CAUSATIVE FACTORS OF URBAN SPRAWL IN THE HOMAGAMA DIVISIONAL SECRETARIAT DIVISION

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Urban sprawl is the unplanned outward expansion of cities towards suburban areas, which often disrupts natural landscapes and resources. Hence, various causative factors contribute to this continuous expansion in suburban areas. Among them, population and road networks play a crucial role because of high automobile dependency and a liveable residential environment in suburban areas. Accordingly, this study aims to investigate the causative factors of urban sprawl in the Homagama Divisional Secretariat Division (1992-2022). To achieve this objective, the satellite images in 1992, 2007, 2017, and 2022 were downloaded from Google Earth Pro, using a 1:20,000 grid reference, and digitized the entire buildings. The road network data for 1992, 2007, and 2017 were collected from the Urban Development Authority (UDA) in Sri Lanka. Moreover, the road network data in 2022 was downloaded from the "Open Street Map" database utilizing the OSM tool in QGIS. Population density maps for 2000, 2007, 2017, and 2020 were downloaded from the "Worldpop" data source. Furthermore, the linear buffer zones with a 1,000 m radius were used to identify the buildings along with primary and secondary roads. As the result, population densities have gradually increased due to migrations of middle- and low-income individuals who cannot afford to live near the Central Business District (CBD) and opt for areas with somewhat developed infrastructure located further from the CBD. Consequently, some apartment complexes are mainly concentrated in Panagoda, Homagama, and Kahathuduwa. Many people have considered purchasing apartments rather than constructing their own houses. The correlation revealed a positive relationship (0.9962) between the population densities and building densities. In particular, the buildings, along with primary and secondary roads, gradually increase by improved accessibility and connectivity. This has further exacerbated sprawl in the study area. Moreover, this trend results in a linear pattern of buildings along these roads, particularly showcasing the growth of commercial buildings rather than residential buildings. According to the findings, it is essential to implement a sustainable urban development master plan to address the social, economic, and environmental challenges arising from high automobile dependency and competition for land acquisition.

Keywords: Geographic information system, population density, road network, urban sprawl.

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INTRODUCTION

Urban sprawl is an undesirable land use pattern with uncontrolled and unplanned expansion of the cities toward the countryside (Karakayaci, 2016). In particular, it is often associated with advancements in mass transportation because of facilitates improved accessibility and connectivity with Central Business Districts (Duany et al., 2000; Ewing et al., 2003). Accordingly, several causative factors like population increase, socio-economic development, and technological development directly influence increasing in the intensity of the urban sprawl. Among them, the population and transportation network play a crucial role in fulfilling the high automobile dependency and providing a liveable residential environment. Moreover, the causative factors vary to determine the urban sprawl levels in different geographical areas, especially suburban areas (Giyarsih & Fauzi, 2017). Thus, the research problem emerged: What are the causative factors of urban sprawl in suburban areas? Most empirical studies have focused on the causes and consequences of urban sprawl. However, they have not specifically discussed the causes of urban sprawl in suburban areas (Habibi & Asadi, 2011). Notably, Giyarsih & Fauzi, (2017), examined the causes of urban sprawl in the Yogyakarta suburban area, China, identifying education as the primary factor. Among local empirical research, most studies have broadly addressed urban sprawl and its causes/consequences in the Colombo metropolitan area, with only a few focusing on sprawl in outer urban regions like Kandy. Nevertheless, there is a notable lack of literature considering the causative factors in suburban areas. Therefore, to fill this research gap, this study seeks to investigate the causative factors, especially using the number of buildings, population, and road network.

This study significantly contributes to identifying the primary causative factors for urban sprawl in suburban areas. Additionally, the urban planners and policymakers can control the unplanned urban sprawl and work along with effective land use planning, combining with sustainable development strategies. Moreover, the most appropriate urban plan for the suburban areas can be introduced by preserving the natural landscapes and resources. However, the study is mainly based on secondary data like population and road network, which is one of the limitations of this study. Moreover, this study did not consider socio-economic factors such as land prices, people's income, private car ownership, housing preferences, and so on. Accordingly, future studies including these components would provide a comprehensive understanding of the most powerful causative factors to determine the intensity of urban sprawl in suburban areas. Accordingly, this study's objective is to investigate the causative factors of urban sprawl in the Homagama Divisional Secretariat

Division (1992 – 2022).

METHODOLOGY

Study area

Homagama ds division, located in the colombo district of western province, was selected as the study area, covering an area of 121.0 km². This area is a rapidly changing suburban area with 81 GNDs.

Data, material, and method

This study utilized building layers, road layers, and population data to achieve its objective. Accordingly, satellite images (table 01) in 1992, 2007, 2017, and 2022 were downloaded from Google Earth Pro using a 1:20,000 grid reference, and digitized all buildings. Moreover, the road network data for 1992, 2007, and 2017 were collected from the Urban Development Authority, and the "Open Street Map" database was used to download the road network in 2022. In particular, the linear buffer zone analysis with a 1,000 m radius was used to identify the number of buildings along with every primary and secondary road for the respective years. Additionally, population densities for 2000, 2007, 2017, and 2020 were downloaded from the "Worldpop" data source. Afterward, the correlation was checked to identify the relationship between building density and population density.

Table 01: Details of downloaded satellite images

Sensor	Resolution	Projection	Data Acquired
Landsat 4-5 TM C2 L2	30*30 m	UTM WGS_1984	3/13/1992
Landsat 4-5 TM C2 L2	30*30 m	UTM WGS_1984	1/2/2007
Landsat 8-9 OLI/TIRS C2 L2	30*30 m	UTM WGS_1984	12/22/2017
Landsat 8-9 OLI/TIRS C2 L2	30*30 m	UTM WGS_1984	12/31/2022

(Source: United States Geological Survey, 2024)

RESULTS AND DISCUSSION

Number of buildings

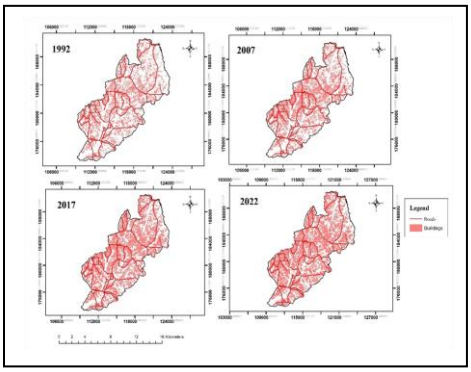

Figure 01: Buildings in the study area

According to the analysis, the number of buildings (Figure 01) was approximately 43,202 in 1992, 58,770 in 2007, 82,091 in 2017, and 95,291 in 2022. These buildings have proliferated throughout the study area from 1992 to 2022. Among these growth periods, there was a significant increment in the buildings between 2007 and 2017 by adding approximately 23,321 buildings.

Population density

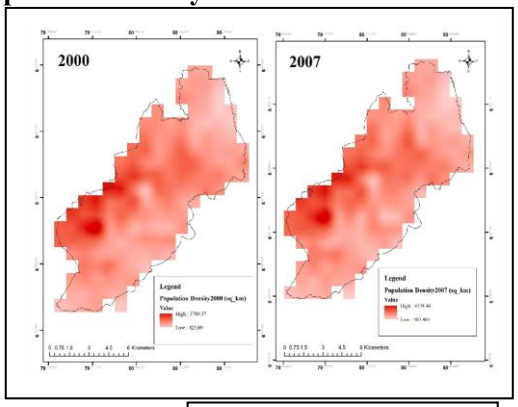

Figure 02: Population density (2000, 2007).

The population densities (Figure 02; 03) were approximately 3,789.37 km2 in 2000, 4,546 km2 in 2007, 5,602 km2 in 2017, and 5,977.08 km2 in 2020, showing an upward trend within the considered period. Primarily, the study area provides adequate geographical spaces and accommodations for population growth.

Road network

The road network provides evidence of an increase in the number of buildings along primary and secondary roads, facilitated by improved accessibility and connectivity (Figure 04). In particular, most of the buildings have spread along the secondary roads rather than the primary roads. In particular, approximately 8,761 in 1992, 40,066 in 2007, 53,318 in 2017, and 59,805 in 2022 buildings were situated within the buffer zone along with the secondary roads. Finally, the correlation revealed a positive relationship (0.9962) between the population densities and building densities in the considered period. According to the results, people's migration and establishment of their permanent settlements were dramatically progressing from 1992 to 2022. Hence, barren lands have been subdivided and made available for sale, particularly in areas such as Maththegoda, Hidigala, and Godagama. Moreover, several infrastructure development projects like "Homagama Bypass Construction", "Homagama Mega Development City", "Middle Income Housing Programme", encouraged

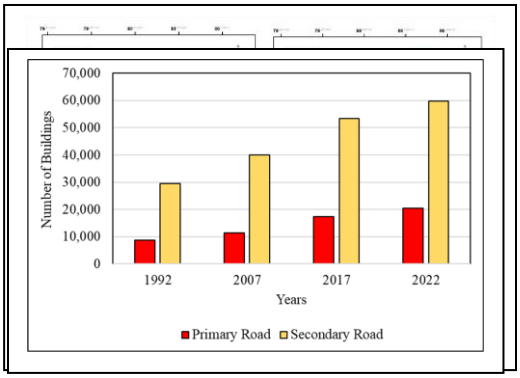

Figure 04: Urban sprawl with road network.

people's migrations, especially middle-income people. Furthermore, the apartment complexes are predominantly located in areas like Panagoda, Homagama, and Kahathuduwa. As a result, people frequently choose to buy apartments rather than construct their own houses. Additionally, the road network development with high accessibility and connectivity has been facilitated to centralize people's settlements and commercial buildings along the road network and keep a continuous connection with the CBD.

CONCLUSIONS/RECOMMENDATIONS

In conclusion, people's continuous migrations and the development of the road network are the main causative factors of urban sprawl in this area. Accordingly, a sustainable urban development master regional plan, like controlling unplanned sprawl, must be introduced to address the social, economic, and environmental challenges arising from high automobile dependency and competition for land acquisitions.

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