Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 5, Issue, 09, pp.2515-2519, September, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

DYNAMICS OF LAND-USE AND LAND-COVER CHANGES AND ITS IMPACTS ON WETLANDS OF RAMANATHAPURAM DISTRICT, TAMIL NADU – REMOTE SENSING AND GIS PERSPECTIVE

[1,*]Sarojini Devi, B., [2]Vijayasekaran, D., [1]Rajiv Das Kangabam, [1]Selvaraj, M. and [1]Govindaraju, M.

[1]Department of Environmental Biotechnology, School of Environmental Sciences, Bharathidasan University, Tiruchirappalli-620024

[2]Institute of Remote sensing, Anna University, Chennai-600025

ARTICLE INFO

Article History:
Received 08th July, 2013
Received in revised form
10th July, 2013
Accepted 25th August, 2013
Published online 14th September, 2013

Key words:
Wetland,
Land use/Land cover,
Spatial Distribution,
Environmental Factors,
Remote sensing,
GIS.

ABSTRACT

Wetland is one of the most important ecosystems and plays an important role in environmental stabilization and species conservation. It comprises only six per cent of the Earth's land surface. This habitat response to climate change and suggestion for restoration will be realized differently on a regional scale. The major objectives of this study are to monitor and assess the spatial and temporal changes in land use / land cover during the period of 1988,1999 and 2010 by using Geographical Information System (GIS) and to conclude the main environmental factors disturbing these changes. The results from this study identified that the key wetland types are lake/pond (316091 ha), tank/pond (237613 ha), river/stream (136878 ha), and reservoir/barrage (56419 ha). Area under mangrove is about 7315 ha. Coral Reef (3899 ha) exists largely in Ramanathapuram district. In this paper, we used remote sensing data to recover the wetland landscape spatial pattern and its 30 years historical development in Ramanathapuram District. Land Use-Land Cover Changes in the study area has decreased wetland ecosystem.

INTRODUCTION

Wetlands are the ecotone or transitional zones between permanently aquatic and dry terrestrial ecosystems. Changes in wetland landscape structure speed and amount are immediately affected by human activities. Wetlands in India occupy 58.2 million hectares area under wet paddy cultivation (Directory of Indian Wetlands). Climate change is known as a major part of the threat to the survival of species and reliability of ecosystems worldwide. It will affect the hydrology of individual wetland ecosystem mostly through changes in precipitation and temperature regimes with significant global variability.Urbanization is a significant symbol of development in science and technology and human's better capability to enhance the natural environment. India is subjected to rapid urbanization in the current decades. However, a wetland ecosystem is often spatially worried during urbanization because many wetlands have been rehabilitated into other types of land use as a result of urban extension (Bendor 2009). Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh 1989). The basic premise in using remotely sensed data for change detection is that changes in the objects of interest will result in changes in reflectance values or local texture that are separable from changes caused by other factors such as differences in atmospheric conditions, illumination and viewing angles, and soil moistures. Land-use/land-cover (LULC) change is an important field in global environmental change research. Inventory and monitoring of LULC changes are an essential aspect for more accepting of change mechanism and modelling the impact of change on the environment and associated ecosystems at different scales (William *et al.* 1994). Earth observation data along with advancing geospatial technologies have supported the inventory, assessments and monitoring approach for natural resources system including wetlands worldwide (Davidson 2007). Recently remote sensing is widely used for observing changes and dynamics in land use and land cover observation and land cover dynamics. It provides a variety of advantages in LULC study and a path to assess unreachable locations such as very steep mountains to identify upto date changes. GIS is a technology for creating, storing, analyzing and managing spatial and temporal data associated with their attributes (Longley 2005).

***Corresponding author:** Sarojini Devi, Department of Environmental Biotechnology, School of Environmental Sciences, Bharathidasan University, Tiruchirappalli-620024*

Study Area

Ramanathapuram taluk is located in Ramanathapuram District, which is the south eastern coastal part of Tamilnadu. It lies between the latitude of 9˚20' and 9˚30' longitude 78˚45' and 78˚55' (Fig.1). It covers an area of about 4207.38 Sq.Km. It receives an annual average rainfall 889mm. The economy of

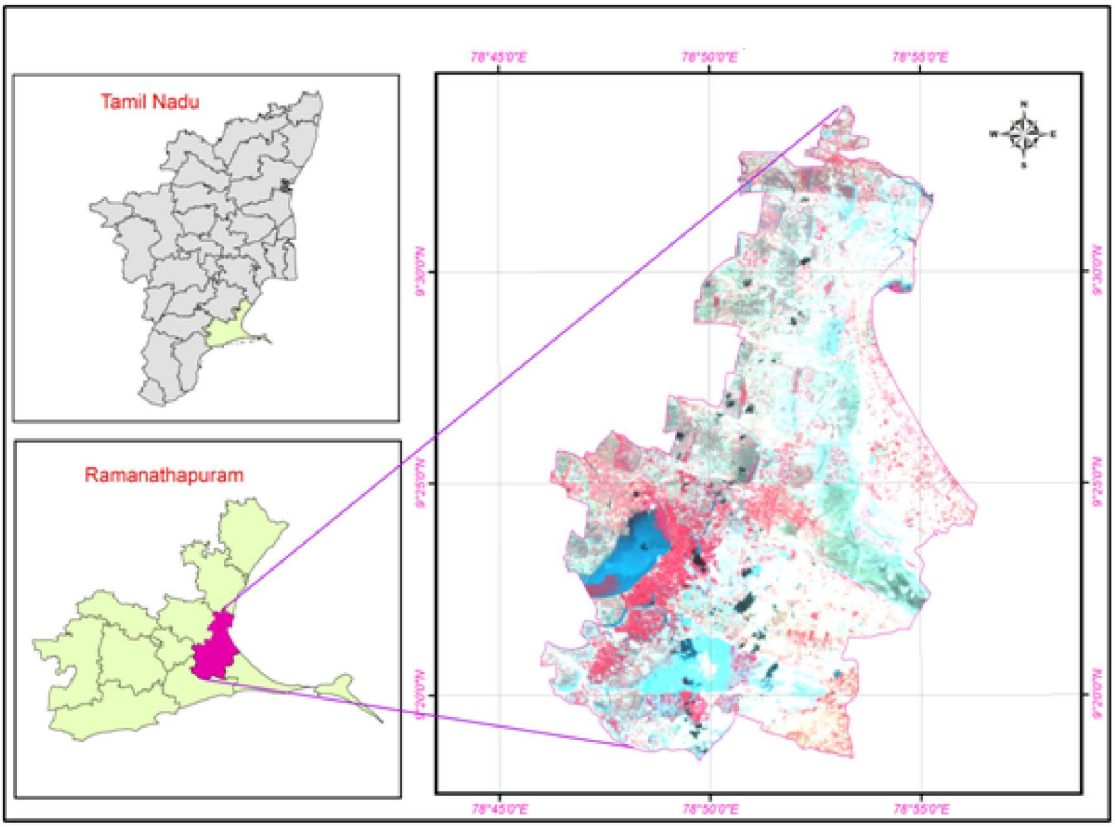

Fig. 1 Study area

the district is predominantly dependant on agriculture and fishing. The sea coast which is nearly one fourth of the total length of coastal line (261km) of the state also plays an important part in economic development. It had been proposed by the state government to develop a marine park with water sports for the attraction of tourists for improving the economic status of the district.

MATERIALS AND METHODS

Land Use/ Land Cover Mapping

Satellite images of LANDSAT 1988, 1999 and 2010 were used for this analysis. Land use maps were prepared by Atmospheric correction restoration/resizing image geo referencing. All the data layers were georeferanced to the Universal Transverse Mercator (UTM) coordinate system (Chunyang He *et al*., 2011). Conventional classification system deals with Land Use/ Land Cover which identify the change in wetlands and agricultural lands (Dieter Muller Dombois 1974; Murica 1995; Navalgund 2007; Nobi 2009). The land use/ land cover features were classified into agricultural lands, wetlands, scrub lands, wastelands, water bodies, industries, and settlement. Visual image interpretation used to identify the features using the interpretation elements like shape, size, pattern, texture, shadow, association, etc., (Thomas M. Lillesand *et al*., 2007). Even though the visual image interpretation provides better mapping accuracy, supervised and unsupervised classification algorithm has been developed to classify the satellite images.

Accuracy Assessment

An equalized stratified random sampling approach was used for the present study to assess the accuracy of each land use / land cover classification. The overall accuracy and Kappa analysis were used to perform classification accuracy assessment using random point tools. Kappa analysis is a discrete multivariate technique used for accuracy assessment (John R. Jensen 2007). A number of 40 points from each class were randomly selected. The selected points were verified on the LULC classified map generated. The accuracy of the map was assessed by comparing the thematic map with ground observation points.

RESULTS AND DISCUSSION

The current scientific technology of remote sensing and visual image interpretation is extremely useful in periodic assessment of the land use land cover changes and to analyze them to formulate the better management. Land use/ land cover mapping serves as a basic inventory of land resources for all levels of government environmental agencies and private industries throughout the world (Shuck 2003). The classification was done under the following heads industrial, agriculture land, cropland, and agricultural land fallow, aquaculture, built up, sandy area, scrubland, swamps forest, wastelands, coastal wetlands, inland natural wetlands, water bodies and others (Table 1). In present years, the mechanical detection and analysis in multi temporal remote sensing images have assumed an ever increasing strategic role in numerious domains. This is direct result of the wide range of real world applications that benefits from these methodologies, as proved by an impressive amount of literature published in the field (Singh 1989; Chavez and Mackinnon 1994; Bruzzone and Fernandez Prieto 2000). Land Use/Land cover mapping is of great significance in scientific, scholarly research, planning and management. Regional land use pattern reflects the character of

Table 1. Land use-Land Cover (LU/LC) classification scheme (NRSC, INDIA 1995)

S.No.	LEVEL-I	LEVEL-II	LEVEL-III
1.	Built up Land	1.1 Towns/Cities	
		1.2 Villages	
2.	Agricultural Land	2.1 Crop land	2.1.1 Kharif
			2.1.2 Rabi
			2.1.3Kharif + Rabi (Double Crop)
		2.2 Fallow	
		2.2 Plantation	
3	Forest	3.1 Evergreen/Semi-evergreen	3.1.1 Dense
		3.2 Deciduous (Moist & Dry)	3.1.2 Open
			3.2.1 Dense
			3.2.2 Open
		3.3 Scrub Forest	
		3.4 Forest Blank	
		3.5 Forest Plantations	
		3.6 Mangrove	
4.	Wastelands	4.1 Salt Affected Land	
		4.1 Waterlogged Land	
		4.2 Marshy / Swampy Land	
		4.3 Gullied / Ravenous Land	
		4.4 Land with Scrub	
		4.5 Land without Scrub	
		4.6 Sandy area (Coastal and desertic)	
		4.7 Mining / Industrial Wasteland	
		4.8 Barren Rocky / StonyWaste / Sheet Rock Area	
5.	Water Bodies	5.1 River/ Stream	-
		5.2 Canals	-
		5.3 Lake * /Reservoirs /Tank	
6.	Others	6.1 Shifting Cultivation	
		6.2 Grass Land / Grazing land	6.2.1 Dense
		6.3 Salt Pans	6.2.2 Degraded
		6.4 Snow covered / Glacial Area	

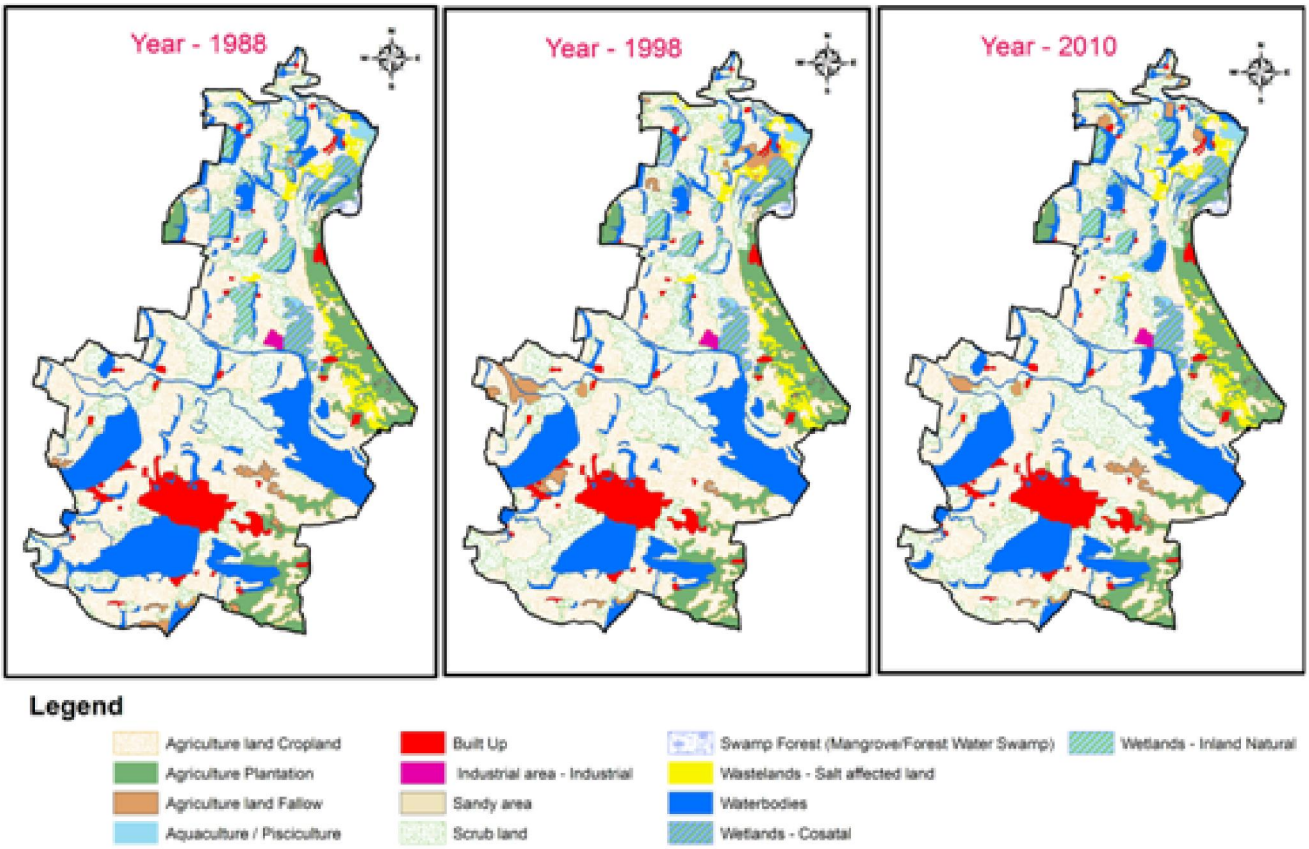

Fig. 2 Land Use / Land Cover Change map

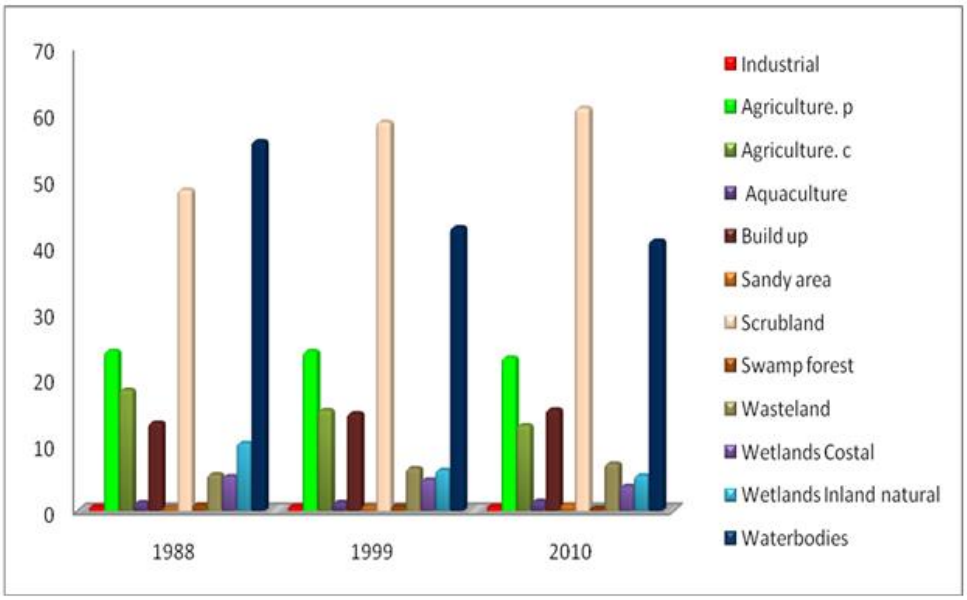

Fig. 3. Variation of Land Use / Land cover in three decades

interaction between man and environment and the influence of distance and resources based on mankind's basic economic activities. Remotely sensed satellite images provide a synoptic overview of the whole area in a very short time span. This leads to quick and truthful representation of the real world in the best possible manner. National Remote Sensing Agency (NRSA), India, Level II classification scheme has been adopted for the present study.

Ground Truth Verification and Accuracy Assessment

Ground truth verification was carried out to check the result obtained using a mobile GPS system for validating the locations of different vegetation classes. Overall 40 points from each location were randomly selected. The conducted ground based suitability assessment and point count of terms at most wetland from May to July (David A and Michael J. Alexander, 2013). The selected points were verified for the LU/LC map. The accuracy of the map was assessed by comparing the thematic map with ground observation points which results in overall classification accuracy of 87%, which is acceptable for LU/LC mapping (Anderson *et al*., 1976 and Thomlinson *et al*., 1999). Frequent field visits were conducted for this purpose. In the study area traditionally rice, cotton, leguminous crops and chilies are being cultivated. However, the income generated through the yield from these crops was not guaranteed as the region is rain fed. This made the farmers to leave their lands uncultivated and promoted the growth of *Prosopis juliflora* scrub. The invasions of this woody scrub occupied the wetlands and water bodies. Regrettably the water bodies have also been affected by human induced land use changes. Invasive vegetation can affect wetlands by changing habitat structure, nutrient cycling productivity, food web composition and tropic level dynamics and by reducing biotic diversity (Andrew J. Rodusky *et al*., 2013) During 1988 to 2010, agricultural land is converted into scrub land and wetlands decreased. In 1988, the study area has scrub land covering an area of 48.47 sq.km, where as the status of 1999 was 59.71 sq.km and 60.33sq.km in 2010 and more than 6 sq.km of crop land area has been reduced in the year 2010. Water bodies were decreased from 55.81 to 51.80 sq. km (Fig. 4) because of the invasions of *Prosopis juliflora*. In the year 2010, inland and coastal wetlands reduced 50% of total area. There were no major changes in built up, industrial, and plantation from 1988 to 2010. The assessment of the land use changes and the bar diagram shows that the scrub land has increased drastically and the water bodies and wetland has reduced. Therefore it is clear that the scrubland plays an important role in the land use pattern changes in the study area during the year of 1988 to 2010. The cropping area has decreased further (net average area shown was 118.25 sq.km in the year 1988, 115.18 sq.km in 1999 and only 112.92 sq.km in 2010) in the study sites (Figure 3).

Conclusion

The present study demonstrated the adaptability of remote sensing and GIS technology for mapping and monitoring the Land Use / Land cover dynamics and to understand the negative impacts on the environment over time with very low cost and short time. The rapid growth of *Prosopis juliflora* weed itself as a localized problematic scrub jungle. The invasions of this woody scrub occupied the wetlands and water bodies. Also it can be decrease moisture of atmosphere and ground water level. Continuous monitoring of these biological invasions is necessary for proper management. The efforts need to be taken to avoid the destruction of the wetlands and water bodies by this invasive plant.

REFERENCE

Anderson,cJ.R., Ernest, E., Hardy., Roach, J.T.,Witmer, E.R. 1967. A Land Use and Land Cover Classification System for Use with Remote Sensor Data, US Geological Survey professional paper 964, pp 138-145.

Andrew, J. Rodusky., Bruce Sharfstein., Charles, G.Hanlon., Karen, A.Donnely 2013. Ecological attributes of a native and exotic emergent subtropical marsh community in lake Okeechobee, Florida (USA). Wetl Ecol Manag 21:87-105.

Bendor, T. 2009. A Dynamic Analysis of the Wetland Mitigation Process and Its Effects on no-net-loss Policy. Landscape Urban Plan, 89:17–27.

Bruzzone, L., Fernandez, Prieto, D. 2000. An Adaptive Parcel-based Technique for Unsupervised Change Detection. Int J Remote Sens, 21:817–822.

Chavez, P.S., MacKinnon, D.J. 1994. Automatic Detection of Vegetation Changes in the Southwestern United States using Remotely Sensed Images. Photogramm Eng Rem S, 60 (5):571–583.

Chunyang He., Jie Tian, Peijun Shi., and Dan Hu. 2011. Simulation of the Spatial Stress Due to Urban Expansion on the Wetlands in Beijing, China Using a GIS-based Assessment Model. Landscape and Urban Plan, 101: 269–277.

David, A., Shealder., Michael, J. Alexander. 2013. Use of aerial imagery to assess habitat suitability and predict site occupancy for a declining wetland-depandent bird.Wetl Ecol Manag, DOI 10.007/s11273-013-9300-z.

Davidson, N.C., Finlayson, C.M. 2007. Earth Observation of Wetland Inventory, Assessment and Monitoring. Aquat Conserv, 17 (3):219-229.

Dieter Muller Dombois *et al*., 1974. "Aims and Methods of Vegetation Ecology". 1st Eds. (John Wiley & sons Publications, USA) pp.382.

John, R. Jensen *et al*., 2000. "Remote Sensing of the Environment: An Earth Resource Perspective". 2nd Eds. (John Wiley & sons Publications, USA) pp. 401.

Longley, Paul, A et al., 2005. "Geographic Information Systems and Science". 1st Eds. (John Wiley & sons Publications, USA) pp.202.

Murcia, C. 1995. Edge Effects in Fragmented Forests: Implications for Conservation. Trends Ecol Evol, 10 (2):58-62.

Navalgund, R.R., Jayaraman, V., Roy.P.S. 2007, Remote sensing application: An overview. Curr Sci India, 93(12): pp 1747-1766.

Nobi, E.P., Umamaheswari R.., Stella. C., Thangaradjou. T. 2009. Land Use and Land Cover Assessment along Pondicherry and its Surroundings Using Indian Remote Sensing Satellite and GIS. Am J Sci, 4(2):54-58.

Singh A. 1989. Digital Change Detection Techniques Using Remotely Sensed Data. Int J Remote Sens, 10:989–1003.

Schuck, A., Paivinen, R *et al*., 2003. Compilation of a European forest map from Portugal to the Ural Mountains based on earth observation data and forest statistics. Forest Policy and Economics 5, pp 187– 202.

Thomas, M. Lillesand *et al*., 2007. "Remote Sensing And Image Interpretation". 5th Eds. (John Wiley & sons Publications, USA) pp.202.

Thomlinson, J.R., Bolstad, P.V., Cohen, W.B. 1999. Coordinating Methodology for Scaling Land Cover Classifications from Site-Specific to Global: Steps toward Validating Global Map Products. Remote Sens Environ, 70:16-28.

William, E.R., B.M. William, and B.L. Turner II. 1994. Modelling Land Use and Land Cover As Part of Global Environmental Change, Climate Change, 28:45–64.

****