

Spatial Decision Intelligence for Sustainable Cities: A Causal GeoAI Framework for Equitable Land Value Capture and Investment Planning in Turkish Metropolises

Mehmet Alkan and Okan Yılmaz (Türkiye)

Key words: Cadastre; Land management; Land Policies; Strategic Site Selection; Land Value Capture; Causal Machine Learning; Spatial Decision Support System

SUMMARY

Public infrastructure investments and planning interventions in urban areas generate unearned increments in land values. The public capture of these increments forms the basis of sustainable urban financing. However, the effectiveness of Türkiye's Land Value Capture (LVC) instruments remains contested, as a substantial share of the planning-induced land value uplift accrues to landowners, resulting in significant resource leakage. It leads to the concentration of land rent within certain private interests and highlights the critical need for a rational, data-driven mechanism capable of efficiently and equitably recapturing the value created through public actions. To address this institutional and technical gap, the study proposes a five-stage hybrid spatial decision-support framework for equitable LVC and strategic site selection of public facilities. The workflow begins with land/property value modelling using machine learning techniques and identifies the correlational value drivers through explainable artificial intelligence tools. In the next stage, a causal machine learning analysis is proposed to estimate the specific causal impact of a "treatment"—such as access to a new facility—on land value while controlling for all other factors. The estimated treatment effect is then integrated with spatial impact diffusion modelling and cluster analysis to compute the citywide propagation patterns of value uplift associated with any proposed investment. Building upon this global impact, the methodology incorporates an optimisation module that generates the most efficient, spatially balanced, and equity-sensitive investment scenarios for each public facility type. Finally, investment prioritisation is determined through a Multi-Criteria Decision-Making Analysis, which synthesises causal impact outputs with LVC objectives, planning standards, and other spatial-institutional criteria. The proposed framework is expected to provide Turkish public authorities with a robust, evidence-based LVC instrument and to scientifically substantiate the contribution of public investments to equitable and sustainable urban development.

Spatial Decision Intelligence for Sustainable Cities: A Causal GeoAI Framework for Equitable Land Value Capture and Investment Planning in Turkish Metropolises (14109)
Mehmet Alkan and Okan Yılmaz (Türkiye)

FIG Congress 2026
The Future We Want - The SDGs and Beyond
Cape Town, South Africa, 24–29 May 2026