Does building development in Dhaka comply with land use zoning? An analysis using nighttime light and digital building heights

Rahman, M.M.

Avtar, R.

Ahmad, S.

Inostroza, L.

Misra, P.

Kumar, P.

Takeuchi, W.

Surjan, A.

Saito, O.

Abstract

Zoning is an important tool to regulate the use of land and to characterize built form over land, and thus to facilitate urban sustainability. Availability of reliable data is crucial for monitoring land use zoning, which contributes directly to the success of the Sustainable Development Goals (SDGs) in general, and SDG Goal 11 for sustainable cities and communities in particular. However, obtaining this valuable information using traditional survey methods is both costly and time-consuming. Remote sensing technology overcomes these challenges and supports urban policymaking and planning processes. This study unveils a novel approach to developing a cost-effective method for identifying building types using Sentinel-2A, Visible Infrared Imaging Radiometer Suite (VIIRS)–based nighttime light (NTL) data, and TanDEM-X–based Digital Surface Model (DSM) data. A newly developed index for this study, the Normalized Difference Steel Structure Index (NDSSI), is useful for rapidly mapping industrial buildings with steel structures. The implementation status of Dhaka's existing land use plan was evaluated by analyzing the spatial distribution of different types of building uses. This study classifies residential, commercial, and industrial buildings within Dhaka using building height, and nighttime light emission. The experimental results reveal that about 67% of commercial and 51% of industrial buildings within the Dhaka Metropolitan Area (DMA) do not comply with the land use zoning by the Detailed Area Plan (DAP). It also reveals that approximately 10% of commercial buildings, 9% of industrial buildings, and 6% of residential buildings have encroached upon conservation zones (such as open space, flood-prone zones, water bodies, and proposed areas for future road extension). A major constraint in the study was the low spatial resolution of the nighttime light dataset, which made it difficult to distinguish individual sources of light. Still, the methodological approaches proposed in this study are expected to promote reduced costs and efficacious decision-making in urban transformation and to help achieve SDG 11, especially in developing countries.

Urban planning
Urban sensing