Journal of Environmental Management 148 (2015) 134–142

Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: www.elsevier.com/locate/jenvman

Spatial changes of estuary in Ernakulam district, Southern India for last seven decades, using multi-temporal satellite data

P.T. Dipson, S.V. Chithra*, A. Amarnath, S.V. Smitha, M.V. Harindranathan Nair, Adhem Shahin

School of Environmental Studies, Cochin University of Science and Technology, Kochi 682 022, Kerala, India

ARTICLE INFO

Article history:
Available online 10 May 2014

Keywords:
Estuary
Wetland
Remote sensing
Spatial changes
Reclamation
Encroachment

ABSTRACT

The study area, located in the western side of Kerala State, South India, is a part of Vembanad-Kol wetlands – the largest estuary in India's western coastal wetland system and one of the Ramsar Sites of Kerala. Major portion of this estuary comes under the Ernakulam district which includes the Cochin City – the business and Industrial hub of Kerala, which has seen fast urbanization since independence (1947). Recently, this region is subjected to a characteristic fast urban sprawl, whereas, the estuarine zone is subjected to tremendous land use/land cover changes (LULC). Periodic monitoring of the estuary is essential for the formulation of viable management options for the sustainable utilization of this vital environmental resource. Remote sensing coupled with GIS applications has proved to be a useful tool in monitoring wetland changes. In the present study, the changes this estuarine region have undergone from 1944 to 2009 have been monitored with the help of multi-temporal satellite data. Estuarine areas were mapped with the help of Landsat MSS (1973), Landsat ETM (1990) and IRS LISS-III (1998 and 2009) using visual interpretation and digitization techniques in ArcGIS 9.3 Environment. The study shows a progressive decrease in the estuarine area, the reasons of which are identified chronologically.

1. Introduction

Wetlands are defined as 'lands transitional' between terrestrial and aquatic ecosystems where the water table is usually at or near the surface or the land is covered by shallow water (Mitsch and Gosselink, 1986). They are considered as a vital ecosystem, although they occupy only 4% of the earth's ice free surface. They play prominent roles in economic, cultural, social, recreational and ecological perspectives. They perform crucial ecological functions by providing habitats for flora and fauna through enabling groundwater recharge, nutrient retention, flood control, sediment filtration, etc (Prasad et al., 2002). Estuary is a partly enclosed coastal wetland with one or more rivers or streams debauching into it. They possess a direct link to the open sea and hence are subject to strong seasonal changes in chemical composition, flow patterns, sedimentation rates, etc. They are also transitional zone between fresh water and marine ecosystems (Boschker et al., 2005). They are subject to marine influences such as tides, waves, incursion of saline water; as well as riverine influences like influx of fresh water and sediments (Nayak, 2002).

Drastic changes in wetland regions due to the geometric progression in population characterised by the indiscriminate use of land resources have been reported from all over the world (Rajiv et al., 2001, Mallik et al., 2011). Half the world's population lived within 60 km of the sea, and three-quarters of all large cities were located on the coast even by 2005 (UNEP, 2005), and developmental activities usually revolve around such centres. The Government of India has declared a Coastal Regulation Zone (CRZ) in the year 1991, to keep the developmental activities of these ecologically sensitive areas at check. Coastal Regulation Zone (CRZ) includes coastal stretches of bays, seas, estuaries, backwaters, creeks, etc. which are influenced by tidal action towards landward side (MOEF, 1991).

Remote sensing is a very useful tool in monitoring wetland changes; a few pertinent works are noted below. Mallik et al. (2011) studied the spatio-temporal change analysis of wetland in Dhaka city, Bangladesh between 1978 and 2009 using remote sensing and GIS techniques. Chang-Qing et al. (2011) mapped coastal wetland change in Yancheng National Nature Reserve, China, using remote

* Corresponding author. Tel.: +91 9995091194.
E-mail addresses: ptdipson@gmail.com (P.T. Dipson), chithu1010@gmail.com, chithra.sv@aol.com (S.V. Chithra), amarenvis@gmail.com (A. Amarnath), smithamanu.adithya@gmail.com (S.V. Smitha), harinathses@gmail.com (M. V. Harindranathan Nair).

http://dx.doi.org/10.1016/j.jenvman.2014.02.021
0301-4797/

sensing and landscape change matrix analysis. Shuqing et al. (2009) identified wetland changes in China's Sanjang Plain using remote sensing. Alphan and Yilmaz (2006) have estimated the temporal changes in the coastal landscape of Turkey between 1984 and 2000 using digital interpretation of remotely sensed satellite data. Chen et al. (2005) analysed the change detection of Pearl River Estuary in China over two decades. Sajeeva and Subramanian (2003) have studied the Land use/land cover (LULC) changes in Ashtamudi wetland region in Kerala, from 1967 to 1997 using Remote Sensing and Geographic Information System (GIS) techniques. Baghdadi et al. (2001) mapped Canadian wetlands and studied changes observed at three times within the vegetation season using SAR (Synthetic Aperture Radar) Data. Rajiv et al. (2001) have mapped and monitored the Harike wetland ecosystem, Punjab, India using remote sensing data for deriving conservation strategies. Rao et al. (1999) have monitored the spatial extent of coastal wetlands in Sunderbans Delta, India and analysed wetland area changes between 1973 and 1993 using remote sensing data.

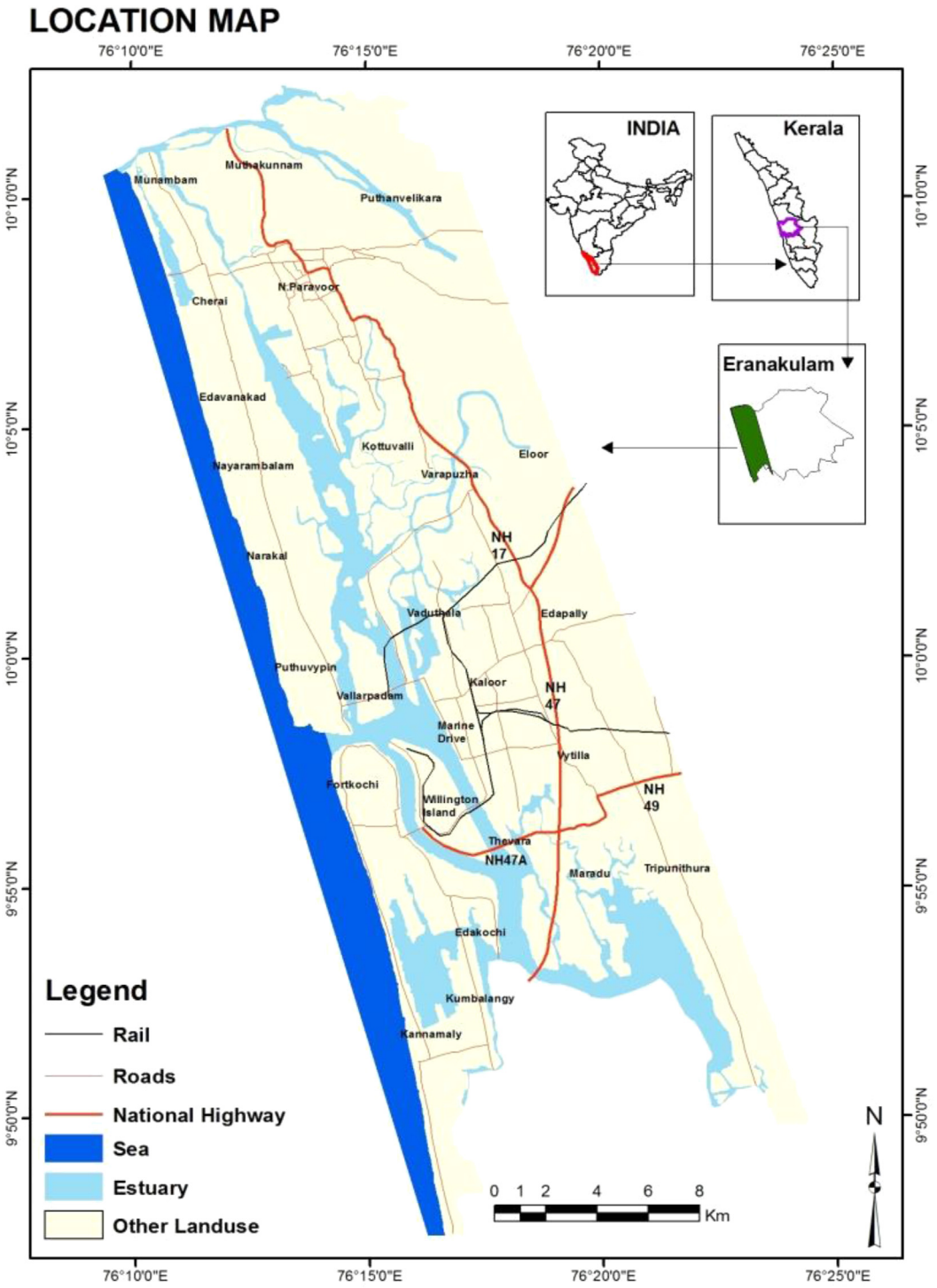

Fig. 1. Location Map of the study area.