IDENTIFICATION AND ESTABLISHING THE RELATIONSHIP OF THE GEOLOGY, ELEVATION AND LANDUSE OF THE CHERRAPUNJEE, SHELLA AND ITS ADJACENT AREAS USING SRTM DATA, MEGHALAYA,INDIA

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ABSTRACT

The study area is towards the southern boundary of this plateau near the dawki fault. The area includes mainly cherrapunji and shella, ishamati region. The aim of the study is to establish a relation between lithology, drainage pattern, different present structural elements, elevation, slope and landuse - land cover pattern of the area. First of all the boundary of the study area is defined. Then elevation, slope, drainage pattern, lithology and landuse landcover maps are prepared. In this study SRTM DEM, LANDSAT imagery and geological and mineral map by geological survey of India are used. Here Qgis 2.2, ArcGIS 9.3, USGS earth explorer, EARDAS imagine version 9.1 are used. Since the study area is situated near the international border, it was difficult to collect a toposheet of this area. So, google earth is taken as a base for this study. Surrounding the central highest flat portion a radial drainage pattern is seen here. Some eastward movement of rivers towards south and some rectangular pattern indicates the presence of dawki fault and its dextral movement. From landuse landcover map it is seen that most places of the study area are covered by forest. Most of the forests are in highly slopy areas. The central flat highland is mostly builtup area and most of the degraded forests are there due to human activity. The low slope angle in this area makes more comfortable for living. So in this flat portion no forest cover is seen. Some builtup areas are seen towards the southern boundary of the study area near the rivers where slope angle is very low along with elevation which make soils of this area fertile. So here most of the lands are dominated by agriculture.

KEYWORDS: Landsat, SRTM, Landuse Landcover, Elevation, Slope

I. INTRODUCTION

Constant erosion of the faces of escarpments by winds and rain water led to the formation of structural platforms/plateau remnant. Notable among these platforms are the Cherrapunjee Platform (1337 m), Mawsynram Platform (1305m) and Langkyrdem Platform. However the study area falls under the Cherrapunjee platform of East Khasi Hills district of Meghalaya. The rivers which flow towards south are Kynshi (River Jadukata-in Bangladesh), Uniew, Umngi and Umrilang. These rivers have cut deep gorges in Cretaceous sandstones and tertiary limestones. In many places, older rocks like gneisses and schists have been exposed. The whole plateau is bounded by many large and small scale structural elements. some of them are the east west trending dawki fault, NW-SE trending kopili fault. The Dhubri /Jamuna fault bounds the shilling plateau to the west. The Dudhnai and the Kulsi fault in the central part of the plateau trending N-S bear the indication of recent tectonic activities (Rajendran,2004;Sukhija et al,1999) along with Chidang fault and Dapsi thrust in the garo hills.The study area is towards the southern boundary of this plateau near the dawki fault. The area

includes mainly cherrapunji and shella ishamati region. The area is bounded by longitudes 91^0 37'- 91^0 47' E and latitude 25^0 21' N – 25^0 7' N. As the availability of topographic sheets are restricted along the international borders SRTM data and landsat imageries become very helpful in the present study.

II. AIM AND OBJETIVES

The aim of the study is to establish a relation between the lithology, drainage pattern of the area, the structural elements present in the area, the relation between its elevation, slope which may affect in the landuse - land cover pattern of the area.

- To study the structural control on drainage pattern of the area.
- To study the landuse landcover pattern of the area and its relation with the elevation, lithology and slope of the area.

III.STUDY AREA

The area under investigation is between two rivers namly Kynshi (Jadukata) and Umiew. It includes partially cherrapunjee area, the shella village of the east khasi hills district of Meghalaya (Fig. 1). The northern, eastern and the western boundary of the study area is based on the lineaments along which Jadukata and Umiew rivers are flowing. The study area is located between longitudes 91^0 37'- 91^0 47' E and latitude 25^0 21' N – 25^0 7' N.

IV.GEOLOGY

The State of Meghalaya is occupied by rocks belonging to Archaean-Proterozoic Gneissic Complex, Khasi Basic-Ultrabasic Intrusives of Proterozoic age, Shillong Group of metasediments of Meso-Proterozoic age, Granite Plutons viz. Kyrdem, Nongpoh and Mylliem Granite Plutons and South Khasi batholith of Neo Proterozoic–Lower Palaeozoic age, Lower Gondwana sedimentary rocks of Carboniferous–Permian age, Cretaceous volcanic rocks represented by Sylhet Trap and Alkaline-Ultramafic-Carbonatite Complex of Sung, Cretaceous–Tertiary shelf sediments and Pleistocene to Recent fluvial sediments (Fig. 2)

V.TECTONIC SETTING

The southern part of the study area is marked by an E-W trending fault known as Dawki fault. It separates the Meghalaya plateau from Bangladesh. The northern boundary of Meghalaya plateau lies to south of the Brahmaputra. To the east, it is separated from the Bengal-Assam shelf. To the west, the Garo-Rajmahal gap separates the plateau from the main Indian shield. The disposition of present day Meghalaya Pleateau is mainly along the E-W trend (Murthy et.al, 1967). However, some N-S and NW-SE faults and fractures are also reported from the plateau, which have affected the major E-W trending Dawki fault system and are still active (Fig. 3).

VI. METHODOLOGY

First of all the boundary of the study area is defined. The southern portion of the study area itself represents the international boundary between India and Bangladesh. The eastern and the north eastern portion represents the Umiew river as well as western and the north western part represents Jadukata river. These two rivers are flowing from north of the study area and finally it reaches the surma valley at south. The boundary is defined using Qgis 2.2 version. In this study SRTM DEM and LANDSAT imageries are used. With the help of GIS techniques slope and elevation maps are prepared using SRTM data. The 9.3 version of ArcGIS software is used here. To prepare the lithology map, drainage pattern map the geological and mineral map by geological survey of India and LANDSAT imagery is used respectively. Here also ArcGIS 9.3 is used. The LANDSAT imagery and the SRTM data are downloaded from the USGS earth explorer. To prepare the LANDSAT imagery for this purpose after downloading layerstacking is done in EARDAS imagine version 9.1.

VII. RESULTS AND DISCUSSION

The present study is to identify the relation between landuse landcover of the area with the geology,elevation and slope as well as the local tectonics.

VIII. DRAINAGE PATTERN

The overall drainage pattern of the whole plateau may be different but locally the study area shows a radial type of pattern (Fig.4). Here all rivers and their tributaries flows outward from a central elevated area. It is seen that all these streams and rivers show a tendency to flow towards south. The southern part of the area shows rectangular type of drainage pattern. They reflect control exerted by joint or fault systems.

IX. STREAM ORDER

Here all the stream orders are identified manually in ArcGIS. Upto 4^{th} order rivers are found in the study area (Fig. 4). As we know that the well known dawki fault is near the southern boundary of the study area, the flow tendency of all the rivers towards south is might be due to the influence of this fault. There is an abrupt change of the rivers near this boundary. The hilly area becomes plain abruptly in the border region. Due to which the river nature changes. The dawki fault is a dextrally moving strike slip fault though there are many controversies about this, in some part of the southern boundary of the study area the rivers show a tendency to flow towards east. All these may be due to the dextral movement of the fault.

X. ELEVATION AND SLOPE

The elevation and the slope map of the study area is prepared from the SRTM DEM (Fig 5). The elevation of the area varies upto 1964 meter. The northernmost part of the area is highly elevated which continuously decreases towards south and near the southern boundary the elevation approximately equals to 0 to 500 meter. The shella ishamati region is in between these 0 to 500 meters of elevation.

The slope is defined as the angle of inclination of a plane. Here in the present study area the slope varies from 0 degree to approximately 59 degree (Fig. 6). The central portion of the area is showing very low slope angle differing from 0 to 11 degree. That is this portion is nearly a flat area. The cherrapunjee area partly falls under this area. The southern portion of the study area also shows a slope angle of 0 to 11 degree. Where shella, ichamati region falls. The surrounding portion of this flat abruptly becomes slopy and it varies from 35 to 59 degree. Forming gorges around this flat topped hill the slope becomes low and low upto the boundary of the study area. This type of flat topped hill is often called plateau and sometimes as butte.

XI. LANDUSE AND LANDCOVER

From the landuse landcover map (Fig. 7) it is clear that most of the places of the study area is covered by forest. The forest areas are seen mostly in the highly sloping areas. Most of the builtup areas are seen in the flat top of the hills ie, in the highly elevated flat region. Some built up areas are seen towards the southern boundary, most of which are the agricultural lands. The degraded forests are near the builtup areas which are now grasslands and these areas have the probability for future builtup areas.

XII. RELATION OF LANDUSE LANDCOVER WITH ELEVATION AND LITHOLOGY

In different elevation and lithology levels different landuse classes are seen. These are shown in the following maps (Fig. 8,9,10,11; Table 1) **.** As elevation, in different lithology of the area different landuse landcover classes are seen (Fig.12,13, 14, 15, 16; Table 2)

XIII. CONCLUSION

The entire north eastern region of India is a tectonically active zone due to its unique geographical location bounded by two collision zone (Tibet and Burma). This area witnessed two major earthquake (magnitude >8.5) during the historical period on 1897 in the Shillong plateau and the another in the eastern Himalaya in 1950. Locally the drainage pattern of the area is radial type. Rivers originated from the central highest zone and all these rivers are flowing towards south. Towards the southern part of the basin rectangular drainage patterns are seen which may be due to the presence of dawki fault. Some eastward movement of rivers also indicates the presence of dawki fault and its dextral movement. Here the central part of the area have very high altitude and the surrounding area of the central part got very high angle of slope differing from 25 to 58 degree. The elevation of the area also decreases towards south. So here the southern part of the area is mainly depositional area. Due to loss of elevation and slope angle here the rivers start to widen like braided river making this southern part more suitable for agriculture. All this abrupt change towards the south of the area along with its tapering nature towards south and south eastern side may be due to the activity of the dawki fault. From landuse landcover map it is seen that most places of the study area is covered by forest. Most of the forests are in the

highly slopy areas. The central flat highland is mostly builtup areas and most of the degraded forests are there due to human activity. The low slope angle in this area makes more comfortable for living. So in this flat portion no forest cover is seen. Some builtup areas are seen towards the southern boundary of the study area near the river jadukata and umiew where slope angle is very low along with elevation which makes soils of this area fertile due to these rivers and their tributaries. So here most of the land is covered by agricultural lands.

XIV. Acknowledgement

The auhor offers her sincere gratitude to The HOD, Cotton College, Guwahati for arranging and providing the necessary infrastructural facilities to conduct the project work in a smooth and systematic manner. The author also acknowledges the sincere help of Dr. Santanu Sarma, Associate Professor, Cotton College, during the laboratory work.

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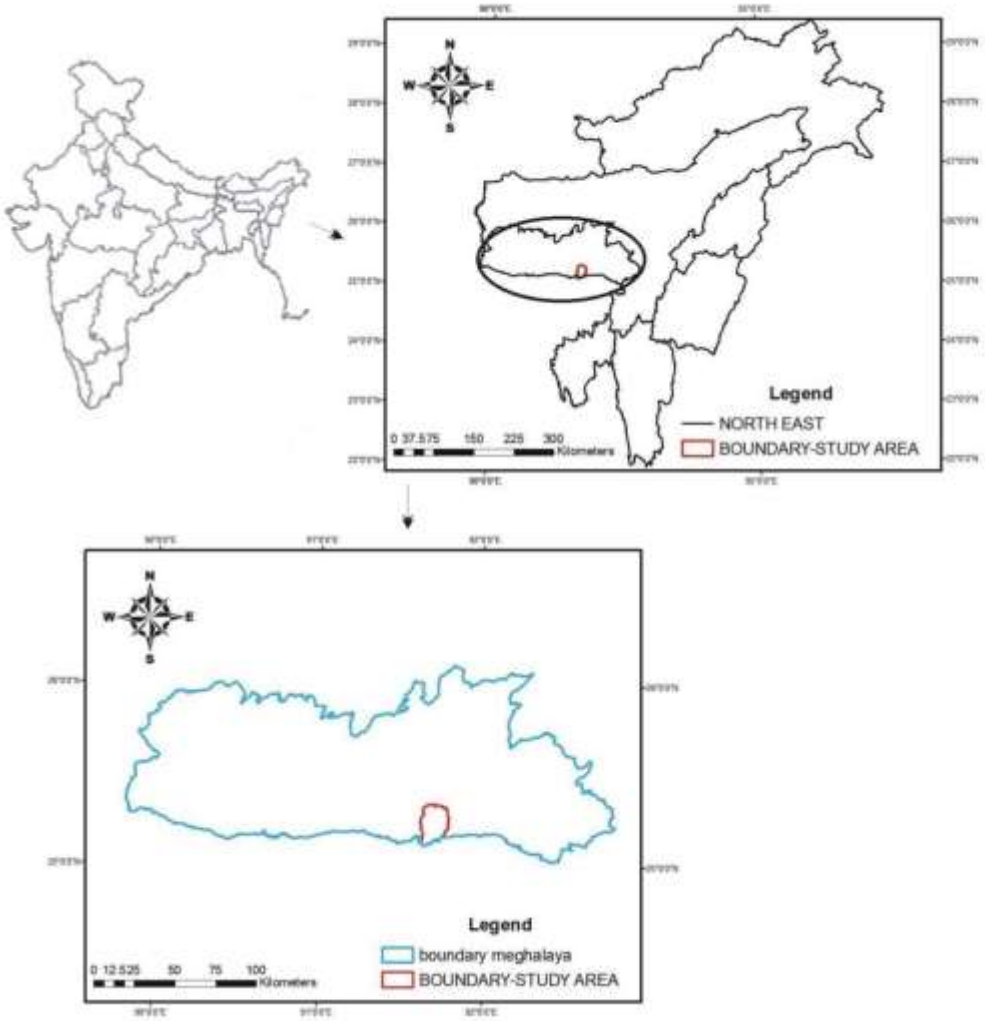

Fig 1: Location map of the study area

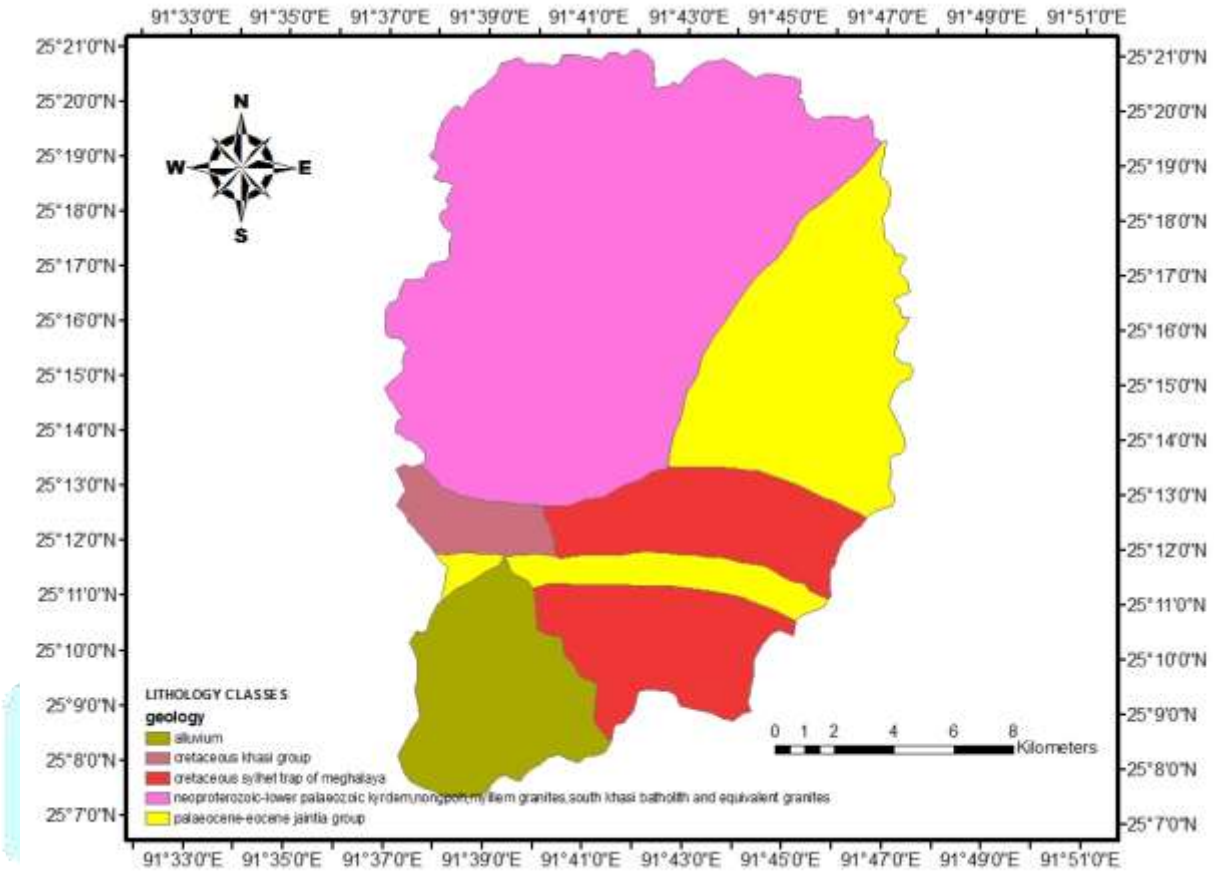

Fig 2: Lithological map of the study area

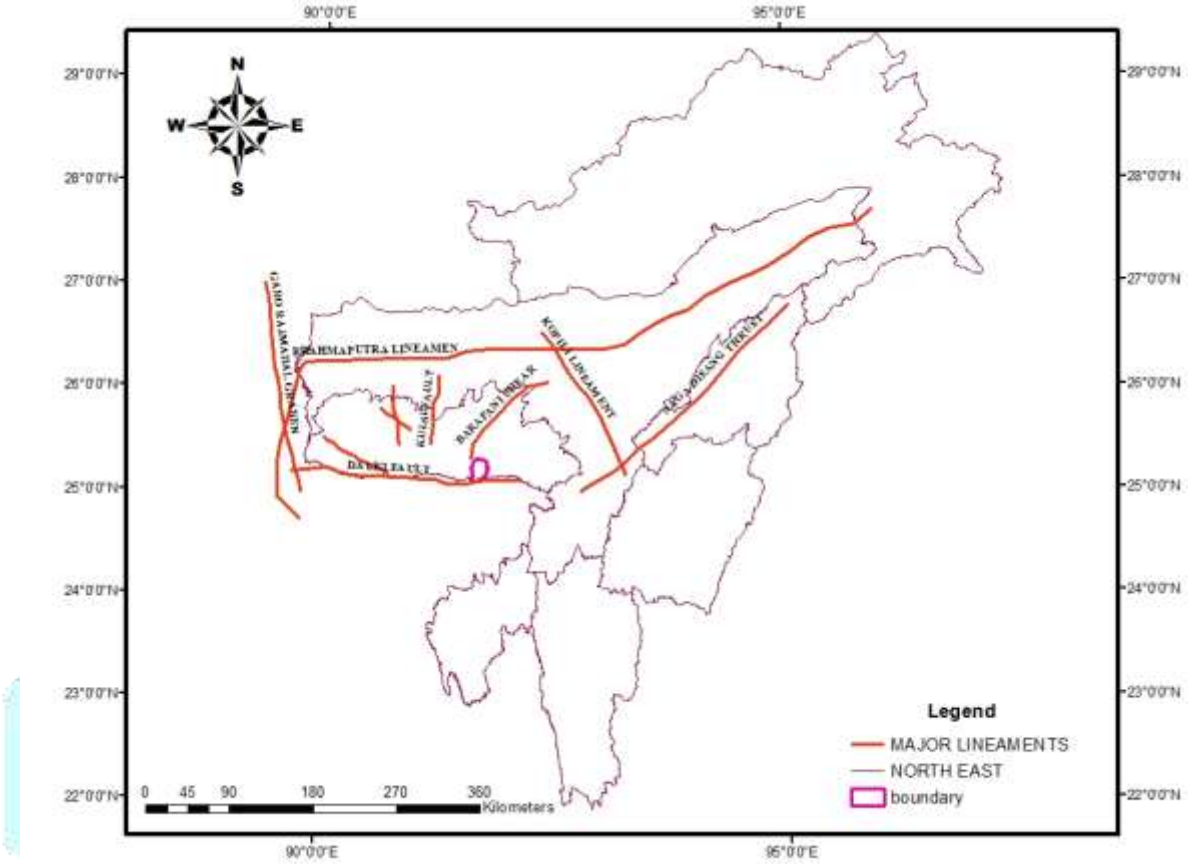

Fig3:Tectonic setting of Meghalaya

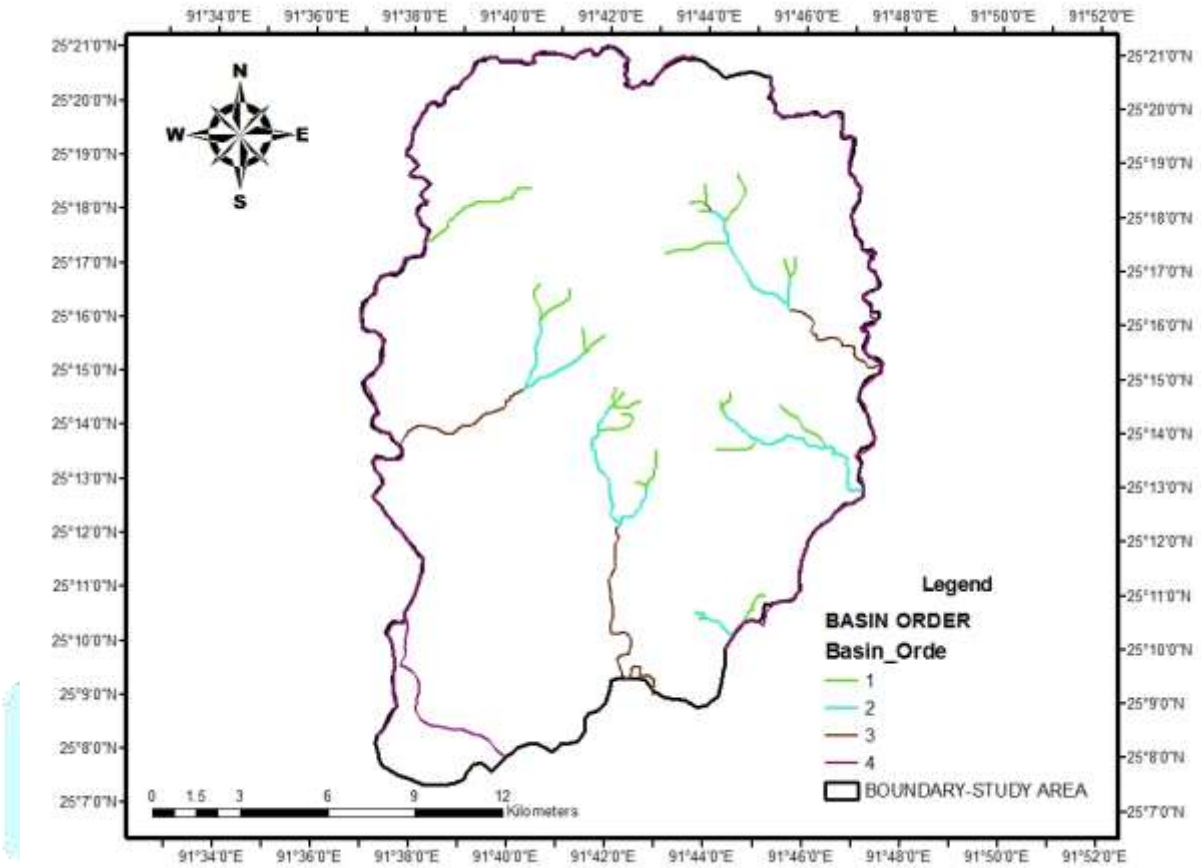

Fig 4: Drainage pattern map the study area

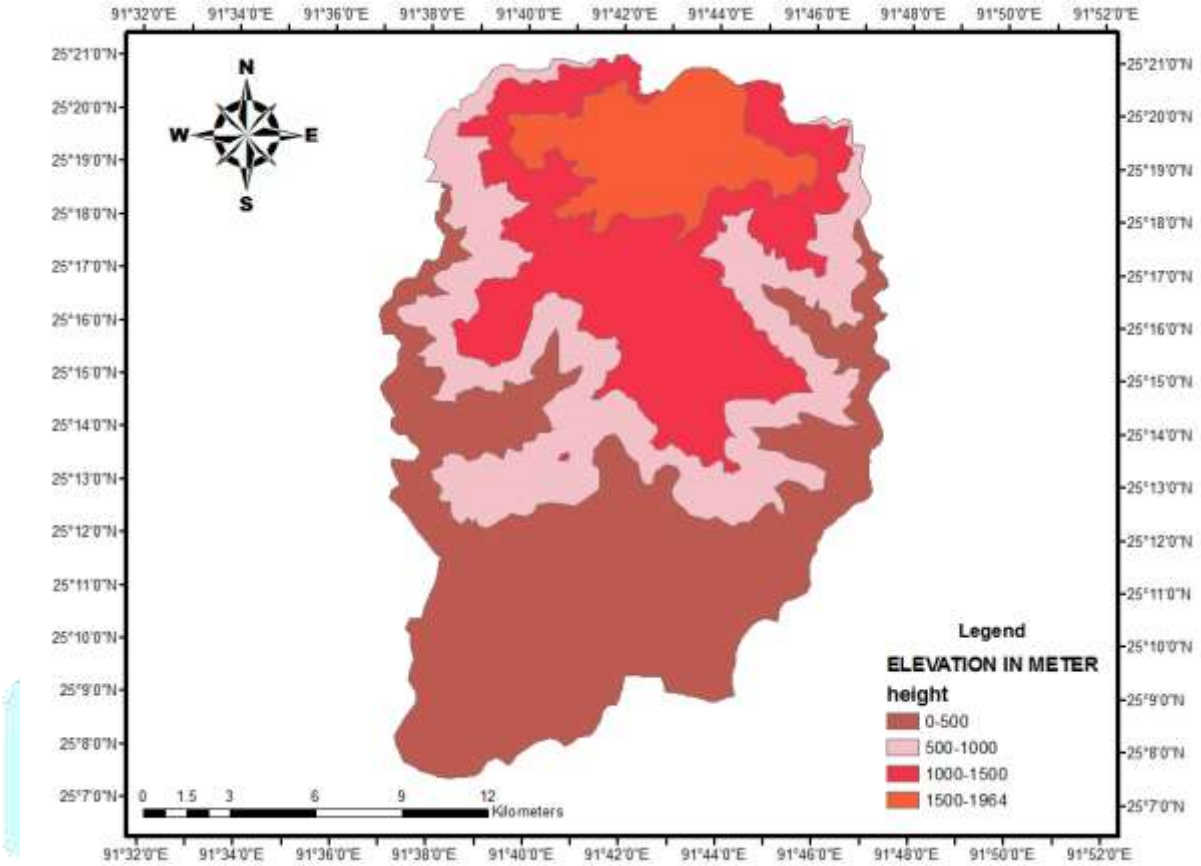

Fig 5: Elevation map of the study area

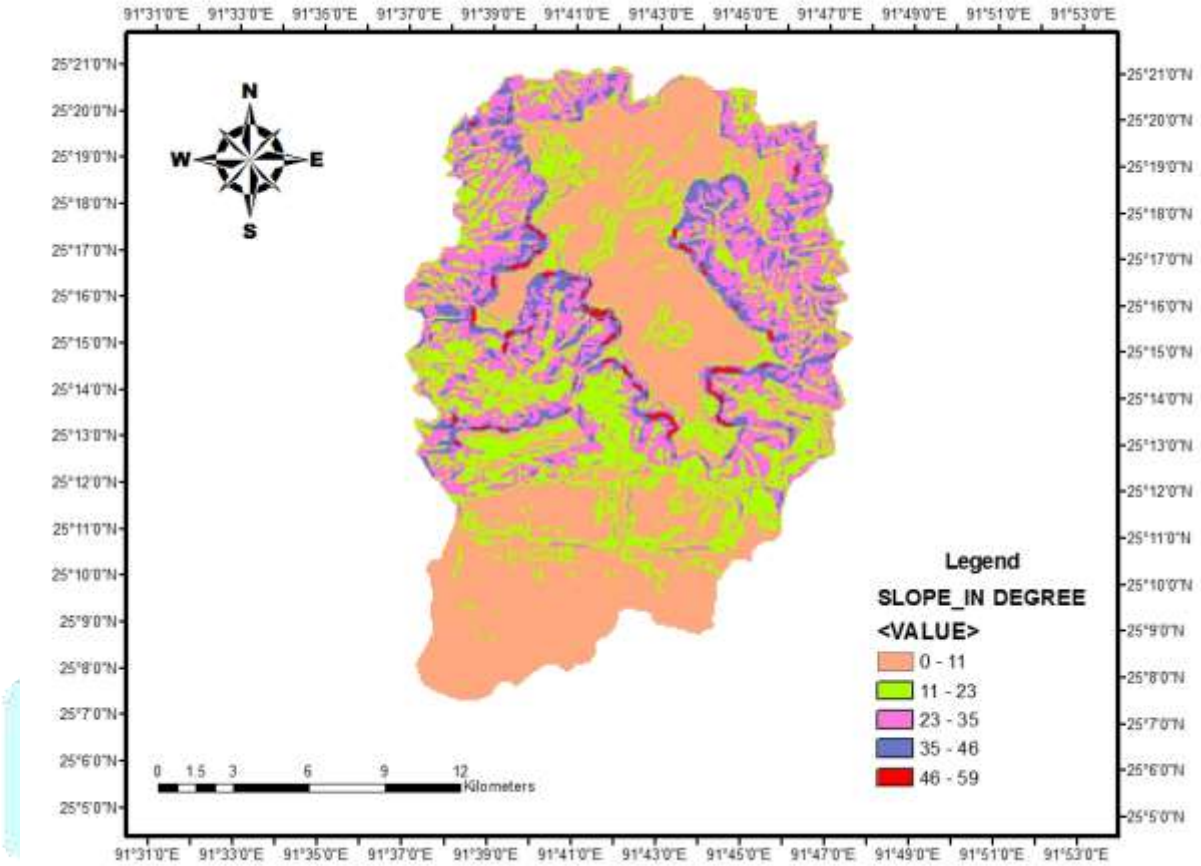

Fig 6: Slope map of the study area

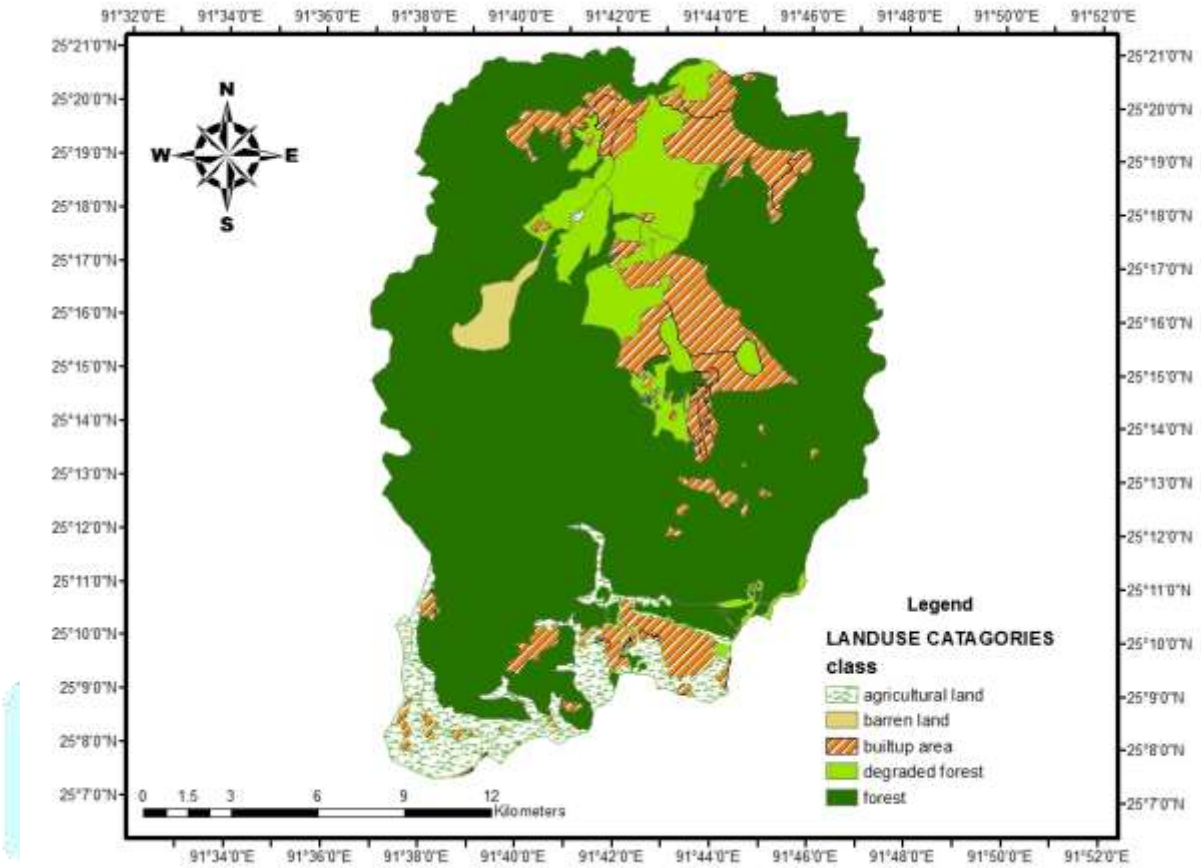

Fig 7: Landuse landcover map of the study area

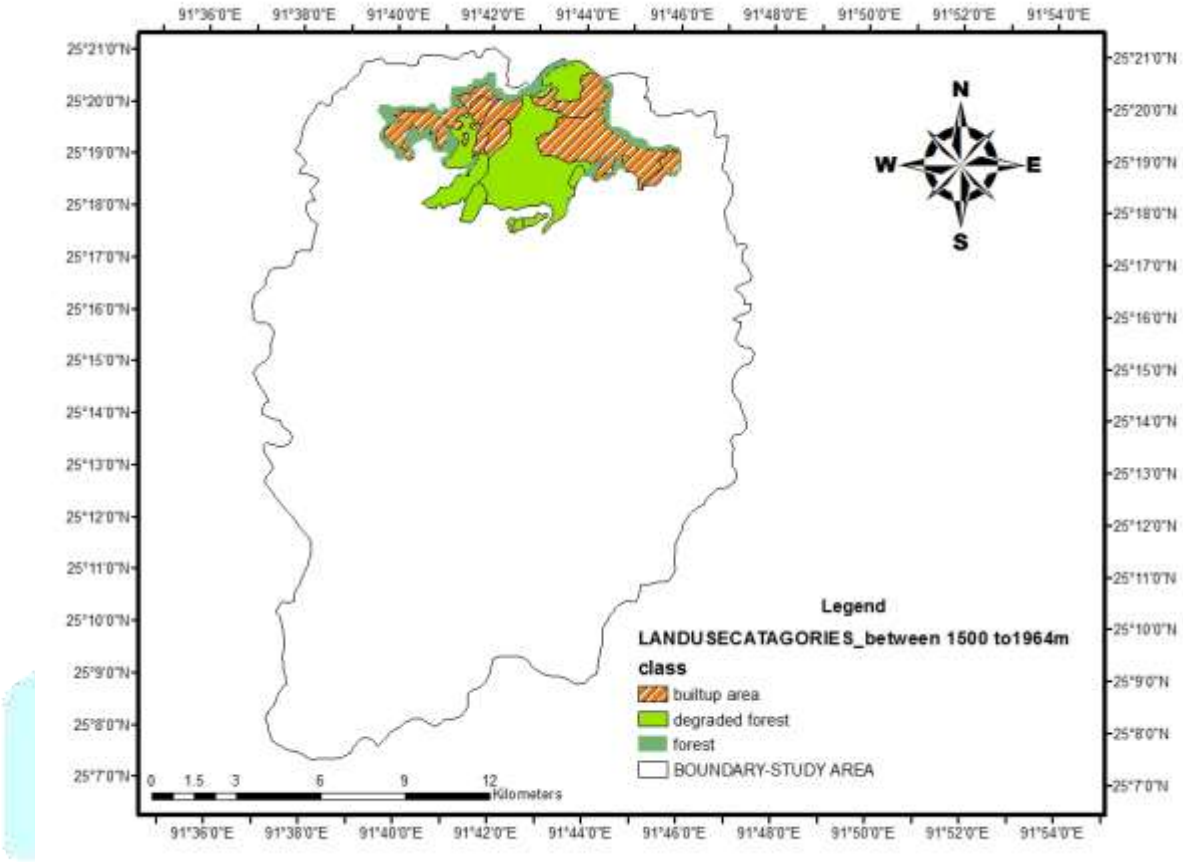

Fig 8: Landuse categories between 1500 to 1964 meter

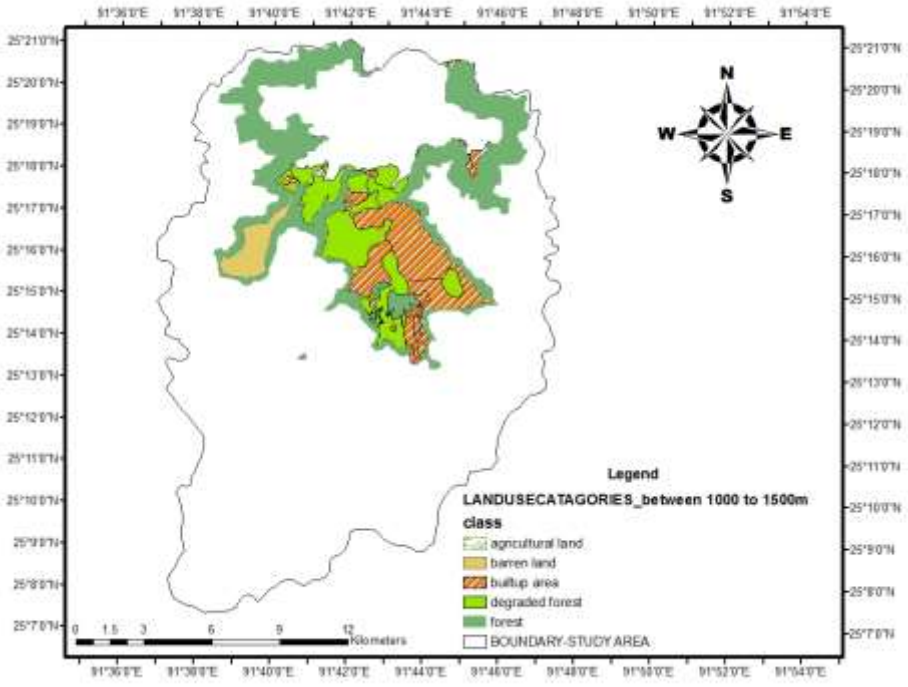

Fig 9: Landuse categories between 1000 to 1500 meter

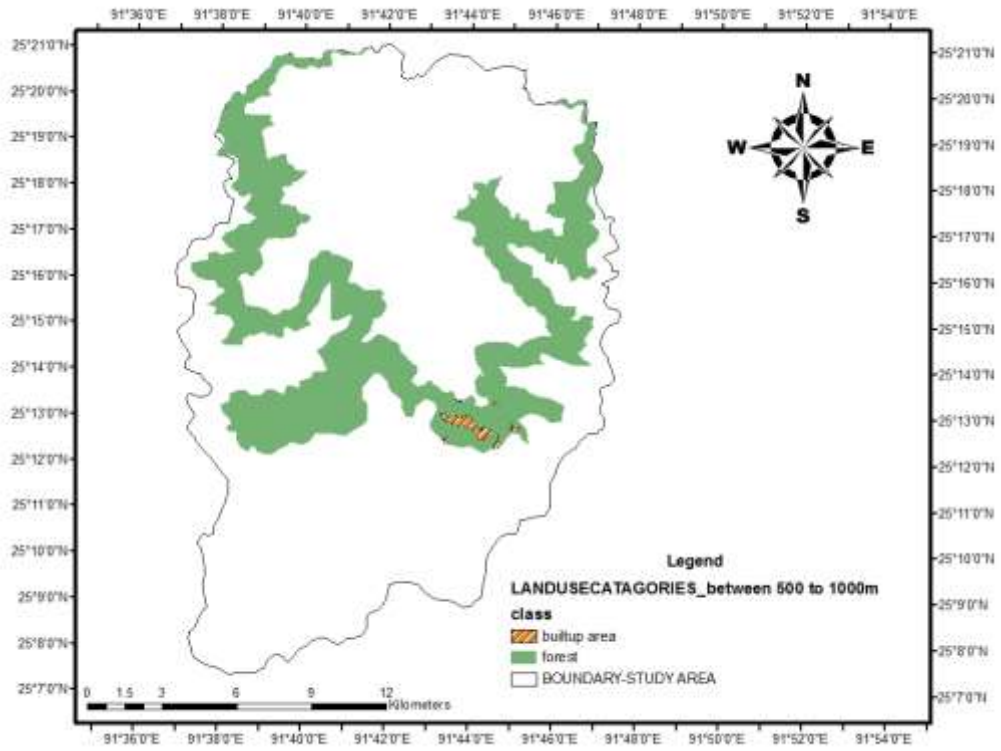

Fig10: Landuse categories between 500 to 1000 meter

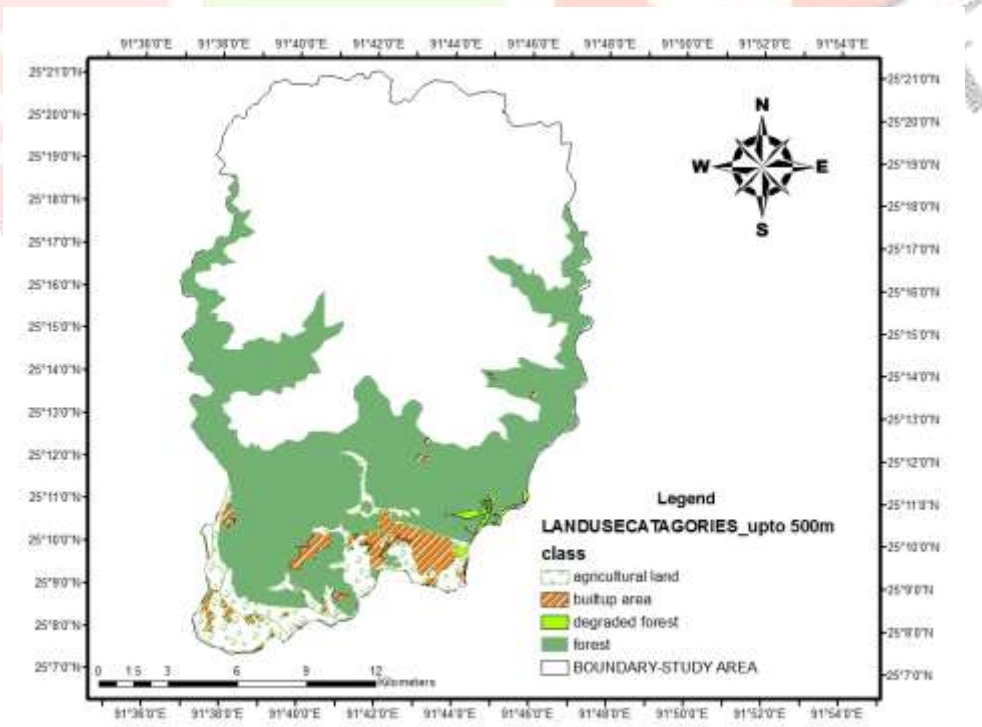

Fig 11: Landuse categories upto 500 meter

Table 1: Different landuse landcover(LULC) categories along with their areas in each elevation level

ELEVATION (meter)	LULC CLASS	AREA (sq km)
Upto 500 m	Agricultural land	20.61
	Builtup area	9.17
	Degraded forest	1.13
	Forest	108.02
500 to 1000 m	Builtup area	5.02
	Forest	74.98
1000 to 1500 m	Agricultural land	0.11
	Barren land	3.88
	Builtup area	26.23
	Degraded forest	28.03
	Forest	21.80
1500 to 1964 m	Builtup area	14.64
	Degraded forest	14.82
	Forest	4.42

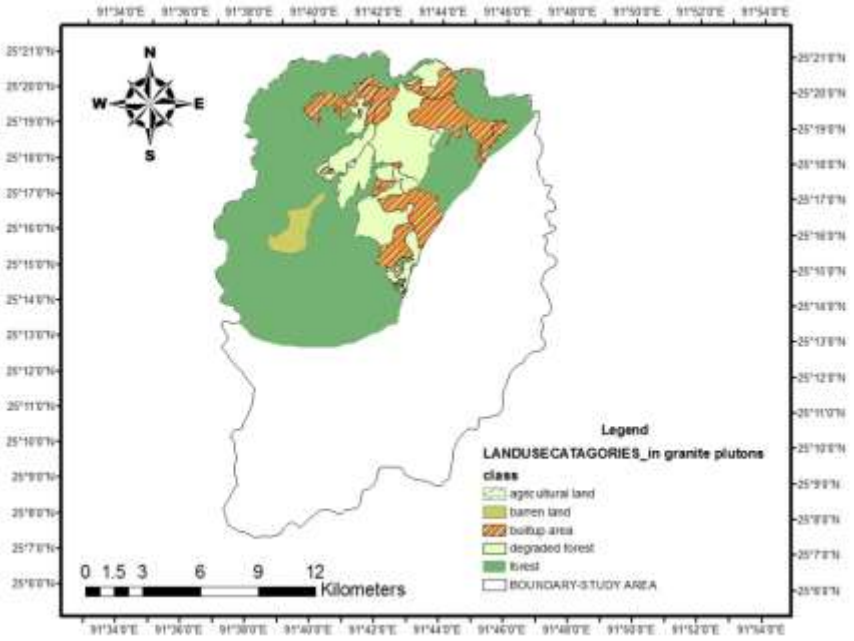

Fig 12: Landuse categories in granite plutons

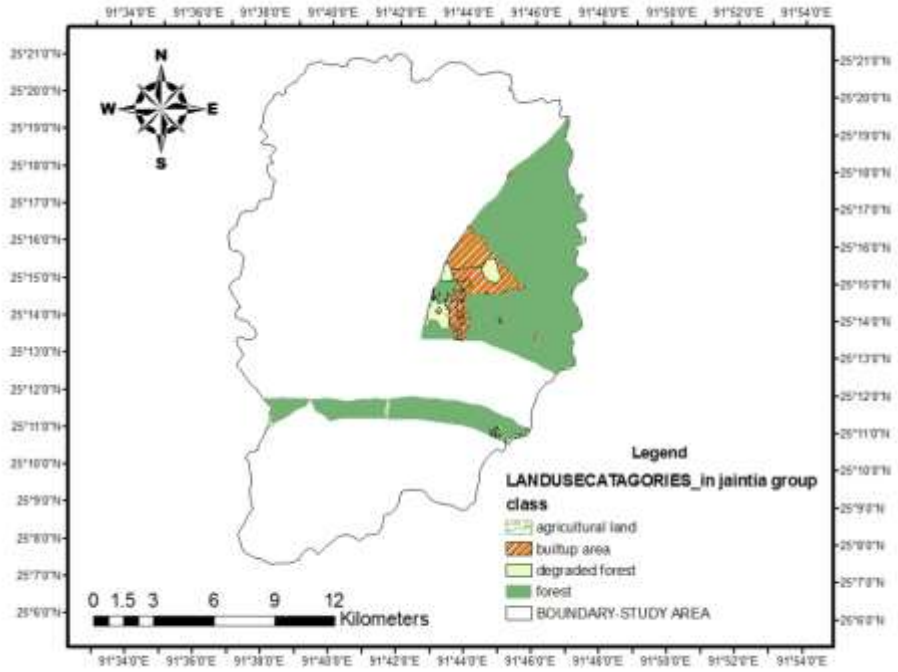

Fig 13: Landuse categories in jaintia group

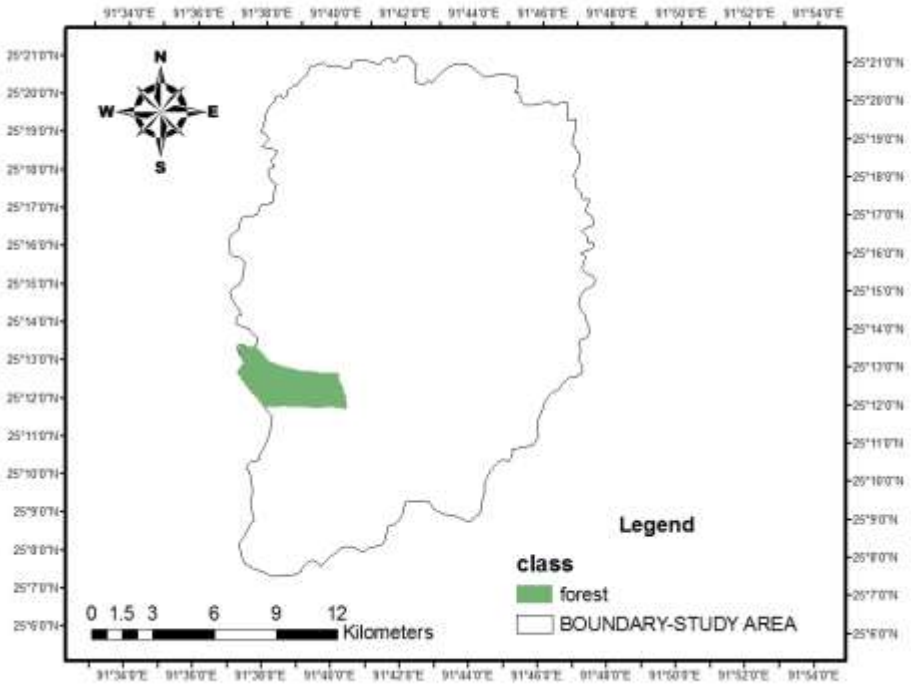

Fig 14: Landuse categories in khasi group

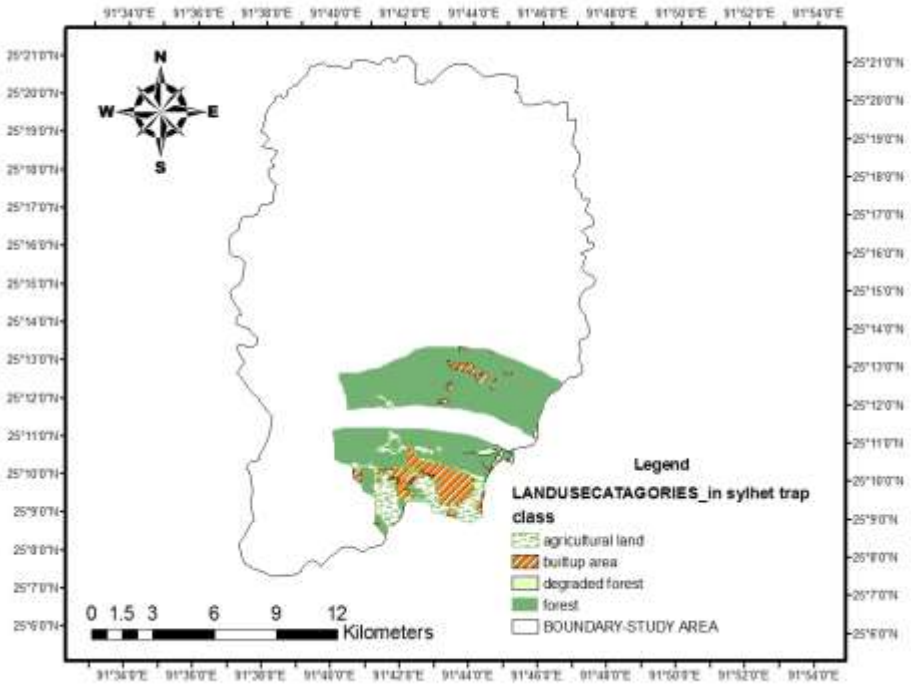

Fig 15: Landuse categories in sylhet trap

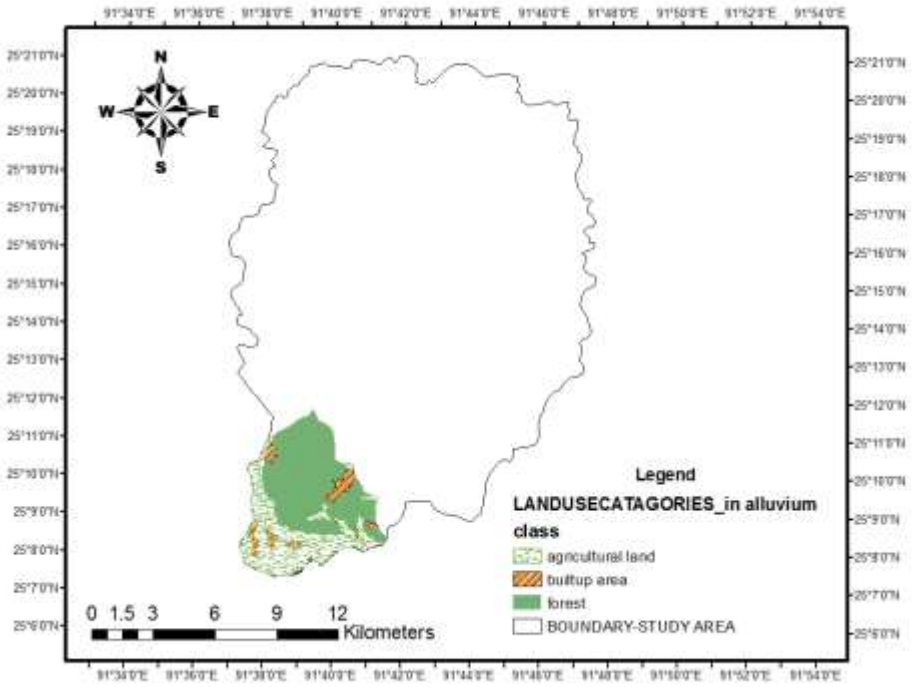

Fig 16:Landuse categories in quarternary deposits

Table 2: Different landuse landcover(LULC) categories along with their areas in each lithology class.

LITHOLOGY	LULC CLASSES	AREA(sq km)
Granite plutons	Agricultural land	0.11
	Barren land	3.88
	Builtup area	25.41
	Degraded forest	28.83
	Forest	103.71
Palaeocene_eocene jaintia group	Agricultural land	13.29
	Builtup area	18.89
	Degraded forest	5.37
	Forest	33.59
Cretaceous Khasi group	Forest	9.68
Cretaceous sylhet	Agricultural land	8.47

trap of meghalaya	**Builtup area** **Degraded forest** **Forest**	**12.43** **1.18** **32.82**
Quarternary deposits	**Agricultural land** **Builtup area** **Forest**	**21.33** **2.94** **11.06**