



LAND-USE/LAND-COVER ALTERATION AND THEIR GEO-ECOLOGICAL EFFECTS ON BANDARBAN SADAR UPAZILA OF BANDARBAN DISTRICT, BANGLADESH: A REMOTE SENSING AND GIS STRATEGY

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ABSTRACT

This study aimed to explore land-use and land-cover change processes of Bandarban Sadar Upazila in Chattogram Hill Region of Bangladesh. Satellite data were used to identify changes in land-use and land-cover in the past 28 years in Bandarban Upazila of Bandarban district of Bangladesh. Decreasing of vegetation and increasing of settlement and bare land area in land-use configuration have been observed using satellite data of remote sensing technology. The study found that during the last 28 years (1983-2011) 4,162.085 hectares of the hill forest area have been changed into 1,633.213 bare land and 2177.408 hectares to settlement. The principal destination of the study was to seek out the land-use changing types and its geo-ecological effects due to these on Bandarban Sadar Upazila of Bandarban in Chattogram division, Bangladesh. This study was conducted to prepare land-use and land-cover patterns of Bandarban and identifying the trends and underlying causes of land-use and land-cover alterations in Bandarban.

Key words: Land-use, land-cover, geo-ecological effects, bandarban

INTRODUCTION

The investigation zone is located in the southeastern part of the nation in the middle of 22°55' and 22°22' north latitudes and in the middle 92°08' and 92.20' east longitudes. Bandarban is part of the Chattogram division and is situated in the southeastern zone of Bangladesh. Bandarban is one of the three elevated districts of Bangladesh and a piece of the Chattogram Hill Tracts, although the others being Topographical but this Hill District is a continuity of the Himalayan Tract. About 90% of the absolute zone of the district is hilly, 4% covers townlets, waterways, and swamps, and the other 6% valley is applicable for abundant agricultural yield (Osman *et al.* 2013). Bandarban (4,479 km²) isn't just the most far-off region of the nation yet in addition is the most un-populated (populace 388,335) one.

Bandarban is one of the best fascinating tourist destinations in Bangladesh for its adventuresome characteristics and awesome view of natural scenery. The economy is vigorously subject to Jhum cultivating which is a cut and burn agricultural strategy. Bandarban yields small portion that

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Figure 1. Location map for study area

is of economic rate outside the self-consuming of the hill people also called Jumia. Organic products like masala (ginger, turmeric), fruits (banana, pineapple, jackfruit, and papaya), and ancestral textile are the significant exports of this region. Bandarban incorporates the three most noteworthy pinnacles of Bangladesh-Tajingdong (or Bijoy), Mowdok Mual (or Saka Haphong) and Keokradong. Shifting cultivation, regionally known as 'jhum' is the prevalent cultivating method in the Chattogram Hill Tracts (CHTs), which in the past has been all around adjusted to the lives and subsistence of ancestral individuals with a little antagonistic impact on the environment of the locale (Nath *et al.* 2005).

Expanding populace pressure combined with a deficiency of reasonable uplands diminished the shifting cycle from 15-20 years in 1900 to 3-5 years during the 1990s without guidelines to forestall deforestation, soil attrition, biodiversity ruination and natural corruption (Gain 1998). Environmental degradation is usually demonstrated through various indicators of environmental parameters i.e., loss of vegetation cover, increasing salinity covered bed of land, decreasing the agricultural land, etc. which may have an impact on the local and regional environment (Gain 1998). The likely utility of remote sensing information has been very much perceived in mapping and evaluating land credits, for example, topography, soils, land-use/land-cover, and so on (Solanke *et al.* 2005). Control of assets use, an appropriate arrangement and the board of human exercises (extemporary settlement, land-utilization, deforestation and underground water usage) can amplify the approach to execute supportable development and management (Riches 2008).

METHODOLOGY

Remote sensing information was Geo-referenced to Transverse Mercator (TM) projection framework utilizing Linear Transformation Matrix with Nearest Neighborhood re-sampling strategy. Pre-processed data were characterized utilizing on digitization procedure. Land-use alteration was resolved in the previous long time of 28 years from 1983 to 2011. Essential satellite frequency bands into Satellite images were utilized for the study of land-use boundaries for the particular necessities of the investigation.

For investigation of the changing type of land-use in Bandarban Upazila and its geo-ecological effect, satellite pictures were anatomized to identify changes. The expansion of vegetation and alteration in land-use design has been explored utilizing remote sensing computerized pictures of IRC Aerial Photo of the year 1983 and Rapid Eye Satellite picture of 2011 of Bandarban Sadar Upazila. The drivers of land-use changes were investigated concerning their consequences for social and biological frameworks.

Table 1 shows remote sensing data utilized in the current research work. Figure 3 shows the land-use maps of year 1983 (IRC Aerial Photo) and 2011 (Rapid Eye Satellite Images) of Bandarban Sadar Upazila. Table 2 is the BBS Report of territory and yield of Rice harvests, Pineapple and Banana for the long years of 2009-10 and 2010-2011 for Bandarban Sadar Upazila.

Table 1. Remote sensing data used in the study

| Remote sensing data used | | | |
|--------------------------|------------|-----------|------|
| Type of Data | Resolution | Year | Band |
| Aerial Photo | 1m*1m | 1983-1984 | RGB |
| Rapid Eye Satellite | 5m*5m | 2011 | RGB |

Table 2. BBS Report of territory and yield of Rice crops, Pineapple and Banana for the years of 2009-10 and 2010-2011 for Bandarban Sadar Upazila.

| Years | Aus crop | | Aman crop | | Boro crop | | Pineapple | | Banana | |
|-----------|----------|------------|-----------|------------|-----------|------------|-----------|------------|--------|------------|
| | Area | Production | Area | Production | Area | Production | Area | Production | Area | Production |
| 2009-2010 | 1503 | 1090 | 4600 | 4851 | 1675 | 1883 | 660 | 2986 | 1580 | 9933 |
| 2010-2011 | 3466 | 111132 | 4769 | 5485 | 1680 | 1827 | 670 | 3032 | 1590 | 10196 |

Area in acre and production in metric ton

ERDAS Imagine Version 9.3 and Arc GIS 10 software have been used for data processing, analysis and generation of products supported data.

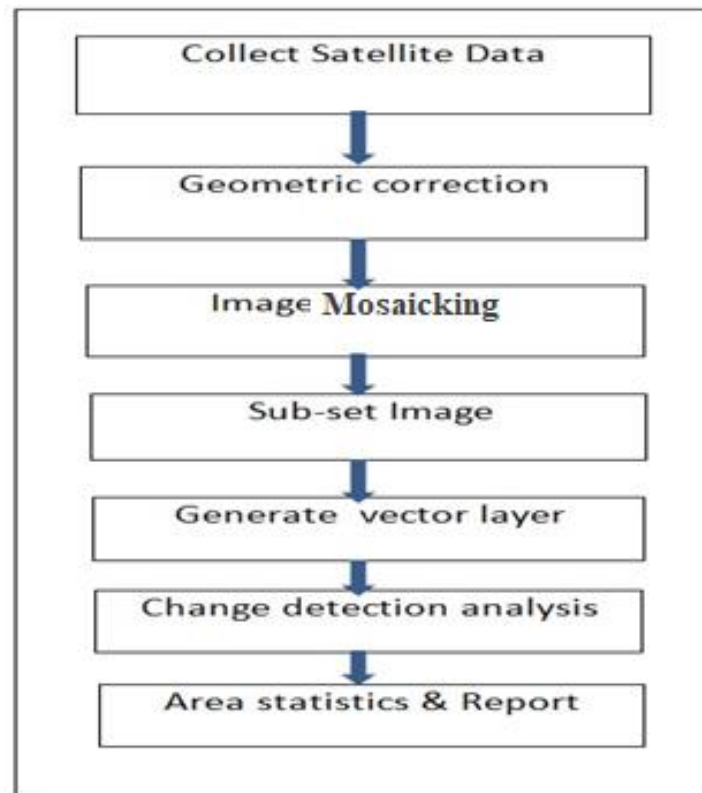


Figure 2. Diagram of methodology utilized for data preparing and analyzing

RESULTS AND DISCUSSION

This research work examines the alteration in land-use and land-cover for the previous 28 years of Bandarban Sadar Upazila. From Digital examination we found significant alteration in land-use and land-cover of that region. The information gained from the Satellite picture indicated that in 1983, there were 47350.304 hectares of Hill Forest which is decreased to 43188.219 hectares in 2011. So, we noticed that the vegetation region of 1983 is diminished by 4,162.085 hectares in 2011. On the other hand, we can see the land was used for settlements in 1983 was 770.627 hectares, in 2011 was 2948.035 and the increase of settlement area is 2177.408 hectares. In 1983, 432.176 hectares land was used for city area but in 2011 it was increased to 706.728 hectares as the total increase is 274.552 hectares. In 1983, 746.615 hectares of land was used as water bodies' area but in 2011 was decreased to 546.03 hectares total decreased is 200.585 hectares. We found in 1983, 939.763 hectares land was used as a Bare Land area but in 2011 it was increased to 2572.976 hectares as total increase is 1,633.213 hectares.

This expansion inside the settlement zone would require impressive development of urban limits. As an outcome of this urban extension, advancement and furthermore the development of the habitation and business structures, metropolitan transportation offices and correspondences frameworks will interfere enormous volumes of land materials. A lot of this aggravation will be on hillsides that are vulnerable to landslides. Likewise, pressures made by the populace density, individuals are keen to build on hills because of the artistic excellence and furthermore the scenic nature from their property. As depicted by the reference (Spencer 1966), "Hillsides guise unparalleled issues for the development and maintenance of human settlements". They're at risk

to natural disasters, and that they geographically oblige the designing of settlements. Vegetation and water bodies are a truly significant component of the natural ambience. Thus, from the findings of this research work decreased territory in vegetation and water bodies and increment of settlement region will have adverse effect on the indigenous habitat and biological system of the Bandarban Upazila.

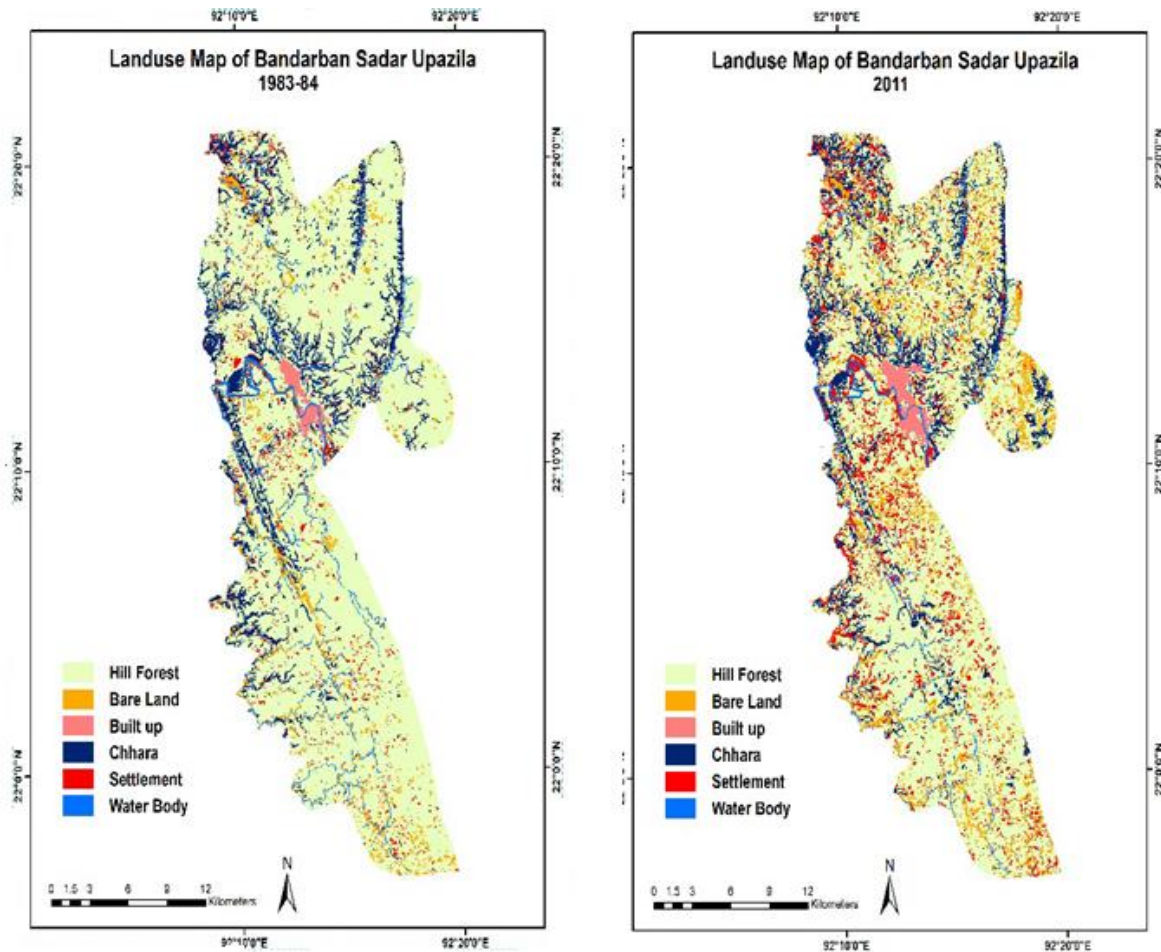


Figure 3. Land-use map of year 1983 and 2011 prepared by utilizing of Erdas Imagine software.

Decreasing vegetation, water bodies and increase of settlement area might be the major causes of landslides within the Bandarban Sadar Upazila. Landslide is one of normal and eminent catastrophic events in hilly conditions. The hilly zones of Bangladesh are inclined to landslide in comparison to other highly elevated regions of the planet. Landslide happens often inside the hilly regions of Chittagong, a south-eastern part of Bangladesh (Ahmed *et al.* 2014). The decreasing of hill forests and water bodies along with the increase of settlements and bare land is hurting the ecological balance. Unplanned urbanization is also deteriorating the natural habitats of wild animals. Public awareness about stopping the importance of illegal hill and forest cutting along with the implementation of an appropriate plan for protection, preservation, and restoration of the ecological balance and to prohibit the further unplanned expansion of the city, enforcement of those rules and regulations should be strictly implored.

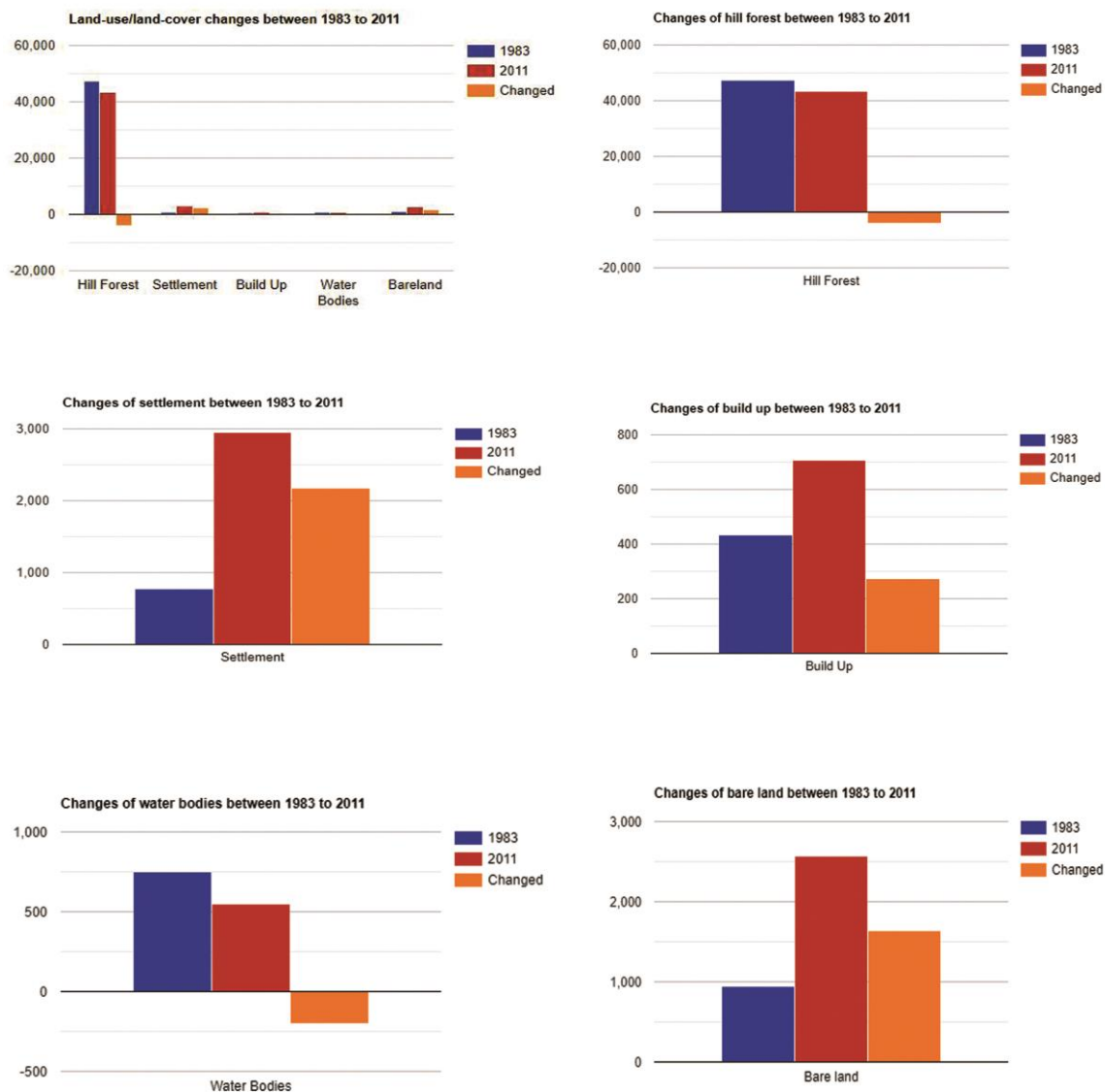


Figure 4. Changes of land-use/land-cover between 1983 to 2011 (area in hectares).

CONCLUSION

The current investigation set up the best possible utilization of Remote Sensing and GIS procedures for detection and evaluation of land-use and land-cover boundaries in Bandarban Sadar Upazila. Territorial ecological changes are a rising worry as they are connected with global climate changes. In recent times, environmental degradation has been noticed south-eastern zone of Bangladesh. Environmental degradation is usually demonstrated through various indicators of environmental parameters, such as loss of vegetation cover, water logging, siltation, increasing unplanned urbanization, decreasing the agricultural land, etc. which may influence the local as well as the regional environment. Food yield and reservation of forests are essential to preserve many direct and indirect services for confirmative rural livelihoods in Bandarban Sadar Upazila. From this work, it was seen that the land-use and land-cover manner has been changed

in Bandarban Sadar Upazila because the lack of planned settlement, deforestation and irrigation Project. Due to the necessity of agricultural land for food security and agricultural development, many forest areas have been deforested and hills area has been converted into agricultural land and settlement area.

For this extended agricultural activities, underground water has been used for irrigation. The use of excessive underground water against lesser recharge is causing the depletion of underground water that sometimes might cause land subsidence. Jhumming or shifting cultivation, a deep-rooted practice of ancestral individuals, has methodically decimated numerous regions of virgin forests of this region (Spencer 1966).

The outcome of this research work will be useful for the sustainable development and management of the rampant and unplanned utilization of natural assets and lands as a settlement in Bandarban Sadar Upazila.

REFERENCES

- Ahmed B, Rahman MS, Rahman S Huq FF and Ara S. 2014. Landslide inventory report of Chittagong metropolitan area, Bangladesh. BUET-Japan Institute of Disaster Prevention and Urban Safety, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh. p. 125.
- Gain P. 1998. Forests, In Gain, P. (Ed :), "Bangladesh Environment: facing the 21st century, SEHD, Dhaka. Bangladesh." pp. 69- 93.
- Osman KS, Jashimuddin M, Haque SMS and Miah S. 2013. Effect of shifting cultivation on soil physical and chemical properties in Bandarban hill district, Bangladesh. *Journal of Forestry Research*. 24(4): 791-795.
- Riches CR. 2008. The High Barind Tract: a challenging drought-prone agricultural environment. In: Riches, CR. Harris, D., Johnson, D.E. and Hardy, B., (Eds.) *Improving agricultural productivity in rice-based systems of the High Barind Tract of Bangladesh*. International Rice Research Institute, Los Banos (Philippines). pp 3-6.
- Solanke P, Srivastava R. Prasad J, Nagaraju MSS, Saxena RK and Barthwal AK. 2005. Application of remote sensing and GIS in watershed characterization and management. *Journal of the Indian Society of Remote Sensing*. 33(2): 239-244.
- Spencer JEP. 1966. *Shifting cultivation in southeastern Asia* (Vol. 19), University of California Press, ISBN 978-0520035171
- Nath TK, Inoue M and Chakma S. 2005. Shifting cultivation (*jhum*) in the Chittagong hill tracts, Bangladesh: examining its sustainability, rural livelihood and policy implications. *International Journal of Agricultural Sustainability*. 3(2): 130-142.