A Time Series Analysis of Spatial Data for Examining the Land Transformation in Urban Areas

Course project for AI-703- Geographical Information Systems 2020

Under the guidance of Prof. Uttam Kumar

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1. Introduction

Urbanisation in India is growing at unprecedented rates. Percentage population residing in urban areas was 28.53% in the 2001 census, and is now 34% in 2017 according to The World Bank. This has led to significant changes in and around urban areas with respect to land cover and usage patterns. In this project we plan to look at Bangalore *(or any other Indian city) and changes in land cover and usage patterns over time. This work will provide a visual understanding of the growth patterns. We aim to quantitatively evaluate various factors like *(Infrastructure, weather, population density and others). Through this project, we try to understand the effect of urbanisation on the agricultural land of Bangalore by implementing the techniques used by other scholars like Fazal, 2000; Pandey & Seto, 2015; Kumar et. al, 2011 and others to analyse. This will help in sustainable urban planning of infrastructure, natural resources conservation and other aspects.

(Keywords: GIS, Urbanisation, Temporal Patterns, Bangalore, Time Series Analysis)

2. Problem Statement

Looking at remotely sensed data of urban area (*Bangalore or specific areas of bangalore) to examine the effects of conversion of agricultural land to non-agricultural land. To quantitatively evaluate infrastructural, climatic and demographic factors which are affected by the conversion.

3. Background and Previous Work

Fazal et al. [1], in 2000, used Remote Sensing along with field checks and surveys to analyse the extent of urbanisation in the Saharanpur City at the expense of agricultural land. The study uses the data of 10 years, from 1988 and 1998.This study of land-transformation because of rapid

urbanisation uses the data set obtained from IRS-1C geo-coded panchromatic satellite analogue imagery along with field checks and surveys.

Another study done by Pandey, & Seto,2015, investigates the loss of agriculture land using the econometric time series analysis, because of urbanisation, a phenomenon commonly known as “urban conversion of agricultural lands” from June 2000 to May 2011 across India (Pandey & Seto,2015). The dataset used in the study is the MODIS MOD13Q1 time series dataset (Pandey & Seto,2015).

A similar study was done in Ranchi by Kumar et al, in 2011 to understand the urban expansion in Ranchi. The dataset used includes Landsat MSS for 1975,Landsat TM for 1986 & 1996 , IRS P6-LISS IV for 2005 and USGS topographical sheet of 1927.

Since the loss of agricultural land to urban land is most common in low and middle income nations, from our study, we would like to examine this trend of land transformation for the Silicon Valley of India, Bangalore. The timeline of focus for this project will be from 1991, the start of liberalisation in India with the New Economic Policy of 1991, till 2010.

References:

1. Fazal, S. (2000). Urban expansion and loss of agricultural land-a GIS based study of Saharanpur City, India. *Environment and Urbanization*, *12*(2), 133-149.
2. https://www.geospatialworld.net/article/geo-visualisation-of-urbanisation-in-greater-bangalore
3. Pandey, B., & Seto, K. C. (2015). Urbanization and agricultural land loss in India: Comparing satellite estimates with census data. *Journal of environmental management*, *148*, 53-66.
4. Kumar, A., Pandey, A. C., Hoda, N., & Jeyaseelan, A. T. (2011). Evaluating the long-term urban expansion of Ranchi urban agglomeration, India using geospatial technology. *Journal of the Indian Society of Remote Sensing*, *39*(2), 213-224.

4. Research Goals

By drawing on the paper by Fazal (Fazal, 2000), in our project we will try to analyse similar patterns of land transformation in Bangalore (or any other Indian city).
Goal 1 : To understand man-made land transformation in the city of Bangalore (or any other Indian city) over a period of time A time series analysis of the data will enable us to estimate the loss of area under agriculture and to quantitatively evaluate various factors like *(Infrastructure, weather, population density and others) The land usage patterns include:

1. Planned Residential
2. Unplanned Residential
3. Commercial
4. Institutional
5. Industrial
6. Vacant

Goal 2: To understand urban planning and the expansion of the city region.

5. Approach and Tools

This work will be based on remotely sensed data i.e aerial photographs and satellite images. The aerial photographs and satellite images would be interpreted to identify various land use classes - Commercial, Institutional, Industrial, Agricultural land, Plantation etc. Classification algorithms would be applied across the classes. Based on the research paper cited the tentative dataset used will be - Time series spatial data acquired from **Landsat** Series, Survey of India (SOI) toposheets. Other datasets in consideration are **IRS-1C: dataset from Bhuvan.**

The work will be done in a GIS environment because of the inherent flexibility of GIS techniques that allow quite complex quantitative and spatial relationships to be made and displayed in graphical form thus improving the clarity of the planning and decision making process. We plan to use **GRASS GIS, ILWIS Software** for the execution of the project.

6. MILESTONES

Tentative schedule of deliverables and project progress.

Tentative Deadline (Bi Week)	Description	Deliverable
Oct 7 (Week 0)	Complete project proposal.	Project Proposal
Oct 20 (Week 2)	Complete data gathering, data preprocessing and data cleaning.	Presentation and discussion with Professor
Nov 3 (Week 4)	Understanding tools to be used and finalizing the approach	Presentation and discussion with Professor
Nov 17 (Week 6)	Working Model* and Project Report or final documentation	Final Output
Nov 23 (Week 7)		