Geomorphological Study of Jaflong Area near Dauki Fault Using Remote Sensing and Geographic Information System

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Abstract
Geomorphology is closely related to geology, soil science, hydrology and environmental science and is being increasingly applied in planning, mining and hydrological sectors, and within environmental consultancy and tourism. The study area lies in the north-eastern part of the country and tectonically this area belongs to Surma Basin situated into Bengal Fore deep zone of Bengal Basin also known as Sylhet Trough. Under this study an attempt was made to establish the relationship between geomorphic unit and existing landuse based on remote sensing data. In the study area nine landuse categories were identified through remote sensing and GIS techniques. Two different physiographic units which are North-Eastern Terrace Land and Surma-Kushiyara Flood Plain are belongs to the study are. Moreover two surface geological units include Young Gravelly Sand and Marsh Clay and Peat are also there. From analysis no relationship has been found between landuse classes with its physiography and surface geology.

Key words: Geomorphology, Physiography, Remote sensing, Sentinel

Introduction

Geomorphology is the study of the physical features of the Earth's crust as related to its geological features. Morphology means outer study. It deals just with the study of the earth's outer surface or the crust. It is closely related to geology, soil science, hydrology and environmental science and is being increasingly applied in planning, mining and hydrological sectors, and within environmental consultancy and tourism.

Understanding of geomorphology helps us to understand how landforms form and the processes affecting them. This allows us to make better decision on building surface structures and how landscapes will develop over time. Because of continually changing nature of land forms, in many places may generates significant geo-hazards to existing structures and planned structures. Through understanding the threats posed by the changes and the processes we can avoid upcoming major disasters.

The genesis of relief forms of the surface of the earth's crust deals with geomorphology. The surface of the earth is formed through certain natural processes. To understand the environment a thorough understanding of various processes leading to landforms is necessary. An effective tool for this understanding is remote sensing, as aerospace images contain integrated information of all that is on the ground, the landform, the ecology, the resources contained in the area and the impact of human actions on the natural landscape. Ovi *et al.* (2014) identified various geomorphic signatures of active tectonics of Sylhet and adjoining area has been identified by using remote sensing techniques.

Repeated coverage of images of the same area at different times can reveal the dynamic changes occur in the landscape. The untrained eye can see many things through images. Previously unknown or unseen features on the ground are also transparent to the professionals while they analyses the images (Rao, 2002).

For the representation, analysis and visualization of geological processes thematic maps is essential tool. To understand natural phenomena associated with human activities, geomorphological maps are particularly useful in among the large variety of thematic maps (Melelli *et al.*, 2012; Dramis and Bisci, 1998). Islam *et al.* (2014) recognized geomorphic unit and prepare geomorphic and land use map with the help of remote sensing data of Rangpur district.

Study area

The study area lies in the north-eastern part of the country between longitude 91°54′17.89″E to 92°3′54.83″E and latitude 25°11′12.77″N to 25°5′4.17″N. Tectonically this area belongs to Surma Basin situated into Bengal Fore deep zone of Bengal Basin also known as Sylhet Trough. Study area consists of two unions of Gowainghat upzila under Sylhet district named as Paschim Jaflong union and Purba Jaflong union (Fig. 1).Tectonically the study area belongs to Surma Basin (also known as Sylhet Trough) situated into Bengal Fore deep zone of Bengal Basin. The Surma Basin is a foreland basin and a sub basin of Bengal Basin, which is located in the northeastern Bangladesh (Johnson and Alam, 1991; Uddin and Lundberg, 1998, 2004) and is characterized by a large, closed, negative gravity anomaly.

Data and software used

Sentinel-2 data has been collected from online site of Copernicus. Digital image processing (DIP) of the satellite data were carried out in ERDAS IMAGINE software. Vector layers have been prepared in Arc/Info software.

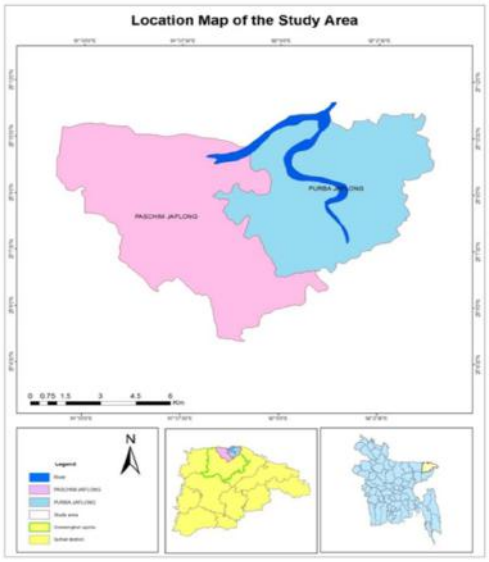

Fig. 1. Location map of the study area

Methodology

Cloud free Sentinel 2 data has been downloaded from Sentinel website. Geometric distortion was checked among the satellite images and image-to-image geometric corrections were verified. Field verification survey was conducted using GPS based ground truthing. Available maps, reports, case studies results from the literature were also taken into consideration during interpretation. The flow chart of the methodology for the present research has been shown in figure 2.

Results and Discussion

In this section an attempt is taken to established relation between physiography and surface geology of the study area with existing land-use classes. Details are described in the following sections.

Land-use of the study area during March and October

Total nine land-use classes was identified in the study area from image analysis viz. exposed area, crop, sparse vegetation, vegetation, water, very low water land, sand, settlement and other.

During March the dominant land use category is crop which is 24.83 percent of total land-use while sand is the less prominent land-use which is 2.05 percent (Fig. 3 and Table 1). In March 2688.58 hectare area was covered by crop, the second highest was sparse vegetation (2622.50 hectare) then settlement 2097.91 hectare, vegetation 1324.00 hectare, exposed area 942.41 hectare, water 327.36 hectare, very low water area 275.39 hectare and sand 221.56 hectare (Table 1).

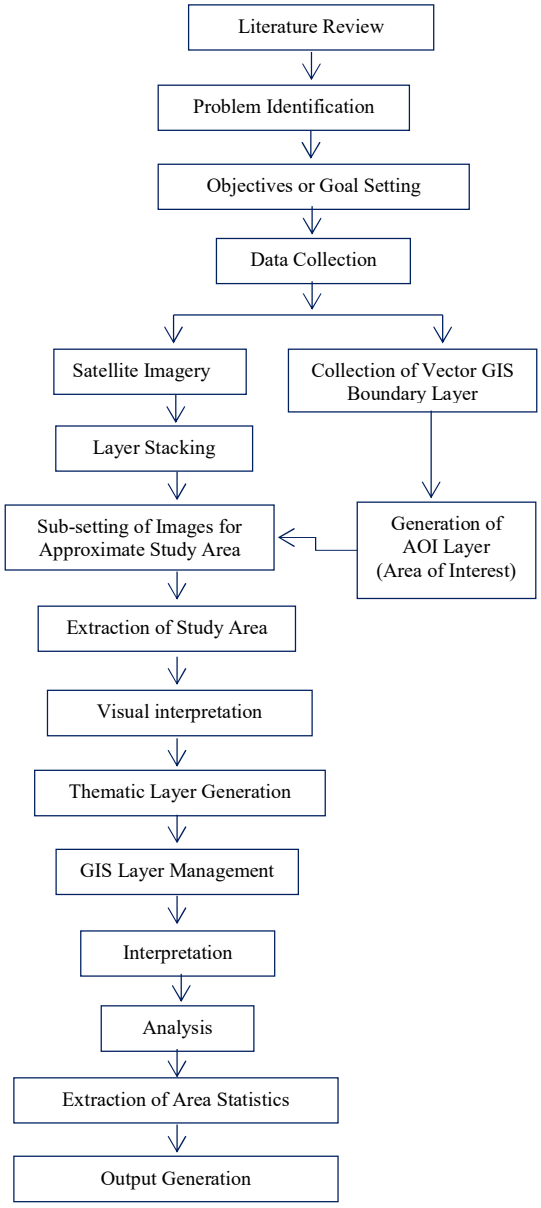

Fig. 2. Flow chart of the methodology

During October the dominant land use category is vegetation (26.71 percent) while the less prominent land-use is very low water land (0.88 percent) (Fig. 4 and Table 2). In this time water and vegetation cover rapidly increased then that of March, while crop, sparse vegetation, very low water land and exposed area rapidly decreased. In October 2873.04 hectare area was covered by vegetation, the second highest was settlement (2046.27 hectare) then crop 1531.78 hectare, sparse vegetation 1444.11 hectare, exposed

area 791.76 hectare, water 1340.13 hectare, sand 281.76 hectare and very low water area 95.82 hectare (Table 2).

Table 1. Land-use statistics of the study area during March 2019

S.N.	Land-use	Area (hectare)	%
1	Crop	2688.58	24.83
2	Exposed area	942.41	8.70
3	Sand	221.56	2.05
4	Settlement	2097.91	19.37
5	Sparse vegetation	2622.5	24.22
6	Vegetation	1324	12.23
7	Very low water land	275.39	2.54
8	Water	327.36	3.02
9	Other	328.22	3.03
Total		10827.93	100

The research findings show that spatial extent of eight land-use classes has no significant distribution pattern in the study area expect sand. Sand was dominated only river side areas.

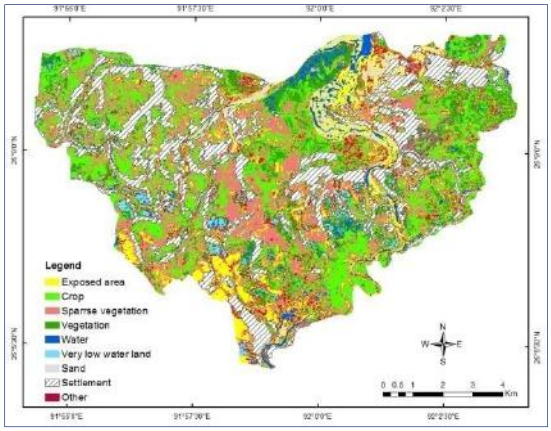

Fig. 3. Land-use of the study area during March 2019

Corresponds of Land-use classes with physiography and surface geology

The study area Jaflong is under two different hysiographic units (1) North-Eastern Terrace Land and (2) Surma-Kushiyara Flood Plain. Again, Jaflong is also covered by two surface geological units (1) Young Gravelly Sand and (2) Marsh Clay and Peat. Purba Jaflong area is falls in North-Eastern Terrace Land (Fig. 5 and 6) and Marsh Clay and Peat deposit (Fig. 7 and 8). But Paschim Jaflong area is falls physiographically in both North-Eastern Terrace Land and Surma-Kushiyara Flood Plain. It is also cover Young Gravelly Sand and Marsh Clay and Peat geological deposit. Table 3 represents Physiographic unit wise land-use statistics of the study area during March and October 2019 and table 4 represents Surface Geological unit wise land-use statistics of the study area during March and October 2019.

Table 2. Land-use statistics of the study area during October 2019.

S.N.	Class	Area (hectare)	%
1	Crop	1531.78	14.15
2	Exposed area	791.76	7.31
3	Sand	281.76	2.60
4	Settlement	2046.27	18.90
5	Sparse vegetation	1444.11	13.34
6	Vegetation	2873.04	26.53
7	Very low water land	95.82	0.88
8	Water	1340.13	12.38
9	Other	423.26	3.91
Total		10827.93	100

From analysis it is revealed that there is no correspondence of land-use classes with physiography and surface geology of the study area. All land-use classes are present in each physiographic and surface geological unit.

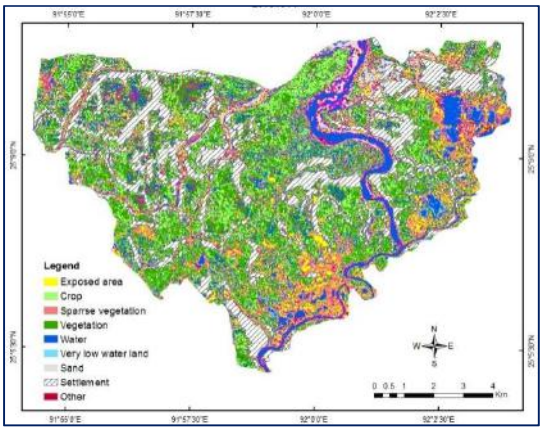

Fig. 4. Land-use of the study area during October 2019

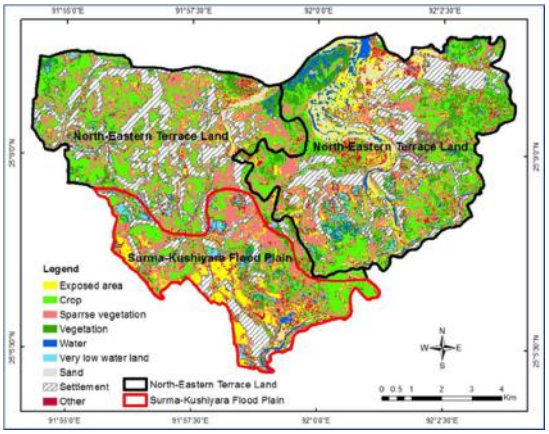

Fig. 5. Physiographic unit wise land-use setting of the study area during March 2019

Table 3. Physiographic unit wise land-use statistics of the study area during March and October 2019

Physiography class	Land-use class	Area (hectare)	Area (hectare)
		March 2019	October 2019
North-Eastern Terrace Land	Exposed area	391.39	585.26
	Crop	2205.8	1162.16
	Vegetation	1147.09	2276.51
	Sparse vegetation	1914.11	1004.51
	Water	254.88	1044.53
	Very low water land	153.14	76.79
	Sand	215.56	278.39
	Settlement	1780.89	1741.31
	Other	220.44	318.61
Surma-Kushiyara Flood Plain	Exposed area	551.03	206.5
	Crop	482.78	369.62
	Vegetation	176.9	596.53
	Sparse vegetation	708.39	439.6
	Water	72.48	295.6
	Very low water land	122.25	19.03
	Sand	6	3.36
	Settlement	317.02	304.95
	Other	107.78	104.67
Total		10827.93	10827.93

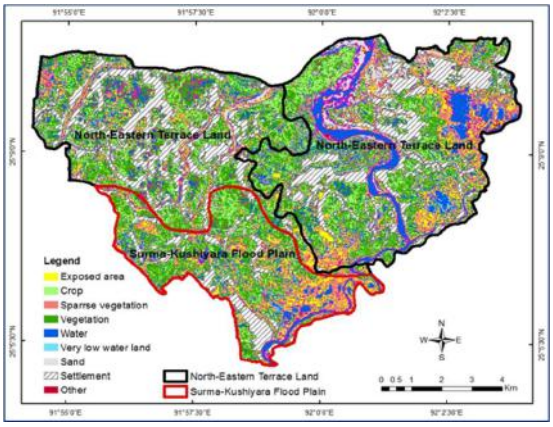

Fig. 6. Physiographic unit wise land-use setting of the study area during October 2019

Table 4. Surface Geological unit wise land-use statistics of the study area during March and October 2019

Surface Geology Class	Land-use class	Area (hectare)	Area (hectare)
		March 2019	October 2019
Surface Geology Class Marsh Clay and Peat	Exposed area	666.69	582.03
	Crop	1327.13	756.27
	Vegetation	884.43	1115.45
	Sparse vegetation	1230.88	892.26
	Water	276.73	984.46
	Very low water land	119.46	66.62
	Sand	184.80	240.18
	Settlement	1014.56	963.18
	Other	222.77	251.70
Young Gravelly Sand	Exposed area	275.719	209.73
	Crop	1361.45	775.50
	Vegetation	439.57	1757.59
	Sparse vegetation	1391.62	551.85
	Water	50.63	355.66
	Very low water land	155.93	29.20
	Sand	36.76	41.58
	Settlement	1083.35	1083.08
	Other	105.45	171.59
Total		10827.93	10827.93

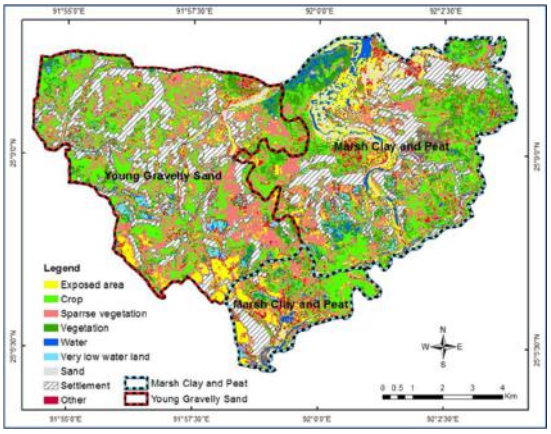

Fig. 7. Surface Geological unit wise land-use setting of the study area during March 2019

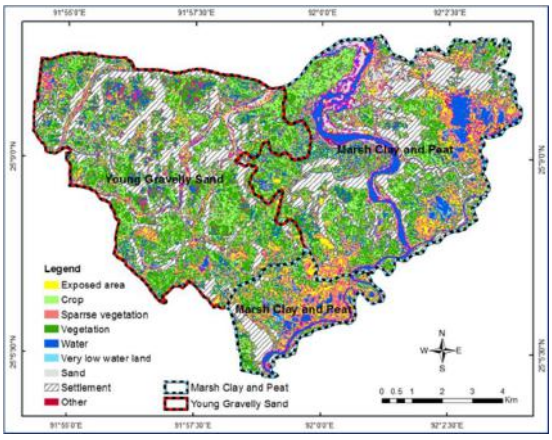

Fig. 8. Surface Geological unit wise land-use setting of the study area during October 2019

Conclusion

In Jaflong area nine land-use categories were identified through remote sensing and GIS techniques. The study area fall under two different physiographic units North-Eastern Terrace Land and Surma-Kushiyara Flood Plain with two surface geological units Young Gravelly Sand and Marsh Clay and Peat. From analysis no relationship has been found between land-use classes with its physiography and surface geology.

Acknowledgements

The authors are thankful to Bangladesh Space Research and Remote Sensing Organization (SPARRSO) for the encouragement extended for this study.

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