Modelling urban green space accessibility to evaluate Sustainable Development Goal 11.7, case study of the Monterrey Metropolitan Area

Huerta-Garcia, Roberto E. [1]; Yépez-Rincón, Fabiola D. [1]; Ferriño-Fierro, Adrián L. [2]; Guerra-Cobián, Víctor H.[3]

[1] Universidad Autónoma de Nuevo León, Geomatics Department, Civil Engineering Faculty, Mexico – roberto.huertagc@uanl.edu.mx, fabiola.yepezrn@uanl.edu.mx
[2] Universidad Autónoma de Nuevo León, Liaison Subdirectorate, Civil Engineering Faculty, Mexico – adrian.ferrinofr@uanl.edu.mx,
[3] Universidad Autónoma de Nuevo León, International Water Center Department, Civil Engineering Faculty, Mexico – victor.guerracb@uanl.edu.mx

Keywords: SDG 11.7 monitoring, urban green space equity, network analysis, green infrastructure

1. Introduction

Adopted in the 2030 Agenda for Sustainable Development, the Sustainable Development Goals (SDGs) represent a global framework for achieving a sustainable future by addressing critical global challenges. Comprised of 17 interconnected objectives with specific targets to be reached by 2030, the SDGs aim for transformative action across various sectors.

Unprecedented urban growth threatens unprepared cities with sprawl, pollution, and limited green spaces, jeopardizing vulnerable populations. SDG 11.7 targets building inclusive, sustainable cities by emphasizing universal access to safe public spaces, especially for those most in need.

Accessible urban green spaces (UGS) within walking distance are crucial for city dwellers' well-being, particularly vulnerable populations (SDG 11.7). Studies (Takano et al., 2002) show their positive impact on longevity. Researchers employ diverse methods to model UGS accessibility, including remote sensing data (Texier et al., 2018), neighbourhood patterns (Tian et al., 2017), and network analysis considering proximity, density, and infrastructure (Coombes et al., 2010; Farfán Gutiérrez et al., 2021).

Uneven UGS distribution in Mexican cities (Huerta, 2022; Ruíz-Luna et al., 2019; Ayala-Azcarraga et al., 2023) underscores the need for UGS accessibility assessments to promote environmental justice, urban sustainability, and effective urban planning.

2. Objective

In this work we generated a UGS accessibility model that allowed us to evaluate the status of SDG 11 target 11.7 for the Monterrey Metropolitan Area using data generated from a synergy of very high-resolution satellite imagery and deep learning techniques.

3. Material and Methods

The study area encompasses the Monterrey Metropolitan Area (MMA), an urban region in northern Mexico comprising the state capital, Monterrey, and eleven surrounding municipalities, with a total area of 7,657 km² and a population of 5,341,171 inhabitants in 2020, exhibiting an average urban density of 108.3 inhabitants per hectare.

High-resolution UGS data produced with deep learning techniques (Huerta et al., 2021) and census data (INEGI, 2020) were used to model accessibility for total population and SDG 11.7 groups. Network analysis (Farfán Gutiérrez et al., 2021) with 300 m buffer and 100 m intervals defined accessibility levels (high, medium, low, none) based on walking distance to UGS centroids. The process of the information was done in ArcGIS software, requiring the UGS access point generation, network topology correction and network analysis.

4. Results and discussion

Maps of the results were generated for each county present in the MMA. As is appreciated in the example of the result obtained for the municipality of Monterrey in Figure 1, the maps reveal the disparity of the UGS accessibility in the counties of the MMA.

Spatial join between the UGS accessibility results and block polygons with population information revealed the accessibility levels for the total population and SDG 11.7 groups in the MMA (Figure 2). As shown in the graphs, most of the people of each group have no access to UGS at a 300m walking distance.

5. Conclusions

UGS accessibility modelling enable the generation of updated maps and indicators that serve decision-makers to understand the current situation of UGSs in terms of their geographical location and accessibility. As observed in the results, there is a lot of work to be done related to the resilience of SDG 11.7 groups in the MMA.

6. References

Takano, T., Nakamura, K., & Watanabe, M. (2002). Urban residential environments and senior citizens' longevity in megacity areas: The importance of walkable green spaces. Journal of Epidemiology and Community Health, 56(12), 913-918. doi.org/10.1136/jech.56.12.913

Texier, M. Le, Schiel, K., & Caruso, G. (2018). The provision of urban green space and its accessibility: Spatial data effects in Brussels. PLoS ONE. doi.org/10.1371/journal.pone.0204684

Full list of references will be added in the final camera-ready paper.

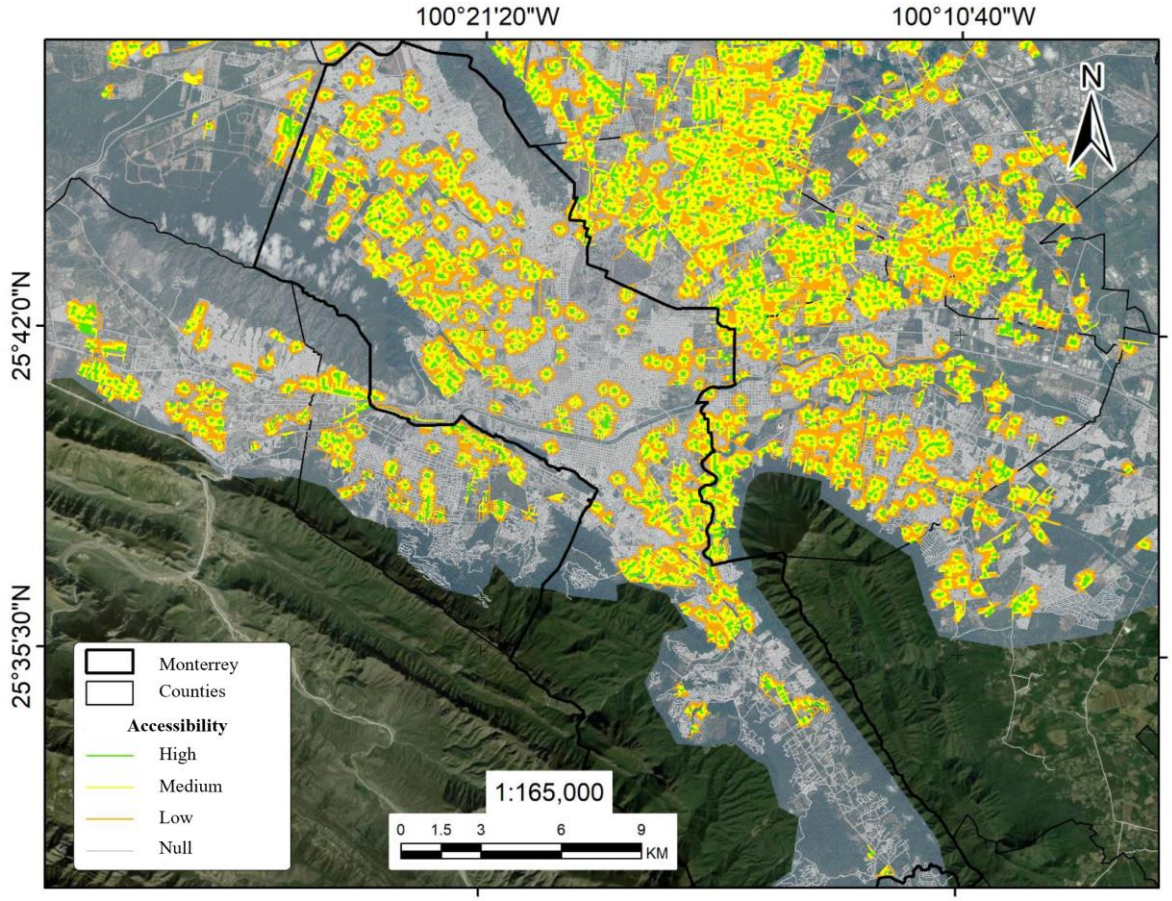

Figure 1. UGS accessibility in Monterrey, México.

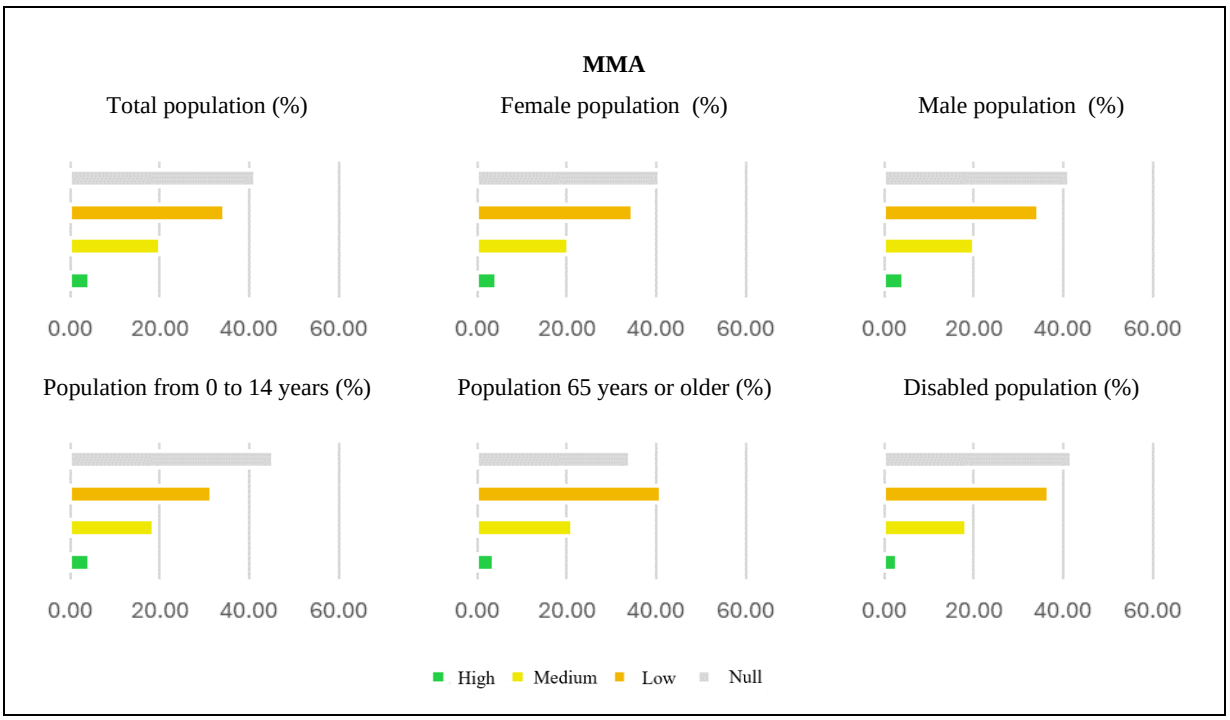

Figure 2. Graphs of SDG 11.7 groups UGS accessibility for the MMA.