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Assessment of Landuse/Landcover Using Geoinformatics: A Case Study Of Pulwama District (Kashmir) India

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ABSTRACT

Land use maps are useful tools for agricultural and natural resources studies as a base data. Due to dynamism of natural resources, updating these maps is essential. Employing traditional methods through aerial photos interpretation to produce such maps are costly and time consuming. Satellite data is suitable for such purpose, as a consequence of its fast repeatability, wide and unique view and availability of data from most part of electromagnetic spectrum. The present study is conducted to investigate the capability of IRS-P6 LISS-III data on land use mapping of Pulwama District, J&K. The studied area was 1462 km2. Image of 24th October, 2007 were registered to 1:50000 digital topographic maps. Images were enhanced using contrast enhancement and a standard False Color Composite (FCC) was developed. On-screen visual interpretation and simultaneous digitization was performed to prepare landuse/ landcover map of Pulwama District. The overall accuracy of 89% was obtained in the final maps.

KEYWORDS : Landuse, Geoinformatics.

INTRODUCTION

A modern nation, as a modern business, must have adequate information on many complex interrelated aspects of its activities in order to make decisions. Land use is only one such aspect, but knowledge about land use and land cover has become increasingly important as the Nation plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of prime agricultural lands, destruction of important wetlands, and loss of fish and wildlife habitat. Knowledge of the present distribution and area of such agricultural, recreational, and urban lands, as well as information on their changing proportions, is needed by legislators, planners, and State and local governmental officials to determine better land use policy, to project transportation and utility demand, to identify future development pressure points and areas, and to implement effective plans for regional development.

Remote sensing technology has emerged as an efficient and powerful tool in providing reliable information on various natural resources of a region in a spatial format so essential for planning (Roy et al. 1991). The use of Remote Sensing (RS) and Geographic Information System (GIS) technologies can greatly facilitate the process of collection, analysis and presentation of resource data. Repeated satellite images and/ or aerial photographs (AP) are useful for both visual assessments of natural resources dynamics occurring at a particular time and space as well as quantitative evaluation of land use/land cover changes (Awasthi et al. 2002, Balla et al. 2003, Sinha et al. 1995, Trapp and Mool 1996). Land use data are needed in the analysis of environmental problems that must be understood if living condition and standards are to be improved or retained at current level (Anderson et al. 1976). Land use is a dynamic phenomenon and both its value and pattern change spatially and temporally with varying efficiencies, priorities and needs (Bisht and Tiwari 1996). The information on landuse and landcover patterns, their spatial distribution and changes over a time scale are the prerequisite for making development plans (Dhinwa et al. 1992).

STUDY AREA

District Pulwama is centrally located in the valley of Kashmir, situated between the geographical coordinates of 33°37´ – 34°06´ N latitude and 74°33´ – 75°14´ E longitude. The district, situated 32 kms from Srinagar in south Kashmir, is surrounded in the north by Srinagar, in the west by Poonch and Budgam and in the east and south by Anantnag. The total geographical area of the district is 1462 km^2 of which 810 km^2 are under forests. The valley enjoys climatic conditions resembling sub-mediterranean type characterized by rainfall occurring throughout the year. The area supports a varied topography exhibiting altitudinal extremes of 1600m to 5000m above mean sea level. The high hill ranges are covered with forests and the dominant species are *Pinus wallichiana, Cedrus deodara, Abies pindrow and Picea smithiana.* A myriad of shrubs and herbs of medicinal value are found in the forests.

MATERIALS AND METHOD

Satellite Data

IRS (Indian Remote Sensing Satellite) - P6 LISS-III satellite data was used in the present study (Table 1 and Figure 1).

Table 1: Detail of satellite data used in the study

Data Used	Path/Row	Date of Pass	Bands
IRS-P6 LISS-III	92/46	24 Oct, 2007	4
IRS-P6 LISS-III	92/47	24 Oct, 2007	4

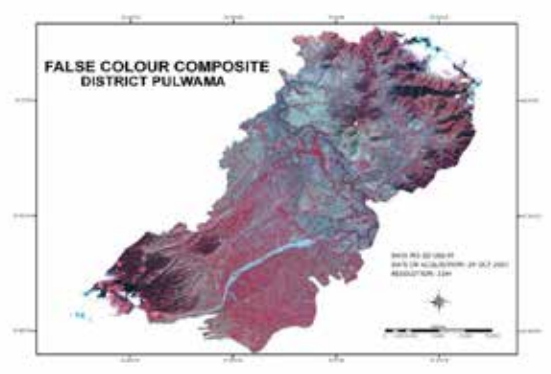

Figure 1: Standard False Color Composite of Study Area.

Ancillary Data

Toposheets: Survey of India (SOI) topographic maps of 1:50,000 scales covering entire project area were used for preparing base map. ERDAS IMAGINE 9.1, Arc/Info 9.2 software was used. Other instruments used for carrying out field work included Global Positioning System (GPS) reciever, measuring tapes, etc.

Preprocessing of satellite data

IRS-P6 LISS-III data (October, 2007) was used to prepare landuse/ landcover map on 1:50,000 scale following the standard procedures outlined in the National natural Resource Information System Manual. Average root mean square error within one pixel was maintained while georeferencing and preparing second order transformation. Lambert Conformal Conic projection (LCC) was used during rectification of image. Each rectified scene was subjected to radiometric correction before mosaicing it to a single image.

Ground truthing
Reconnaissance survey was carried out in the area to acquire knowledge of the natural and man-made landuse classes. Interpretation key was formulated and onscreen digitization was performed.

Data Interpretation
Visual and digital interpretation methods were used to prepare pre-field interpreted map. The satellite data is interpreted based on photo elements like tone, texture, size, shape, pattern, aspect, association etc. These pre-field interpreted maps and digitally enhanced satellite data are used on the ground to identify different elements of various themes.

Field Verification and Data Collection
The field data collection was aided by GPS in order to locate the ground verification points on the image and for further incorporation of details. For all the sample collection and field points visited, attribute information on vegetation, geomorphological and topographic parameters are also collected. Complete methodology is shown in Figure 2.

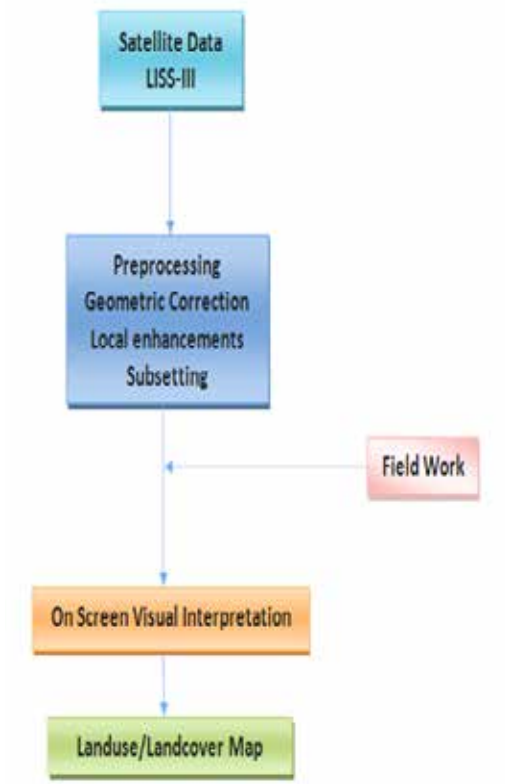

Figure 2: Flowchart showing methodology involved

Finalization of Maps
Based on the pre-field interpretation, ground truth verification and available secondary information final maps were prepared in 1: 50000 scales.

RESULTS AND DISCUSSION
The analysis of satellite data enabled identification and delineation of 18 categories of landuse/landcover classes. The classes mapped in this study are Mixed Coniferous formations, Pine forest, Dry Alpine Pastures, Moist Alpine Pastures, Moist Alpine Scrub, Open Scrub and Degraded forest. As non-forest classes, Mixed Plantations, Agricultural Land, Barren/Fallowland, Waterbodies, Almond, Apple, Saffron, Snowbound Area, Willow and Settlements. Figure 3 shows the landuse under different categories, Figure 4 shows the landuse map prepared in the GIS Environment and Table 2 represents the area in km^2 for each landuse category. District Pulwama has about 38% of its area under Agriculture and nearly 9% under horticulture comprising apple and almond plantation. Forests cover the major portion (about 43%) of the total area consisting of Mixed Coniferous Forests and Pine Forests. Alpine Pastures and Snowbound areas constitute about 7% of forest area, while as settlements are scattered over 3% of the total area of district. Willow, Waterbodies, Wetlands contribute to 5% of total area. Though the world famous Saffron grows in this district, but takes only about 2% (29.11sqkm^2) chunk of land.

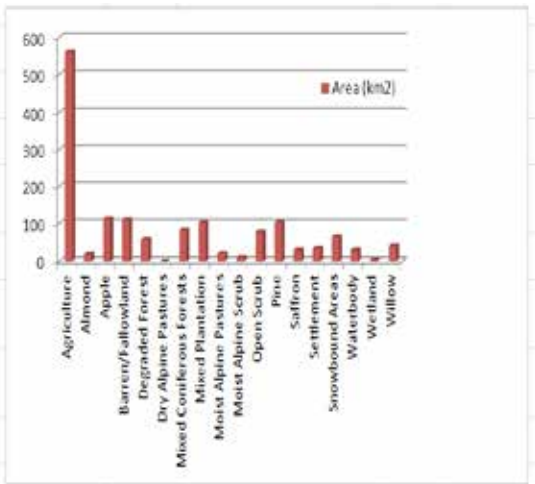

Figure 3: Bar diagram showing area under various landuse categories

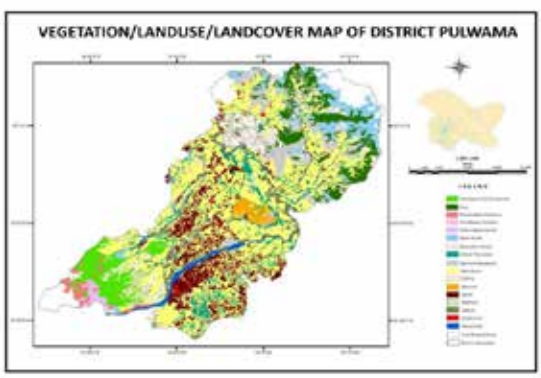

Figure 4: Landuse/Landcover Map of Pulwama District

Table 2: Area statistics of vegetation cover type map

Landcover	Area (km^2)	Percent
Agriculture	561.82	38.42
Almond	20.25	1.38
Apple	112.81	7.71
Barren/Fallowland	110.66	7.56
Degraded Forest	57.06	3.90
Dry Alpine Pastures	0.052	0.003
Mixed Coniferous Forests	82.88	5.66
Mixed Plantation	102.07	6.98
Moist Alpine Pastures	21.88	1.49
Moist Alpine Scrub	11.06	0.75
Open Scrub	77.76	5.31
Pine	103.21	7.05
Saffron	29.11	1.99
Settlement	33.06	2.26
Snowbound Areas	64.23	4.39
Waterbody	29.48	2.01

Landcover	Area (km^2)	Percent
Wetland	4.08	0.27
Willow	40.53	2.77
Total	1462	100

Kappa analysis for accuracy assessment using GPS points for landuse classes' points and field knowledge yielded the value of 0.8935 which can be thought of as an indication that an observed mapping accuracy is 89% better than resulting from chance.

CONCLUSION

The spatial layers generated in GIS environment will have far reaching implications on planning process in urban as well as rural areas. The action plans, reports, etc. can be created using the Geodatabase and total decision support system can be developed to depict location and type of action/control measures. Land use and Land cover plan can be incorporated using statistics of the Personal Geodatabase of the respective Theme to suggest a suitable action plan for sustainable development of land and water after scientific analysis of the spatial and non-spatial data.

The action plans are basically recommendations towards improved soil and water conservation for ensuring enhanced productivity, while maintaining ecological/environmental integrity of the area/region. The action plans, to illustrate, address identification of sites/areas for surface water harvesting, groundwater recharge, soil conservation measures – through check dams, vegetation bunding; sites for improved farming systems with fodder, fuel wood plantations, agroforestry, agro-horticulture, etc. These action plans can then be presented to the people for sensitizing them to get involved and to integrate their planning with reflections of their aspirations and with a convergence approach for Panchayats and Local Bodies to take decisions.

REFERENCES

Anderson, J.R., Hardy, E.E., Raoch, J.T. and Wirmer, R.E. 1976. A Land Use Land Cover Classification System for Use with Remote Sensing Data. US Geological Survey, Reston, VA. 28 pages. | | Awasthi, K.D. 2002. Land Use Change Effects on Soil Degradation, Carbon and Nutrient Stocks and Green- house Gas Emission in Mountain Watersheds. Ph.D. thesis, Agricultural University, Oslo, Norway. 35 pages. | | Balla, M.K., Awasthi, K.D., Shrestha, P.K. Sherchan, D.P. 2003. Land use changes in two subwatersheds in Chitwan and Tanahun districts, West Nepal. Nepal Journal of Science and Technology 5: 49-56. | | Bisht, B.S. and Tiwari, P.C. 1996. Land-use planning for sustainable resource development in Kumaun, Lesser Himalaya: A study of the Gomti watershed. Inter- national Journal of Sustainable Development and World Ecology. 3:23-34. | | Dhinwa. P.S. Pathan. S.K., Sastry, S.V.S., Rao Mukand. 1992. Land-use change analysis of Bharatpur district using GIS. Journal of the Indian Society of Remote Sensing 4: 237-250. | | Kachhwaha, T.S. 1985. Temporal monitoring of forest land for change detection and forest cover mapping through satellite remote sensing. Proceedings, Sixth Asian Conference on Remote Sensing, Hyderabad: 77-83. | | Khorram, S. and John, A.B. 1991. A regional assessment of land use / land covers types in Sicily with landsat TM data. International Journal of Remote Sensing 1:69-78. | | Luong, P.T. 1993. The detection of land-use/land-cover changes using remote sensing and GIS in Vietnam. Asian Pacific Remote Sensing Journal 2: 63-66. | | NRIS Action Plan, NNRMS publication, Jun 1995. | | Roy, P.S, Ranganath, B.K., Diwakar, P.G.,Vohra, T.P.S,, Bhan, S.K., Singh, I.J. and Pandian, V.C. 1991. Tropical forest type mapping and monitoring using remote sensing. International Journal of Remote Sensing 11: 2205-2225. | | Sabins, F.F., 1996, Remote sensing: principal and interpretation 3rd Ed., W.H. Freman and Company, New York.,494pp. | | Sharma, K.D., Singh, Surendra Singh Nepal and Bohra. D.N. 1989. Satellite remote sensing for detecting temporal changes in the grazing lands. Joural of the Indian Society of Remote Sensing, 4: 55-59. | | Sinha, T.K., Tripathi, D.N. and Singh, R.S. 1995. Study of land use change of head water region in Dun Valley by remote sensing. Pages 253-263, In: Singh, R.B. and Haigh, M.J. (Editors) Sustainable Reconstruction of Highland and Headwater Regions, Proceedings of Third International Symposium on Headwater Control, New Delhi, October 6-8, 1995. Oxford and IBH Publishing, New Delhi. | | Trapp, H. and Mool, P. 1996. Lamjung District Information System for Local Planning and Asssessment of Natural Resources using GIS and Remote Sensing Technology. MENRIS Case Study Series No. 4, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu. 228 pages. | | Whyte, R.O. 1961. Evaluation of land-use in south western Asia. Pages 12-16, In: Stamp. L.D. (Editor) A History of Land-use in Arid Regions. UNESCO, Paris | | Wilkie, D.S., Finn. J.T., (1996), "Remote Sensing Imageries for Natural Resources Monitoring", New York: Columbia University Press. |