Change detection in Land use/Land cover using Remote Sensing In Palakkad district: A Case Study

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Abstract:

Information on land use/land cover in the form of maps and statistical data plays an important role in development planning, management and effective utilization of land. In this paper we make use of Remote Sensing, GIS and Image processing to study land use/land cover. Change in Land use influences many natural phenomena and conservation processes which include processes like runoff, soil erosion and sedimentation and soil conditions. The changes are due to human and development activities along with changes in natural conditions. Present study is to detect land use changes between 2001 to 2010 using Landsat satellite images (ETM+). The objective of the study is to see the land use/land cover changes in Palakkad district and also to study the relationship between population growth and its impacts. Palakkad is situated in the South West Coast of India and with a total area of about 4480 sq.km representing 11.53 per cent of the State's geographical area. Palakkad is popularly called as “Rice bowl” of Kerala. Palakkad is bordered by Malappuram, Thrissur and Coimbatore districts. Its large expanse of paddy fields helps it to be the leading producer of rice in the state. However over the years due to a rapid rise in industrialization and constructions there is a remarkable decrease in the area under paddy cultivation apart from changes to the already existing land-use land cover pattern.

Key words: Land use/land cover, supervised classification, Change detection, GIS, Image Processing software

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Introduction

Land-use and land-cover change **(**LULCC**)** is a general term for the human modification of Earth's terrestrial surface. The land cover is what covers the surface of the earth and land use describes how the land is used. The land cover of the Earth has a central role in many important biophysical and socioeconomic processes of global environmental change. Contemporary land cover is changed typically due to human use therefore, knowledge of land-use pattern variation is essential in understanding land-cover change. Remote sensing (RS) data have been one of the most important data sources for studies of spatial and temporal changes. Actually, multi-temporal remote sensing data, suitably dealt with and elaborated, allow mapping and identifying landscape changes, providing a real effort to ecological landscape planning and management (Dewan et al., 2009). Advances in remote sensing technology enable land scientists to identify on-going land cover change processes and their locations (Herold *et al.*, 2006). Meanwhile, one of the main challenges of this technology is to ensure that a change is not a result of short-term variations in land cover (Lunetta *et al*., 2006, Lambin *et al.,* 2003). Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh, 1989). Land use and land cover change helps in strategic planning and management of natural resources and monitoring environmental changes. The systematic assessments of Earth's land cover must be reiterated, at a frequency that allows monitoring of both long-term trends as well as inter annual variability, and at a level of spatial detail to allow the study of human-induced changes.

Land cover mapping is a product of the development of remote sensing, initially through aerial photography. Change detection is the process of identifying difference in the state of an object or phenomenon by observing it at different time (P. K. Yadav, 2012). Change detection in Land use/cover can be performed on temporal scale such as decades to assess landscape changes caused due to anthropogenic activities on the land (Gibson and Power, 2000). These anthropogenic activities are due to rapid growth of human population and demands of food resources.

Remote sensing technology, because of the benefits it offers (wide area coverage, frequent revisits, multispectral, multisource, and storage in digital format to facilitate subsequent updating and compatibility with GIS technology) proved very practical and economical means for an accurate classification of land cover. In the present study, land use land cover mapping and change detection has been done for Palakkad district.

Study area

The study area is Palakkad district in Kerala, which is the leading producer of paddy in the state, and hence rightly known as "Rice Bowl of Kerala" and "The Granary of Kerala". Its latitude is 10°46'21"N and longitude is 76°39'5"E. The average rainfall is about 211 cm and is good for cultivation. The district administration is split into five Taluks and 163 villages and also four Municipal towns and Ninety one Panchayaths in the district. There are 13 Community Development Blocks for the real enactment of various developmental activities. The district is gifted by nature by way of a number of rivers, Bharathapuzha and its tributaries. Two tributaries of Cauvery are also flowing through Attapady hills in the district- Bhavani and Siruvani. The land is well irrigated by a

number of dams like Malampuzha, Parambikulam, Thunakadavu, Peruvanipallam, Mangalam, Pothundy, Moolathara, Meenkara, Chulliyan, Walayar and Kanjirapuzha.

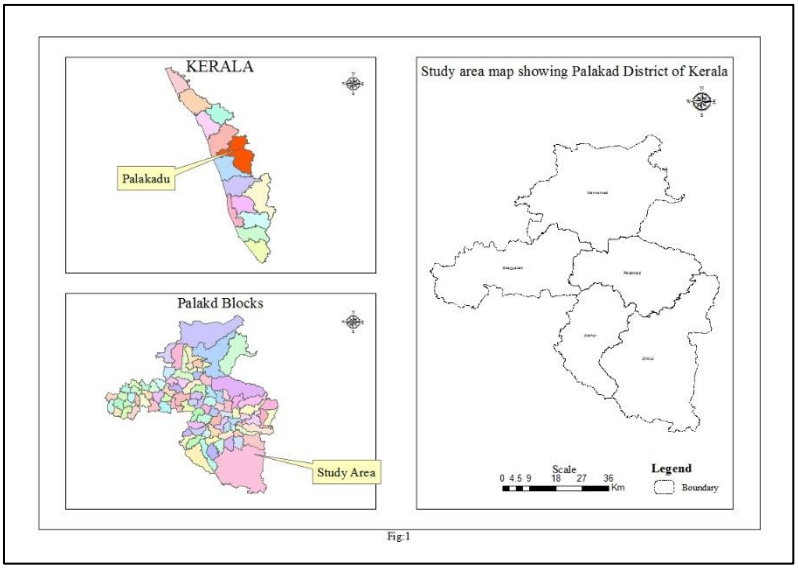


Fig 1: Study area

Methodology

The satellite data sets of Palakkad IRS-R2 LISS-III of the year 2010 and Landsat ETM of year 2001 were corrected in Image Processing software by Geo-referencing the data using already corrected SOI topo maps of the specific area by giving latitude and longitude values. After this the data were opened in ArcGIS 10 and by visual elucidation the classes were identified and they were digitized as shape files to create a detailed land use/land cover map for both the digital data sets of the study area.

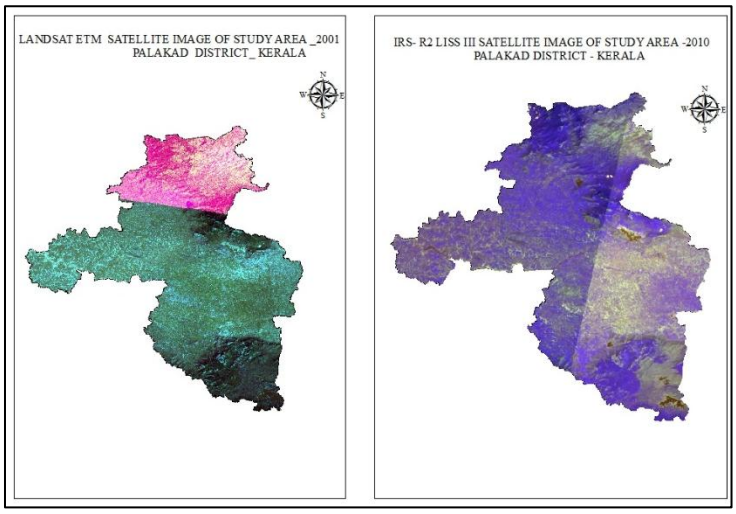


Fig 2: Satellite images

Results and Discussions

Remote Sensing technology has a varied number of applications of which change detection is of great importance. This helps us in identifying the changes in different features within a particular interval of time. GIS is one such technology that plays an important role in land use change detection. According to Burrough (1986) GIS can be defined as "a set of tools for collecting, storing, retrieving at will transforming and displaying spatial data from the real world for particular set of purposes".

Once the detailed land use/land cover statistics is obtained, change detection analysis can be done by means of the two data sets to observe the ebb and flow that have taken place over the years 2000 and 2010. A meticulous and detailed characteristic data of the feature classes that has changed between the two data sets is provided in the Tables 1 and 2. Table-1 shows the broad classification of land use pattern whereas Table-2 gives the area under cultivation of individual items.

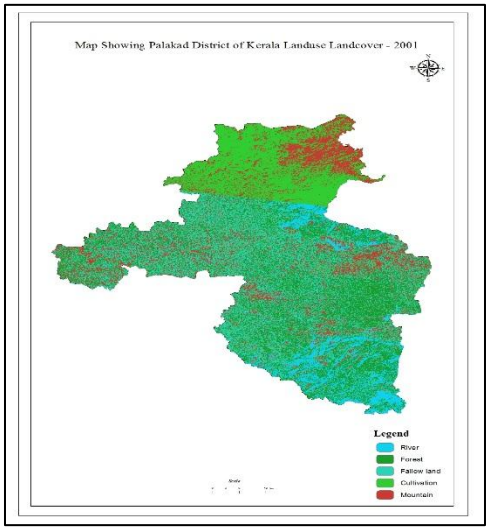


Fig 3: Land Use pattern in 2001

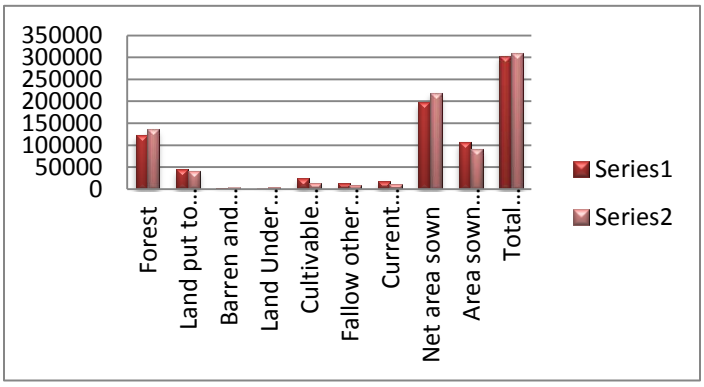


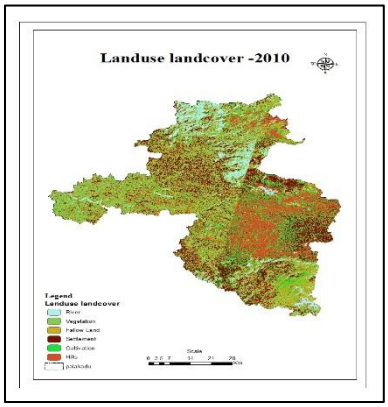
Fig- 4: Comparison of Land Use pattern in 2001and 2010

From tables 1 and 2 we can infer that forest area in the district reduced drastically from 136287 hectares in 2001 to 122397 hectares in 2010 (10.17%). Other major reductions in the land area are in respect of net area sown (from 218336 to 196818-9.85%), paddy cultivation (from 107467 to 96190-10.49%) and vegetable cultivation (from 22224 to 7747). These differences can also be inferred from the classified images.

On the other hand, major items which showed an increase in land area during the same period are land put to non-agricultural use, cultivable waste and fallow lands in table-1 and plantation crops, including rubber, tea, coffee and coconut, arecanut, fruits cultivation etc. in Table-2. By definition, land put to non-agricultural use and fallow lands include in a category of cultivable land, previously under cultivation and now left uncultivated for one or the other reasons. Taken together the land under this category registered a phenomenal increase of 59% from 33914 Ha to 53918 Ha during the period under study. This is indicative of a major shift in the land use pattern in this district.

The following factors require special mention in analyzing the reasons for the shift in land use pattern in this district.

Paddy cultivation which engaged a major portion of the land cultivated and labour utilized, became unremunerative over the years due to increased cost of inputs like labour, fertilizer etc. and resulted in the low price of output, in spite of governmental subsidies on inputs and support prices offered for the output. Even if better yields are ensured through advanced scientific cultivation practices, the income generated is not sufficient to maintain households, as the land Holdings in the hands of each of them, are small in size, thanks to the Land Reform Acts enacted in Kerala during sixties and seventies. Small holdings further restrict the scope for introducing advanced techniques of farming, which requires huge investments. Cooperative societies have helped to overcome the problem of small land holdings to some extent. Adding to the agriculturist's woes, is the scarcity of labour for farming activities as they turn to better pastures in other sectors of employment, where there are good opportunities due to overall economic development and diversification of activities.



Fi 5: Land use pattern in 2010

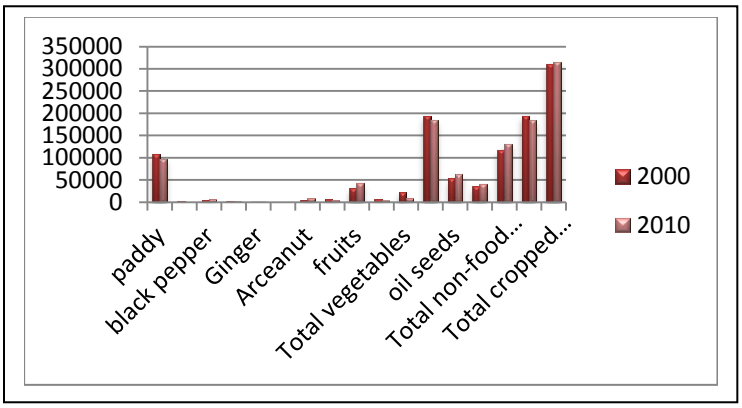


Fig 6: Comparison of land use pattern in 2001 and 2010

It is quite natural that the agriculturist's shift their land use to more income generating varieties or keep the land uncultivated and seek employment in other sectors.

Due to unscientific ways of waste disposal, pollution level is increasing on a daily basis. During 2001 the population of Palakkad was around 8.22% of the total states population, while in 2011 this increased to about 8.41%. This increase in population led to over exploitation of the natural resources, mainly water resources. The climate in the district changed from 38°C to 42°C over the past decade due to global warming which also in a way influence the land use pattern in the district. The water bodies are also drying up fast due to change in climatic conditions.

Table: 1
Land use pattern classification

LAND USE TYPE	Area in Hectares (2000)	Area in Hectares (2010)	CHANGE in area in hectares
Total geographical area	447548	447548	-
Forest	136257	122397	-13860

Land put to non-agricultural use	41410	43704	2294
Barren and Uncultivable land	3037	2756	-281
Land Under miscellaneous tree crops	3660	1023	-2637
Cultivable Waste	13602	24033	10431
Fallow other than Current Fallow	9326	12837	3511
Current Fallow	10986	17048	6062
Net area sown	218336	196818	-21518
Area sown more than once	91701	106643	14942
Total cropped area	310037	303461	-6576

Source: *Department of Economics and Statistics*

Table: 2
Detailed land use pattern change detection

Name Of Crop Utilization	2000	2010	Change
Paddy : Autumn	45915	45659	-256
Winter	55730	42388	-13342
Summer	5822	8143	2321
	107467	96190	-11277
Sugarcane	2653	772	-1881
black pepper	4733	5661	928
Pulses	2704	1982	-722
Ginger	940	1044	104
Turmeric	598	528	-70
Arceanut	3767	8195	4428
Tamarind	6014	4449	-1565
Fresh fruits: Jackfruit	4812	5860	1048
Mango	7905	8479	574
Banana	4612	11517	6905
Other plantains	4966	10819	5853
Pineapple	99	102	3
Papaya	1006	1412	406
	24440	39373	14933
Dry fruits: Cashewnuts	5998	3740	-2258
	30438	43113	12765
Tuber crops: Tapioca	6815	3200	-3615
Total vegetables	22224	7747	-14477
Total food crops	193647	183742	-9905
Oil seeds: Groundnut	7019	1733	-5286
Coconut	45439	59076	13637
Others	844	677	-167
	53302	61486	8184

Plantation crops: Rubber	28550	34840	6290
Tea	829	852	23
Coffee	4650	4150	-500
Cocoa	32	156	124
	34061	40498	6437
Total non-food crops	116390	130945	14555
Food crops	193647	183742	-9905
Total cropped area	310037	314687	4650

Source: *Department of Economics and Statistics*

Conclusion

The study helps in evaluating the land use land cover changes in the district of Palakkad. The study indicates the Impact of Globalization and urbanization in the region. The study was carried out with the help of satellite images over a decade's time. The study clearly indicates the decrease in agricultural area as well as cultivable land. It also points towards the increase in the urban settlements and road network.

The pattern of change in land use/land cover in this area detected over a 10 years period may be made more accurate by reducing the year gap, i.e., introducing an intermediate year like 2005 between 2000 and 2010, and it also helps in predicting the future of the land use pattern. The results which we obtained from the above studies helps in future planning of urbanization, infrastructure development etc. duly considering natural resources and keeping the balance intact.

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