

Research Article

DOI: 10.15740/HAS/AJSS/13.2/104-108

Land use land cover and slope interaction mapping of Ribhoi district of Meghalaya using geospatial technique

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Received : 07.09.2018; Revised : 05.11.2018; Accepted : 13.11.2018

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Co-authors :**Naorem Janaki Singh and Chandan Goswami**, College of Post Graduate Studies (Central Agricultural University), Umiam (Meghalaya) India**B.K. Handique and Abdul Q. Khan**, North Eastern Space Applications Centre, Umiam (Meghalaya) India**Summary**

The aim of the study is to generate the land use/ land cover and slope interaction acreage map using modern geospatial techniques of remote sensing and GIS. The seasonal data of Resourcesat-2 LISS-III images and data were used to analyze the dynamics of land use / land cover and slope interaction map of Ri-Bhoi district. Erdas and Arc-GIS softwares were used for classification of land use/land cover. The experiment was conducted in Ri-Bhoi district, Meghalaya which lies between 91°20'30" - 92°17'00" E longitude and 25°40' - 26°20' N latitude covering geographical area of 2448 km², forest area 869.07 km², net sown area 222.6 km² and the total cropped area 251.7 km². The area has been classified into 21 classes at Level II. Among 21 classes 5 land use classes were selected for land use and slope interaction map. Land use and slope interaction map was generated by intersecting slope and land use land cover map in Arc-Gis10.2. and Erdas software. The highest area observed in abandoned jhum slope 5 (AJS5) (6323.71 ha) followed by abandoned jhum slope 4 (AJS4) (4937.49 ha). The minimum area observed in *Rabi* crop slope 7 (RCS7)(0.003 ha). However, in case of land use land planning the maximum area found in tree clad area closed area (80247.21 ha) followed by abandoned jhum (16096.20 ha).

Key words : Land cover, Slope, Ri-Bhoi, Remote Sensing, LISS-III, Erdas, Arc-GIS**How to cite this article :** Debbarma, Kabir, Singh, Naorem Janaki, Handique, B.K., Goswami, Chandan and Khan, Abdul Q. (2018). Land use land cover and slope interaction mapping of Ribhoi district of Meghalaya using geospatial technique. *Asian J. Soil Sci.*, 13 (2) : 104-108 : DOI : 10.15740/HAS/AJSS/13.2/104-108.**Introduction**

The North-Eastern India is distinct geophysical region around 77 per cent of the region is covered with undulating hills, rolling grasslands, waterfalls, snaking rivers, terraced slopes and thrilling flora and fauna, abundant water resources, evergreen dense forests, high and dependable rainfall and agriculture-friendly climate. The region is categorized into the Eastern hills, North

eastern hills, Brahmaputra and the Barak valley plains (Barah, 2006). Land transformation and land cover change due to large scale deforestation, clearing of forest lands to temporary agricultural, jhumming on hill slopes, conversion of natural forests into horticultural plantations etc. are some of the most common land degradation factors presently operating in NE region (Choudhury *et al.*, 2012). Land use/cover is two separate terminologies

which are often used interchangeably (Dimiyati *et al.*, 1996). Land cover refers to natural and physical cover of the earth, *viz.*, forest, savannah, desert, river, roads, runways etc. On the other hand, the land use refers to various human uses of land *viz.*, human settlements, agricultural land, transportation networks, reservoirs, etc. Therefore, accurate classification of land use/land cover tops natural resource management priorities worldwide especially in complex and heterogeneous landscapes (Alrababah and Alhamad, 2006). Land use/cover changes is a widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn drive changes that would impact natural ecosystem (Ruiz-Luna and Berlanga Robles, 2003 and Turner and Ruscher, 2004). Understanding landscape patterns, changes and interactions between human activities and natural phenomenon are essential for proper land management and decision improvement. Earth resource satellites data are very applicable and useful for land use/cover change detection studies (Yuan *et al.*, 2005 and Brondizio *et al.*, 1994). Remote sensing is the dynamic technology to monitor land resources from space and evaluate the land cover changes (Shanwad *et al.*, 2008; Dutta *et al.*, 2003; Foody, 2002; Chowdary *et al.*, 2001 and Csaplovics, 1998). With the invent of remote sensing and Geographical Information System (GIS) techniques, land use/cover mapping has given a useful and detailed way to improve the selection of areas designed to agricultural, urban and/or industrial areas of a region (Selcuk *et al.*, 2003). In India, researches on land use/land cover have been done by various scholars, especially by using remote sensing data. Pooja *et al.* (2012) have quantified land use/cover of Gagans watershed, district Almora using survey of India topographic sheet of the year 1965 and LISS III satellite data for the year 2008 over a period of 43 years. Rawat *et al.* (2013) have carried out a study on land use/land cover of five major towns (*i.e.*, Ramnagar, Nainital, Bhimtal, Almora and Haldwani) of Kumaun Himalaya in Uttarakhand (India). Therefore, an attempt has been made to find out the acreage of LULC in Ribhoi, Meghalaya using geospatial techniques in recent year.

Resource and Research Methods

Ri-Bhoi district of Meghalaya, India lies between 91°20' to 92°17' East Longitude and 25°40' to 26°20' North Latitude covering geographical area of 2448 sq.km. The average annual rainfall is 2935 mm and the

temperature ranges from 10°C in December to 30°C in July-August. The western and northern part of the district comprises of deep, narrow intermontane valleys covered with or without colluvium. In the central and eastern part high hills with deep valleys are found to exist. In the south-eastern part low hills are found to occur with valleys. Umtrew, Umsiang, Umran and Umiam are the major rivers. (4). The study area has been shown in Fig. A.

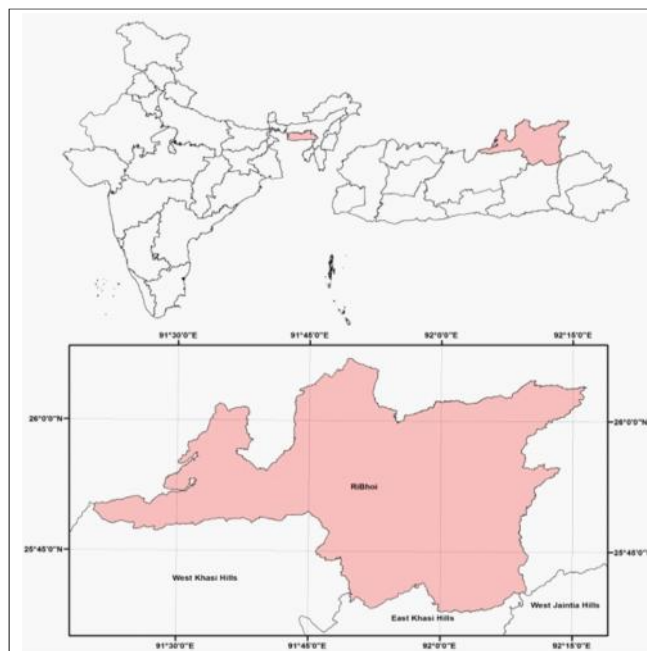


Fig. A : Study area (Ribhoi district of Meghalaya, India)

Data source :

Satellite imagery of Resourcesat-2 Linear Imaging Self Scanner III (LISS-III) sensor were used for LULC analysis. The sensor specifications of the Resourcesat-2 LISS-III sensor has been given in Table A. Digital Elevation Model generated from Cartosat-1 satellite imagery (Carto-DEM) was used for generating slope map. The specifications of Carto-DEM have been given in Table B.

Data analysis :

LULC classification system developed by National Remote Sensing Centre (NRSC), Hyderabad was followed in the present study (NRSC, 2017). The satellite image of the study area was classified following visual image interpretation (tone, texture, size, shape, pattern, association and shadow) of False Colour Composite (FCC) of LISS-III data using ArcGis 10.2.

Table A : Specifications of resourcesat-2 LISS-III sensor

Date of launch	20 th April, 2011
Altitude	817 km
Inclination	98.69
Launch vehicle	Polar Satellite Launch Vehicle (PSLV)-C16
No. of bands	4
Spectral bands (µm)	B2: 0.52 – 0.59 B3: 0.62 – 0.68 B4: 0.77 – 0.86 B5: 1.55 – 1.70
Resolution (m)	23.5
Swath (km)	140
Revisit (days)	24
Data rate (Mbps per stream)	105
Quantisation	10-bit
Gains	100% Albedo, No gain setting

(NRSC, 2017)

Table B : Specifications of CARTO-DEM

Generating agency	National Remote Sensing Centre (NRSC)
Image format	Geo-Tiff
Data type (DEM)	Signed short (2 bytes)
Data type (Ortho-image)	Unsigned short (2 bytes)
Satellite	Cartosat-1
Sensor	PAN stereo
Datum	WGS84
Projection	Geographic
Ortho image resolution	1/12 arc sec ~ 2.5 m
DEM posting	1/3 arc sec ~ 10 m
DEM accuracy (Planimetric)	15m
DEM accuracy (Elevation)	8m
DEM ellipsoidal height units	Meters
Tile extents (size)	7.5'x7.5' ~ 13.5 km x 13.5 km

(Muralikrishnan *et al.*, 2013)

Research Findings and Discussion

The results obtained from the present investigation as well as relevant discussion have been summarized under following heads :

Land use land cover map :

Twenty-one categories of LULC were identified (Fig. 1) *viz.*, *Kharif* crop, *Rabi* crop, double crop, built up-rural, built up-urban, builtup-Industrial, deciduous forest -dense, evergreen forest-dense, evergreen forest-open, forest-plantation, scrub forest, abandoned jhum, current jhum, tree clad area closed, tree clad area open,

barren rocky/ stony, sandy area, open scrub, lakes/ponds –perennial, river/stream dry and river/stream dry–perennial.

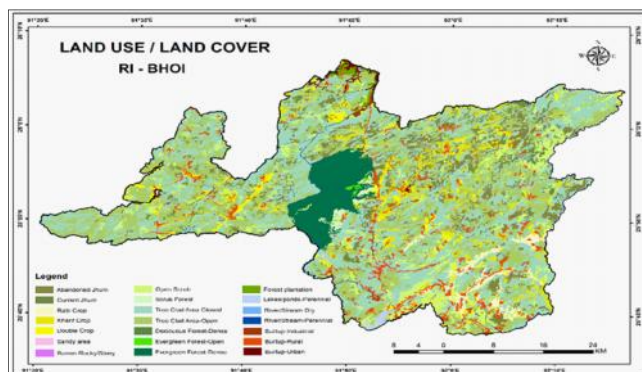


Fig. 1: Land use land cover map of Ri-Bhoi district

Land use /land cover practice in the Ri-Bhoi district were determined in order to classify different land use according to 7 slopes. Table 1 shows the spatial extent of the land cover in hectares. Tree clad area closed area with the largest land cover of 80247.21ha followed by abandoned jhum (16096.20 ha). Also, *Kharif* crop area which covers 11513.05 ha. *Rabi* crop area (3872.85 ha), double crop area (7299.61 ha) and current jhum (7379.48 ha).

Table 1 : Area of selected land use land cover

Land use	Area(ha)
<i>Kharif</i> crop	11513.05
<i>Rabi</i> crop	3872.84
Double crop	7299.60
Abandoned jhum	16096.19
Current jhum	7379.47
Deciduous forest-dense	168.73
Evergreen forest-dense	15750.38
Tree clad area- closed	80247.21
Evergreen forest-open	262.13
Forest plantation	2156.01
Scrub forest	1178.79
Tree clad area open	63548.85
Open scrub	16305.64
Built up-rural	10150.65
Built up-urban	921.69
Built up-industrial	402.24
Barren rocky/ stony	9.76
Sandy area	44.74
Lakes/ponds-perennial	1557.75
River/stream-dry	2.09
River/stresm-perennial	1141.79

Slope map :

Table 2 shows the 7 slopes which are considered for the preparation of Land use land cover and slope interaction map of Ri-Bhoi district taken from the text book (A text book of Pedology, J. Sehgal). The DEM (Digital elevation model) data of Ri-Bhoi district, Meghalaya was taken from satellite and its converted into a raster form in Arc GIS 10.2. Fig. 2. Show the slope map of Ri-Bhoi district.

Table 2 : 7 slopes which are considered for interaction with LULC map

% Slope	Class	Symbol
0-1	Level to nearly level	S1
1-3	Very gently sloping	S2
3-8	Gently sloping	S3
8-15	Moderately sloping	S4
15-30	Moderately steep sloping	S5
30-50	Steeply sloping	S6
>50	Very steeply sloping	S7

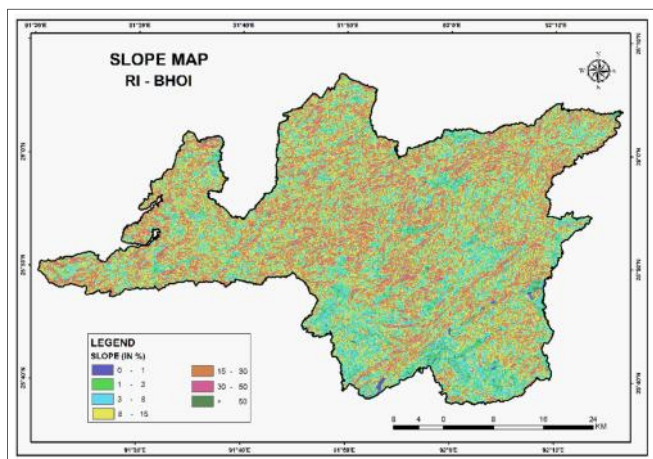


Fig. 2 : Slope reclassifying map of Ri-Bhoi district

Land use and slope interaction map :

Among these twenty-one major classes five classes were taken for preparing slope interaction map. Selected five classes are: *Kharif* crop, *Rabi* crop, Double crop

area, abandoned jhum, current jhum. Land use and slope interaction map was done by intersecting slope and land use land cover map in Arc-Gis10.2. After intersecting different strata was generate based on slope elevation and land use land cover map (Fig. 3). Table 3 shows different strata in Ri-Bhoi district. The highest area is with a maximum area of abandoned jhum slope 5 (AJS5) (6323.71 ha) followed by abandoned jhum slope 4 (AJS4) (4937.49 ha). The minimum area observed in *Rabi* crop slope 7 (RCS7) (0.003 ha).

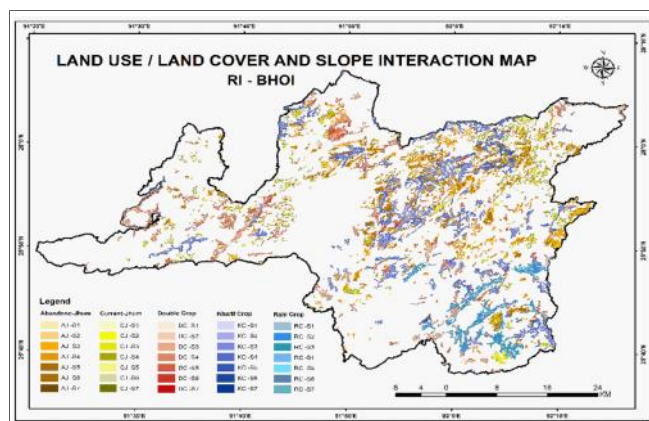


Fig. 3 : Land use land cover and slope interaction map of Ri-Bhoi district

Conclusion :

The study area has been classified into different land use/land cover by the help of Indian Remote Sensing Satellite (IRS) data, image processing and Geographical Information System techniques. Resourcesat-2 LISS-III satellite data combination of geographic Information System (GIS) were used to generate the land use and land cover map of study area. Different land use categories such as built-up area, agricultural area, tree area, water bodies etc. were identified. The results show that the major land use area in the study area is tree clad area closed (80247.21 ha). Further, land use land cover and slope interaction map has been generated where maximum area is abandoned jhum slope 5 (AJS5) (6323.71 ha)

Table 3 : Area (ha) of each strata

Land use codes	Slope						
	S1	S2	S3	S4	S5	S6	S7
KC	126.06	1217.85	4773.74	3123.52	1951.50	258.92	0.47
RC	536.54	949.31	1505.85	574.41	267.56	37.91	0.003
DC	125.88	650.00	2391.67	2022.53	1788.12	277.90	6.43
AJ	23.82	438.77	3150.18	4937.49	6323.71	1209.75	8.37
AC	19.29	330.79	1735.94	2102.63	2622.57	554.89	9.44

and the minimum area found in *Rabi* crop slope 7 (RCS7) (0.003 ha). However, Arc-GIS and ERDAS are important remote sensing computer software for analysis and quantification of acreage of different land use which is very important for mapping of study area.

Acknowledgement :

Authors' heartiest gratitude go to the Mr. P. Raju, Director, NESAC, Barapani, Meghalaya, India and Dean, College of Post Graduate Studies, Umiam for supporting in carrying out this research work.

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