

URBAN GROWTH PROCESS OF GREATER KANDY DEVELOPMENT AREA: AN INVESTIGATION OF PAST, PRESENT AND FUTURE SCENARIOS OF GROWTH PATTERN

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Abstract

The purpose of conducting this study is to identify present and past spatiotemporal growth patterns of urban expansion in the Greater Kandy Development Area (GKDA). In addition, a comprehensive definition to detect the urban area by interacting with several geospatial data was developed. Specifically, Landsat images, nighttime light data, carbon data, population grid data, and schools, hospitals, and roads data were employed. Data demonstrated that the dynamic pattern of urbanization in GKDA resulted in progressive growth in built-up regions while lowering non-built-up areas. A high concentration of built-up areas along the road is vital by showing ribbon-type urban growth. Based on the developed definition, Aluth Pallekale and Madawala GNDs can be identified as "emerging urban nodes" in the area.

Keywords: *GKDA, Land use/cover changes, Urban growth, Projection, Urban definition*

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Introduction

The population living in urban areas in developing countries in 2018 was 50.6 percent and it will increase up to 65.6 percent in 2030. The present trend reveals that a higher level of urban growth will take place in developing countries. In parallel to this pattern, Sri Lanka being a developing country exhibits rapid urban growth mainly concentrating on the Colombo Metropolitan Region (CMR) in the urban landscape.

It is reported that the urban growth of Sri Lanka was prompted after the British arrival and tended to spread into the peripheral areas leading to “messy” urbanization. Today, Sri Lanka's urbanization is characterized by sprawl and ribbon development patterns, with signs of rapid expansion on the periphery of the CMR and along major transportation corridors (Maskorala and Daawansa, 2015) The World Bank (2014) estimated that up to one-third of Sri Lanka's population lives in rural areas with urban characteristics

UDA has launched a new project titled "Urban Area Development" to assist city and town dwellers in managing the negative impacts of suburbanization. The current policy environment in Sri Lanka focuses a heavy emphasis on the development of secondary cities. In addition to the western region, the continuous policy emphasis aims to develop the Greater Kandy Development Area, which stretches beyond the Kandy Municipal Council's 26.8 square kilometers and 45 Grama Niladari Divisions to over 210 square kilometers (Greater Kandy Development Plan, 2019). The proposed area for the current study has not been investigated properly. Not just Kandy, but also the Greater Kandy Area, is situated in an extremely environmentally fragile region. As in developed nations, thorough monitoring of the physical growth of urban areas is essential in this region. Several issues may arise if this environmentally sensitive area is degraded by urbanization. But there has never been a proper study to track and forecast the growth of urban centers in this region. This is why there are issues with urban growth in this region. This study examines the previous growth of the Greater Kandy Development Area and predicts its future growth. On the basis of these findings, a new method to assist and manage urban expansion will be developed in this region. Specifically, the methods employed to conduct this study will assist in predicting the urban expansion of another city.

Material and Methods

This study was based on secondary data. This study used secondary data from websites and literature reviews. Landsat data was downloaded through the official website of the United States Geological Survey (USGS). The nightlight data was obtained from NASA, Earth Science and Applied Science's

official website. The population grid data were collected from the official website of NASA Earth Data: Socioeconomic Data and Applications Center (SEDAC). The carbon data (CO₂ data) was obtained from the Center for Global Environmental Research's (CGER) official website. Data on urban functions, especially schools and hospitals, were collected by the national data archive. Data about roads were collected using 1:50000 metric maps.

LULC mapping is the most widely used in remote sensing for studying changes (Subasinghe et al.,2016). Using Landsat imagery from three selected years (2005, 2011, and 2020), LULC maps were created to examine the land-use changes. This process mainly includes several steps. Classification of Landsat Images is the first step. The pixel-based-supervised classification was employed to generate 3 land use maps of selected years. The accuracy of each land use map was checked by using randomly selected 100 points for each year. For this, Google Earth TM images were used. Using a particular formula, land use changes for 2005–2011, 2011–2020, and 2005–2020 were identified.

Predictions were made for the Greater Kandy Development Area using TerrSet software's multi-layer perceptron neural networks (MLP NN) and CA-Markov modules. These modules can be used to forecast future land usage and cover from one point in time to the next. By combining multi-criteria, particular definitions for urban areas were prepared. Nighttime Light Data (NLTD), carbon data (CO₂ data), distance from schools, distance from roads, and distance from hospitals were the criteria used to prepare the definition.

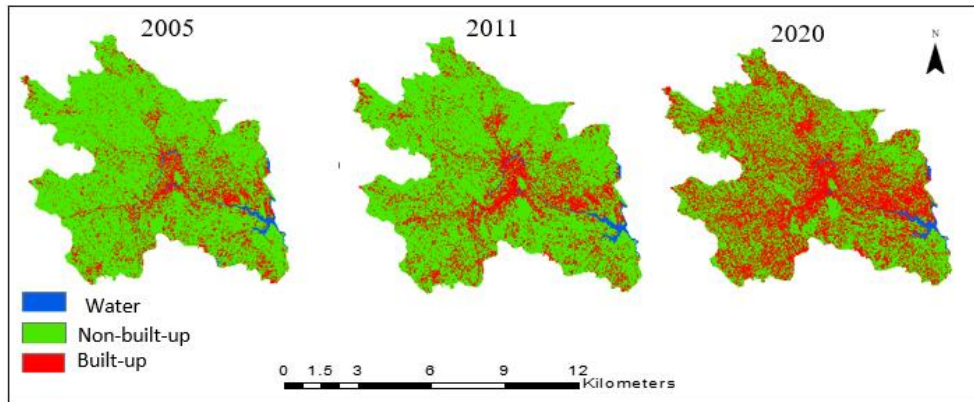
Results and Discussions

According to the analysis, after 2011, the urban growth in GKDA has become more visible. (Figure 1)

The east part of the city shows the start of the development of built-up areas. In 2005, 489.34 thousand hectares of land was non-built-up, and that fell to 462.36 thousand hectares or 77.45% in 2011. In 2020, it continued to decline to 350.99 thousand hectares or 58.79% of the total area.

Figure 1:

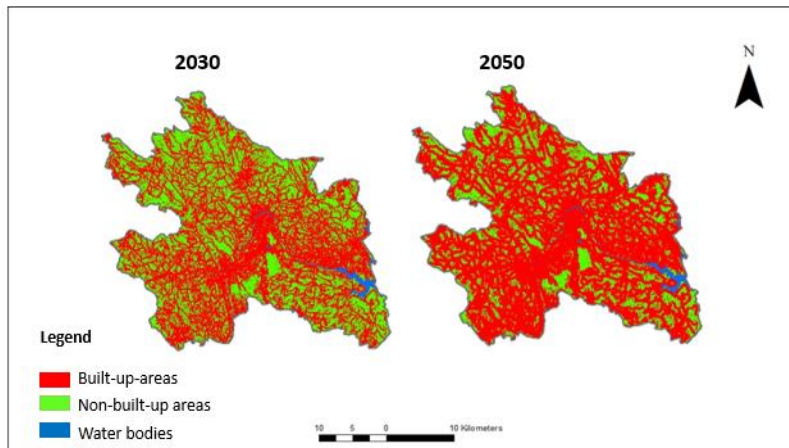
Land Use/Land Cover (LULC) changes in GKDA in 2005, 2011 and 2020



The region located in the center of the study area exhibits the greatest increase in built-up areas. Of the study areas, the urban areas are located in the middle, but urbanization is more prevalent in the south and west. When non-built-up regions are taken into account, the majority of forest areas outside of protected zones have deteriorated significantly.

Figure 2:

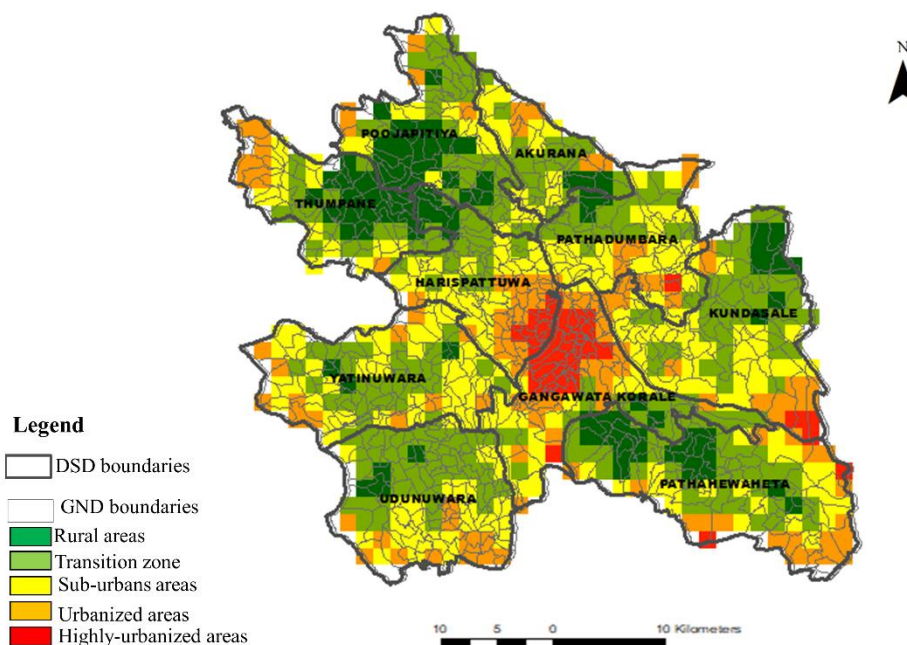
Predicted LULC maps of GKDA for years 2030 and 2050



In 2011, 77.45% of the land, or 462,36 thousand hectares, was undeveloped in the GKDA. After the year 2020, water bodies exhibited neither gain nor loss. The total land area will increase to 338,57 thousand hectares by 2030. In 2050, 447,61 thousand hectares, or 74.98% of land area, will be included.

Figure 3:

Spatial distribution pattern of urban areas in GKDA according to the newly created definition



In GKDA, Kandy MC is the only municipal council area. Almost all the land extent within the city boundary shows at least suburban characteristics (Figure 3). The large area of the northern part of the Udunuwara Divisional Secretariat Division (DSD) demonstrates transition characteristics. As a result of urban growth exceeding the city boundaries, urban growth starts to spread towards the adjacent Harispattuwa DSD. Aluth Pallekale Grama Niladari Division (GND) indicates highly urbanized characteristics and surrounding areas also show urbanized as well as suburbanized characteristics.

Conclusion and Recommendations

Potential migrants from rural to urban areas find Sri Lanka's cities unappealing. Sprawl and development patterns are a representation of their "messy" urbanization. As Sri Lanka's first completely unbounded metropolis, Kandy city is starting to grow beyond its physical confines. The amount of non-built-up areas has been replaced by the expansion of developed land as a result of the rise in urbanization.

The growth of the city has increased the demand for land. The Yatinuwara, Akurana, and Poojapitiya DSDs frequently experience flash floods. 79 % of

historic structures are found in the city center, according to the World Heritage Committee. A development plan with a clustered pattern of growth (2008–2020) was envisaged in the Greater Kandy Development Plan. The LULC maps unequivocally show how the city center is becoming a business concentration.

There are many educational institutions located all across the city of Peradeniya. The central business district of the city is where the majority of KMC's urbanized areas are located. Numerous urban problems have been caused by urban sprawl and ribbon development along important transportation lines. Due to the underuse of natural resources, rural economies are experiencing economic stagnation. The only municipal council area in the Greater Kandy Area is Kandy MC.

Only a few sites show signs of suburbanization, whereas the majority of the remaining regions display characteristics of urbanization. It is possible to disregard growth that takes place outside of metropolitan zones in urban peripheries as not being urban.

Due to the lack of adequate monitoring of urban expansion in Sri Lanka, Kandy can be identified as the second unbounded city in Sri Lanka. There is a special need for a new policy to further control the growth of the city. It is essential to plan a proper urban defense system.

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