

# Detection of Land Use Land Cover Changes in the Wetlands of Kuttanad, Kerala

Roopa.V<sup>1</sup>, Vijayan.N<sup>2</sup>Assistant Professor, Department of Civil Engineering, Carmel College of Engineering & Technology, Punnappra, Kerala, India<sup>1</sup>Professor, Department of Civil Engineering, College of Engineering, Trivandrum, Kerala, India<sup>2</sup>

**ABSTRACT:** This paper investigates the land use land cover changes on wetlands of Kuttanad. The study mainly focuses on detection of land use land cover changes by geographic information system and changes in spatial extent of Vembanad Lake within the boundary limit of the study area. The study indicates that, land cover of the study area comprises agricultural land, built up land, forests (dense vegetation), water bodies and wetlands. The changes in land use of Kuttanad had resulted in the transformation of prime agricultural lands of the area. Present study revealed that in the past 46 years, significant loss of wetland has been occurred in the area due to urbanization, illegal settlements, industries, etc. Spatio-temporal characteristics of wetlands serve as a tool in conservation and prioritization of wetlands. Detection of changes in spatial extent of Vembanad Lake had revealed that there is 5% depletion in area of Vembanad Lake from 1967 to 2001, within the boundary limit of Kuttanad. From 2001 to 2014, the decline in area was around 2%.

**KEYWORDS:** Vembanad Lake, Georeferencing, Land Use classification.

## I. INTRODUCTION

Wetlands are those areas [saturated](#) with [water](#), either permanently or seasonally, which shows characteristics of a distinct [ecosystem](#). Characteristic vegetation adapted to wetlands distinguishes it from other landforms. Wetlands play important role in water purification, flood control, and shoreline stability. Human activities cause wetland degradation by changing water quality, increasing pollutants and changing species composition. Destruction of these wetlands can lead to serious consequences, such as increased flooding, extinction of species, and decline in water quality. Therefore it is necessary to avoid these consequences by maintaining valuable wetlands.

It is widely known that wetland hydrology depends on many factors, including land use, climate, and soil conditions [2]. But the relative impacts of different types of land use on the wetlands are yet to be ascertained and quantified. The changes in land use affect the ecosystem in terms of land cover, land quality and capability, weather and climate, quantity of land that can be sustained and in short the whole population as well as socio-economic determinants.

Land use change detection using remote sensing data and analysis using GIS is very efficient for assessing the change or degrading trends of a region. Landscape changes, transformations and conversions, are results of various pressures on ecosystems [4]. All the natural areas including forests, grasslands, wetlands, and shores around the globe often undergo diverse kinds of transformation and conversion in varying degrees. Urbanization, a major cause of land use changes and land conversions, has made natural habitats open to unpredictable and long lasting changes that may later challenge the existence of the ecosystems that offer several known and unknown precious ecosystem goods and services. The triggering factors for landscape changes can be analysed through remote sensing.

Kuttanad is known to be 'The Rice Bowl of Kerala' as the major occupation of rural people is farming. Human interventions and resulting land use changes in the wetland causes serious consequences in the ecological conditions of the area. The area suffers regularly from flooding, salinity intrusion into ground water and thus degrading the water quality leading to scarcity of potable water. In addition to these, there has been depletion of water bodies which had

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 6, June 2017

affected the agricultural production of the area. Since major occupation of people is farming, the excessive use of pesticides has resulted in contamination of soil and thus degradation of the area [7]. The objectives of the study were

1. Detection of land use land cover types and their changes over years in Kuttanad.
2. Assessment on the depletion in agricultural lands of Kuttanad.
3. Detection of changes in spatial extent of Vembanad lake within the boundary limit of Kuttanad.

## II. STUDY AREA

In the present study Kuttanad wetland, Kerala, India was selected as the study area. Kuttanad has a total area of about 1157 sq.km comprising 66048 hectares of wetlands, 31,086 hectares of dry garden lands and 18623 hectares of backwaters. It is the region with the lowest altitude and where farming is carried out below sea level. Rapid modernization with less focus on sustainable development is creating an imbalance in the intricate ecosystem of this region.

Kuttanad wetland is located at the southern portion of India's largest Ramsar site, the Vembanad-kole wetland between 9°17'-9°40' N & 76°19'-76°33'E. It is a deltaic formation of four rivers namely the Pamba, Manimala, Achankovil and Meenachil which criss cross the region before flowing into 'Vembanad' lake. Vembanad Lake is famous for its exceptional beauty, comprising of lush green surroundings. It is the largest humid tropical wetland ecosystem of the south west coast of India. It is designated as a Ramsar site, a wetland of global importance for its biodiversity values. The Vembanad wetland is under severe environmental stress arising from various anthropogenic activities like drastic reduction/shrinkage due to reclamation erosion and pollution from various sources affecting the quality of water.

## III. METHODOLOGY

An integrated approach involving, geographic information system, statistical and spatial analysis was used in this study. Landsat 8 ETM data was used to extract the land use land cover information of the study area. Satellite images were collected mainly for the years 2001 and 2013. For the year 1967, land use land cover classification was mainly determined from the toposheets. To extract land cover from Landsat ETM+ data, supervised classification method was adopted using ERDAS IMAGE 2011, which is the procedure most frequently used for quantitative analysis of remote sensing data and maximum likelihood algorithm was employed to detect the land cover types. The classification was based on United States Geological Survey standards. During the process of supervised classification, the collection of training sites was very essential and all the required classification classes were sampled. The quality of supervised classification depends on the quality of the training sites. In order to select the accurate training sites, different band combinations were used to identify different land categories.

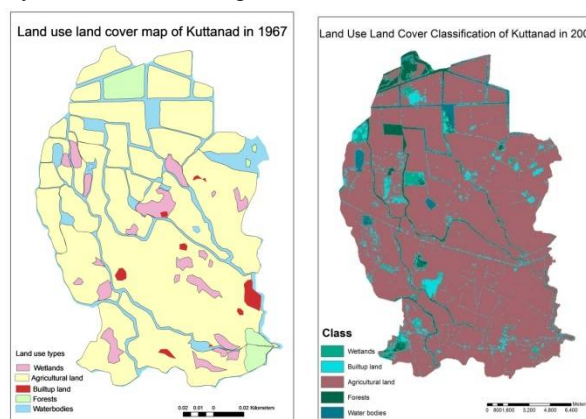


Fig. 1 & Fig. 2: Land use classification of Kuttanad in 1967 & Land use classification of Kuttanad for the year 2001

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 6, June 2017

Toposheets collected for the year 1967 was georeferenced and then the various land use classes were identified and digitized as shown in figure 1. Then the corresponding geographical area was calculated. Thus the changes in land use were analysed.

Land use classification was done for the year 2001 from landsat image using supervised classification method in ERDAS IMAGINE 2011 as shown in figure 2. Land use classification for the year 2013 was determined using landsat images in ERDAS IMAGINE 2011 following the supervised classification method as shown in figure 3.

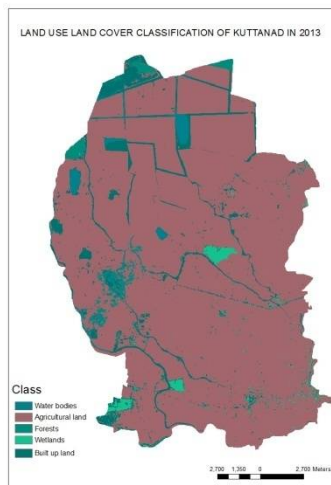


Figure 3: Land use classification of Kuttanad for the year 2013

Changes in spatial extent of Vembanad lake was analysed by using satellite images and toposheets of the area. Methodology includes digitising the boundary of lake from the satellite images and toposheets. The corresponding geographical area of the lake within the boundary limit of Kuttanad was calculated.

## IV. RESULTS AND DISCUSSION

### A. Detection of Land use change

Land use land cover detection revealed that in 1967, about 86.7% of the area covered agricultural land. About 3.7% of the area were found to be dense vegetation, 6.5% of the area was wetlands, 2.5% of the area were water bodies and built up land covers the least area, which was about 0.6%. This was because the occupation of people in the area was farming and thus area under agriculture was found to be more as shown in table 1.

TABLE.1: AREA UNDER EACH LAND COVER CLASSES IN 1967

Land Use Category	1967	
	Area (km <sup>2</sup> )	Percentage (%)
Agricultural land	267.89	86.70
Built up land	1.83	0.60
Forests(dense vegetation)	11.46	3.70
Water Bodies	7.87	2.50
Wetlands	19.97	6.50

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 6, June 2017

In 2001, about 85.5% of the area was agricultural land, 3.07% of the area was under dense vegetation, 3.05% of the area covered wetlands, 2.06% were water bodies and 6.21% were built up land as shown in table 2. It was found that there was a remarkable increase in the area of built up land for the year 2001 when compared to 1967. This is due to the access of land for rapid development, establishment of infrastructures and also due to formal and informal settlements. There was also decrease in the area of agricultural land. It was also witnessed a sudden gradual decrease in the area of wetlands.

TABLE.2: AREA UNDER EACH LAND COVER CLASSES IN 2001

Land Use Category	2001	
	Area (km <sup>2</sup> )	Percentage (%)
Agricultural land	261.64	85.50
Built up land	19.01	6.32
Forests (dense vegetation)	9.39	3.07
Water Bodies	6.30	2.06
Wetlands	9.34	3.05

In 2013, about 80.4% of the area is under agricultural land, 2.5% of the area was under dense vegetation, 1.42% of the area covered wetlands, 1.72% were water bodies and 13.8% were built up land as shown in table 3. The trend of increase in built up land has proved to be continuing till 2013. The decrease in the area under agricultural land also requires serious attention. Apart from all these the rapid decrease in wetlands was found out.

TABLE.3: AREA UNDER EACH LAND COVER CLASSES IN 2013

Land Use Category	2013	
	Area (km <sup>2</sup> )	Percentage (%)
Agricultural land	245.64	80.44
Built up land	42.38	13.88
Forests (dense vegetation)	7.75	2.54
Water Bodies	5.25	1.72
Wetlands	4.33	1.42

Over the years 1967-2001 and 2001-2013, an increase in area under built up land had been witnessed from the study. Also, there has been a dramatic decrease in the area under water bodies, wetlands, forests (dense vegetation) and agricultural land.

### B. Detection of changes in spatial extent of Vembanad lake

In 1967, the area covered was found to be 81.28 km<sup>2</sup> in 2001, it was 77.07 km<sup>2</sup> and in 2014, area covered was 75.22 km<sup>2</sup>. Thus study revealed that spatial extent of the lake was decreased by 5% in 2001 and by 2% in 2014.

# International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: [www.ijirset.com](http://www.ijirset.com)

Vol. 6, Issue 6, June 2017

## V. CONCLUSION

The land use land cover classification of the study area comprises agricultural land, built up land, forests(dense vegetation), water bodies and wetlands. From the land use land cover classification it was clear that there has been a decreasing trend in agricultural land of the study area. About 90% decrease in area under agricultural land had been witnessed. The area under wetlands was also found to be depleting over the years. About 46% decrease in area under wetlands have been found out. The changes in land use of Kuttanad had resulted in the transformation of prime agricultural lands of the area. Present study indicates that in the past 46 years, significant loss of wetland has been occurred in the study area.

Detection of changes in spatial extent of vembanad lake had revealed that there is 5% depletion in area of vembanad lake from 1967 to 2001, within the boundary limit of Kuttanad. From 2001 to 2014, the decline in area was around 2%.

## REFERENCES

- [1] Jyotishman Deka, Om Prakash Tripathi & Mohammad Latif Khan, "A Multi-temporal remote sensing approach for monitoring changes in spatial extent of freshwater lake of Deepor Beel Ramsar Site, a major wetland of Assam", *Journal of Wetlands Ecology* (5):40-47, 2011.
- [2] Kumar.B.M, "Land use in Kerala: changing scenarios and shifting paradigms", *Journal of Tropical Agriculture* 42 (1-2): 1-12, 2005.
- [3] Nikhil Raj P.P and Azeez P.A, "Land Use and Land Cover Changes in a Tropical River Basin: A Case from Bharathapuzha River Basin, Southern India", *Journal of Geographic Information System*, vol.2, 185-193, 2010.
- [4] Sreejith .K.A, "Human impact on Kuttanad wetland ecosystem - an overview", *International Journal of Science, Environment and Technology*, vol. 2, No 4, 679 – 690, 2013.
- [5] Stephan Pauleit, Roland Ennos & Yvonne Golding, "Modelling the environmental impacts of urban land use and land cover change—a study in Merseyside, UK", *Landscape and Urban Planning* 71, 295–310, 2005.
- [6] Tang.Z, Engel.B.A, Pijanowski.B.C & Lim.K.J, "Forecasting land use change and its environmental impact at a watershed scale", *Journal of Environmental Management* 76, 35–45, 2005.
- [7] K A Sreejith, "Human Impact on Kuttanad wetland ecosystem", *International Journal of Science, Environment and Technology*, vol.2, no.4, 679-690, 2013.