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RESEARCH ARTICLE

MONITORING CHANGES IN LAND USE/ LAND COVER USING MULTI TEMPORAL/SENSOR SATELLITE DATA(A CASE STUDY IN PALANI)

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ABSTRACT

The present investigation revealed that the various land use and land cover classes delineated include built-up, agriculture, sand, water, scrub and open/ barren land of Palani Town by using multi-sensor satellite data and to monitor the changes in various land use/ land cover classes using digital remote sensing techniques.. The spatial coverage of each class may be visualized on both maps. The area of each class for the year 2006 and 2011 data has been compiled.Land use/ land cover change monitoring of the study area were done through Landsat ETM and IRS-LISS-III digital Data of the year 2006 and 2011 respectively. The Anderson's multilevel classification system has been adopted. Image processing software and its GIS analysis capabilities have been used for the preparation of multi-date land use/ land cover maps and to monitor the change pattern. The SOI topographical map 63-G was georeferenced for registration, 9 well-distributed Ground Control Points (GCPs) at the intersection of latitude-longitude lines have been selected. The second order polynomial transformation with nearest neighborhood resampling technique has been. Process of image-to-image registration is then adopted for the registration of satellite imagery on already registered SOI topographical map. The land use/ land cover map of year 2006, depicts that built up area constitutes 17.2% of total area, while the agriculture classes like Crop land, Fallow and Plantation covers 70.0% the study area. Water bodies and Barren land covers 10% and 2% of area respectively. In year 2011, the built up area obtained from digital image processing techniques has been 25.7% of the total area. The agriculture covers an area of 61.6%, which shows a decrease in agriculture land. The water bodies covers 10.0% and barren area covers 2% of the study area. The increase in the area under built up lands may lead to a lot of environmental and ecological problems. The study was successfully able to detect vegetation change and concluded that the area of the urban has increased whereas the area of crop land and plantation has been decreased within the period 2006-2010. To sum up it could be stated that Palani Taluk is one of the biodiversity zones of the country is under the threat of environmental and ecological problems due to improper management.

INTRODUCTION

Ensuring sustainable development, it is necessary to monitor the changes in land use/ land cover pattern. Human communities cannot exist in isolation, economically, socially or physically. They have to be inter-dependent for the mutual satisfaction of their requirement and also for meeting their basic needs. For meeting their basic needs, they are also dependent on the nature specially the immediate environment. Flux of population in urban territories due to migration from rural areas coupled with rapid growth in population has disturbed the ecological balance. This process hampers the socio economic sustainable development of any region. Expansion of suburban territory with encroachment in prime land is a matter of concern for all and in particular for the authorities associated with the urban planning and development.

Any planning requires spatial distribution of land use/ land cover information and its changes, the local, regional and national level land use/land cover mapping important for management and monitoring programmes to understand land utilization aspects. Planning means the assessment of future and making provisions for it. Urban planning and development is a continuous process and involves planners, administrators, developers, investors and of course, the residents. In order to achieve sustainable urban planning and to check haphazard development, it is necessary that authorities associated with the

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urban development generate such planning models so that every bit of the available land is used in most rational and optimal way. This requires the present and past land use/ land cover information of the area and pattern of changes with respect to urban settlements and other local resources (Chaurasia, *et. al*, 1996).

Remote Sensing Based Change Analysis

There are several urban applications where satellite based remotely sensed data are being applied, namely, urban sprawl/ urban growth trends, mapping and monitoring land use/ land cover, urban change detection and updation, urban utility and infrastructure planning, urban land use zoning, urban environment and impact assessment, urban hydrology, urban management and modeling (Raghavswamy, 1994). Remote sensing technology and geographic information system (GIS) provide efficient methods for analysis of land use issues and tools for land use planning and modeling. By understanding the driving forces of land use development in the past, managing the current situation with modern GIS tools, and modeling the future, one is able to develop plans for multiple uses of natural resources and nature conservation. The change in any form of land use is largely related either with the external forces and the pressure built-up within the system (Bisht and Kothyari, 2001; Thomas *et al*., 2014; Ward *et al.*, 2014).

Remote sensing techniques offer benefits in the field of land use/ land cover mapping and their change analysis. One of the major advantages of remote sensing systems is their capability for repetitive coverage, which is necessary for change detection studies at global and regional scales.

Detection of changes in the land use/ land cover involves use of at least two period data sets (Jenson, 1986). The changes in land use/ land cover due to natural and human activities can be observed using current and archived remotely sensed data (Luong, 1993). Land use/ land cover change is critically linked to natural and human influences on environment. With the availability of multi-sensor satellite data at very high spatial, spectral and temporal resolutions, it is now possible to prepare up-to-date and accurate land use/ land cover map in less time, at lower cost and with better accuracy (Kachhwaha, 1985).

Keeping the above in view, the present work has been undertaken to prepare the multi-date land use/ land cover maps of Palani Town from multi-sensor satellite data and to monitor the changes in various land use/ land cover classes using digital remote sensing techniques.

Study Area and Data Sets

Palani is a city/municipality in the Dindigul district of the South Indian state of Tamil Nadu. Palani is pronounced using the special 'L' used in Tamil and is also spelt as "Pazhani" in English. It is located about 60 km from the city of Dindigul. It is a famous pilgrimage town and every year more than 7 million devotees visit the Palani Murugan Temple and offer their prayers to the Lord Muruga. This temple draws the largest number of devotees in Tamil Nadu. The study area is bounded between the latitudes 10°29'N to 10°25'N and longitudes 77°28'E to 77°34'E.

Figure 1 Study area.

Geography

The town is formed in the slopes of an offshoot of the Western Ghats, the Palani Hills, whereon lies the esteemed hill-station of Kodaikanal. The ranges extending east-west, to the south of the town, frame the town presenting a most inimitable sight. The view within the town is dominated by the two hills, Sivagiri and Sakthigiri. At the foot of the hills lie several lakes, the largest of which, the Vaiyyapuriyan Kulam, used, in days past, to serve as the primary water reservoir to the inhabitants of the town. At its greatest expanse during and immediately after the monsoons rains, the lake drains to the Shanmughanadi, a short distance from the town. Though shrunken in expanse due to encroachments and overgrown with weeds, the lake still remains an extensive water sheet during the rainy season.

The Shanmughanadi, a tributary of the Amaravathi River, takes its source on the slopes of the Palani Hills and runs not very far from the town. On this river, a few short kilometres from the suburbs, in the lower reaches of the Palani Hills, is built the Varadhaman Nadi Dam, which supplies the town with its supply of fresh water. Although Palani lies in a geologically stable area, construction of a dam at Idukki, in neighbouring Kerala State, has been known to cause tremors occasionally.

Demographics

As of 2001 India census, Palani had a population of 67,175. Males constitute 51% of the population and females 49%. Palani has an average literacy rate of 75%, higher than the national average of 59.5%: male literacy is 81%, and female literacy is 69%. In Palani, 10% of the population is under 6 years of age.

Data Used

Land use/ land cover change monitoring of the study area were done through Landsat ETM and IRS-LISS-III digital Data of the year 2006 and 2011 respectively. Landsat ETM and data was downloaded from available sources, whereas LISS-III procured from National Remote Sensing Centre (NRSC).

METHODOLOGY

The overall methodology adopted for the preparation of land use/ land cover map and change analysis is shown with the help of a flow chart in Figure 1. Digital image processing techniques

have been used for preparation of land use/ land cover maps from the multi-date, multi-sensor satellite data. The Anderson's multilevel classification system has been adopted (Anderson, *et. al.*, 1976). Image processing software and its GIS analysis capabilities have been used for the preparation of multi-date land use/ land cover maps and to monitor the change pattern.

Study Area Image Extraction

The SOI topographical map 63-G was georeferenced for registration, 9 well-distributed Ground Control Points (GCPs) at the intersection of latitude-longitude lines have been selected. The second order polynomial transformation with nearest neighborhood resampling technique has been. Process of image-to-image registration is then adopted for the registration of satellite imagery on already registered SOI topographical map.

The multispectral classification was carried out using supervised classification techniques with maximum likelihood classifier. The overall accuracy of the classification is finally obtained through the computation of confusion matrix to assess the reliability of the prepared maps.

ANALYSIS OF RESULTS

The land use/ land cover maps prepared using the methodology described above have been shown in Figure 2 (LISS-III data of 2006) and Figure 3 (LISS-III data of 2011). The various land use and land cover classes delineated include built-up, agriculture, sand, water, scrub and open/ barren land. The spatial coverage of each class may be visualized on both maps. The area of each class for the year 2006 and 2011 data has been compiled in Table 1.

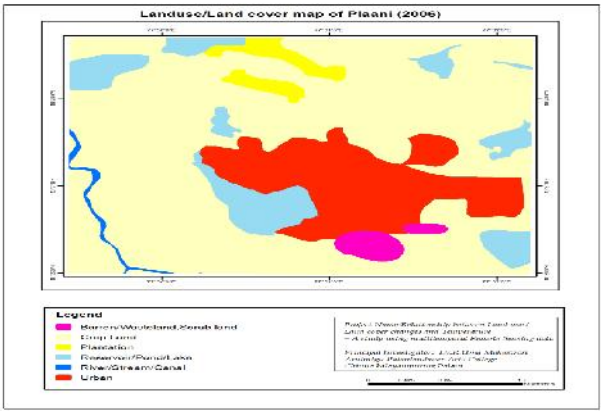


Figure 2 Landuse/Landcover map of Palani in 2006

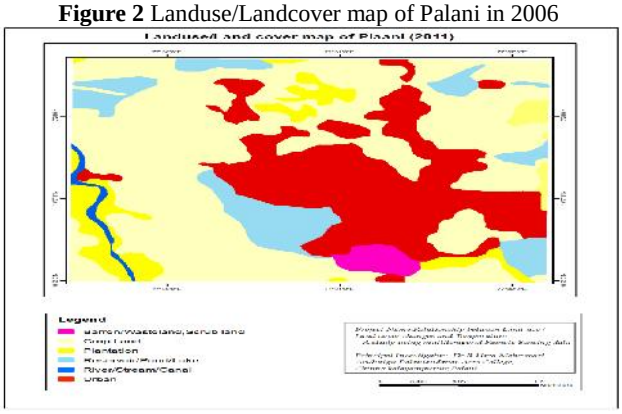
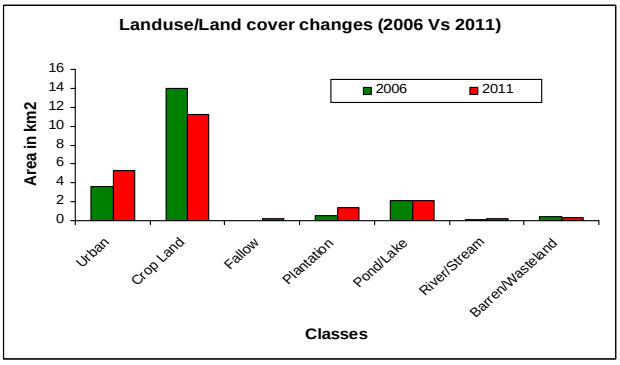


Figure 3 Landuse/Landcover map of Palani in 2011

Table 1 Landuse/Land Cover Changes between 2006 and 2011

2006 2011	Urban	Crop Land	Fallow	Plantation	Pond/ Lake	River/ Stream	Barren/ Wasteland	Total
Urban	3.35	1.82	0	0.03	0.05	0	0.09	5.34
Crop Land	0.06	10.42		0.25	0.38	0.01	0.06	11.18
Fallow	0	0.24		0	0	0	0	0.24
Plantation	0	1.03		0.24	0.01	0.06	0	1.34
Pond/Lake	0.15	0.26		0.05	1.63	0	0	2.09
River/ Stream	0	0.10		0	0	0.07	0	0.17
Barren/ Wasteland	0	0.13	0	0	0	0	0.24	0.37
Total	3.56	14.0	0	0.57	2.07	0.14	0.39	20.73



The land use/ land cover map of year 2006, depicts that built up area constitutes 17.2% of total area, while the agriculture classes like Crop land, Fallow and Plantation covers 70.0% the study area. Water bodies and Barren land covers 10% and 2% of area respectively. In year 2011, the built up area obtained from digital image processing techniques has been 25.7% of the total area. The agriculture cover an area of 61.6%, which shows an decrease in agriculture land. The water bodies covers 10.0% and barren area covers 2% of the study area.

CONCLUSIONS

Information from satellite remote sensing can play a useful role in understanding the nature of changes in land cover/use, where they are occurring, and projecting possible or likely future changes. Such information is essential to planning for development and preserving our natural resources and environment, and is needed by urban planners and citizens. Satellite remote sensing approaches provide a cost-effective alternative when more information is needed, but budgets are declining. Our continuing work includes adding satellite imagery from other acquisition times, before and after the dates reported here, and classifications to the temporal series. The purpose of this study was to detect vegetation change using supervised and unsupervised change detection approaches. Future work with more satellite images and ground truth data may help to map the land cover changes with maximum level of accuracy. Palani is a famous pilgrimage in south India the major source of income is through tourism. The major land use

in Palani Taluk is forests. But the land under forest cover has experienced a declining trend in the past five years. Here forest land converted to Agricultural land, Built up, and Harvested land due to this changes we loss our natural ecosystem and biodiversity also. The increase in agricultural land is a welcoming trend. But empirical observation reveals that due to increase in cost of cultivation, problems due to shortage of labor, supply of low quality adulterated fertilizers and price fluctuation in the market the farmers prefer to sell their land to property promoters. Hence there is a risk of decline in the extent of land under agriculture in the near future. The increase in the area under built up lands may lead to a lot of environmental and ecological problems. The study was successfully able to detect vegetation change and concluded that the area of the urban has increased whereas the area of crop land and plantation has been decreased within the period 2006-2010. To sum up it could be stated that Palani Taluk is one of the biodiversity zones of the country is under the threat of environmental and ecological problems due to improper management.

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