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Urban expansion and loss of Agriculture land - A case of Bengaluru city

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ABSTRACT

The cultivated land across India has fragmented significantly resulting in change in landuse. The agricultural land has continued to shrink due to rapid urbanization. Nearly 45% land across India is cultivated area and 22% of the landuse area is forestland. The study using Remote Sensing data for the metropolitan fringe of Bengaluru reveals the expansion of built up to 446.55 sq. km by 2014. The increase in built up has reduced the agriculture land by 212.49 square kilometers. The agriculture land comprised of 27.57 square kilometers of agriculture plantation and 184.91 square kilometers of cropland. 96.29 square kilometers of agriculture land has been converted to "to-be built up" area. The 50.57% of the combined land area of built up and to-be built up is from agriculture land and the rest 49.43% from other land category. Over the years, the urban expansion to the fringes has declined the agricultural land by 16.31%. With the increase in requirement of both land and food security, it becomes imperative to protect and conserve the farmlands by policy and guidelines.

Keywords: Agriculture land, Agriculture plantation, Cropland.

1. Introduction

Growing population, changes in lifestyle and rapid urbanizationis changing the landuse pattern significantly around the globe (Hubacek and Vazquez, 2002). It is estimated that more than 50% of the world's population lives in urban areas, and the projected proportion of urban population will reach 69.6% by 2050 (United Nations, 2010). Urban population across India has been growing consistently from 27.81% in 2001 to 31.16% in 2011. Among its 30 districts in Karnataka, Bengaluru district attracts large population of 9.6 m for urban Bengaluru alone (Census, 2011). It is continued to be one of the fastest growing cities in India and Asia. The population of Bengaluru grew by 35.09 % in 2001 to 47.18 % in 2011 (Census, 2011). Such steep changes in population impact the environment much higher resulting in loss of arable land (Lopez et al., 2001).

Expansion of urban landscape has affected the food production in multiple ways; age-old farming land has been altered, traditional practice of farming from farmers and family farms have decreased due to migration to urban areas (Roca, 1993). Between 1987 and 1992, China lost close to one million hectares of farmland each year to urbanization and the expansion of roads and industries (Tyler, 1994). In the USA, urban expansion takes away nearly 400,000 hectares of farmland every year (Feder, 1997). The city of Tirunelvelli in the state of Tamil Nadu's expansion is directly due to loss of agricultural land(Chandrasekar et al, 2010). The present study is visualized to assess the impact of urban expansion on agriculture land using spatial data.

2. Study area

Bengaluru lies between the 12°49' to 13°9' N latitude and 77°27'to 77°47' E longitude at an average elevation of 2953 ft. Bengaluru due to its high elevation enjoys a more moderate climate throughout the year. The coolest month is December with an average low temperature of 15.4 °C and the hottest month is April with an average high temperature of 32.8 °C (91). Bengaluru is located over ridges delineating four watersheds, viz. Hebbal, Koramangala, Challaghatta and Vrishabhavathi. It has a scope of expansion in all the direction except towards southeast region where the Tamilnadu state boundary occurs.

Bangalore renamed as "Bengaluru" is the sixth largest city in India. The city attracts people on the basis of its global importance as Information Technology and Bio-technology hub of India. Emerging global companies influenced much of the expansion primarily through jobs and development. It spurred a large-scale expansion of housing and infrastructure. As employment opportunities grew, so did the population and migration to the city. This required expansive infrastructure particularly good road network connecting peripheral areas. Bengaluru though covers only 0.5% of the geographic area of the state, 4,381 persons crams every square kilometers space of the district making it an overwhelming 10.5% of the state's population in 2011 when compared to 2,985 people per square kilometers in 2001. Since January 2007, the erstwhile old Bengaluru city jurisdiction was expanded from 226 square kilometers to 800 square kilometers and it is now called as Greater Bengaluru. Study area (Figure 1) includes Greater Bengaluru area (800 km^2) excluding urban core (226 km^2) Bengaluru and 20km buffer area beyond it.

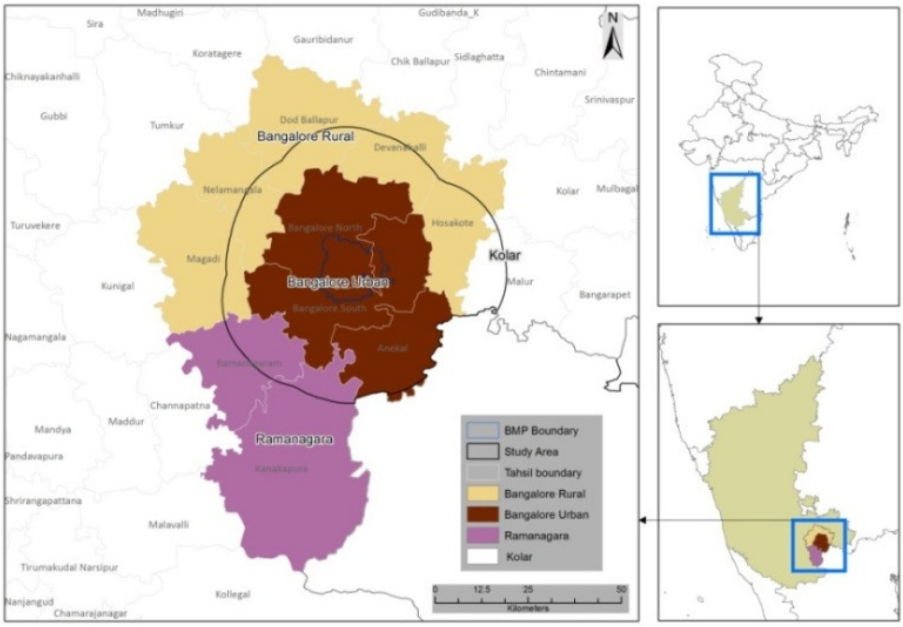

Figure 1: Study area map

3. Methodology

3.1 Data collection

Study area map was developed using the Survey of India (SOI) topo sheets of 57g/7, 57g/11, 57g/12, 57g/16, 57h/5, 57h/6, 57h/9, 57h/11, 57h/12, 57h/13 and 57h/14 of 1:50.000 scale by

geo referencing for further analysis. The forest boundaries were delineated using the SOI topo sheets. A cloud free multi-spectral image of Landsat 7 ETM+ and Landsat 5 TM acquired on December 2014 was selected for the study. The image was classified for built up and non-built up class.

3.2 Data analysis

For the 2014 imagery supervised classification was done by using maximum likelihood algorithm. For this a set of homogenous pixels were selected and algorithm was trained to classify the data based on 'training sites'. Size, shape, location, number of pixels, number of training sites for a particular class, placement, and uniformity were some of the characteristics considered while assigning the training sites. Error of misclassification was rectified by manually re-coding the class after comparison with Google Earth imagery of the same date, wherever it was available. The final results of the classified image data were processed using ERDAS (version 9.2) and ARC GIS (version 10.2). Then the proposed landuse for built up (layouts with clear demarcation) here after called "To be built up" were digitized for 2014 using google earth as reference. The built up and to be built up area maps of 2014 were overlaid on the Karnataka State Remote sensing Applications Center (KSRSAC)'s 2007 landuse map to assess the extent of land conversion from agriculture to built up.

4. Results and discussion

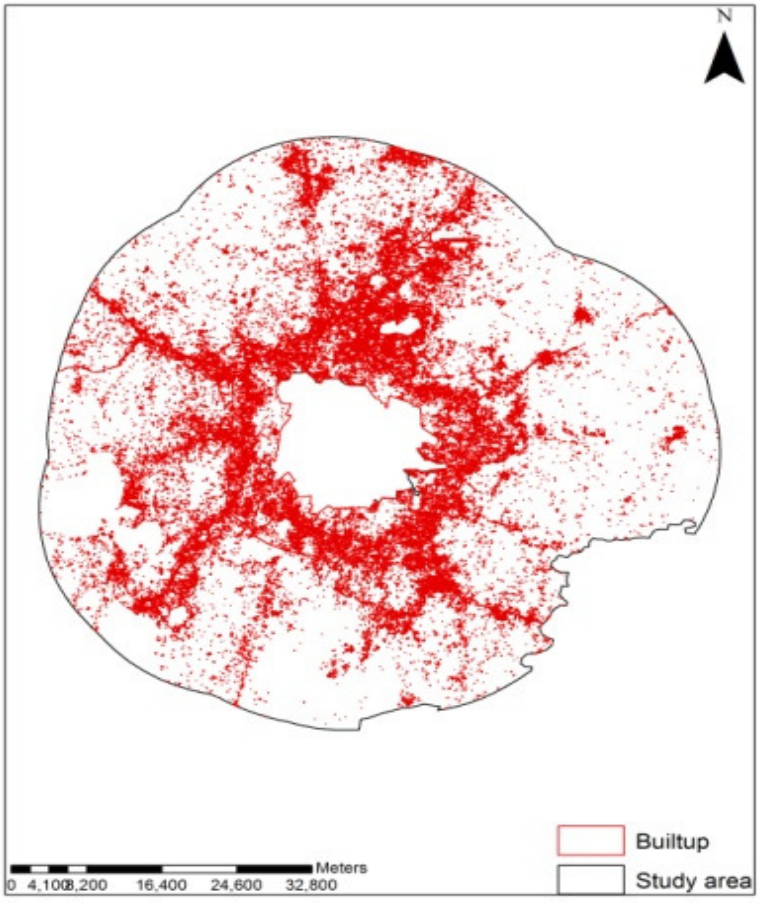

Figure 2: Classified image for built up area of Bengaluru fringe for 2014

Table 1: Built up area 2014

Landuse category	**Area** (km^2)	**Change (%)**
Built up	446.55	11.93
Non built up	3296.45	88.07
Total	3743	100

Built up 2014: The 2014 classified image (Figure 2) shows a built up area of 446.55 km^2 (11.93%) and 3296.45 km^2 (88.07%) of non built up area beyond the metropolitan fringe out of the 3743 km^2 study area (Table 1).

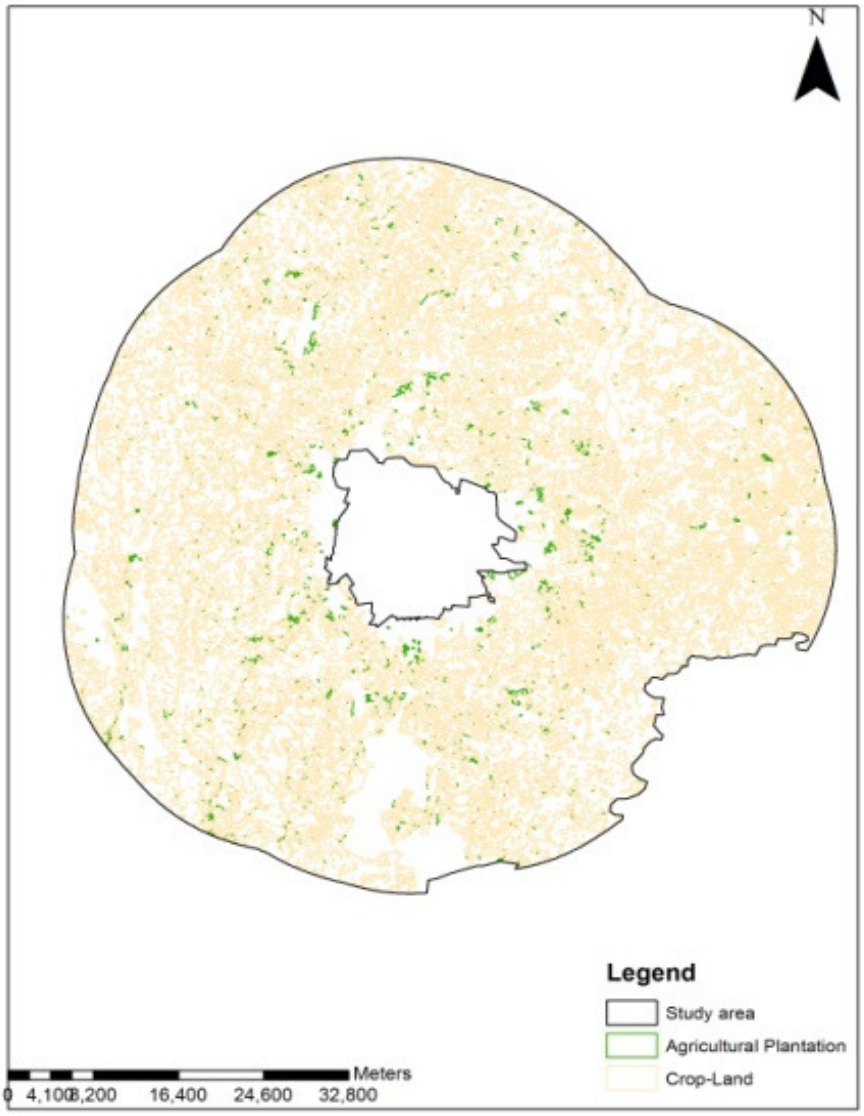

Figure 3: Agriculture land in Bengaluru fringe in 2007

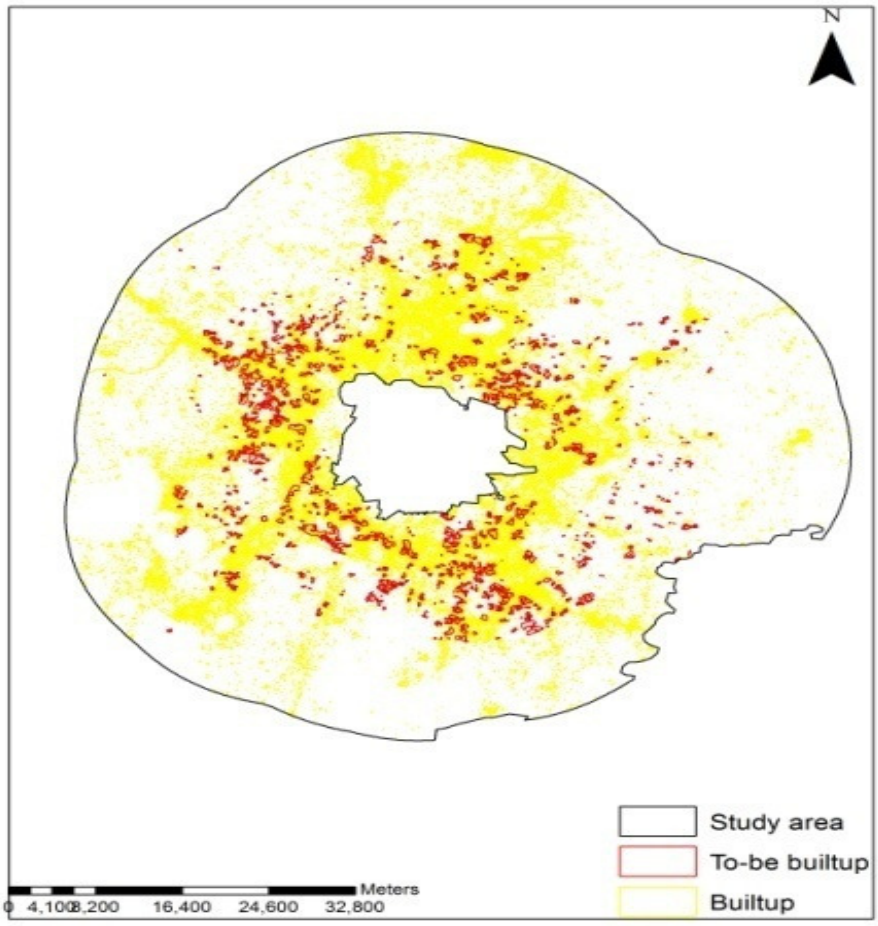

Figure 4: Built up and To-be built 2014 in Bengaluru fringe

Table 2: Agriculture land2007, Built up and To-be built up 2014

Agriculture Land(2007)	Total area (km^2)	Built up (2014) (km^2)	Change (%)	To- be built up (2014) (km^2)	Change (%)	Total change (2014) (km^2)	Change (%)	Change in agriculture land (%)
Agricultural Plantation	302.76	27.57		15.19		42.77		
Crop-Land	2221.85	184.91		81.1		266.02		
Total agriculture land	2524.61	212.49	47.58	96.29	58.68	308.78	50.57	**16.31**
Other landuse	1218.39	234.07	52.42	67.79	41.32	301.86	49.43	
	3743	**446.56**	**100**	**164.08**	**100**	**610.64**	**100**	

The forest department landuse category map of 2007 (Figure 3) shows an area of 2524.61 square kilometers for agriculture land and 1218 square kilometers for other land use category. The other land category includes: previous built up, open land, water bodies, forestland, rock, quarry etc.,. Out of the 2524.61 square kilometers of agriculture land, 302.76 square kilometers comprises agricultural plantation and 2221.85 square kilometers is cropland area (Table 2).

The 212.49 square kilometers of agriculture land and 234.07 square kilometers of other land has contributed to built up area of 446.56 square kilometers in 2014. Out of the 212.49 square kilometers of agriculture land comprises 27.57 km^2 agricultural plantation and 184.91 square kilometers of cropland. In the "to-be built up" land category of 164.08 square kilometers, 96.29 square kilometers is from agriculture land comprising 15.19 square kilometers of agriculture plantation and 81.1 square kilometers of cropland. The remaining 67.79 square kilometers is from the other landuse.

The total land of 610.64 square kilometers of "built up" and "to-be built up" has been contributed from 302.78 square kilometers (50.57%) of agriculture and 301.86 square kilometers (49.43%) of other land category. This reveals that, agriculture land category has contributed majorly to built up compared to other land which consist several other smaller landuse categories. Across the years 16.31% of agriculture land has gone to built up. The urban expansion at the cost of agriculture land reveals that the urban containment policy has been ineffective (Madasala, 2014). The successive management plans from 1972 have been absorbing the illegal and unplanned layouts in to city (Nair, 2005). The urban expansion has lead to the fragmentation of farms intern causing the loss of traditional economic base (Brabec and Smith, 2002). As predicted if the global demand for food doubles by the year 2030 there will be threat to food security globally (Godfray, 2013. Crosson, 1997). To meet the future demands of increasing food production more land under agriculture is required (Smith, 2013. Postel, 1998).

5. Conclusion

Agriculture is crucial in terms of employment, food security and budgetary allocation, even though the share of agriculture income has decreased in the national market. In the growing population it's important to conserve and protect the potential farmlands. Vertical construction should be promoted. The government should ensure the developmental projects in certain areas other than productive agriculture land, strengthen the zoning regulation and enact policies to reduce agriculture land losses. The farmers with productive agriculture land should be economically compensated to keep their land agriculturally active than selling it to developmental projects.

6. References

1. Brabec, E., and Smith, C. (2002), Agricultural land fragmentation: the spatial effects of three land protection strategies in the eastern United States. Landscape and Urban Planning, 58(2), pp 255-268.

2. Census. (2011), India's population in the year 2011: the Registrar General Census Commissioner of India (www.censusindia. gov.in).

3. Chandrasekar, N., Sivasubramanian, P., and Soundranayagam, J. P. (2010), Ecological consequences of rapid urban expansion: Tirunelveli, India. African Journal of Basic and Applied Sciences, 2(5-6), pp 167-176.

4. Crosson, P. (1997), Will erosion threaten agricultural productivity? Environment: Science and Policy for Sustainable Development, 39(8), pp 4-31.

5. Economic, U. N. D. O. (2010, United Nations e-government survey 2010: Leveraging e-government at a time of financial and economic crisis (Vol. 2): United Nations Publications.

6. Feder, B. (1997), Sowing preservation—Towns are slowing invasion of farms by bulldozers. New York Times, D1-19.

7. Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F., and Toulmin, C. (2010), Food security: the challenge of feeding 9 billion people. Science, 327(5967), pp 812-818.

8. Hubacek, K., and Vazquez, J. (2002), The economics of land use change. Interim Report, IR-02-015. The Economics of Land Use Change Klaus Hubacek, IIASA

9. López, E., Bocco, G., Mendoza, M., and Duhau, E. (2001), Predicting land-cover and land-use change in the urban fringe: a case in Morelia city, Mexico. Landscape and Urban Planning, 55(4), pp 271-285.

10. Nair, J. (2005), The promise of the metropolis: Bengaluru's twentieth century: Oxford University Press.

11. Postel, S. L. (1998), Water for food production: will there be enough in 2025? Bioscience, 629-637.

12. Roca, Z. (1993), Urbanization and rural women: Impact of rural-to-urban migration: UN.

13. Smith, P. (2013), Delivering food security without increasing pressure on land.Global Food Security, 2(1), pp 18-23.

14. Tyler, P. E. (1994), Nature and economic boom devouring Chinas farmland. New York Times, pp 1-8.

15. Madalasa Venkataraman (2014), Analysing Urban Growth Boundary Effects on the City of Bengaluru, 18(48), Economic and Political Weekly, pp 54-61.