Journal of Environmental Management 148 (2015) 124–133

Contents lists available at ScienceDirect

Journal of Environmental Management

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

Implications of sea level rise scenarios on land use /land cover classes of the coastal zones of Cochin, India

R. Mani Murali [a, *], P.K. Dinesh Kumar [b]

[a] CSIR-National Institute of Oceanography, Dona Paula, Goa 403004, India
[b] Regional Centre, CSIR-National Institute of Oceanography, Kochi, India

ARTICLE INFO

Article history:
Received 15 July 2013
Received in revised form
21 March 2014
Accepted 10 June 2014
Available online 16 July 2014

Keywords:
Land use
Land cover
Sea level rise
Inundation
Vulnerability
Cochin
India

ABSTRACT

Physical responses of the coastal zones in the vicinity of Cochin, India due to sea level rise are investigated based on analysis of inundation scenarios. Quantification of potential habitat loss was made by merging the Land use/Land cover (LU/LC) prepared from the satellite imagery with the digital elevation model. Scenarios were generated for two different rates of sea level rise and responses of changes occurred were made to ascertain the vulnerability and loss in extent. LU/LC classes overlaid on 1 m and 2 m elevation showed that it was mostly covered by vegetation areas followed by water and urban zones. For the sea level rise scenarios of 1 m and 2 m, the total inundation zones were estimated to be 169.11 km^2 and 598.83 km^2 respectively using Geographic Information System (GIS). The losses of urban areas were estimated at 43 km^2 and 187 km^2 for the 1 m and 2 m sea level rise respectively which is alarming information for the most densely populated state of India. Quantitative comparison of other LU/LC classes showed significant changes under each of the inundation scenarios. The results obtained conclusively point that sea level rise scenarios will bring profound effects on the land use and land cover classes as well as on coastal landforms in the study region. Coastal inundation would leave ocean front and inland properties vulnerable. Increase in these water levels would alter the coastal drainage gradients. Reduction in these gradients would increase flooding attributable to rainstorms which could promote salt water intrusion into coastal aquifers and force water tables to rise. Changes in the coastal landforms associated with inundation generate concern in the background that the coastal region may continue to remain vulnerable in the coming decades due to population growth and development pressures.

1. Introduction

Global sea level rise (SLR) ranging from 0.5 m to 2 m has been predicted over the next century and it would disrupt the physical processes, economic activities and social systems in the coastal zones (Gommes et al., 1997; NOAA Report, 1999; Solomon et al., 2007). Besides the destruction through increased rates of erosion, sea level rise situations increase the risk of inundation (Nicholls et al., 1999). Among the different impacts of climate change, sea level rise raise much concern mainly due to the direct physical impact of inundation and potential habitat loss. A comparative analysis on the impact of permanent inundation due to sea level rise on 84 countries of the world revealed that hundreds of millions of people in the developing nations are likely to be displaced (Dasgupta et al., 2007). Inundation poses substantial risks to coastal communities which are projected to increase with the accelerated sea level rise along vulnerable shorelines (Solomon et al., 2007). As a consequence of various factors, 2.3 m C-1 sea level rise is expected in the next 2000 years (Levermann et al., 2013). GIS techniques were used to delineate the inundation areas in Mekong Delta region, Vietnam under SLR scenarios of 20 cm and 45 cm. The results were that the water levels will be shifted to 25 km and 50 km towards the sea (Wassmann et al., 2004). Reece et al., 2013 characterized the vulnerability to major threats to biodiversity of Florida region using the projections of SLR by the year 2100 and human land use pattern. If the global sea level rises in the manner predicted, there will be extensive submergence of low-lying coastal areas. The highest tide will reach above their present limits and the low tide line will move landward. These will result into the existing intertidal area to become permanently submerged. Variations resulting will be site specific and depending on coastal

* Corresponding author.
E-mail addresses: mmurai@nio.org, niomurali@gmail.com (R. Mani Murali), pkdineshkumar@yahoo.com (P.K. Dinesh Kumar).

http://dx.doi.org/10.1016/j.jenvman.2014.06.010
0301-4797/

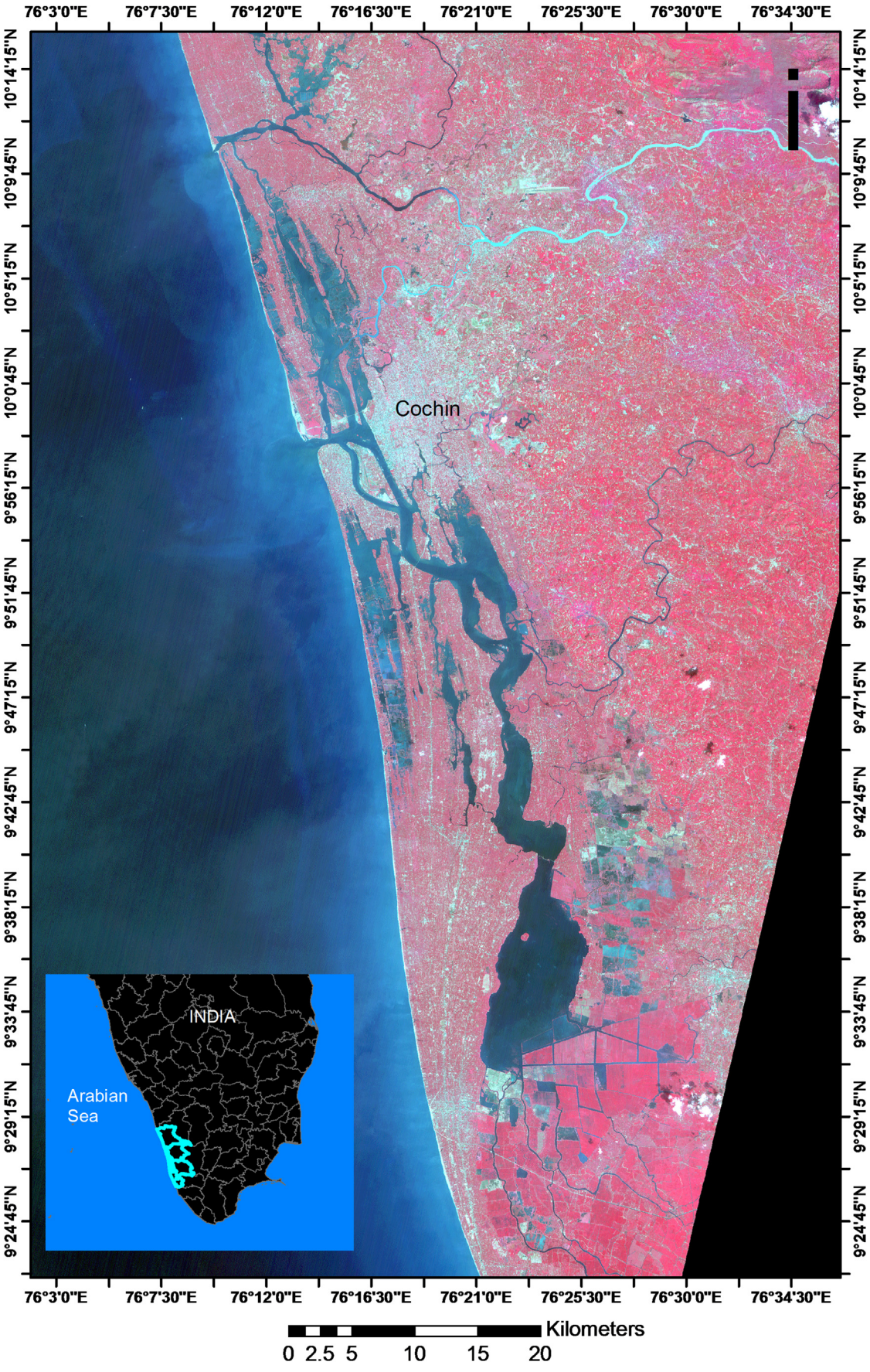

Fig. 1. Location map with the IRS P 6 LISS-3 image.