

MODELING COASTAL LANDUSE / LAND COVER CHANGES TO GENERATE SCENARIO USING REMOTE SENSING DATA: A CASE STUDY IN HAZIRA REGION OF SOUTH GUJARAT

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ABSTRACT

Coast is area where the Space, land and water meet. Coastal zone is dynamic in nature compare to other terrestrial areas. Because of natural resources, high productivity of its ecosystems and national and international trade route, it invites human induced developmental activities. Exploitation of limited and unique coastal resources for development, Pollution generated and vulnerability of the coast to the natural hazards require the use of coastal zone in integrated and sustainable manner. The developmental activities are varying spatially and temporally. Remote sensing because of synoptic, repetitive and multi – sensor capabilities, becomes an important tool for mapping and monitoring the natural and man – made changes. In the present study, Hazira region of Chorasi Taluka of Surat district in South Gujarat selected for preparing model for coastal landuse / landcover changes. This area witnessing very high growth rate because of off and on – shore developmental activities. Various remote sensing time series satellite data of 20 years is used for identifying landuse / land cover changes in the study area. Based on this the annualized rate of change for different coastal landuse categories has been calculated. Non – spatial data like, temperature, rainfall, census and industrial growth had been used to find out major driver of these changes. In the present study, industrial growth is the prime driving force for the coastal landuse / landcover changes. Based on this information, a model has been developed for generating the scenario for this area. This model is developed with the help of the cellular automata and coding has been done in the FORTRAN 77 language. This model is developed with the option of creating unplanned development as well as planned development scenario. Different date remote sensing data is used for validation of this model. Validation of the model was carried out using satellite data of the year 2003. This model can be used for monitoring the landuse changes occurring during the developmental processes and it can be used for the development of any coastal area in sustainable, integrate manner.

1. INTRODUCTION

India has a coastline of about 7500 km including that of its islands territories. Coastal zone in India assumes its importance because of high productivity of its ecosystems, concentration of population, exploitation of natural resources, discharge of waste effluents, increasing load of harbour, spurt in recreational activities and above all petroleum exploration activities (Chauhan et al.2004). Thus, there is a need to protect coastal environment while ensuring constant production and development.

Coastal areas can be used for more than one use and many a times, interest conflicts with each other among user. Thus, activities listed above and other anthropogenic activities disturb the fragile ecosystems and jeopardize the sustainability of the coast. As coastal land is limited it should be used optimally and development should be done in integrated manner. To maintain the sustainability of the coast there should be some guiding and controlling mechanism for protection of coast. In addition to this, coast is also susceptible to natural hazards like cyclone, tidal storms, etc. These can cause the loss of human life and economic losses. Applying some guiding and controlling mechanism this also can avert. Thus moving from unplanned to plan sustainable coastal zone in integrated manner requires the present status of the development and history of the development. Remote sensing

because of its repetitive, synoptic and multi – sensor capabilities gives unique opportunity to collect the scientific and reliable data at local to global level for understanding the developmental process.

DATA USED: Satellite data of TM dated 12 January 1987, LISS III data of 10 February 1999 is used. Non – spatial data like rainfall, temperature available at Website of Indian Institute of Tropogaphic Meteorology (IITM), census data from census department and and industrial development data of Gujarat.

2. METHODOLOGY

To understand the recent changes in the Earth – system, quantitative and spatially explicit data of the landuse land cover changes by human use over last 300 years and how it will be changed in the next 50 to 100 years is need of the hour. The understanding of complex interaction of structure and function forms the basis of modeling the ecosystem response to the global climate and land use changes. Basic objective of land use land cover studies and the identification of drivers of change to understand the processes active in the coastal zone of Hazira region and the inter relationship of these processes with each other.

Analysing the remote sensing data of more than 20 years and integrating other non – spatial data industrial development stands as major driver of the landuse land cover changes. Using this inputs predictive model has been attempted which gives the future scenario of the area spanning 5 to 10 years.

Landuse maps prepared using remote sensing data was used to calculate the rate of change. After analyzing data for different years with varying time span, annualized rate of change in different landuse categories has been established (Chauhan and Nayak, 2005). These rates have been used and pixel – by – pixel analysis was carried out using cellular automata theory. These model accounts the processes acting upon land and give resultant effect on land use and landcover.

Cellular automata is being used and the parameters are measured and processes identified for the development of mode. Following criteria has been used for this.

1. Identification of change boundary: To identify the change boundary occurred, directional 3 x 3 matrix filter has been used. At every pixel, the weightage for the minimum and maximum (aggregated weightage) is being calculated. Each pixel in matrix is allocated the weightage of 0.1 and central pixel having weightage 0.2. On the boundary pixels the maximum weightage can be 0.6 to 0.7 (aggregated) and minimum be a 0.1 to 0.4 (aggregated). This will help in identifying the boundary pixel for categories.

2. Attractiveness or likeliness matrix: Considering all possible category changes occurring in landuse an attractiveness matrix has been generated (Appendix 1). These will be used by the pixel under observation (input and state pixel) that change can take place or not. If change in category from input to state is not possible, value of this change in state will be zero and next pixel will be analysed. If the change in category from input to state is possible, the state pixel will be converted as output pixel.

3. Rate of change for output: To convert the state pixel in the output pixel the direction of change will be decided by positive or negative value of the rate, if the rate is positive, the change will take place in forward direction (e.g. if input is hb(habitation Category), state is Ag(agriculture Category), the rate is positive then output will be convert from Ag to hb, and in the reverse case, the conversion of Ag to hb in reverse direction). It will further check the rate in numerical value if it is more than average, then 2 successive pixels (or equivalent the rate of change in hecter) will be changed and if it is less than average than corresponding pixel will be converted as output.

Computer program for the above exercise has been coded in visual FORTRAN language available in Visual studio of Windows. To make the software independent of commercially available image processing software, input data accepted in the ASCII format and output generated will be in ASCII format. To visualize the changes onscreen, user can convert ASCII pixel available in the image pixel. In the present exercise, image processing software Imagine and input image to ASCII conversion was done by the facility available in it.

Once the processing is completed the ASCII converted to image format using Imagine software and output is being displayed. To visualize the changes at different time – scale, provision has been made in software such that for different

interval of time change scenario can be generated. Provision also is being made such that controlled growth vs. uncontrolled growth scenario can be generated

3. RESULTS AND DISCUSSIONS

Remote sensing data because of its repetitive, synoptic, multispectral and multitemporal nature can be used for monitoring and planning any developmental activities. Remote sensing inputs of changes in landuse land cover. Changes in landuse categories are different and from increase of 293 ha for the habitation with vegetation to decrease of 320 ha for mudflat is observed. (Chauhan and Nayak, 2005).

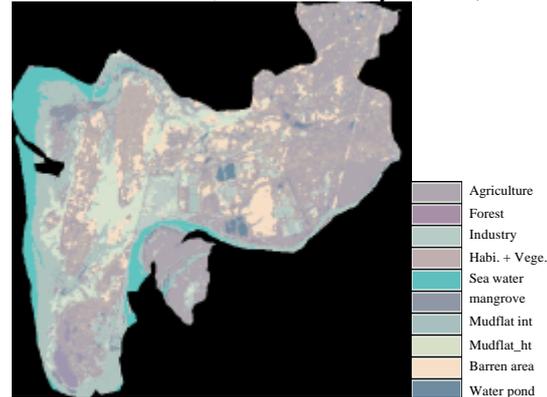


Fig.1 classified image of Chorasi Taluka, Surat District

To identify the driver of these changes, non – spatial data was correlated and found that industrial development in this area shows positive correlation with increase in population (Census data). Thus industrial growth in this region is the major driver of the land use changes. With this inputs, model ‘luc_land’ were run for the satellite data of the 1999 (Fig. 1) for five years to generate scenario and it is observed that high tide mudflats

and barren area are change very fast as agriculture and habitation area (Fig. 2). Part of the study area showing annualized change (fig. 3) can be useful to understand landuse changes takes place in particular direction, this can be help in to regulate some activity for the management purpose. This model can be modifying to accommodate the regulation, which can be imposed for management purpose. For example, if development around mangrove area is to be stopped, provision can be made in the model accordingly. Remote sensing data of 2003 (LISS III dated 31st March and 5th April) were used for the validation of the model and it is giving very good correlation.

Present exercise has been carried out using *Imagine*, image-processing software. Though, input and output accepts ASCII

format to make the model image processing software

[http:// tropmet.res.in/data.html](http://tropmet.res.in/data.html).

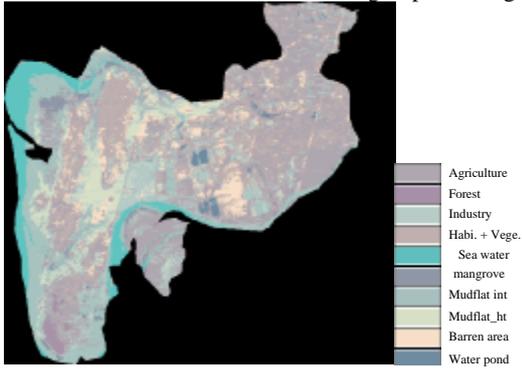


Fig.2 image of Chorasi Taluka, Surat District showing change in landuse after running the model luc_land for 5year

independent, presently the image to ASCII and ASCII to image conversion supports the image format of *Imagine* software. Also, in present exercise during the processing the rate of change for all categories are considered as uniform.

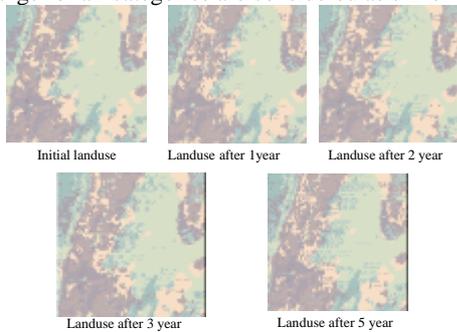


Fig.3 Part of classified image of Chorasi Taluka, Surat District showing change in landuse at different time-scale after running the model luc_land

4. CONCLUSIONS

Remote sensing data along with non – spatial data can be used to develop the model, which can be used to monitor developmental activities. This model can be useful for planning the developmental activities along the coastal zone and monitoring the planned development.

This can be useful for impact assessment studies also. The model can be further updated to accommodate the regulation activities proposed for the management

5. REFERENCES

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