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MODELING URBAN GROWTH BASED ON TRANSPORT AND ACCESSIBILITY CHANGES IN KURUNEGALA

Farasath Hasan[1], Amila Jayasinghe[2]
University of Moratuwa.
[1]*farasathhasan5@gmail.com,*
[2]*amilabjayasinghe@gmail.com*

ABSTRACT - This research uses spatial modeling techniques to assess how urbanization is affected by transportation andaccessibility in Kurunegala. It has been built on an approach to simulate urban growth patterns by examining a wide range of variables, such as land use, excluded areas from development, slope, and road network. The findings indicate that improvements in transportation and ease of access have a major bearingon urban development, especially in regions with higher population density and economic activity. The level of urbanization considering road influence is 6.78%, and when it is not considered it is 13.13%. The study used a CA model for comparing and contrasting the simulated results with the Agent-based (Net Logo) modeling outputs. The results generated from the CA-Python simulation, the level of urbanization was obtained as 11.12% and the results are quite similar when it is not considering the road-influenced growth. Accordingly, when road influence growth is considered, less urban dissemination can be observed and the results can be emphasized using the CA model. The model validation of the derived results was done using the urbanization level and the comparison of the level of urban area expansion. The validation of the CA-Python results was done using the same model itself.

Keywords: Spatial modeling; Transportation; Accessibility; Land-use; Population-density.

1. INTRODUCTION

This approach, using an agent-based modeling framework, checked how road-influenced urban growth would alter the normal urban growth process. The main objective of this research is to simulate the urban growth within Kurunegala with and without the influence of roads and compare the results generated with the CA model. Combining geospatial analysis, transportation modeling, and urban planning may simulate city expansion in response to alterations in transportation and accessibility [1] Policymakers are very interested in questions related to the scale, causes, velocity, and geographical pattern of urbanization. It has been stated that the three most important elements affecting modern modifications to land use are accessibility, neighborhood relationships, and spatial policies [2]. It is widely held that transportation infrastructure may encourage and direct urban expansion by increasing convenience [3]. It is a well-known fact that urbanization tends to happen close to already-established urban centers. This can be seen in the way cities grow outward from their centers or in the way suburbs form around large cities [4]. Most studies that look at the long-term effects of transportation infrastructure use growth and urbanization as a measure of population change. The spread of rail networks has changed the way people live and helped more people move to cities, though the effect has been different in different places and at different times [4]. Thus, the contemporary literature reveals the following research gaps. The first one is, there is a significantknowledge gap when it comes to studying the impact of road accessibility on urban expansion across a variety of urban growth scenarios. [3] The second one is the use of sophisticated modeling approaches to examine the interconnected dynamics of road availability and urban expansion [4]. Finally, further studiesare required to provide evidence-based insights into the correlation between road accessibility and urban growth [4].

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2. MATERIALS AND METHODS

The study has utilized an agent-based model (Net Logo) while emphasizing the road of uninfluenced growth. Five coefficients had been used for the change analysis such as dispersion, breed, spread, slope, and road gravity coefficients. The dispersion coefficient assesses the spontaneous growth, the breed coefficient emphasizes the new spreading center growth, the spreading coefficient emphasizes the edge growth, and slope coefficient highlights the building ability on the ground, and the rg_coefficient assesses the road gravity which relates to the maximum search distance for a road. By changing these coefficients, it has been primarily targeted to predict future urban growth and compare the generated results with the cellular-automata Python model. The simulation from the Net Logo could be done both using the road-influenced growth as well as without the influence.

2.1. Research design

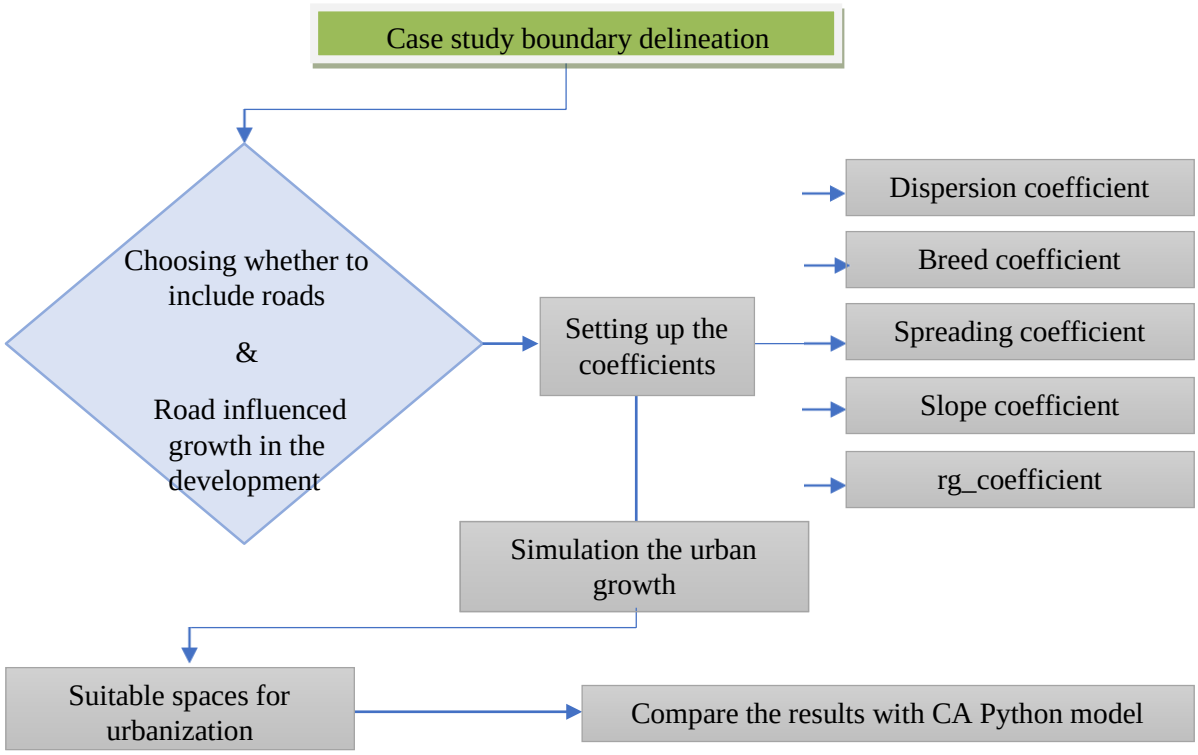

Figure 1. Research Design

3. RESULTS AND DISCUSSION

For the CA Python model simulation, variables such as land use, slope, distance to amenities, and distance to roads were used. When the Net Logo simulation is done without considering road-influenced growth (Figure 1), it can be identified that the simulation done with CA Python is quite similar. Also, road-influenced growth is predominantly limited along the main arteries. Additionally, the area's current urban concentrations do not have a significant impact on it. The level of urbanization is not the same when the accessibility of the roads and the influence of transportation are considered in the simulation framework. Therefore, through the simulation results, when road accessibility is exerted on the expansion, the development cannot be identified as much impacted, and an even dissipation of urban activity can be identified along the roads. The level of urbanization considering road influence is 6.78%, and when it is not considered, it is 13.13%. not considering the road-influenced growth (Figure 2) and considering it (Figure 3). Accordingly, the accuracy is a little bit higher when it is not considering the road influence. Additionally, based on the results generated from the CA-Python simulation, the level of urbanization was obtained as 11.12% and the results are quite similar when not considering the road-influenced growth.

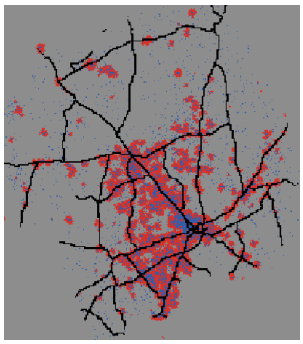

Figure 2. Without road influence

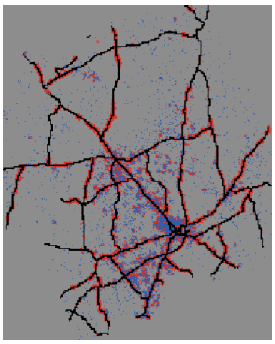

Figure 3. Considering road influence

3.1. Comparison with CA Python model –without considering the road-influenced growth

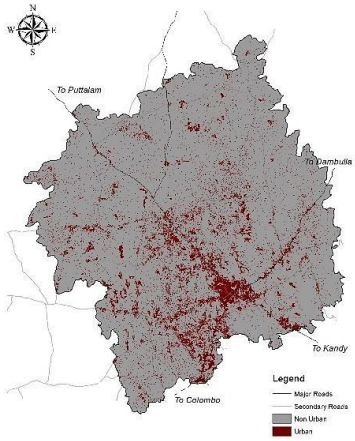

Figure 4. CA simulation

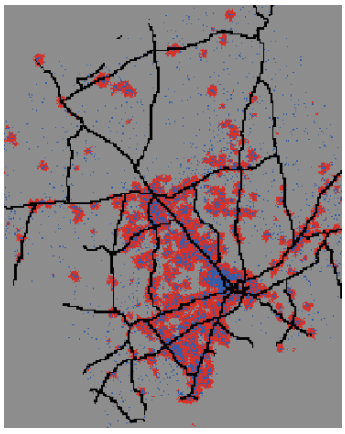

Figure 5. Without road influence

4. CONCLUSION

This study examined how urban growth is differentiated within the Kurunegala town center when road accessibility is impacting the simulation process. An agent-based model, (Net Logo) was used to compare and contrast the results with the CA Python model results. The CA Python model simulation for road-influenced development revealed that road accessibility has a substantial effect on urbanization levels. When road influence is taken into account, the level of urbanization is less than when it is not. This is because road accessibility promotes the even dispersion of urban activity along roads, resulting in a lower level of urbanization overall. The simulation accuracy of the CA Python model is also improved when road influence is disregarded. This is because road influence makes the model more sensitive to the current urban concentrations.

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