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Change Recognition in Land-Cover Dynamics for Bangalore City due to Rampant Urbanization, using Quantum G.I.S.

Ramya R.[1], Rajesh Gopinath[1], Jayant Kumar Soren[2], Rohit Chourasia[2], Md. Izhar[2] and Anush M. Shetty[2]
[1]Faculty, [2]Scholar
[1,2]Department of Civil Engineering,
Acharya Institute of Technology
Karnataka, India

Abstract: *The present research engages Quantum G.I.S. as a tool in order to reflect on land-cover pattern changes of Bangalore region for the past 15 years, with the aid of satellite imageries that were downloaded and pre-processed as a part of the exercise. Training sets were marked that included different land-use patterns in the imagery and then the images were subsequently classified leading to the determination of area. The research unveiled that water-cover was worst affected with 69% loss, followed by green-cover at 5.2% loss. While there was meagre shift in loss of barren land, all these had subsequently contributed to a multi-fold rise in built-up spaces by 125% gain. The study inferred that the rampant urbanisation of Bangalore in the name of development has to be brought to a standstill and alternate plans needs to be devised with minimal environmental disturbance in terms of land-use pattern, and this can be achieved only if a tool such as Quantum G.I.S. is incepted in the planning stages itself.*

Keywords: *Bangalore; urbanization; Quantum G.I.S.; imagery; green cover; land-use.*

I. Introduction

Rampant urbanization under the guise of economic development and industrialization, leads to various negative socio-cultural and environmental impacts. In this context, Bangalore is experiencing an unprecedented urbanization with consequent problems such as overcrowding, traffic congestion, housing problem, unemployment, slums increment, environmental pollution, urban crimes, and loss of green cover etc. [1]. Invariably, this is an inadvertent consequence of rampant or ill town planning, and hence to ensure that Bangalore and other upcoming new townships are protected from further downfalls; necessary measures have to be incorporated by implementing proper and modernized town planning strategies/tools wherein there is complete information about presence of natural landscape so as to select the most suitable location for residential, industrial and commercial purposes with least ill-effects on environment [2]. Quantum G.I.S. in this context serves to provide the land-cover estimation with utmost accuracy. Essentially a cross-platform free and open-source desktop Geographic Information System application, Quantum G.I.S. provides data viewing, editing, and analysis capabilities [3].

II. Methodology

The present study focuses on ascertaining the rate of depreciation of natural terrain namely water-cover, green-cover, barren-land to support built-up spaces for Bangalore in the past few decades. The objective was arrived at by first procuring Cloud-free Satellite imageries of 2000 and 2015 from the website "glovis.usgs.gov" (location coordinates i.e. latitude 12.9667°N and longitude 77.5667°E), upon which Image pre-processing was conducted with aid of Quantum G.I.S. (Figure 1) for extraction of land cover pattern. Herewith, the 'merging procedures' were applied on the two panchromatic Landsat images for increasing the classification accuracy. After merging of images having various bands was accomplished; and colours red, blue and green were given to the bands leading to the creation of a shape file. Generally for more accuracy, maximum numbers of different land-cover ought to be classified. Further the accuracy check of classification is done and cross checked [3]. Eventually this led to determination of rate of change of land-use pattern for Bangalore city.

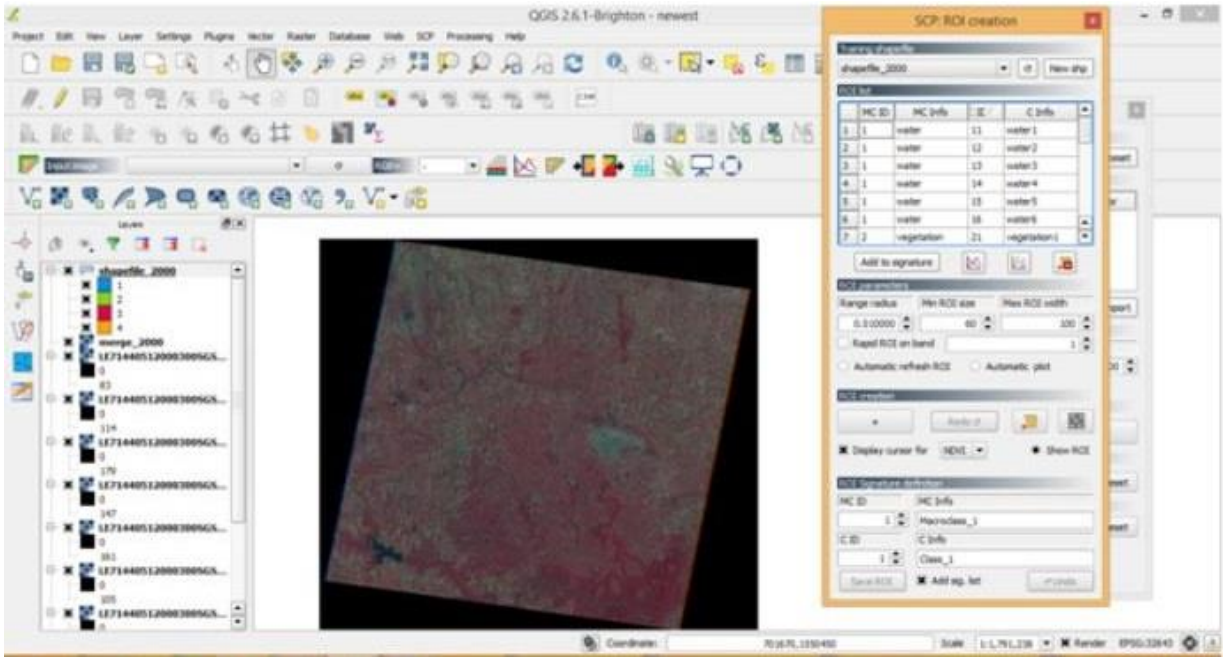
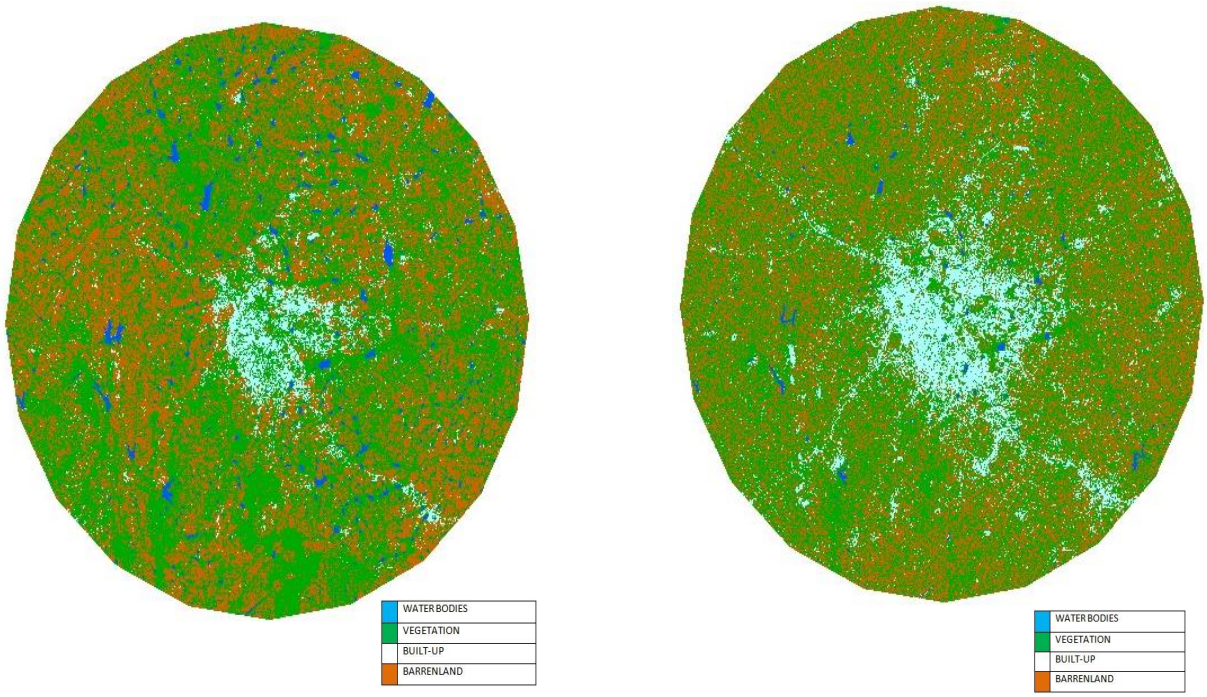


Figure 1: **A Screenshot of Quantum G.I.S. GUI with uploaded satellite image for Bangalore.**

III. Results and Inference

From the classified images Figures 2 [a] and [b], it can be easily observed that while the built-up area (represented by white colours) have increased immensely from 2000 to 2015, the presence of water bodies and vegetation (represented by blue and green colour respectively) have witnessed a downfall.



Figures 2 (a) and 2 (b): A Screenshot of Quantum G.I.S. GUI with uploaded satellite images for Bangalore, for 2000 and 2015 respectively.

The estimated areas as subsequently calculated from classified images have been tabulated in Table 1 and supports the visual theory. The classification of 2000 satellite imagery has revealed that about 147.528 km^2 area of Bangalore region was covered then with water bodies and vegetation covered about 3085.185 km^2 area. Also during this period, Built-up spaces which included residential buildings, industries, public sectors etc. covered

about only 278.203 km^2 area, and barren land covered about 2428.352 km^2 area. However, 15 years later, as can be observed from classification of 2015 satellite imagery; the water cover, green cover and barren land had got reduced to 45.701 km^2, 2922.878 km^2 and 2343.814 km^2 respectively. All along these losses had eventually got translated to increase in Built-up spaces, with a multi-fold increase to an area of 626.875 km^2, due to rapid urbanization and population explosion. Hence, the percentage occupancy was worst affected for water-cover and green-cover from 2000 to 2015, by 69% and 5% respectively. This consequently saw a mighty leap in built-up spaces by 125%.

Table I: Land-use distribution of Bangalore for 2000 and 2015.

Year	**2000 (km^2)**	**2000 (%)**	**2015 (km^2)**	**2015 (%)**	**2000 to 2015 (km^2)**
Facet	**Area**	**% Occupancy**	**Area**	**% Occupancy**	**Change in Area**
Water	147.528	2.48	45.701	0.77	101.827
Green cover	3085.185	51.95	2922.878	49.21	162.307
Built-up	278.203	4.68	626.875	10.55	- 348.672
Barren land	2428.352	40.89	2348.814	39.46	84.538

All along it can be realized that the percentage occupancy from 2000-2015 for water cover, green cover and barren land had reduced from 2.48 to 0.77%, 51.95 to 49.21% and 40.89 to 39.46% respectively, with direct influence on the percentage occupancy of the built-up spaces which rose from 4.68 to 10.55%. The aforementioned visual and statistical finding is a result of rapid industrialization and urbanization due to imminent population explosion in Bangalore city, as the district had got transformed to I.T. Hub. The impact of this was most suffered by the water bodies and vegetation, due to lack of proper policies and guidelines. As most of water bodies of Bangalore are seasonal and rain-fed, these were encouraged upon, and the corrupt practices of conversion and de-conversion led to most green-spaces losing out to residential, commercial and industrial enclaves. Hence, it becomes pertinent that the rampant urbanisation of Bangalore in the name of modernization has to be brought to a standstill and alternate plans needs to be devised such as satellite towns; and that also with assurance that there is minimal environmental disturbance in terms of land-use pattern, and this can be achieved only if tools such as Quantum G.I.S. are incepted early in the town-planning stages.

IV. Conclusion

The current study had focused on understanding urbanisation and town planning with their implications in the context of Bangalore and its land-use pattern over a 15 years period. Upon analysis, it was found that the built-up area was found to increase from 278.203 km^2 to 626.875 km^2 from 2000 to 2015. This increase literally translated to decline in area of water bodies from 147.528 km^2 to 45.701 km^2, green cover from 3085.185 km^2 to 2922.878 km^2, Barren land from 2428.352 km^2 to 2348.814 km^2. Hence it's evident that the percentage occupancy from 2000 to 2015 for water cover, green cover and barren land had reduced from 2.48% to 0.77%, 51.95% to 49.21% and 40.89% to 39.46% respectively. The percentage occupancy from 2000 to 2015 the built-up spaces i.e. from 4.68% to 10.55% respectively.

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