

## Assessment of Land Use / Land Cover Changes in South Garo Hill District of Meghalaya - A Geospatial Approach -

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### Abstract:

*There are numerous studies on land use/land cover change using remote sensing and GIS for natural resource management and environment related issues throughout the world. Presently, land use/land cover change played an important role globally to observe, implement and monitor all type of problems whether it is natural or man-made. Remote sensing and GIS technique provides accurate and detail information of the problems. The Himalayan range and north-eastern part of India is a hot-spot in biological and natural resources. With the increasing population and unscientific uses of these biological and natural resources are in critical position. For this purpose, the present study focuses on to analyze the land use/land cover changes using satellite imagery in GIS environment of South Garo Hill District of Meghalaya. It is noticed that the agricultural land increases 6.24% in 2009 to 7.41% in 2013. On the other hand, shifting cultivation area*

*increased 0.07% per year during the study period. The forests cover area whether it is dense or open, both categories decreased during this period. Where as degraded forest increased due decreasing rate of dense and open forest. The increasing rate of shifting cultivation, encroachment in forest land, illegal timber businesses, traditional agricultural practices, lack of knowledge are the main causes of decreasing forest cover in the South Garo hill district of Meghalaya.*

**Key words:** Land use/land cover, resource management, environment, remote sensing, GIS, Himalayan, biological, natural, agricultural, shifting cultivation, encroachment

## **Introduction:**

Land use/land cover is an important parameter for managing natural resources and environmental changes in a particular region (Foody 2002, Sreenivasulu and Bhaskar 2010). Changes of land use/land cover played an important role in the observation of global changes and it is largely resulted in global warming (Nisar and Lone 2013), deforestation, biodiversity loss (Gautam et. al 2002, Mas et. al 2004, Falcucci et. al 2007) and increase the volume and magnitude of disasters (Lambin et. al 2003, Reis 2008). Land use/land cover is dynamic in nature and provides the comprehensive information which helps us to understand the phenomena of natural and anthropogenic of the area (Matsa and Muringaniza 2011, Yadav et. al 2012). It is important to note that the Land use/land cover changes have direct or indirect impact on its natural resources, agricultural practices, economic growth etc. Increasing destructive rate on natural resources by men, the land-man ratio, agricultural pattern, economic growth and day-to-day life style of human being are changed (Sandoval et. al 2007, Manonmani and Suganya 2010, Sarma et. al 2008) which creates new problems

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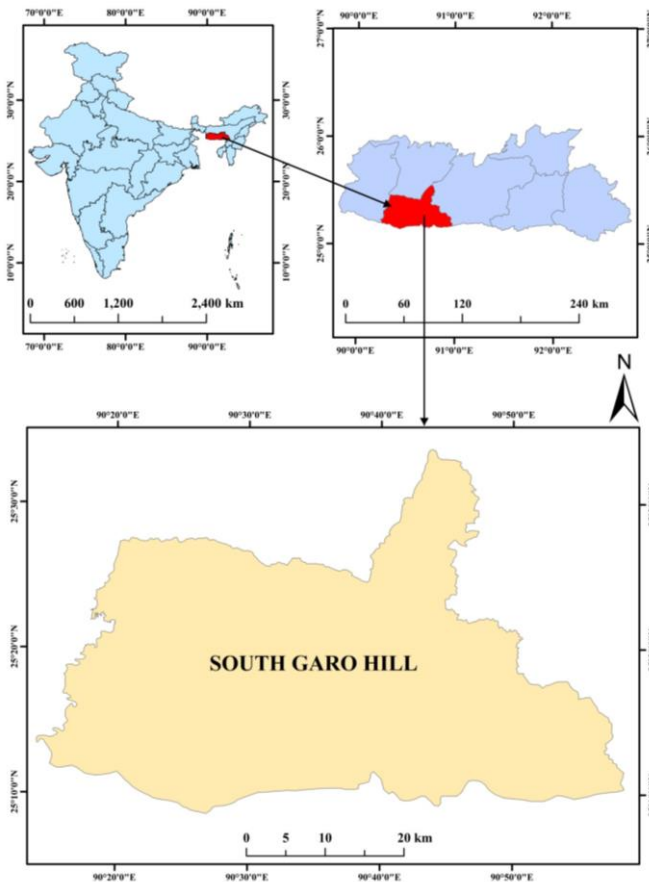
to the global community to focus and provide fresh drinking water, dwellings to the poorer, control pollution, invent new medicine for newly emerge diseases.

Geographical information system (GIS) and remote sensing is well established and sophisticated technique that can provide the detail information regarding all aspects like natural resources, land use/land cover changes, water bodies etc. (Anil et. al 2011, Tiwari and Saxena 2011, Pandian et. al 2014). Now-a-days, GIS and remote sensing technique is extensively used for analyzing land use/land cover changes throughout the world (Sarma 2010, Dittrich et. al 2010).

The Himalayan region of India represents nearly 18% of the total area of Indian sub-continent. It is geologically young and rich in biological resources (Pant et. al 2000). North-Eastern region of India is also rich in biological resources (Al Huda and Singh 2014, Chakraborty 2009) of flora as well as fauna. The land use/land cover changes rapidly from 1980s in this region. High population growth rate has direct impact on land use/land cover pattern. Increasing population growth leads the decreasing trends in land use/land cover mainly in the forest covered areas (Chebet 2013, Yadav et. al 2013). Most of the hilly tribes of north-eastern region practices shifting cultivation through burning the forest lands (Roychoudhury 1991, Ryngnga and Ryntathieng 2013). Tribal people of this region are mostly dependent on forest resources for their livelihood. The Garo tribal community lived in three Garo Hill district of Meghalaya and the people are fully dependent on natural resources of forest (Hazarika 2013). For these reason the main aim of the present study is to analyze the land use/land cover changes using satellite imagery in GIS environment of South Garo Hill District of Meghalaya.

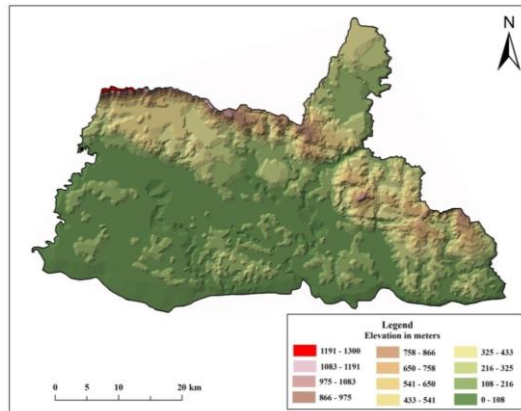
## Study Area:

The study area South Garo Hills district, falls under biogeography zone 9B (North-Eastern India) and lies in the southern part of the state of Meghalaya, and the district is hilly with difficult terrain with it's headquarter at Baghmara, the only town in the district (Sarma et. al 2013). The district is situated between  $25^{\circ}10'$  and  $25^{\circ}35'N$  latitudes and  $90^{\circ}15'$  and  $91^{\circ}0'E$  longitude (Fig.-1). It covers an area of 1887 sq. Km. It is bounded in the North by East Garo Hills, in the East by the west Khasi Hills district, in the West by West Garo Hills district and in the South by Bangladesh.

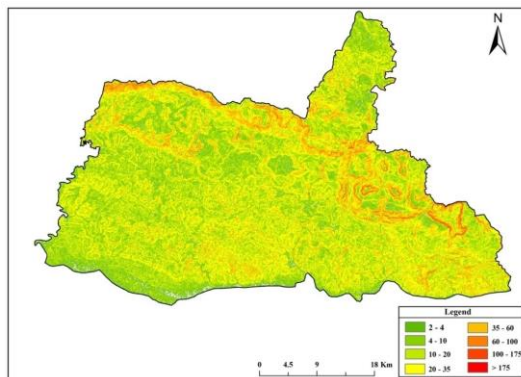


**Fig.-1: Location of Study Area**

South Garo Hill district of Meghalaya is situated in a transitional zone of hilly topographic features in the north, east and west and plain areas of Bangladesh in south. More than half of the area covers at an elevation of 800 meter above mean sea level (Fig.-2). More than half of the area of South Garo Hill district is moderately steep to steep slope because of its hilly topographic features. The gentle slope has been observed in the south-eastern part whereas most steep and extremely steep slope located northern most part of the district (Fig.-3).



**Fig.-2: Digital Elevation Model (DEM) of South Garo Hill District**



**Abbreviations:** Slope in percent; Very Gentle (2- 4), Gentle (4-10), Moderate (10-20), Moderately Steep (20-35), Steep (35-60), Very Steep (60-100), Most Steep (100-175), Extremely Steep (> 175).

**Fig.-3: Slope Variation in South Garo Hill District of Meghalaya**

## **Materials and Methods:**

The base map of the South Garo Hill District has been prepared from the Survey of India toposheets (No. 78K/7, 78K/8, 78K/11, 78K/12, 78K/15, and 78K/16 of R.F. 1:50,000). To identify the land use/land cover changes, two cloud-free IRS-P6-LISS-III data acquired on February-March 2009 and 2013 were used for the present study. The satellite digital data was processed and rectified using Survey of India (SOI) topographic maps for carried out to collect the ground information. Area statistics of each land use/land cover classes was generated and calculated in sq. Km attribute table. The land use/land cover classes including Agricultural Land, Built up Area, Shifting Cultivation, Waste Land, Water Bodies, Wet Land, Dense Forest, Open Forest and Degraded Forest were identified based on the visual interpretation of the acquired satellite imagery with the help of ground verification. Mapping works of land use/land cover changes was processed and analyzed in ArcGIS 9.2 and Erdas 9.1 of GIS environment.

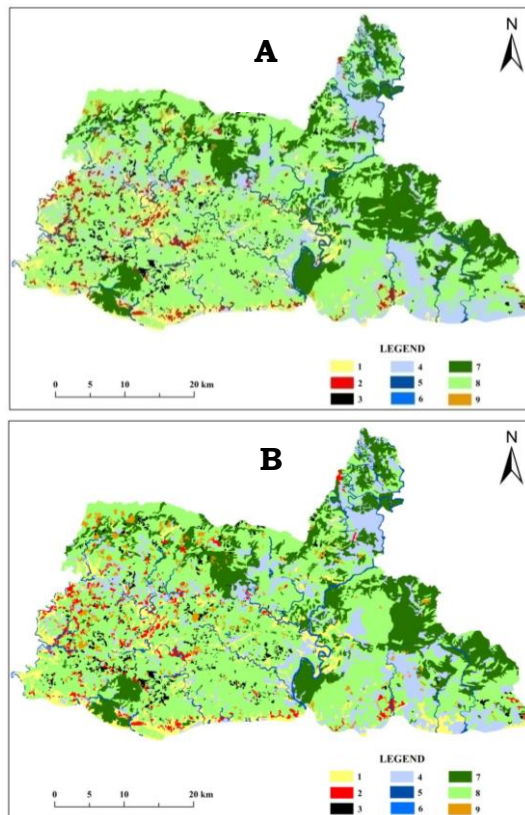
To identify the location of land use/ land cover changes in South Garo Hill district of Meghalaya, the digital elevation model (DEM) was generated from the digitized contour at an interval of 20 meter in SuperMap 7C with 30 meter spatial resolution. The slope variation of this area was developed from generated DEM.

## **Results and Discussion:**

Change detection is widely used in GIS technique for analyzing the satellite imagery and it gives us the information of changes of specific classes of land use/land cover within specific time period. We can observe the location of changes of the area through this technique.

The total agricultural land of South Garo Hill district was calculated 117.72 sq. km (6.24% of total area) in 2009

which is increase 1.18% in 2013 (Fig.-4 and Table-1). The seasonal agricultural activity practices in gentle slope and valley areas of south-eastern part of district. The shifting cultivation is an important agricultural activity which is practices by the Garo tribe of Meghalaya (Yadav et. al 2013). The shifting cultivation was increased 41.38 sq. km to 42.30 sq. km during these periods. The main causes of shifting cultivation are the hilly topographic features of the area, traditional agricultural practice, lack of agricultural land, less agricultural per capita land holding capacity, easy to cultivate etc. which destroy the ecology and biological environment to the surroundings.



**Abbreviations:** 1. Agricultural Land; 2. Built up Area; 3. Shifting Cultivation; 4. Waste Land; 5. Water Bodies; 6. Wet Land; 7. Dense Forest; 8. Open Forest and 9. Degraded Forest

**Fig-4: Land Use/Land Cover Changes in South Garo Hill District of Meghalaya for the year A. 2009 and B. 2013**

The total population of South Garo Hill district is 142,574, out of which more than 80% people where settle in flat and gentle slopes. The population density is only 77/km<sup>2</sup> with the growth rate of only 0.07% during the study period (Census of India 2011). The settlement concentrated mostly in the south-eastern part of district due to its gentle to moderate slope.

**Table-1: Classification of area under different Land Use/Land Cover in South Garo Hill District of Meghalaya**

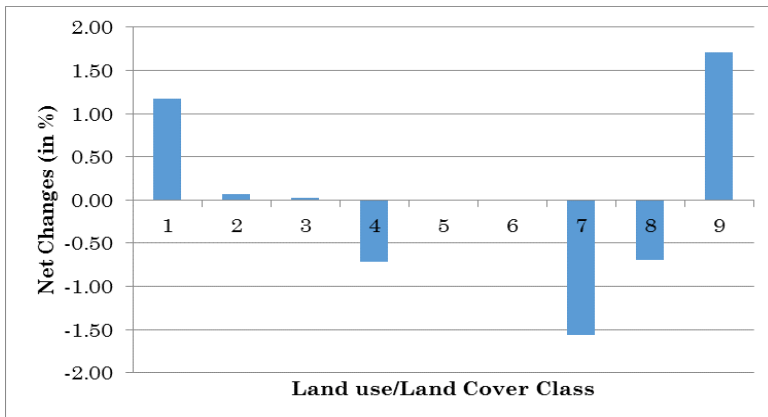
| LULC Classification     | Area (in sq. Km) | Area % | Area (in sq. Km) | Area % | Net Changes (2009-2013) % |
|-------------------------|------------------|--------|------------------|--------|---------------------------|
|                         | 2009             |        | 2013             |        |                           |
| 1. Agricultural Land    | 117.72           | 6.24   | 139.90           | 7.41   | +1.18                     |
| 2. Built up Area        | 48.26            | 2.56   | 49.59            | 2.63   | +0.07                     |
| 3. Shifting Cultivation | 41.83            | 2.22   | 42.30            | 2.24   | +0.03                     |
| 4. Waste Land           | 277.86           | 14.73  | 264.43           | 14.01  | -0.71                     |
| 5. Water Bodies         | 30.74            | 1.63   | 30.70            | 1.63   | 0.00                      |
| 6. Wetland              | 1.26             | 0.07   | 1.07             | 0.06   | -0.01                     |
| 7. Dense Forest         | 371.29           | 19.68  | 341.89           | 18.12  | -1.56                     |
| 8. Open Forest          | 985.19           | 52.21  | 972.02           | 51.51  | -0.70                     |
| 9. Degraded Forest      | 12.82            | 0.68   | 45.08            | 2.39   | +1.71                     |
| Total                   | 1887.00          | 100.00 | 1887.00          | 100.00 |                           |

The waste land, water bodies and wetlands covers 16.43% of total area in 2009 which is decreased to 15.70% in 2013 (Fig.-4 and Table-1). Due to encroachment by the people is the main cause of decreasing these lands.

Dense forest covers almost one fifth area which is found mainly in the hills and foot-hill areas of South Garo Hill district. It is observed that the dense forest located at an elevation of 800 meter above mean sea level in the study area which is decreased at the rate of 1.56% during 2009 to 2013



(Fig.-5). On the other hand, open forest covers more than half of the area located all the physiographic features of South Garo Hill district. Betel nut, chestnut, strawberry, tea estate and rubber plantation mainly grows in moderately steep to steep slope areas which categories as an open forest in this study (Fig.-4).



**Abbreviation:** 1. Agricultural Land; 2. Built up Area; 3. Shifting Cultivation; 4. Waste Land; 5. Water Bodies; 6. Wet Land; 7. Dense Forest; 8. Open Forest and 9. Degraded Forest

**Fig.-5: Net Changes of Land use/land cover in South Garo Hills District during 2009-2013**

The increasing rate of degradation of forest cover both dense and open increases the degraded forest land and decreases dense and open forest in South Garo Hill district of Meghalaya (Fig.-5). The increasing rate of shifting cultivation, encroachment in forest land, illegal timber businesses are the main causes of decreasing forest cover in the South Garo Hill district of Meghalaya.

## **Conclusion:**

The land use/land cover change is an important factor for over all development of a region. However, it is not a single factor

which is responsible for the development. It is observed that the Garo Hill district of Meghalaya dominated by the open forest cover mainly Betel nut, chestnut, strawberry, tea estate and rubber plantation which are practices in the gentle and moderately steep slopes. There are some specific findings inferred from the present analysis:

- (a) The degraded forest of South Garo Hill district increases at the rate of 1.71% per year which means the dense and open forest cover decreases day by day.
- (b) Agricultural land increases in South Garo Hill district which is a good sign for economic development. However, increasing rate of shifting cultivation is a dangerous indication of ecological imbalances in near future.
- (c) The maximum land use/land cover changes observed in the moderate to moderately steep slope due to human accessibility in this region.
- (d) The illegal mining of timber, encroachment in the forest cover and water bodies, traditional agricultural practices, lack of knowledge etc. are the main factors responsible for degradation of forest cover.

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