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ADVANCED GIS-BASED SPATIAL DECISION SUPPORT SYSTEM FOR OPTIMIZING PUBLIC LAND USE IN BUKHARA CITY (FOCUSING ON MULTICRITERIA ANALYSIS AND GEOSPATIAL INTEGRATION)

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Abstract. *This article presents a novel decision-support approach for the optimal management of public use land (markets, parks, squares, recreational areas, sports complexes, libraries, and museums) in Bukhara city using geoinformation technology. The study builds upon Paragraph 3.2 of the doctoral dissertation and introduces a geospatial model combining Analytic Hierarchy Process and Weighted Linear Combination to determine the most suitable land plots. Multicriteria parameters including accessibility, environmental impact, population density, and infrastructural availability were processed in a GIS environment to produce weighted suitability maps. The article demonstrates how advanced spatial decision systems can assist urban managers in sustainable spatial planning.*

Keywords*: public land use, spatial decision support, AHP, WLC, GIS, Bukhara, land suitability.*

INTRODUCTION. Urban public land, particularly spaces accessible to all citizens, plays a vital role in the social, economic, and environmental wellbeing of cities. However, rapid urbanization, inadequate spatial planning, and limited monitoring capacities have compromised the efficiency of public land utilization in Uzbekistan. There is an urgent need to move from conventional methods of site selection and management to geoinnovative, data-driven approaches that can integrate multiple criteria, stakeholder preferences, and real-time spatial data.

In this context, Bukhara city, with its complex urban morphology and increasing development pressure, serves as a compelling case study. The objective of this research is to apply a multicriteria spatial decision support system that integrates AHP and WLC methods with geospatial data layers to identify optimal locations for expanding or enhancing public land use functions.

Methodology and Core Analysis

Criteria Framework and Data Collection. The methodology began by defining evaluation criteria relevant to public land use planning:

- Proximity to residential areas
- Distance from major roads
- Land slope (topography)
- Land use compatibility
- Environmental sensitivity (proximity to green zones)

• Access to utilities and public transport

Each criterion was standardized using raster-based geoprocessing in ArcGIS Pro. Expert surveys were conducted among local urban planners and academics to determine pairwise weights using the Analytic Hierarchy Process (AHP). Consistency Ratio (CR) was calculated to ensure logical consistency (CR = 0.06).

Weighted Overlay and Suitability Analysis. Using the Weighted Linear Combination (WLC) model, each raster criterion was reclassified and multiplied by its corresponding weight. The cumulative weighted sum produced a suitability map with five classes: very high, high, moderate, low, and unsuitable. Table 1 below summarizes the classification output:

Suitability Class	Area (ha)	Percentage of Study Area
Very High	135.4	11.8%
High	284.7	24.9%
Moderate	397.1	34.7%
Low	223.5	19.5%

Raster outputs were then converted to vector format to identify specific parcels. GIS buffering and spatial join techniques were used to link suitability with cadastral attributes.

Result Interpretation. The spatial analysis revealed that:

• Northern and southwestern districts of Bukhara have the most potential for new recreational spaces and green infrastructure.

• The central area, while densely populated, faces space constraints and thus favors vertical development (e.g., rooftop parks, cultural centers).

• Eastern zones were mostly unsuitable due to environmental and land-use conflicts.

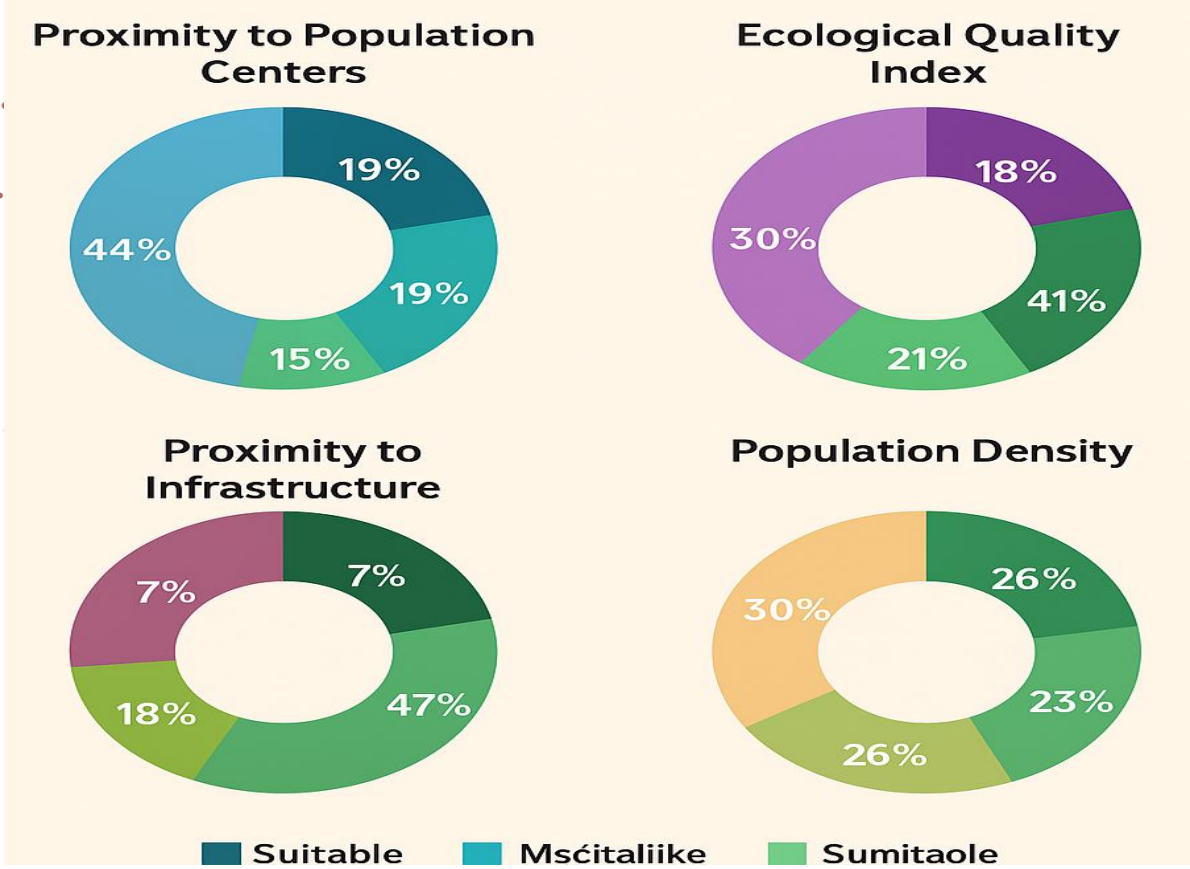
Figure 1 shows the resultant suitability map. This figure visually presents the outcome of the AHP-WLC-based geospatial analysis, highlighting zones ranked by suitability for public use expansion.

Extended Visual Interpretation and Diagrams. To enhance decision-making, additional visualizations and thematic breakdowns were developed based on four dominant criteria:

1. **Accessibility to Residential Areas** – depicted through a heatmap to highlight underserved zones.
2. **Environmental Compatibility Index** – generated from NDVI data layers.
3. **Population Density Influence** – charted to align land demand with population clusters.
4. **Infrastructure Proximity Matrix** – represented via a GIS-based proximity grid.

These are summarized in the diagrams below to support multicriteria visualization.

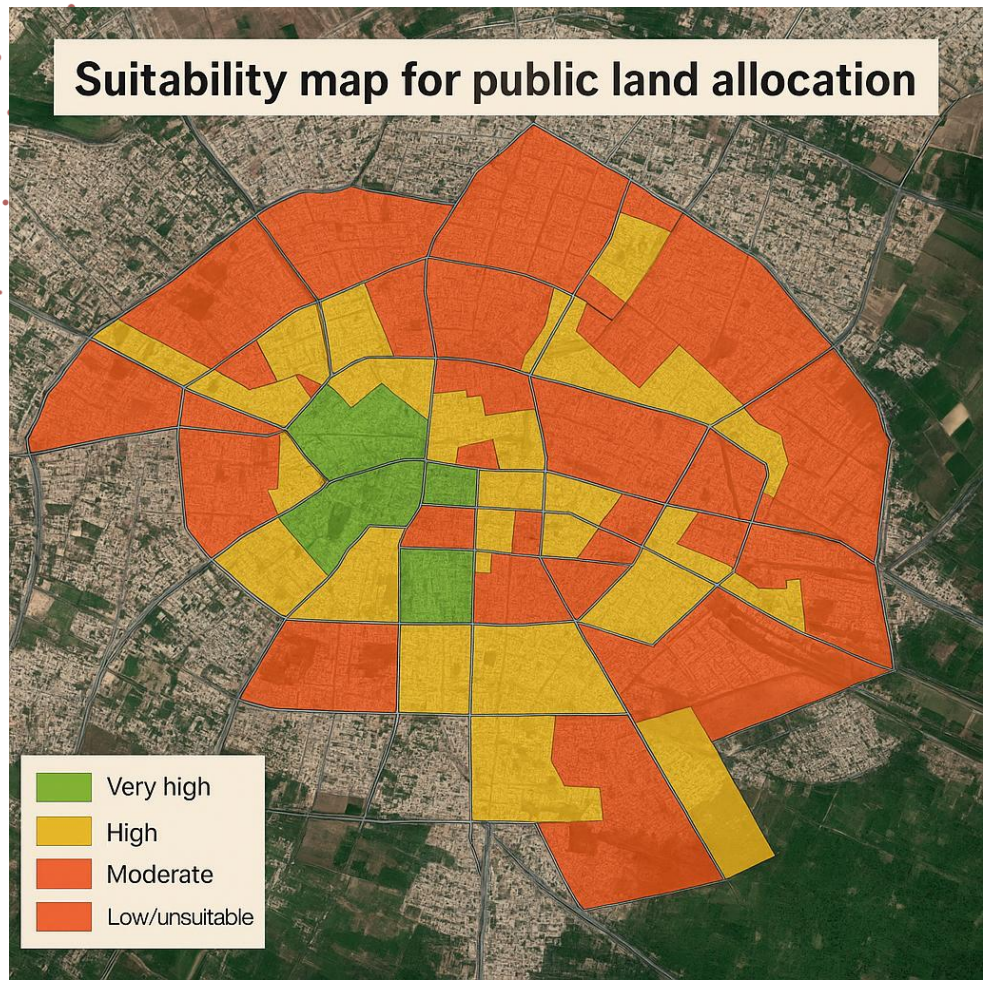
This image visualizes layered spatial factors and outputs from the AHP-WLC model to prioritize land allocation. The integration of these diagrams allows city planners to intuitively identify trade-offs and opportunities across various planning scenarios.



Scientific Contribution. This article introduces a scalable spatial decision framework for public land management in historical cities like Bukhara. The main scientific innovations include:

- Adaptation of AHP-WLC for public urban land allocation;
- GIS-based automation of multicriteria analysis for local governments;
- Integration of cadastral and environmental data for holistic planning;
- Identification of spatial conflicts and prioritization zones.

These methods can be embedded into smart urban planning platforms or geoportals to assist ongoing urban reforms in Uzbekistan.



Conclusion. This study demonstrated the feasibility of combining AHP and WLC within a GIS platform for evidence-based, transparent, and participatory land use planning. The proposed model provides urban planners in Bukhara with clear insights into spatial priorities, reduces planning subjectivity, and supports data-driven governance of public lands. Further development can integrate real-time data, cloud dashboards, and participatory GIS tools to enhance responsiveness and accountability.

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