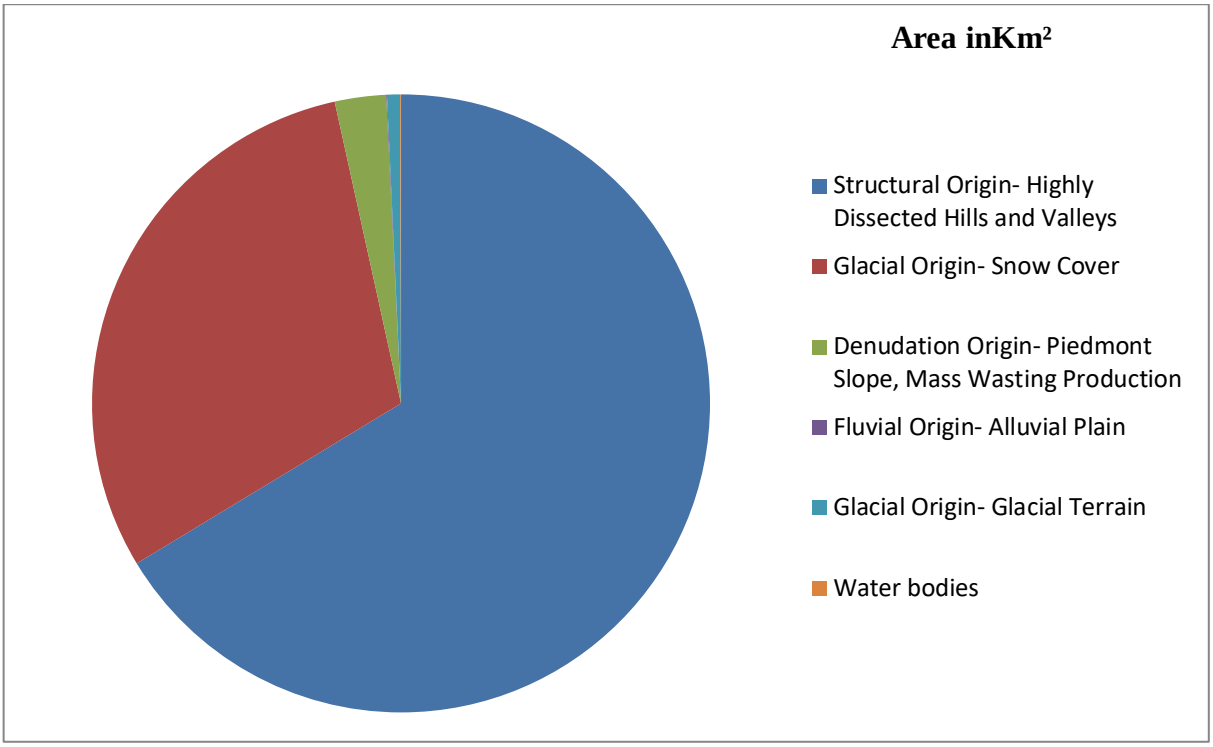


Map -2

Table 1 Area Under Different Geomorphological Feature

Categories	**Area inKm²**	**Area in Percent**
Structural Origin- Highly Dissected Hills and Valleys	251.3	66.34
Glacial Origin- Snow Cover	114.47	30.22
Denudation Origin- Piedmont Slope, Mass Wasting Production	10.15	2.68
Fluvial Origin- Alluvial Plain	0.16	0.04
Glacial Origin- Glacial Terrain	2.58	0.68
Water bodies	0.17	0.04
Total Area	378.83	100.00

Source: - calculated by researcher Based on Map -2



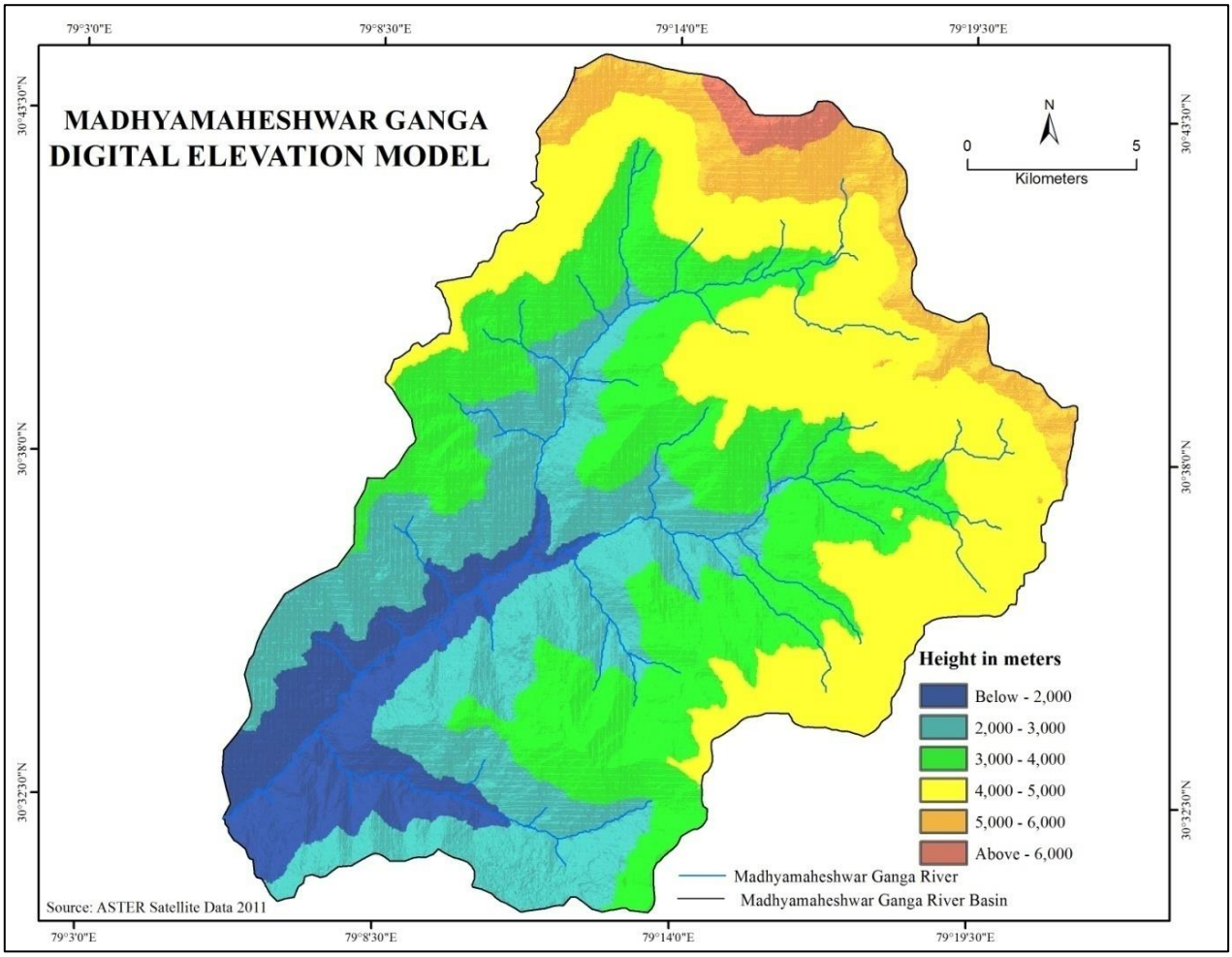
Source: - Based on Table -1

Fig. 1 Area distribution of under categories

The maximum area under the category is structural origin 251.3 Km² which is 66.34 percent while the lowest the area under the category water body is 0.17 Km². The lineaments are generally related to faults and bending deformation, fracturing etc. These lineaments are generated due to different terrestrial tectonic process like strike-slip faults or dip-slip and reverse faults and thrusting. These lineaments are of peculiar important for ground water storage as these lineaments increases the process of infiltration for surface runoff into sub-surface and hence it represents the subsurface phenomenon.

Digital Elevation Model :

Burrough (1986) has defined DEMs any digital representation of continuous variations of relief our place. DEM provides detailed descriptions for evaluation of surface morphological factors like slope. With help of these images DEMs show the relationship between topography and geology. With the help of ASTER, GDEM and elevation map is prepared in Arc-GIS 9.3 which classifies terrain into sex classes of evaluation differences. The Map- 3 is showing the area under different category of heights ranges below 2000 m to above 6000 m. The highest elevation is more than 6000 m near Pandusera and Chokhambha Mountaining while lowest elevation 1050 m near Niwasini where its meet a Mandakini River.

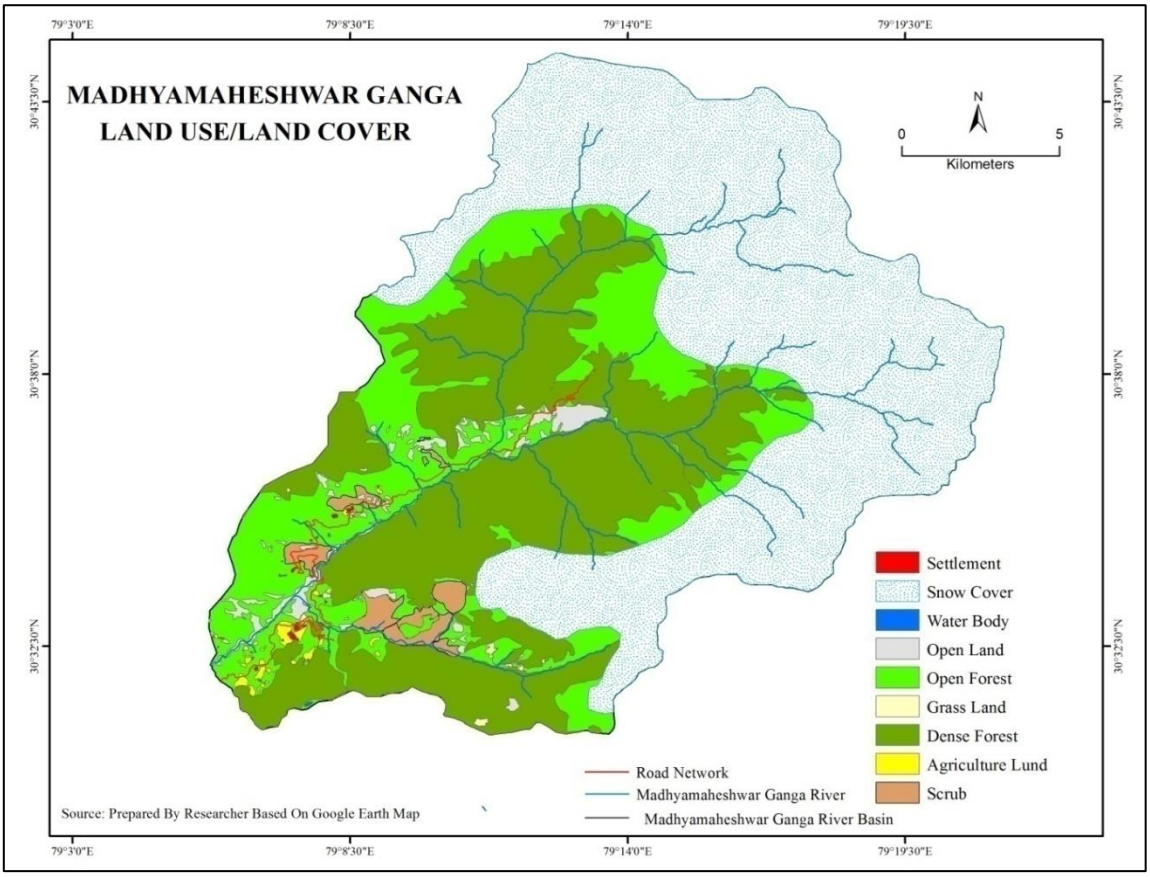


Map-3

Land use/Land cover :

Land is an important constituent of earth surface. Land cover is a physical entity which constituents natural vegetation, bare earth, water bodies, impervious surface, etc. whereas land use refer to these activities performed by human being for agriculture, economic purpose etc. Land use is illustration of how people use the land for socio-economic purpose. The urban and agricultural land uses are two most commonly activities performed by man. The map 4 of land use and land cover is prepared by using data from Google Earth software (2017). With the help of GIS-9.3 software whole basin is classified in 9 categories whose total geographical area 378.83 Km².

The maximum area covered by snow is173.6 Km² and 45.83 per cent of the whole basin area. Out of this Dense forest has area of 119.38 Km² which is 31.51 per cent of total geographical area of the basin. The main trees include Quercus incana etc. in these forests. The space occupied by settlement is 0.44 Km² which is 0.12 per cent of the total area of basin. It is also present in the lower basin region.



Map -4

Table 2 Area Under of Categories Land Use/Land Cover

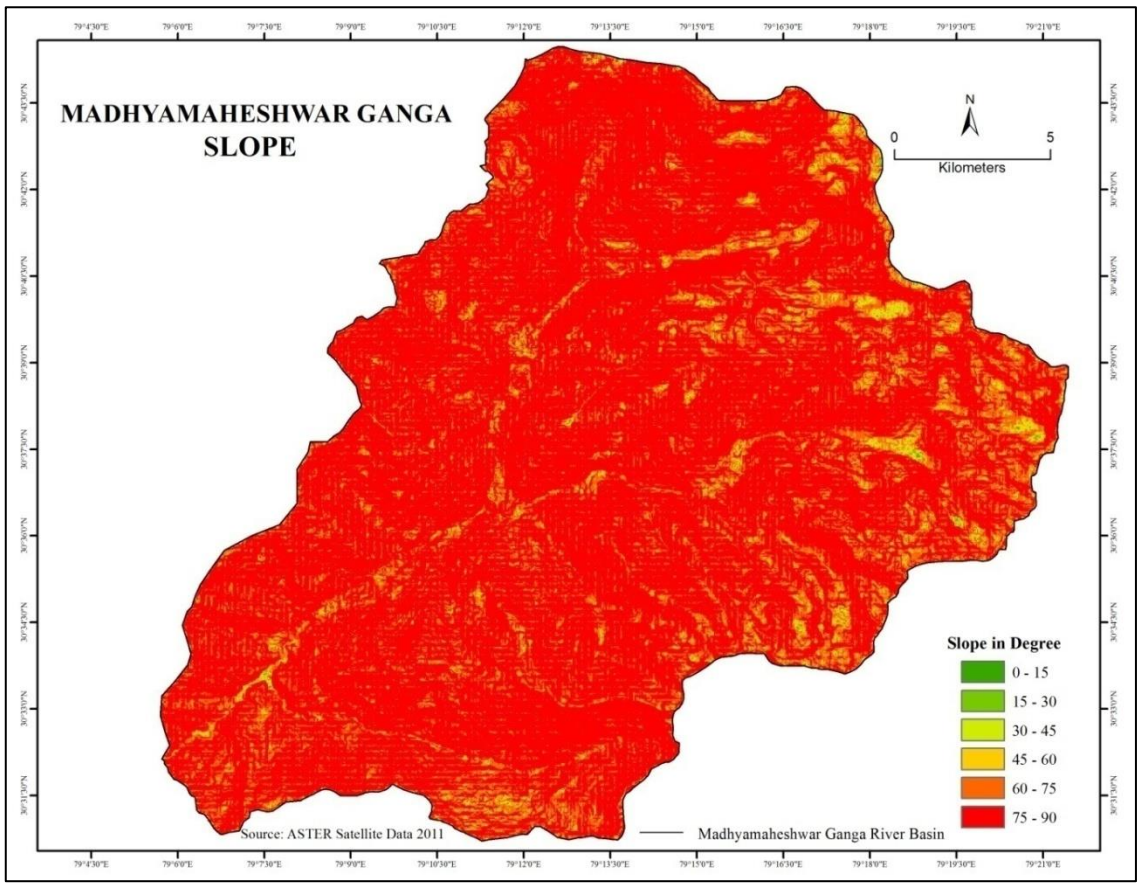
Categories	Area inKm²	Area in Percent
Agriculture Land	1.48	0.39
Snow Cover	173.6	45.83
Water body	0.17	0.04
Scurb Land	6.61	1.74
Settlement	0.44	0.12
Dense Forest	119.38	31.51
Grass Land	0.38	0.10
Open Land	6.5	1.72
Open Forest	70.27	18.55
Total Area	378.83	100

Source: - calculated by researcher Based on Map -4

Slope

The term slope has two commonly used meanings, one referring to the angle of inclination of the surface, express in degrees or a percent, and the other is the inclined surface itself (Chorrley Richard, 1984). The more is the steepness of slope, greater will be the rates of runoff, soil flowage soil erosion and lesser will be the socio-economic development. The study of slope form can be

made with the help of slope profile, morphometry and contours which provide clear portrait of shape of ground surface. Slope map of Madmaheshwar Ganga rivers basin is generated from the ASTER GDEM (2011) data using Arc GIS 9.3 software. Slope map 5 is classified into six categories. These are 0°-15°, 15°-30°, 30°-45°, 45°-60°, 60°-76° and 75°-90°. The map shows that the maximum areas are steep slope above 60° category.



Map-5

Conclusion :

Geomorphologically, the area of river basin have been divided into six different geomorphic regions and maximum area under the category is structural origin 251.3 Km² which is 66.34 percent while the lowest the area under the category water body is 0.17 Km². The height ranges the basin is below 2000 m to above 6000 m. The highest elevation is more than 6000 m near Pandusera and Chokhambha Mountaining while lowest elevation 1050 m near Niwasini where its meet a Mandakini River. The maximum area covered by snow cover and dense forest. The main trees include Quercus incana etc. in these forests. The maximum areas are steep slope above 60° category.

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