Assessment of Urban Growth in Peri-Urban Areas of Mysuru Using GIS & Remote Sensing

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Abstract-

Peri-urban areas may be described as Fringe areas of a city or adjoining rural areas/ outgrowth/ urban agglomeration linked with rapid spatial transformation and characterized by a mix of urban and rural activities. Peri-urban areas' key issues are rapid changes of land cover/ land-use changes, unplanned and uncontrolled spatial growth, large scale formation of slums and squatter settlements and environmental vulnerability, etc. Such issues are greater in Metropolitan cities where the pace of Physical development is very rapid, Demographic pressures are intense, and the Institutional and Administrative mechanisms cannot respond appropriately.The integration of remote sensing and GIS provides a useful method for examining urban growth changes over time.Thus, this study's main aim is to apply a multi-temporal remote sensing and GIS techniques for monitoring the Land use /Land Cover changes in peri-urban areas of Mysuru from 2001 to 2012.

Initially, the Population growth and land use pattern of Mysuru Local planning area are studied. Next, the Peri-urban area beyond the Local Planning Area (LPA) of Mysuru was delineated and divided into two buffer zones of 5 Km and 10 Km radius from the edge of LPA. Using Satellite Images and Geospatialdata, Urban Growth analysis such as Change Detection Technique were carried out to Monitor the urban growth in Peri-Urban Areas of Mysuru from 2001 to 2012.

The study reveals that during the study period (2001-2012), the built-up areas have increased significantly by 96 % and 184 % for 5 km and 10 km buffer respectively, but the area under Agriculture, Forest, and Water Bodies have reduced significantly. The study also highlights that Good accessibility, availability of adequate land at a cheaper cost, fewer fees, levy, easy approval process, etc. promotes development in the Peri-urban areas. Finally, the study concludes that GIS and Remote sensing techniques can be used extensively to map and quantify the spatial and temporal phenomena, predict the land required for future development and provide a valuable tool for City planners to develop Peri-urban areas in a sustainable manner.

Keywords – Peri-urban areas, Urban Growth, Local Planning Area (LPA), GIS & Remote Sensing, Change Detection Techniques.

I. INTRODUCTION

Over the last two to three decades, the pattern of spatial growth and population absorption has changed significantly in India's Peri-urban areas. As the city grows horizontally beyond its legal jurisdiction, the demand for additional land and natural resources leads to a massive expansion of suburban areas, often encroaching vast areas of surrounding agriculture land and severely stressing rural areas adjacent to them. These changes have been the highest in the Metropolitan cities. Peri-urban locations are areas of intense land-use change, social and economic heterogeneity, contested natural resource use and occupational diversification (Narain 2013). A mixture of land characterizes peri-urban areas uses associated with a range of urban and rural livelihoods. Peri-urban areas are characterized by not only geographical but also social and institutional transition. Socially, Peri-urban areas are dynamic, wherein social forms are constantly created, modified and discarded (Iaquinta and Drescher 2000).

II. OBJECTIVES

This study aims to apply a multi-temporal remote sensing and GIS techniques for monitoring the Land use /Land Cover changes in peri-urban areas of Mysuru from 2001 to 2012.

III. METHODOLOGY

Initially, the Population growth and land use pattern of Mysuru Local planning area is studied. Next, the Peri-urban area beyond the Local Planning Area (LPA) of Mysuru was delineated and divided into two buffer zones of 5 Km and 10 Km radius from the edge of LPA. To identify and quality the built-up area and study the changes over time, we have collected the satellite images of 2 periods, i.e., LIS -3(Land Resource Information System) and CORTOSAT SIS-DP 2012 image (Space Information System for Decentralized Programme).Using the above Satellite Images and Geospatial data, Urban Growth analysis such as Change Detection Technique were carried out and change detection matrix table was built for 5 Km and 10 Km Buffer separately to monitor the urban growth in Peri-Urban Areas of Mysuru from 2001 to 2012.

IV. CASE STUDY OF MYSURU

Mysuru was the capital of the former princely state of Mysore. It is situated in the southern part of Karnataka; it is located at 12º 18' N Latitude, and 76º39' E longitude, at an average elevation of 767 m above mean sea level.

4.1. Population Growth

Mysuru is the third biggest city in the state of Karnataka covering an area of 128.42 sq. Kms with a population of 8.87 lakh in 2011 (Census of India, 2011). The city has grown extensively, and the growth rate is considerably high over the past decades. The population increase during 1971-1991 was due to increased heritage and culture as Mysuru became a regular feature on the tourism circuit. The growth in the decade of 1991-2001 and the last five years is largely due to the growth of IT and IT-enabled services in the city.

Mysuru urban agglomeration is among the fastest-growing Indian cities, with a decadal population growth rate of 25.19% with a population of 0.984 million (Census of India, 2011). Mysuru will become a Metropolitan city as the projected population for Mysore city will be 16.5 lakhs for 2021 & 21.00 lakhs for the planning period 2031. Similarly, for Nanjangud; the projected population is 95,000 for 2021 & 1.10 lakhs for the planning period. Thus, the total population for LPA will be 19.09 lakhs for 2021& 23.77lakhs by the year 2031.

Table 1: Mysuru City population and growth rate from 1911 to 2011

Year	Population (Lakhs)	Population variations (Lakhs)	Decadal growth rate (%)	Annual exponential growth rate (%)
1901	**0.68**	-	-	-
1911	**0.71**	0.03	4.41	0.43
1921	**0.84**	0.13	18.30	1.68
1931	**1.07**	0.23	27.38	2.42
1941	**1.50**	0.43	40.19	3.38
1951	**2.44**	0.94	62.67	4.86
1961	**2.54**	0.10	4.10	0.40
1971	**3.56**	1.02	40.16	3.38
1981	**4.79**	1.23	34.55	2.97
1991	**6.53**	1.74	36.33	3.10
2001	**7.86**	1.33	20.37	1.85
2011	**8.87**	1.01	12.85	1.45

(Source: Town Directory, Census of India, 2001 and Census of India 2011)

4.2 Spatial Growth and Dynamics

Mysuru was the capital of the former princely state of Mysore. The population of Mysuru started to increase from 1799 onwards when the capital was shifted from Srirangapatna to Mysuru. Mysuru city had 19.20 Km^2 in 1901; it had rapidly increased to 106.27 Km^2 in 2001(Census of India, 2001 and City Development Plan). Currently, Mysuru city has 106.27 Km^2 areas under Municipal Corporation and 128.42 Km^2underUrban Agglomeration (MC+OG). This demonstrates that the city has expanded significantly in the past 119 years.From the Land Use Analysis Table, the total area demarcated for a residential area in the current land use (2009) is about 7032.89 hectares,which constitutes about 25.24% of the total area. Whereas in Proposed land use of 2031, the total area demarcated for the residential area is about 14,958 hectares it constitutes about 53.68%. Presently Mysuru is witnessing Rapid Urbanization due to IT and Tourism development, resulting in a Population explosion and horizontal development of the city in an unplanned and Haphazard Manner.

Table 2: Land Use Analysis -1995 to 2031

Category	Land Use (1995)		Land Use (2001)		Existing Land Use (2009)		Proposed Land Use (2031)	
	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%	Area (Ha)	%
Residential	3057.30	40.39	2849.91	**39.90**	7032.89	**25.24**	14,958	**53.68**
Commercial	182.23	2.41	215.95	**3.02**	473.76	**1.70**	758	**2.72**
Industrial	1021.01	13.49	962.61	**13.48**	1309.09	**4.70**	1,827	**6.56**
Park & Open space	415.77	5.49	981.70	**13.74**	766.31	**2.75**	1,584	**5.68**
Public & Semi-public	856.45	11.32	639.69	**8.96**	1545.99	**5.55**	2,075	**7.45**
Traffic & Transportation	1530.73	20.22	1150.27	**16.10**	3384.60	**12.15**	4,310	**15.47**
Public Utility	37.26	0.49	36.48	**0.51**	107.19	**0.38**	-	**0.00**
Water Sheet	182.68	2.41	143.99	**2.02**	326.84	**1.17**		**0.00**
Agricultural	285.34	3.77	162.33	**2.27**	12168.34	**43.67**	1249	**4.48**
Forest					749.31	**2.69**	**1103**	**3.96**
	7568.77	**100.00**	**9221.03**	**100.00**	**27864.32**	**100.00**	**27864**	**100.00**

(Source: Master Plans, Mysuru Urban Development Authority (MUDA), Mysuru)

4.3. Methodology for Delineation of Peri-Urban Area

Under the provisions of the Karnataka Town and Country Planning Act 1961, the State Government provides for the regulation of planned growth of land-use and development for Urban Areas can declare any area as Local Planning area (LPA) for the Preparation of Master Plan. The present Local planning area (LPA) of Mysuru includes Mysore City Corporation area, Nanjangud Town Municipal Council area, 84 villages within Mysore taluka, 19 villages within Nanjangud taluka and 14 villages within Srirangapatna taluk. It covers an area of 509.03 sq. km.

Based on nature of spatial expansion, existing and proposed land use (Figure 1 & 2) etc.it is Cleary evident thatthe spatial growth is predominant more towards the western part of Mysuru, i.e., beyond the conurbation boundary and extending towards the edge of Local Planning Area(LPA). Further,this growth is very intense particularly between two main regional roads, i.e. Hunsur Road (SH-88) which connects Mysuru with Bantawal taluk in Dakshina Kannada vi Madikeri and Mangalore and Nanjangud Road (NH 766, previously NH-212) which connects Kozhikode in Kerala with Kollegal in Karnataka via Mysore.

Finally, Extensive field observations and photo documentation further revealed that due to the demand for additional land and natural resources these developments extended beyond the legal jurisdiction, i.e., local planning area into the surrounding village settlements which comprises of the Peri-Urban Area.

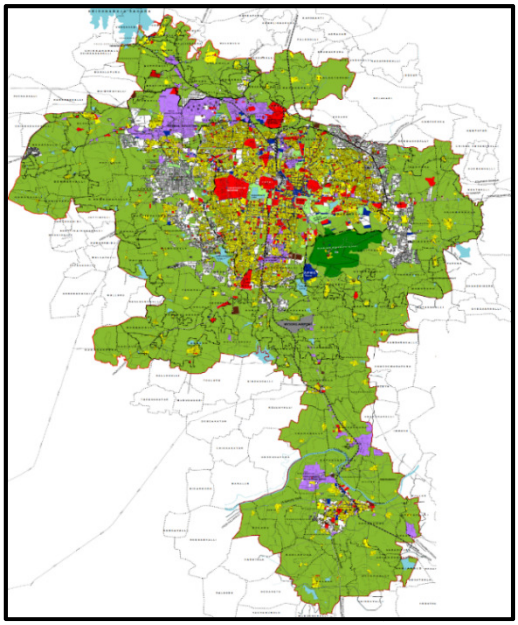


Figure 1: Existing Land Use Map-2009

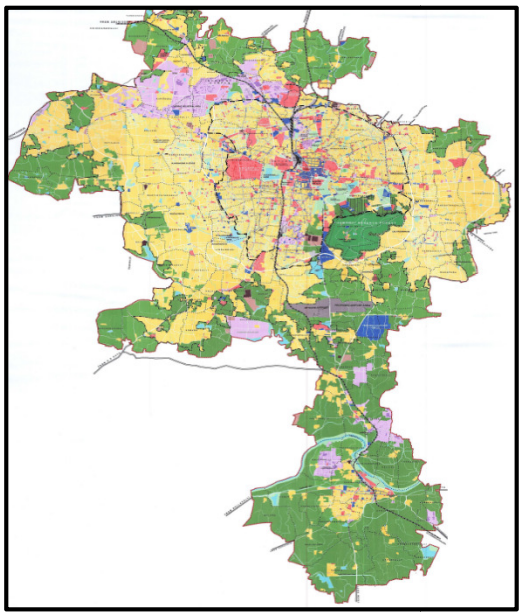


Figure 2: Proposed Land Use Map-2031

(Source: Master Plans, Mysuru Urban Development Authority (MUDA), Mysuru)

Hence there is a need to study the Nature and Impact of these developments on Peri-Urban areas beyond the LPA. By considering the proximity to Mysuru city, the study area was delineated and further divided into two buffer zone of 5 Km radius and 10 Km radius from the edge of LPA. (Figure 3).

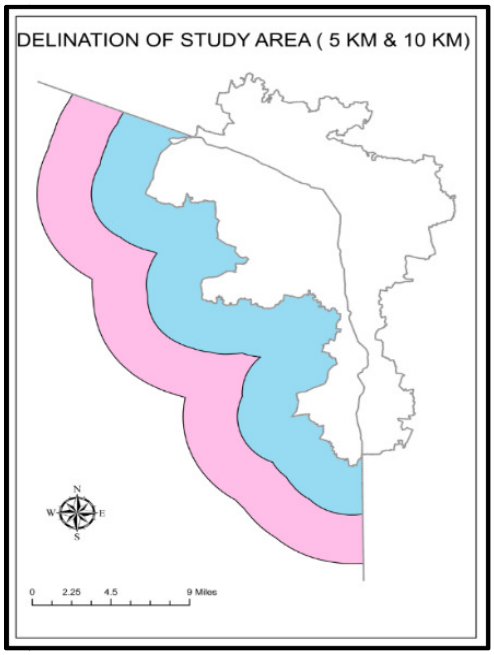


Figure 3: Delineation of the Study area

(Source: Author constructed based on Field Survey and using Satellite image)

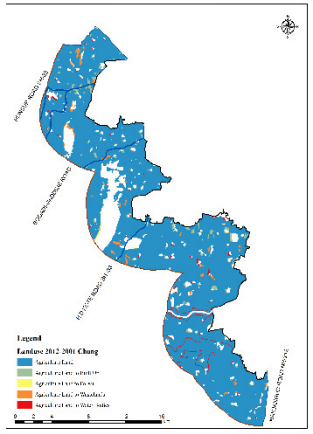
V. RESULTS AND DISCUSSIONS

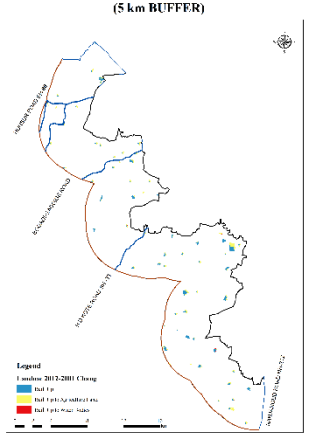
5.1. Change Detection Techniques for Land Use and Land Cover

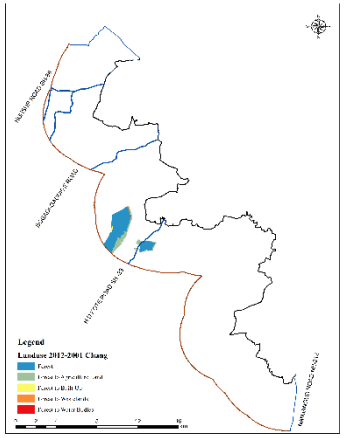
To study the Spatial changes from 2001 to 2012, the satellite images of 2 periods are collected. Using GIS and Remote sensing, Geospatial Analysis such as Change Detection technique to calculate the land use/ land cover changes from 2001 to 2012, were carried out and discussed below.

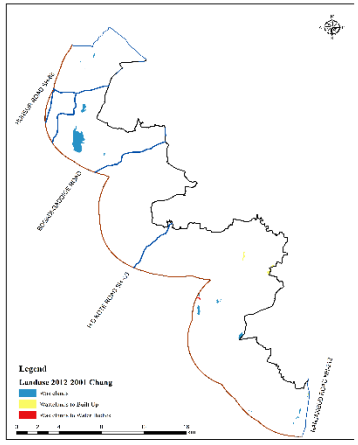
Change detection is a process that measures how the attributes of a particular area have changed between two or more periods. Change detection often involves comparing aerial photographs or satellite imagery of the area taken at different times. Change detection has been widely used to assess shifting cultivation, deforestation, urban growth, the impact of natural disasters like Tsunamis, earthquakes and use/land cover changes, etc.

Multi-spectral pixels of the study area were classified and mapped into five broad land cover classes, i.e., (1) Agriculture land (2) built-up or urban land (3) Forest land (4) Waste or barren land (5) Waterbodies.









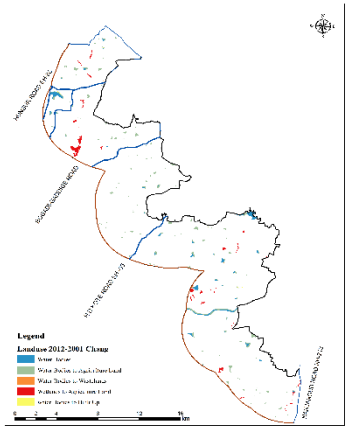
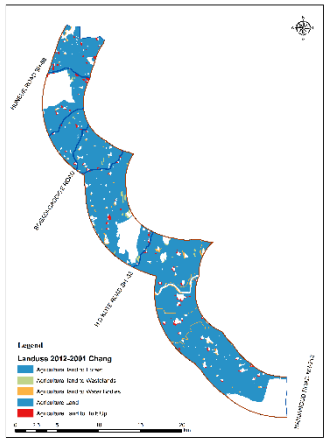
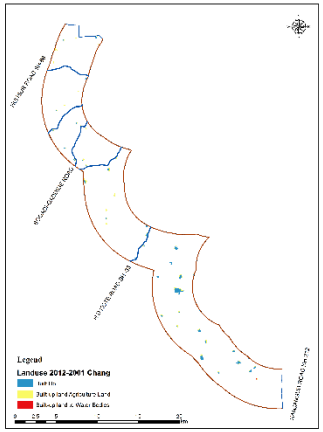
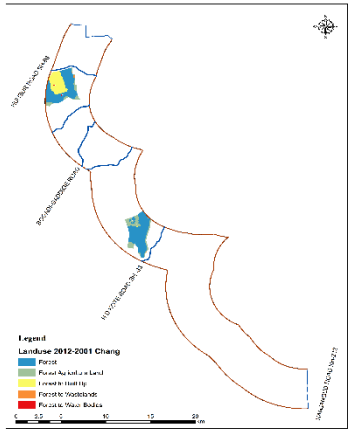


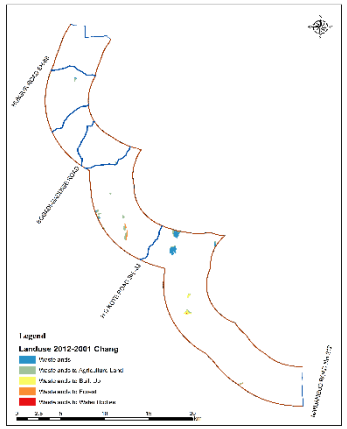
Figure 4: Change Detection for Different Land uses (5 KM Buffer)

(Source: Author constructed based on Field Survey and using Satellite image)









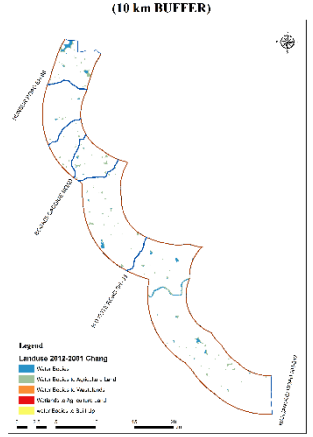


Figure 5: Change Detection for Different Land uses (10 KM Buffer)

(Source: Author constructed based on Field Survey and using Satellite image)

To understand land encroachment in different land categories, the change between the multi-temporal land use/land cover was determined and the change detection matrix table (Table 2& 3) was built for 5 Km and 10 Km Buffer separately.

Table 2: Land use/cover change matrix showing land encroachment (km^2)for 5 Km Buffer

Land use categories		2001				
		Agriculture	**Built Up**	**Forest**	**Waste/Barren**	**Water Bodies**
2012	Agriculture	**276.74**	**6.78**	**0.29**	**3.83**	**3.40**
	Built Up	**2.32**	**2.81**	**-**	**-**	**0.03**
	Forest	**1.79**	**0.11**	**7.15**	**0.049**	**0.015**
	Waste/Barren land	**2.06**	**0.34**	**0.30**	**2.96**	**0.044**
	Water Bodies	**4.08**	**0.06**	**-**	**0.031**	**2.50**

(Source: Author constructed based on Field Survey and Analytical results)

The change between land use 2001 and 2016for 5 Km Buffer reveals that:

a). About 2.32 km^2 of the area under Built up, 1.79 Km^2 of the area under Forest, 2.06 Km^2 of the area under Waste/Barren and 4.08 Km^2 of the area under water bodieshas been converted into Agriculture land area.

b). About 6.78 km^2 of the area under Agriculture, 0.11 Km^2 of the area under Forest, 0.34 Km^2 of the area under Waste/Barren and 0.06 Km^2 of the area under water bodies has been converted into Built Up land area.

c). About 0.29 km^2 of the area under Agriculture, 0.30 Km^2 of the area under Waste/Barren has been converted into Forest land area.

d) About 3.83 km^2 of the area under Agriculture, 0.049 Km^2 of the area under Forest and 0.031 Km^2 of the area under Water Bodies has been converted into Waste/Barren land area.

e) About 3.40 km^2 of the area under Agriculture, 0.03 Km^2 of the area under Built Up, 0.015 Km^2 of the area under Forest and 0.044 Km^2 of the area under Waste/Barren has been converted into Water Bodies.

Table 3: Land use/cover change matrix showing land encroachment (km^2)for 10 Km Buffer

Land use categories		2001				
		Agriculture	**Built Up**	**Forest**	**Waste/Barren**	**Water Bodies**
2012	Agriculture	**232.27**	**4.06**	**0.50**	**1.94**	**3.45**
	Built Up	**1.54**	**2.18**	**-**	**-**	**0.017**
	Forest	**3.55**	**4.08**	**15.12**	**0.061**	**0.024**
	Waste/Barren land	**1.33**	**0.35**	**0.25**	**1.35**	**0.020**
	Water Bodies	**4.49**	**0.037**	**0.04**	**-**	**2.81**

(Source: Author constructed based on Field Survey and Analytical results)

The change between land use 2001 and 2016for 10 Km Buffer reveals that:

a). About 1.54 km^2 of the area under Built up, 3.55 Km^2 of the area under Forest, 1.33 Km^2 of the area under Waste/Barren and 4.49 Km^2 of the area under water bodieshas been converted into Agriculture land area.

b). About 4.06 km^2 of the area under Agriculture, 4.08 Km^2 of the area under Forest, 0.35 Km^2 of the area under Waste/Barren and 0.037 Km^2 of the area under water bodies has been converted into Built Up land area.

c). About 0.50 km^2 of the area under Agriculture, 0.25 Km^2 of the area under Waste/Barren and 0.04 Km^2 of the area under water bodies has been converted into Forest land area.

d) About 1.94 km^2 of the area under Agriculture, 0.061 Km^2 of the area under Forest has been converted into Waste/Barren land area.

e) About 3.45 km^2 of the area under Agriculture, 0.017 Km^2 of the area under Built Up, 0.024 Km^2 of the area under Forest and 0.020 Km^2 of the area under Waste/Barren has been converted into Water Bodies.

VI.CONCLUSION

This study amply demonstrates the use of remote sensing and GIS to analyze the urban growth mapping and detect changes in urban land use and land cover for Peri-urban areas of Mysuru between 2001 and 2012. The spatial dynamics of Mysuru has a wide range of influence over its peri-urban growth. GIS and satellite images provide spatial inputs and test the spatial model describing the growth. The area covers and the rate of increase of built-up area between 2001 and 2012 helps us predict the future built-up area required for Mysuru peri-urban areas. Hence, the present study reveals that geospatial techniques play an essential role in quantifying spatial and temporal phenomena, thus providing valuable inputs for key stakeholders to formulate effective policies and Programmes to manage new growth in peri-urban areas in a planned and integrated manner.

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