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MODELING FUTURE URBAN GROWTH AND AGRICULTURAL LAND DYNAMICS IN CENTRAL BANGLADESH USING A MACHINE LEARNING APPROACH

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Abstract

With increasing population and urbanization being a prevailing trend in developing countries, Bangladesh is experiencing a significant urban shift. Gazipur, the industrial hub of Bangladesh, is at the forefront of this urbanization surge driven by development activities. This study employs a machine learning algorithm to forecast the future state of Gazipur district. Landsat images spanning from 1990 to 2020, with a decadal interval, were utilized. The supervised classification scheme, employing the maximum likelihood classifier, was applied in the analysis. The prediction phase incorporated the Cellular Automata- Artificial Neural network algorithm. The study reveals an estimated urban area of 124.5 km^2 by 2030, signifying an expansion of approximately 20 km^2 during 2020 to 2030. This equates to an annual urban growth rate of 2 km^2, accounting for a 19.7% expansion. The study also reflects the direction of urban expansion, with south, south-west, and north zones exhibiting higher urbanization levels due to their proximity to Dhaka, the capital of Bangladesh, and key transportation routes such as the Dhaka-Mymensingh highway and Dhaka bypass. Notably, this rapid urbanization exerts significant pressure on agricultural land, which would reduce to 594 km^2 by 2030, potentially conflicting with the attainment of Sustainable Development Goal (SDG) 2 (End hunger, achieve food security and improved nutrition, and promote sustainable agriculture). This approach will help policymakers promote integral planning, collaboration, and capacity-building, ensuring long-term sustainable growth while protecting the environment.

Key words: cellular automata-artificial neural network, urban expansion, machine learning, maximum likelihood classifier, land use/land cover change, agricultural land loss, sustainable development goal 2

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