International Journal of Ecology and Environmental Sciences
www.ecologyjournal.in
Online ISSN: 2664-7133; Print ISSN: 2664-7125; Impact Factor: RJIF 5.28
Received: 02-12-2020; Accepted: 17-12-2020; Published: 02-01-2021
Volume 3; Issue 1; 2021; Page No. 06-08

Appraisal of land use change using remote sensing technique: A review

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Abstract
Land use/land cover (LULC) changes are major issues of global environment change. The satellite remote sensing data with their repetitive nature have proved to be quite useful in mapping land use/ land cover patterns and changes with time. This article reviews the results of various studies of land use changes using remote sensing technique based on the land use classification, spectral signatures of land use categories, accuracy assessment and change analysis.

Keywords: land use, remote sensing, spectral signature, accuracy assessment

Introduction

Globally, urbanization is increasing at an unprecedented rate at the cost of agricultural and forested lands in peri-urban areas fringing larger cities. Such land-cover change generally entails negative implications for societal and environmental sustainability, particularly in South Asia, where high demographic growth and poor land-use planning combine. Analyzing historical land-use change and predicting the future trends concerning urban expansion may support more effective land-use planning and sustainable outcomes (Basnyet 1989) [3]. The historical analysis of changes in land use in south and Southeast Asia studied by Flint and Rechard (1991). Three land-use change case studies in India and Burma were examined at the level of ecological zone to illustrate different processes of deforestation, *viz*. (1) agricultural expansion in the Burma Delta, (2) commercial overfelling in Chamba, Himachal Pradesh and (3) shifting cultivation in Meghalaya. Parwal *et al. (*1994) [12] stated that use of remote sensing technique along with GIS reduces the field work. They used Landsat TM False Colour Composite (FCC) and SPOT Panchromatic data on 1:50,000 scale for interpretation of forest cover type associated land uses and density information.

Jaiswal (1999) [10] studied the application of remote sensing technology for land use/land cover change analysis. Land use/land cover changes over a period of 30 years were studied using remote sensing technology in a part of Gohparu block, Shahdol district of Madhya Pradesh. Land use/ land cover maps were prepared by visual interpretation of two period remotely sensed data. Post-classification comparison technique was adopted for this purpose. The loss of vegetation cover was estimated to be 22 percent and 14 percent of the land was found to have been transformed into wasteland between 1967 and 1996. Overall rate of change was found to be 1.8 percent per year during this period.

Debashis *et al.* (2004) [5] developed remote sensing-based health index after analyzing the change in land use and vegetation vigour. Seven land use/land cover types were identified in the watershed, namely; crop area, fallow area, forest land with and without scrub, sandy area and water body. Results indicated that the indices for land use/land cover and vegetation vigour declined from 1.0 to 0.93 and 0.85, respectively, showing non-perceptible change in watershed health. Fox and Vogler (2005) [7] carried out studies on the land-use and land-cover change in Montane mainland Southeast Asia. Results suggest that land use (e.g. swidden cultivation) and land cover (e.g. secondary vegetation) have remained stable and the minor amount of land-use change that has occurred has been a change from swidden to monocultural cash crops. Results suggest that two forces i.e. national land tenure policies and market pressures will increasingly determine land-use systems in this region.

The anthropogenic pressure has led to land use/cover change of the watershed in the past decade with increase of agricultural land at the expense of forests. The pressure of grazing was also high resulting in removal of 47% of annual primary production of floor phytomass (Jain *et al.* 2005) [9]. Semwal *et al.* (2005) [15] reported that the root cause of changes among land use and land cover types had been centered on coal mining activities while studying land use/land cover change using remote sensing technique. The overall rate of change was found as 2.16% per year. This includes 0.1% per year change due to coal mines. The agricultural land was reduced by 26.40 km^2 or 22.35% out of its total area and the land was transformed into coal mines, habitation related to coal mines and the abandoned agricultural land classified as grassland/scrub.

Achard *et al.* (2006) [1] revealed that human influence on the Russian forest landscape has been growing over recent decades, mainly as a consequence of logging activities and human-induced fires, with in particular: (i) clear cuts; (ii) high intensity selective logging; (iii) increased fire frequency. Rapid land-cover change is not randomly or uniformly distributed but is clustered in some locations, e.g., high intensity logging mostly takes place in the European part of Russia (e.g., in the Karelian Isthmus) and along the southern border of the taiga. Annual forest cover change rates in areas identified as rapid change areas may range from 0.26% for diffuse logging activities to 0.65% for areas affected by intense clear-cutting activities, up to 2.3% for areas affected by fires or a combination of fires and logging. Brandt and Townsend

(2006) followed supervised classification techniques and spectral mixture analysis to characterize current landscape patterns and quantify land cover change from 1985 to 2003 in the Altiplano (2535-4671 m) and Intermediate Valley (Mountain) (1491-4623 m) physiographic zones in the Southeastern Bolivian Andes. Current land cover was mapped into six classes with an overall accuracy of 88% using traditional classification techniques and limited field data. The land cover change analysis showed that extensive deforestation, desertification, and agricultural expansion at a regional scale occurred in the last 20 years (17.3% of the mountain zone and 7.2% of the Altiplano).

The land use / land cover change in the U.S. Great Lakes basin resulted changes of 2.5% (798 755 ha) of the U.S. portion of the Great Lakes watershed between 1992 and 2001 (Wolter *et al*. 2006) [18]. Transitions due to new construction included a 33.5% (158 858 ha) increase in low-intensity development and a 7.5% (140 240 ha) increase in road area. Agricultural and forest land each experienced 2.3% (259 244 ha and 322 463 ha, respectively) decrease in area. Singh *et al.* (2007) studied land uses in Nagin watershed of Uttarakhand using GIS and remote sensing and observed that the agricultural area had reduced from 66.71 to 32.75% over a period of 42 years. At the same time, 13.51% area revealed that the forest area increased by approximately 100% including both dense and moderately dense forest.

Halim *et al.* (2008) [8] while studying the land use pattern change over a period of 18 years (1988-2006) in the West Bhanugach Reserved Forest, a hill forest, in Sylhet Forest Division of Bangladesh found that vegetation cover decreased drastically from the year 1988 to 1996 (1826 ha to 1714.85 ha), but increased gradually from the year 1996 to 2006 (1714.85 ha to 1847.83 ha) due to initiation of co-management practice involving local communities. Reddy (2009) [13] studied the land cover classification using IRS – LISS III satellite image and Digital Elevation Model (DEM) in hilly environment of Nongkhyllem Wildlife Sanctuary, Meghalaya. Maximum likelihood classifier algorithm of ERDAS imagine 9.1 version was used to secure supervised classification of pixels into various land use types and vegetation types among the forest class cover.

Mallupattu and Reddy (2013) [11] reported that the LU/LC changes were significant during the period from 1976 to 2003. There is significant expansion of built-up area noticed. On the other hand there is decrease in agricultural area, water spread area, and forest areas. This study indicated the significant impact of population and its development activities on LU/LC change. This study proved that integration of GIS and remote sensing technologies is effective tool for urban planning and management. Andualem *et al.* (2018) [2] carried out study in the upper Rib watershed and found a significant land use change which was due to an increase in population with a high interest to croplands which resulted in an increase of agricultural land by 13.78% over 11 years period.

Tewabe and Fentahun (2020) [17] revealed that the change of forest, bushland, and grassland to agricultural and residential areas which may cause problems including change in streamflow, soil degradation, and hydrological system in the basin. In this study, the change detection analysis using GIS and remote sensing delivered useful information to understand the seasonal patterns of land use dynamics for planners and decision-makers consequently sustainable land management planning is possible.

Conclusion

A change in either however is not necessarily the product of the other. Changes in land cover by land use do not necessarily imply degradation of the land. However, many shifting land use patterns driven by a variety of social causes, result in land cover changes that affects biodiversity, water and radiation budgets, trace gas emissions and other processes that come together to affect climate and biosphere (Riebsame *et al.* 1994) [14]. The basis of using remote sensing data for change detection is that changes in land cover result in changes in radiance values which can be remotely sensed. Techniques to perform change detection with satellite imagery have become numerous as a result of increasing versatility in manipulating digital data and increasing computer power.

References

1. Achard F, Mollicone D, Stibig H J, Aksenov D, Laestadius L, Li ZengYuan *et al*. Areas of rapid forest cover change in boreal Eurasia. Forest Ecology and Management. 2006; 237(1/3):322-334.
2. Andualem TG, Belay G, Guadie A. Land use change detection using remote Sensing Technology. J Earth Sci clim change. 2018; 9(10):496.
3. Basnyet SK. Micro-level environmental management: observation on public and private responses in kankani panchayat of Kathmandu. ICIMOD, 1989, 56.
4. Brandt JS, Townsend PA. Land use-land cover conversion, regeneration and degradation in the high elevation Bolivian Andes. Landscape Ecology. 2006; 21(4):607-623.
5. Debashis C, Dutta D, Singh A, Chandrasekharan H. Satellite remote sensing approach for the health of an arid watershed in Western Rajasthan. Annals of Agricultural Research. 2004; 25(4):609-614.
6. Flint EP, Richards JF. Historical analysis of changes in land use and carbon stock of vegetation in south and Southeast Asia. Canadian Journal of Forest Research. 1991; 21(1):91-110.
7. Fox J\, Vogler JB. Land use and land cover change in Montane mainland Southeast Asia. Environmental Management. 2005; 36(3):394-403.
8. Halim A, Shahid A, Chowdhury MSH, Nahar N, Nuruddin J. Evaluation of land-use Pattern change in West Bhanugach Reserved Forest, Bangladesh, using remote sensing and GIS techniques. Journal of Forestry Research. 2008; 19(3):193-198.
9. Jain Alka, Pal J, Rai SC, Sharma E. An analysis of forest vegetation and land use change in the Khecheopalri Sacred Lake watershed in Sikkim. Indian Journal of Forestry. 2005; 28(4):339-347.
10. Jaiswal RK, Saxena R, Mukherjee S. Application of remote sensing technology for land use/land cover change analysis. Journal of the Indian Society of Remote Sensing. 1999; 27(2):123-128.
11. Mallupattu PK, Reddy JRS. Analysis of land use/ land cover changes using remote sensing data and GIS at an urban area, Tirupati, India. The Scientific World Journal. Article ID 268623, 2013.
12. Parwal MC, Dabral SL, Roy PS. Revision and updating of stock maps using remote and Geographical information

system (GIS). Proc. of ISRS, Silver Jubilee Symposium, 1994, 334-342.
13. Reddy MB. Land Cover Classification Using IRS – LISS III satellite image and digital elevation model in hilly environment – a case study in Nongkhyllem wildlife sanctuary, Meghalaya. Indian forester. 2009; 135(4):487-499.
14. Riebsame WE, Meyer WB, Turner BLII. Modeling land-use and cover as part of global environmental change. Climate Change. 1994; 28:45-46.
15. Semwal DP, Pant DN, Roy PS, Naithanil V. Land use /Land Cover Change Monitoring in Part of Jaintia Hills, Meghalaya using Remote Sensing technique. Indian Forester. 2005; 131(12):1583-1592.
16. Singh R, Sharma HC, Dwivedi RP. Analysis of landuse in Nagin watershed of Uttarakhand using GIS and Remote Sensing. Range Management and Agroforestry. 2007; 28 (2A):69-70.
17. Tewabe D, Fentahun T. Assessing land use and land cover change detection using remote sensing in the lake tana basin, northwest Ethiopia. Cogent Environmental Science. 2020; 6(1):1778998.
18. Wolter PT, Johnston CA, Niemi GJ. Land use land cover change in the U.S. GreatLakes basin 1992 to 2001. Journal of Great Lakes Research. 2006; 32(3):607-628.