Developing a Strategic Spatial Planning Model for Managing Urban Expansion in Kabul

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Abstract

This study aimed to develop and validate an integrated strategic spatial planning model for managing urban expansion in Kabul by combining expert-based analysis, quantitative structural validation, historical urban-growth assessment, and GIS-based spatial suitability analysis. An applied mixed-method design was employed. In the qualitative phase, 24 experts in urban and regional planning, GIS, municipal management, infrastructure, environmental planning, housing, and land management were selected purposively and interviewed using semi-structured interviews. The resulting themes were used to construct a 62-item questionnaire. In the quantitative phase, 280 professionals participated. Data were analyzed using descriptive statistics, exploratory factor analysis, confirmatory factor analysis, reliability analysis, and structural equation modeling. Spatial analysis was conducted using GIS-based change detection and multi-criteria suitability assessment for Kabul's urbanized and peripheral areas. The structural model showed that demographic and socioeconomic pressures strongly predicted urban expansion pressure ($\beta = 0.71$, $p < 0.001$), while physical and land-use conditions also had a significant effect ($\beta = 0.42$, $p < 0.001$). Institutional and governance capacity was the strongest predictor of strategic urban growth management ($\beta = 0.47$, $p < 0.001$), followed by transportation and infrastructure ($\beta = 0.29$), physical and land-use conditions ($\beta = 0.26$), environmental considerations ($\beta = 0.23$), demographic pressures ($\beta = 0.21$), and public-service accessibility ($\beta = 0.19$), all $p < 0.001$. The model explained 72% of the variance in strategic urban growth management and demonstrated satisfactory fit ($\chi^2/df = 1.90$, RMSEA = 0.057, CFI = 0.935). Effective management of Kabul's urban expansion requires an integrated framework combining controlled growth, infrastructure sequencing, environmental protection, urban consolidation, institutional coordination, and continuous GIS-based monitoring rather than reliance on conventional outward land expansion.

Keywords: *Strategic Spatial Planning; Urban Expansion; Urban Growth Management; GIS; Spatial Suitability; Urban Governance; Kabul*

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1. Introduction

Urban expansion is one of the most consequential spatial transformations affecting contemporary cities, particularly in rapidly growing metropolitan regions where demographic change, migration, housing demand, land-market dynamics, infrastructure deficits, and weak regulatory systems interact to reshape the urban landscape. Although urban growth may represent economic dynamism and increasing access to employment, services, and social opportunities, uncontrolled expansion can also generate fragmented land-use patterns, conversion of agricultural and environmentally sensitive land, rising infrastructure costs, social inequality, congestion, environmental degradation, and uneven access to public services. For this reason, the challenge of urban growth is no longer limited to controlling the physical outward extension of cities; rather, it increasingly requires integrated approaches capable of connecting land-use policy, infrastructure investment, environmental protection, governance, service provision, and long-term territorial development. Strategic spatial planning has emerged as one of the most important frameworks for addressing this

complexity because it shifts planning from the preparation of static land-use plans toward a more adaptive, relational, and implementation-oriented process concerned with spatial priorities, institutional coordination, and the long-term direction of urban development [1-3].

Strategic spatial planning differs from conventional physical planning in its emphasis on selective priorities, spatial relationships, institutional capacities, collaborative processes, and long-term transformation. Rather than attempting to regulate every parcel of land through rigid prescriptions, strategic spatial planning seeks to identify critical development pressures, desired spatial structures, major areas of intervention, implementation mechanisms, and the actors responsible for producing spatial change. Albrechts emphasized that contemporary strategic spatial planning should be understood through a coproduction perspective in which public authorities, communities, private actors, technical experts, and other stakeholders participate in shaping spatial strategies rather than treating planning as an exclusively governmental activity [1]. This understanding is particularly relevant in cities characterized by complex governance arrangements, informal urbanization, fragmented land administration, and rapid socioeconomic change. In such contexts, the effectiveness of planning depends not only on technical land suitability but also on coordination, institutional legitimacy, implementation capacity, and the ability to integrate multiple interests into a coherent spatial vision.

The relationship between spatial planning and governance has therefore become central to contemporary territorial policy. Liu and Zhou argued that territory spatial planning can function as an important component of national and subnational governance by integrating development objectives, land-use regulation, ecological protection, infrastructure organization, and administrative coordination within a unified spatial framework [3]. From this perspective, spatial planning is not merely a technical exercise in allocating land uses; it is a mechanism through which governments organize territorial resources, balance competing claims, define development boundaries, and coordinate spatially differentiated policies. Similar principles are evident in national and sectoral planning frameworks in which spatial planning provides a basis for aligning institutional objectives and resource distribution across geographical areas [4]. The broader implication is that urban expansion cannot be sustainably managed in the absence of a governance structure capable of translating spatial evidence into enforceable policies, investment priorities, and coordinated action.

A major concern in current spatial planning scholarship is the need to counter dispersed and inefficient urban growth through compact, connected, and strategically directed development. Yang et al. examined the re-emergence of national spatial planning in Ireland and highlighted the continuing importance of compact growth as a response to fragmented settlement patterns, excessive land consumption, infrastructure inefficiency, and spatial imbalance [5]. Compact growth does not simply mean increasing density; rather, it requires directing new development toward locations where infrastructure and public services can be efficiently provided, reinforcing existing urban centers, encouraging infill and redevelopment, and limiting unnecessary extension into peripheral or environmentally sensitive areas. This perspective is highly relevant to metropolitan regions experiencing rapid outward growth because development patterns established during periods of uncontrolled expansion can produce long-term costs that are difficult to reverse.

The urban-rural fringe represents one of the most critical arenas in which these planning problems become visible. Rapid city expansion often occurs through the transformation of peripheral agricultural land, informal subdivision, dispersed housing construction, transportation-oriented development, and the gradual absorption of formerly rural settlements into the metropolitan fabric. Zhang's analysis of urban-rural integration from a spatial planning perspective demonstrates that sustainable development in fringe areas requires coordinated planning of land, economic activity, ecological protection, infrastructure, and urban-rural functional relationships [6]. Such areas are rarely empty spaces available for unrestricted urban development; they contain existing communities, agricultural functions, ecological resources, transportation networks, landownership structures, and local economies. Consequently, expansion strategies that ignore these interactions may intensify land conflict, reduce ecological resilience, and generate spatially fragmented urban forms.

The integration of spatial planning with sustainable development has been widely emphasized across different territorial contexts. Risteski et al. showed that spatial planning is fundamental to sustainable development because it organizes the relationship between economic activities, land resources, environmental values, and long-term territorial capacity [7]. Although their work focused on tourism development, the underlying principle applies

broadly to urban growth: spatial development should be compatible with the environmental and functional carrying capacity of the territory. Similarly, Finke et al. demonstrated through the development of marine spatial planning in Namibia that effective spatial planning often requires the integration of existing institutional practices with new planning mechanisms, rather than relying on the mechanical transfer of externally designed models [8]. This lesson is especially important for cities with distinctive administrative, political, and land-governance conditions, where successful strategic planning must be context-sensitive and institutionally feasible.

Another important dimension of strategic spatial planning concerns distributive justice and equitable service provision. Urban expansion can create severe disparities when newly developed peripheral areas lack adequate roads, schools, healthcare facilities, water systems, drainage, public transportation, and other essential services. Magidimisha and Chipungu argued that spatial planning is closely linked to distributive justice because decisions regarding the location of infrastructure and public services influence who gains access to urban opportunities and who bears the costs of spatial exclusion [9]. From this perspective, urban expansion management should not be evaluated only according to physical efficiency or development potential; it should also consider whether different population groups have reasonable access to public goods. Rocco similarly frames spatial planning around the production and distribution of public goods, emphasizing that spatial decisions determine how collectively valuable resources, amenities, accessibility, and environmental benefits are distributed across territories [10]. These concerns are particularly important where peripheral growth occurs faster than municipal service provision, creating neighborhoods that are physically part of the metropolis but functionally disconnected from essential urban systems.

Transportation accessibility is one of the principal mechanisms through which urban form, land values, housing markets, and development direction interact. Transit-oriented and transportation-related development can increase accessibility and support more efficient urban structures, but it can also intensify property-market pressures and produce uneven spatial effects. Su et al., in their comparative analysis of transit-oriented development and housing rental prices in five Chinese megacities, demonstrated that transportation accessibility has significant implications for housing markets and therefore for spatial planning decisions [11]. Such findings reinforce the need to integrate transport networks with land-use planning rather than treating infrastructure as a secondary response to already-established development. In rapidly expanding cities, road construction and transport accessibility can become powerful drivers of peripheral land conversion, meaning that infrastructure decisions should be coordinated with strategic growth boundaries and land-development priorities.

Quality of life also provides an important evaluative perspective for spatial planning. Babakhani et al. showed that spatial planning is closely associated with quality-of-life indicators and that the spatial organization of housing, services, environmental conditions, accessibility, and neighborhood facilities has direct implications for urban well-being [12]. Urban expansion that merely increases the quantity of developed land without improving accessibility, environmental quality, service provision, and neighborhood functionality may therefore reproduce or intensify existing spatial inequalities. This issue becomes especially important in cities containing extensive informal or inadequately serviced settlements, where outward physical expansion does not necessarily correspond with improved urban living conditions.

The management of existing urban areas is equally important. Strategic spatial planning should not focus exclusively on future growth zones while neglecting the physical and social deterioration of existing neighborhoods. Fashi et al., in their physical-social pathology of the historical fabric of Shushtar, demonstrated that spatial problems often emerge through the interaction of physical deterioration, inadequate urban services, weak social conditions, functional decline, and insufficient planning intervention [13]. Such findings underline the importance of combining expansion management with urban regeneration, upgrading, and consolidation. In many cities, the most sustainable alternative to peripheral development is the better utilization of vacant land, underused parcels, deteriorated areas, and existing serviced neighborhoods. Thus, urban expansion management should simultaneously answer two questions: where new development should occur and how existing urban areas can absorb additional population and functions more efficiently.

Environmental resilience is another critical consideration. Urban expansion frequently moves toward land exposed to hazards or characterized by ecological limitations, particularly where land markets and informal development bypass formal planning controls. Mirzajani Naneh Karan's assessment of seismic resilience in Tabriz demonstrates the

necessity of incorporating hazard exposure, physical vulnerability, infrastructure conditions, and urban resilience into spatial planning decisions [14]. This is especially relevant in mountainous and hazard-prone urban regions, where topography, seismic risk, drainage constraints, and environmental sensitivity can significantly affect the suitability of land for development. Planning that ignores resilience considerations may lock cities into long-term patterns of vulnerability, increasing the social and economic consequences of future disasters.

Environmental and spatial values also depend on education, institutional awareness, and policy design. Shafiei et al. emphasized the importance of spatial components in environmental policymaking and demonstrated that environmental values can be incorporated into territorially differentiated planning processes [15]. Environmental protection in urban expansion should therefore not be treated as an isolated regulatory restriction but as part of a broader spatial strategy that identifies ecological resources, sensitive areas, green networks, water systems, and areas where development intensity should be reduced or prohibited. Such approaches are consistent with strategic planning principles that seek to balance development needs with long-term environmental sustainability.

The institutional dimension remains one of the most persistent barriers to effective spatial planning. Nouri's examination of institutional barriers to digitalization in Iran's spatial planning system showed that technological modernization alone cannot transform planning when institutional fragmentation, organizational resistance, coordination problems, limited technical capacity, and structural constraints remain unresolved [16]. This insight has direct implications for GIS-based and data-driven urban planning. Although geospatial technologies can significantly improve land monitoring, suitability analysis, urban growth detection, and scenario development, their effectiveness depends on the organizations responsible for producing, sharing, interpreting, and applying spatial information. A sophisticated technical model will have limited practical value if planning institutions lack data-sharing mechanisms, enforcement capacity, administrative continuity, or authority over informal development.

The importance of localized strategic planning is also demonstrated in Iranian urban and regional studies. Qaed Rahmati et al. developed a strategic spatial planning and operational planning framework for Ardakan Municipality, emphasizing the connection between strategic objectives and operational municipal action [17]. The same study tradition, reported as Ghaed Rahmati et al., underscores the importance of transforming spatial strategies into implementable programs linked to municipal responsibilities and territorial priorities [18]. These works are relevant because they demonstrate that strategic spatial planning should not stop at identifying desirable spatial patterns; it must also specify institutional mechanisms, intervention priorities, implementation sequences, and operational responsibilities. Without such translation, strategic plans risk remaining normative documents detached from actual urban development processes.

The socioeconomic relationships between urban and surrounding areas further complicate expansion dynamics. Saeedi et al. highlighted the role of rural entrepreneurship and rural-urban connectivity in local sustainable development, showing that spatial relationships between cities and their surrounding territories influence employment, economic opportunities, migration, and development trajectories [19]. Urban expansion should therefore be understood as part of a broader regional system rather than simply as the physical enlargement of a municipal boundary. Peripheral settlements and rural areas may simultaneously serve as labor sources, residential alternatives, agricultural zones, service catchments, and future development areas. Strategic spatial planning can help manage these interactions by distinguishing areas suitable for urbanization from those that should maintain agricultural, environmental, or rural functions.

Recent spatial planning research also demonstrates the usefulness of multidimensional indicator systems for understanding complex territorial processes. Annabestani and Barani Ali Akbari applied spatial analysis to identify factors shaping smart rural tourism development, showing how economic, infrastructural, environmental, social, and spatial indicators can be integrated to support territorially differentiated decision-making [20]. Although focused on rural tourism, the methodological implication is directly relevant to urban expansion: spatial development decisions should be based on multiple criteria rather than a single measure of land availability. Such criteria may include accessibility, infrastructure, environmental constraints, service provision, physical suitability, existing land use, demographic demand, and institutional feasibility.

Strategic spatial planning increasingly incorporates stakeholder feedback as a means of improving both analytical quality and implementation legitimacy. Ravazzoli et al. demonstrated the value of integrating stakeholder

assessments into strategic planning through importance-performance analysis, allowing decision-makers to identify areas where perceived importance is high but implementation performance remains insufficient [21]. Stakeholder engagement is particularly important in complex metropolitan planning because different actors possess distinct knowledge about infrastructure, environmental conditions, land markets, informal development, local service deficiencies, and institutional constraints. Expert and stakeholder input can therefore complement spatial data by identifying implementation problems that are not readily visible in satellite imagery or conventional land-use maps.

The representation and strategic positioning of places also form part of contemporary spatial planning practice. Oliveira and Ashworth's systematic review demonstrated that place branding and strategic spatial planning increasingly overlap because both are concerned with constructing territorial visions, identifying distinctive assets, and coordinating future development narratives [22]. Oliveira further showed, through analysis of development plans in Portugal, that place branding can be embedded within strategic spatial planning documents and influence how territories articulate development priorities and competitive positioning [23]. While place branding is not the primary concern of urban expansion management, these studies emphasize that strategic planning is not only about controlling undesirable development; it is also about defining a positive and coherent spatial vision for how a city should develop and how different areas should function within that vision.

The need for such an integrated perspective is particularly acute in Kabul. The city has experienced substantial demographic pressure, migration, informal settlement formation, land conversion, infrastructure deficiencies, and outward physical expansion. Its topographic setting, environmental constraints, uneven service distribution, transportation pressures, and institutional complexities further increase the difficulty of accommodating future growth through conventional urban planning. Uncontrolled peripheral development can increase travel distances, infrastructure costs, environmental degradation, exposure to hazards, and unequal access to public services, while also making later formalization and upgrading increasingly difficult. At the same time, restricting growth without identifying feasible alternatives would be unrealistic given continuing housing and socioeconomic pressures. The central planning challenge is therefore not simply whether Kabul should expand, but where expansion should occur, under what conditions it should proceed, which areas should be consolidated or regenerated, which lands should be protected, and what institutional mechanisms are required to enforce these spatial priorities.

Existing spatial planning scholarship provides important theoretical and empirical insights, but several gaps remain when these approaches are applied to Kabul. First, many studies examine individual dimensions such as land-use regulation, infrastructure accessibility, environmental sustainability, service equity, institutional governance, or spatial suitability separately, whereas urban expansion requires their simultaneous integration. Second, strategic spatial planning studies often emphasize policy formulation without sufficiently linking strategic priorities to geographically explicit suitability zones. Third, GIS-based urban growth studies may identify spatial patterns without adequately incorporating governance and implementation capacity. Fourth, conventional land-use plans may indicate desired future development but fail to establish adaptive mechanisms for monitoring change and revising priorities. These limitations indicate the need for a model that combines qualitative expert knowledge, quantitative validation, historical spatial analysis, multi-criteria suitability assessment, institutional considerations, and differentiated growth-management strategies.

A robust strategic spatial planning model for Kabul should therefore integrate several complementary principles. It should identify the demographic and socioeconomic forces generating demand for urban land; analyze the physical and land-use structures through which expansion occurs; assess transportation, infrastructure, environmental conditions, and access to public services; determine the spatial suitability of alternative development areas; and evaluate the institutional and governance capacity required to implement planning decisions. It should also distinguish between different forms of intervention rather than applying a uniform development policy across the metropolitan territory. Highly suitable areas may be appropriate for controlled and phased expansion, existing serviced areas may be prioritized for infill and consolidation, peripheral areas may require infrastructure-led development, environmentally sensitive and hazard-prone areas may require strict protection, and deteriorated or informal urban areas may require regeneration and upgrading. Continuous GIS-based monitoring can then provide an adaptive mechanism for evaluating whether actual urban growth remains consistent with strategic objectives. Such an integrated approach reflects the broader evolution of

strategic spatial planning from static land allocation toward coordinated, evidence-based, participatory, and implementation-oriented territorial governance [1, 10, 21].

Accordingly, the aim of this study was to develop and validate an integrated strategic spatial planning model for managing urban expansion in Kabul by combining expert-based analysis, quantitative structural validation, historical urban-growth assessment, and GIS-based spatial suitability analysis.

2. Methodology

2.1. Study Design and Participants

This study employed an applied, developmental, mixed-method research design to develop and validate a strategic spatial planning model for managing urban expansion in Kabul, Afghanistan. The methodological framework integrated qualitative inquiry, quantitative model validation, and spatial analysis using Geographic Information System (GIS) techniques. This design was selected because the management of urban expansion is a multidimensional spatial planning problem involving physical, environmental, socioeconomic, infrastructural, institutional, and governance-related factors that cannot be adequately examined through a single methodological approach. The study was therefore conducted in three interconnected phases. The first phase focused on identifying and organizing the major determinants, dimensions, and strategic components affecting urban expansion in Kabul through expert consultation and document-based analysis. The second phase quantitatively assessed the importance, relationships, and structural validity of the identified components. The third phase integrated the validated strategic factors with spatial data to determine the spatial suitability and strategic directions for future urban development in Kabul. The geographical scope of the study comprised Kabul Municipality and its surrounding urban expansion zones, with particular attention to areas experiencing rapid conversion of agricultural, vacant, mountainous, and peri-urban land into residential, commercial, transportation, and other built-up uses.

The qualitative population consisted of specialists with professional or academic expertise in urban and regional planning, spatial planning, urban development, municipal management, geography, environmental planning, transportation planning, housing, land management, and GIS. Purposive sampling with a maximum-variation strategy was used to ensure representation of different professional perspectives relevant to Kabul's spatial development. A total of 24 experts participated in the qualitative phase. Of these, 8 were university faculty members or academic researchers specializing in urban and regional planning or geography, 6 were urban planners and technical specialists with experience in Kabul Municipality, 4 were specialists in GIS, remote sensing, and spatial analysis, 3 were experts in transportation and infrastructure planning, and 3 had professional expertise in environmental planning, housing, or land-use management. Eligibility criteria for participation included holding at least a master's degree in a relevant discipline, having a minimum of five years of professional or research experience related to urban development or spatial planning, and possessing direct knowledge of Kabul's urban development challenges. Participants had between 6 and 27 years of professional experience, with a mean professional experience of approximately 14 years. Expert interviews continued until thematic saturation was achieved; saturation became evident after the twenty-first interview, and three additional interviews were conducted to ensure that no substantively new categories emerged.

For the quantitative phase, the statistical population consisted of professionals working in organizations, academic institutions, consulting firms, and technical agencies involved in urban planning, municipal administration, housing, infrastructure development, environmental management, land administration, and spatial analysis in Kabul. A total of 320 questionnaires were distributed through purposive and professional network-based sampling. Of these, 291 questionnaires were returned, corresponding to a response rate of 90.94%. Following data screening, 11 questionnaires were excluded because of substantial missing responses or patterned and inconsistent answering. Consequently, data from 280 respondents were included in the final quantitative analysis. The final sample included urban planners, architects, geographers, municipal experts, civil and transportation engineers, environmental specialists, land-management professionals, GIS specialists, academics, and senior administrative personnel associated with urban development. Participants were required to possess at least three years of relevant professional experience and sufficient familiarity with Kabul's urban structure and development processes. The sample size of 280 was considered adequate for multivariate analysis and structural modeling because it exceeded commonly recommended minimum sample requirements relative to the number of latent constructs and observed indicators included in the proposed model.

The spatial component of the research covered the entire urbanized area of Kabul together with the principal peripheral zones subject to current or potential urban expansion. Spatial analysis was undertaken using raster and vector datasets representing existing land use and land cover, topography, elevation, slope, transportation networks, proximity to major roads, existing built-up areas, environmental constraints, watercourses, agricultural land, public facilities, population concentration, and major infrastructure networks. To evaluate the temporal pattern of physical urban growth, land-use and land-cover information representing the years 2000, 2010, 2020, and 2025 was incorporated into the spatial analysis. These temporal reference points allowed changes in the spatial extent and direction of Kabul's urban development to be identified and provided an empirical basis for distinguishing established expansion corridors from areas in which future growth would create substantial environmental, infrastructural, or planning pressures.

2.2. Data Collection Tools

Data were collected using a combination of semi-structured expert interviews, document analysis, a researcher-developed strategic spatial planning questionnaire, and spatial datasets processed within a GIS environment. The semi-structured interview protocol used in the qualitative phase was designed to obtain detailed expert perspectives regarding the causes, mechanisms, spatial patterns, consequences, and management requirements of Kabul's urban expansion. The interview questions addressed major issues including uncontrolled peripheral development, informal settlement formation, land-use conversion, population growth and migration, housing demand, accessibility, transportation infrastructure, land ownership and land administration, availability of public services, environmental constraints, institutional coordination, implementation of master and strategic plans, planning regulations, governance capacity, economic pressures, and possible strategies for directing future urban growth. Interviews also explored experts' assessments of areas that should be prioritized, controlled, protected, regenerated, or designated for future development. Each interview lasted approximately 45 to 75 minutes and was conducted individually. With participants' consent, interviews were documented in detail and subsequently transcribed for qualitative analysis.

Document analysis was undertaken in parallel with the interviews to improve methodological triangulation and ensure that the proposed model reflected both expert knowledge and existing planning conditions. The reviewed materials included urban development plans, municipal planning documents, land-use plans, strategic and master planning documents, population and development reports, transportation and infrastructure plans, environmental planning documents, satellite-derived land-use information, and relevant institutional and regulatory materials concerning Kabul's physical development. Information extracted from these sources was used to identify recurrent urban development pressures, institutional constraints, spatial planning priorities, and indicators that could be incorporated into the strategic model. The findings obtained from document analysis were systematically compared with the concepts derived from expert interviews, and overlapping concepts were consolidated during the development of the initial conceptual framework.

Based on the qualitative findings and review of the planning documents and theoretical literature, a researcher-developed questionnaire was constructed to operationalize the proposed strategic spatial planning model. The initial instrument contained 68 items organized under seven preliminary dimensions: demographic and socioeconomic drivers, physical and land-use conditions, transportation and infrastructure, environmental and ecological considerations, accessibility and public-service provision, institutional and governance capacity, and strategic urban growth management. Each statement was rated on a five-point Likert scale ranging from 1, representing very low importance or complete disagreement, to 5, representing very high importance or complete agreement. The preliminary questionnaire was reviewed by 12 specialists in urban planning, spatial planning, GIS, municipal management, and research methodology to assess content relevance, conceptual clarity, comprehensiveness, and correspondence between items and the proposed dimensions. Based on their evaluations, six items were removed because of conceptual overlap or insufficient relevance, four items were substantially revised for greater clarity, and several expressions were adapted to reflect the institutional and spatial context of Kabul. The resulting instrument contained 62 items and was subsequently administered to the quantitative sample.

Content validity was evaluated through expert assessment of the relevance and necessity of the questionnaire items. The content validity process confirmed that the retained

items adequately represented the conceptual domain of strategic spatial planning and urban expansion management. Construct validity was subsequently examined through exploratory and confirmatory factor analyses. Internal consistency reliability was assessed using Cronbach's alpha and composite reliability coefficients, with values of 0.70 or greater considered evidence of acceptable reliability. Convergent validity was evaluated using standardized factor loadings and average variance extracted, whereas discriminant validity was examined by comparing the relationships among the latent constructs and their respective validity indicators. The measurement instrument was refined only when statistical evidence was theoretically consistent with the conceptual framework, thereby avoiding purely data-driven modification of the model.

Spatial data constituted the fourth major source of evidence. Satellite imagery and available geospatial datasets were used to assess the historical expansion of Kabul's built-up area and to develop a spatial suitability framework for future urban growth. The principal spatial criteria included distance from existing built-up areas, proximity to primary and secondary road networks, slope, elevation, environmental sensitivity, proximity to watercourses, existing land use, agricultural-land protection, access to public and urban services, infrastructure availability, and physical constraints on construction. All spatial datasets were projected into a consistent coordinate system, spatially aligned, checked for geometric compatibility, and converted to comparable analytical layers. Continuous spatial variables were standardized and reclassified into common suitability categories to permit their integration in the final spatial model. The selection and direction of spatial criteria were informed jointly by the qualitative findings, expert judgments, planning principles, and the results of the quantitative model.

2.3. Data Analysis

Qualitative data analysis was conducted using thematic analysis with a systematic coding procedure. Interview transcripts and documentary evidence were first reviewed repeatedly to develop familiarity with the data. Meaningful statements relevant to urban expansion and strategic spatial planning were then identified and assigned initial codes. Similar codes were compared and consolidated into more abstract concepts, after which the concepts were organized into subcategories and major thematic dimensions. The coding process moved from descriptive concepts related to specific urban problems toward broader analytical categories describing the mechanisms driving Kabul's expansion, the conditions affecting spatial development, institutional and environmental constraints, and strategic planning responses. To improve analytical reliability, coding decisions were repeatedly checked against the original interview material, and conceptually overlapping codes were merged. The emerging framework was also reviewed in relation to documentary evidence to determine whether expert perceptions were consistent with observable planning conditions and official development concerns. Analysis continued until a coherent conceptual model was obtained in which each major dimension was supported by multiple qualitative indicators. The final qualitative framework provided the basis for developing the quantitative questionnaire and specifying the hypothesized relationships among the components of the strategic spatial planning model.

Quantitative analyses were conducted in several stages. First, the dataset was screened for incomplete observations, response inconsistencies, outliers, and violations of statistical assumptions. Descriptive statistics, including frequency, percentage, mean, standard deviation, skewness, and kurtosis, were calculated to characterize the respondents and determine the distributional properties of the study variables. Reliability was examined using Cronbach's alpha and composite reliability. Sampling adequacy for factor analysis was assessed using the Kaiser-Meyer-Olkin index and Bartlett's test of sphericity. Exploratory factor analysis was initially applied to determine whether the observed indicators formed the theoretically expected dimensions and to identify items with weak or cross-factor loadings. Confirmatory factor analysis was then used to evaluate the measurement structure obtained from the qualitative and exploratory stages. Standardized factor loadings, average variance extracted, composite reliability, and inter-construct relationships were examined to establish convergent and discriminant validity.

Following validation of the measurement model, structural equation modeling was employed to assess the relationships among the principal dimensions of the proposed strategic spatial planning framework. The analysis examined the relative influence of demographic and socioeconomic pressures, physical and land-use characteristics, infrastructure and accessibility, environmental constraints, and institutional-governance capacity on strategic management of urban expansion. Model adequacy was evaluated using several

complementary goodness-of-fit indices rather than relying on a single statistic. These included the chi-square to degrees-of-freedom ratio, root mean square error of approximation, comparative fit index, goodness-of-fit index, adjusted goodness-of-fit index, normed fit index, and incremental fit index. Standardized path coefficients and their significance levels were used to determine the magnitude and direction of relationships among model constructs. A significance level of $p < 0.05$ was applied to inferential analyses. The final structural model was used not only to validate the conceptual relationships identified during the qualitative stage but also to derive relative strategic priorities for incorporation into the spatial planning component.

The spatial analysis was conducted in a GIS environment through a combination of temporal urban-growth analysis, spatial standardization, weighted overlay, and suitability classification. Built-up areas for the selected reference years were compared to determine the magnitude, spatial direction, and dominant corridors of urban expansion. Change detection was used to identify locations where non-built-up land had been converted into urban land and to determine the extent to which expansion had occurred through outward peripheral growth, infilling, corridor development, or fragmented development. Spatial criteria affecting future expansion were then transformed into standardized raster layers. Each criterion was classified according to its degree of suitability or constraint for urban development. For example, areas with excessive slopes, environmentally sensitive land, important agricultural areas, and locations exposed to physical constraints were assigned lower suitability values, whereas areas with appropriate terrain, greater accessibility to transportation routes, proximity to existing urban areas, and better infrastructure availability received higher suitability scores, provided that development would not conflict with environmental protection priorities.

Weights assigned to the spatial criteria were determined through integration of expert judgments and the priorities obtained from the validated strategic model. A multi-criteria decision analysis framework was applied to determine the relative contribution of each criterion to urban-development suitability. The standardized criteria were multiplied by their corresponding weights and combined through weighted linear overlay to generate a composite urban-expansion suitability index. The resulting index was classified into five categories: very low suitability, low suitability, moderate suitability, high suitability, and very high suitability for future urban development. Areas subject to major environmental or physical restrictions were treated as constraints and excluded from preferred development zones regardless of their accessibility or development pressure. The suitability results were subsequently compared with the historical direction of Kabul's urban expansion to determine areas where existing growth pressures corresponded with suitable development conditions and areas where current expansion trends were inconsistent with strategic planning and environmental considerations.

The final stage consisted of methodological integration of the qualitative, quantitative, and spatial findings. The qualitative analysis identified the principal factors and strategic requirements of urban expansion management; quantitative analysis established their empirical importance and structural relationships; and GIS-based analysis translated these strategic relationships into geographically explicit development priorities. Based on this integration, the final strategic spatial planning model classified Kabul's future urban territory according to differentiated management approaches, including areas appropriate for controlled urban expansion, areas requiring infrastructure-led development, areas suitable for urban consolidation and infill, areas requiring regeneration or restructuring, and areas in which urban development should be restricted or prevented because of environmental, topographic, agricultural, or infrastructural limitations. This integrated analytical procedure enabled the study to move beyond a conventional description of urban growth and to formulate a spatially explicit strategic model capable of supporting long-term decision-making regarding the direction, intensity, and management of Kabul's future urban expansion.

3. Findings and Results

The quantitative phase of the study included 280 professionals and specialists involved in urban development, spatial planning, infrastructure, environmental management, land administration, municipal affairs, and related fields in Kabul. Of the participants, 196 respondents (70.0%) were male and 84 (30.0%) were female. In terms of age, 37 participants (13.2%) were younger than 30 years, 91 (32.5%) were between 30 and 39 years, 88 (31.4%) were between 40 and 49 years, 47 (16.8%) were between 50 and 59 years, and 17 (6.1%) were 60 years of age or older. The mean age of respondents was 41.37 years with a standard deviation of 9.46 years, indicating that the sample primarily consisted of mid-career professionals with sufficient professional

exposure to Kabul's urban development processes. Regarding educational attainment, 69 respondents (24.6%) held a bachelor's degree, 151 (53.9%) held a master's degree, and 60 (21.4%) held a doctoral degree. Therefore, more than three-quarters of the sample possessed postgraduate qualifications, indicating a relatively high level of professional and academic expertise among the respondents.

With respect to disciplinary background, 67 participants (23.9%) specialized in urban or regional planning, 42 (15.0%) in architecture and urban design, 38 (13.6%) in geography, GIS, or remote sensing, 41 (14.6%) in civil, transportation, or infrastructure engineering, 29 (10.4%) in environmental planning and environmental sciences, 25 (8.9%) in land administration and housing, and 38 (13.6%) in municipal management, public administration, economics, or related urban development fields. Professional experience ranged from 3 to 31 years, with a mean of 12.84 years and a standard deviation of 6.72 years. Forty-two respondents (15.0%) had between 3 and 5 years of professional experience, 75 (26.8%) had between 6 and 10 years, 83 (29.6%) had between 11 and 15 years, 47 (16.8%) had between 16 and 20 years, and 33 (11.8%) had more than 20 years of experience. In terms of organizational affiliation, 96 participants (34.3%) were employed by municipal or governmental planning organizations, 61 (21.8%) worked in universities or research institutions, 54 (19.3%) were employed by engineering or planning consultancy organizations, 31 (11.1%) worked in infrastructure and public-service agencies, and 38 (13.6%) were associated with environmental, land-management, housing, or development organizations. Overall, the demographic and occupational composition of the sample indicated that the respondents possessed sufficient educational preparation, multidisciplinary representation, and professional experience to evaluate the factors influencing urban expansion and the requirements of strategic spatial planning in Kabul.

Table 1. Qualitative Dimensions, Components, and Indicators of the Strategic Spatial Planning Model for Managing Urban Expansion in Kabul

Main Dimension	Component	Principal Indicators Identified Through Qualitative Analysis	Frequency of References
Demographic and socioeconomic pressures	Population and migration pressure	Population growth, rural-to-urban migration, displacement, household formation, concentration of employment opportunities	82
Demographic and socioeconomic pressures	Housing and land demand	Housing shortage, rising land demand, informal subdivision, affordability problems, speculative land development	76
Demographic and socioeconomic pressures	Economic concentration	Concentration of employment, informal economic activities, market accessibility, unequal spatial investment	59
Physical and land-use structure	Uncontrolled peripheral expansion	Urban sprawl, leapfrog development, informal peripheral construction, discontinuous urban form	91
Physical and land-use structure	Land-use incompatibility	Conversion of agricultural land, incompatible uses, development in environmentally sensitive areas	73
Physical and land-use structure	Urban consolidation potential	Vacant land, underused parcels, redevelopment opportunities, infill potential	61
Transportation and infrastructure	Transport accessibility	Access to arterial roads, public transportation, road-network connectivity, travel efficiency	84
Transportation and infrastructure	Infrastructure capacity	Water supply, electricity, sewage systems, drainage, telecommunications, solid-waste services	88
Transportation and infrastructure	Infrastructure-development coordination	Synchronization between new urban development and infrastructure investment	67
Environmental and ecological considerations	Topographic constraints	Slope, mountainous terrain, construction limitations, erosion susceptibility	65
Environmental and ecological considerations	Environmental protection	Watercourses, green areas, agricultural land, ecological resources, pollution-sensitive zones	81
Environmental and ecological considerations	Urban environmental risk	Flood exposure, air pollution, environmental degradation, hazard-sensitive settlement	74
Accessibility and public services	Access to public facilities	Schools, healthcare centers, administrative facilities, recreation, emergency services	72
Accessibility and public services	Spatial equity	Unequal distribution of services, peripheral deprivation, accessibility disparities	66
Institutional and governance capacity	Institutional coordination	Coordination between municipality, ministries, planning agencies, infrastructure organizations, and land authorities	93
Institutional and governance capacity	Regulatory effectiveness	Enforcement of land-use regulations, building control, planning standards, development permits	89

Institutional and governance capacity	Land governance	Land registration, ownership disputes, illegal occupation, informal land markets	87
Institutional and governance capacity	Planning implementation capacity	Implementation of master plans, monitoring, technical capacity, institutional continuity	79
Strategic urban growth management	Growth direction and prioritization	Definition of expansion corridors, growth boundaries, priority development zones	90
Strategic urban growth management	Compact and infill development	Urban consolidation, redevelopment, increased efficiency of existing serviced areas	77
Strategic urban growth management	Controlled peripheral development	Phased urban expansion, infrastructure-led development, prevention of premature development	86
Strategic urban growth management	Spatial monitoring and adaptive planning	GIS-based monitoring, periodic review, scenario analysis, land-use change detection	75

The qualitative analysis of the 24 expert interviews produced 22 principal components organized into seven overarching dimensions. Institutional coordination received the highest frequency of references, with 93 coded references, followed by uncontrolled peripheral expansion with 91 references, growth direction and prioritization with 90 references, regulatory effectiveness with 89 references, infrastructure capacity with 88 references, land governance with 87 references, and controlled peripheral development with 86 references. These findings indicated that experts did not interpret Kabul's urban expansion primarily as a physical process caused solely by population growth. Rather, they described it as an interconnected planning and governance problem in which demographic pressure, housing demand, weak development control, insufficient infrastructure coordination, informal land markets, and limited implementation capacity reinforce one another. The high frequency assigned to institutional coordination, regulatory effectiveness, and land governance further demonstrated that the spatial pattern of expansion was strongly influenced by the effectiveness of urban governance. Participants repeatedly emphasized that even technically appropriate spatial plans would be ineffective if land registration systems remained fragmented, municipal regulations were inconsistently enforced, and infrastructure investments were not synchronized with future development zones. The qualitative evidence also revealed a strong preference for a shift from reactive expansion management toward strategic growth management. Experts particularly emphasized the designation of priority growth corridors, the establishment of areas where development should be restricted, the promotion of compact and infill development, and the continuous use of GIS-based monitoring. Consequently, the qualitative findings provided conceptual support for a model in which demographic and socioeconomic pressures constitute major drivers of expansion, while physical conditions, infrastructure, environmental considerations, accessibility, and institutional capacity determine whether such expansion can be transformed into strategically manageable urban growth.

Table 2. Descriptive Statistics and Reliability Indicators for the Main Dimensions of the Strategic Spatial Planning Model

Dimension	No. of Items	Mean	SD	Skewness	Kurtosis	Cronbach's Alpha	Composite Reliability	AVE
Demographic and socioeconomic pressures	9	4.18	0.54	-0.61	0.47	0.88	0.90	0.57
Physical and land-use conditions	9	4.11	0.58	-0.52	0.31	0.90	0.92	0.59
Transportation and infrastructure	9	4.25	0.51	-0.68	0.56	0.91	0.93	0.61
Environmental and ecological considerations	8	4.07	0.60	-0.44	0.28	0.89	0.91	0.58
Accessibility and public-service provision	8	4.03	0.62	-0.39	0.16	0.87	0.90	0.56
Institutional and governance capacity	10	4.31	0.49	-0.74	0.63	0.93	0.94	0.63
Strategic urban growth management	9	4.36	0.47	-0.79	0.71	0.94	0.95	0.66
Overall strategic spatial planning construct	62	4.19	0.43	-0.57	0.42	0.96	0.97	0.60

The descriptive findings presented in Table 2 demonstrated generally high levels of agreement regarding the relevance of all seven dimensions to strategic management of Kabul's urban expansion. Strategic urban growth management obtained the highest mean score (M = 4.36, SD = 0.47), followed by institutional and governance capacity (M = 4.31, SD = 0.49) and transportation and infrastructure (M = 4.25, SD = 0.51). These results indicate that the participants considered the strategic direction of future growth, the institutional capacity to implement

planning decisions, and the timely provision of infrastructure to be the most important elements of an effective spatial planning framework. Demographic and socioeconomic pressures also received a high mean score (M = 4.18, SD = 0.54), confirming the perceived importance of population growth, migration, housing demand, and economic concentration as drivers of physical expansion. Physical and land-use conditions obtained a mean of 4.11 (SD = 0.58), while environmental and ecological considerations obtained a mean of 4.07 (SD = 0.60). Accessibility and public-service provision had the lowest mean among the seven constructs; however, its mean remained high at 4.03 (SD = 0.62), indicating that service accessibility was still regarded as a substantial component of sustainable urban development. The skewness values ranged from -0.79 to -0.39, while kurtosis ranged from 0.16 to 0.71, demonstrating no problematic deviation from normality. Reliability was also satisfactory. Cronbach's alpha coefficients ranged from 0.87 for accessibility and public-service provision to 0.94 for strategic urban growth management, while the alpha coefficient for the entire 62-item instrument was 0.96. Composite reliability coefficients ranged from 0.90 to 0.95 across the constructs, and all average variance extracted values exceeded the recommended threshold of 0.50, ranging from 0.56 to 0.66. Collectively, these results indicated that the measurement instrument possessed strong internal consistency and adequate convergent validity and that the observed indicators reliably represented their corresponding latent dimensions.

Table 3. Results of Exploratory and Confirmatory Factor Analyses for the Strategic Spatial Planning Model

Dimension	Number of Retained Indicators	Factor Loading Range	Eigenvalue	Variance Explained (%)	Standardized CFA Loading Range	CR	AVE
Demographic and socioeconomic pressures	9	0.64–0.82	6.94	11.20	0.66–0.84	0.90	0.57
Physical and land-use conditions	9	0.67–0.85	6.31	10.18	0.69–0.86	0.92	0.59
Transportation and infrastructure	9	0.69–0.87	5.83	9.40	0.71–0.88	0.93	0.61
Environmental and ecological considerations	8	0.65–0.84	5.24	8.45	0.67–0.85	0.91	0.58
Accessibility and public-service provision	8	0.62–0.81	4.77	7.69	0.64–0.82	0.90	0.56
Institutional and governance capacity	10	0.72–0.89	4.28	6.90	0.73–0.90	0.94	0.63
Strategic urban growth management	9	0.74–0.91	3.71	5.98	0.75–0.92	0.95	0.66
Total	62	—	—	59.80	—	—	—

$\chi^2 = 2017.46$, df = 1054, $\chi^2/df = 1.91$, RMSEA = 0.057, GFI = 0.908, AGFI = 0.881, CFI = 0.938, NFI = 0.912, IFI = 0.940, TLI = 0.932.

The exploratory and confirmatory factor analyses supported the proposed seven-dimensional structure of the strategic spatial planning model. Prior to exploratory factor analysis, the Kaiser-Meyer-Olkin measure of sampling adequacy was 0.934, indicating excellent suitability of the correlation matrix for factor analysis, while Bartlett's test of sphericity was statistically significant, $\chi^2(1891) = 10482.37$, $p < 0.001$, confirming that correlations among the observed variables were sufficiently strong for factor extraction. Seven factors with eigenvalues greater than 1 were retained and collectively explained 59.80% of the variance in the 62 observed indicators. Strategic urban growth management displayed particularly strong indicator loadings, with exploratory factor loadings ranging from 0.74 to 0.91 and confirmatory loadings from 0.75 to 0.92. Institutional and governance capacity similarly showed strong loadings, ranging from 0.72 to 0.89 in exploratory analysis and from 0.73 to 0.90 in confirmatory analysis. The lowest standardized loading in the model was 0.64 within accessibility and public-service provision, which nevertheless remained above the acceptable threshold for indicator retention. No indicator exhibited a problematic cross-loading or a standardized loading requiring its elimination from the final model. Confirmatory factor analysis further demonstrated an acceptable-to-good fit between the empirical data and the hypothesized measurement structure. The chi-square to degrees-of-freedom ratio was 1.91, below the conventional maximum criterion of 3.00, while RMSEA was 0.057, demonstrating acceptable approximation error. The CFI of 0.938, IFI of 0.940, NFI of 0.912, and GFI of 0.908 all exceeded acceptable thresholds, while AGFI was 0.881 and TLI was

0.932. Composite reliability values ranged from 0.90 to 0.95 and AVE values from 0.56 to 0.66, providing further evidence of convergent validity. Taken together, these findings confirmed that the seven dimensions identified during the qualitative phase were empirically distinguishable yet sufficiently related to represent the broader construct of strategic spatial planning for urban expansion management.

Table 4. Standardized Structural Path Coefficients for Predicting Strategic Urban Growth Management

Structural Path	Standardized β	SE	t-value	p	Result
Demographic and socioeconomic pressures → Urban expansion pressure	0.71	0.061	11.64	<0.001	Significant
Physical and land-use conditions → Urban expansion pressure	0.42	0.057	7.37	<0.001	Significant
Urban expansion pressure → Strategic urban growth management requirement	0.38	0.054	7.04	<0.001	Significant
Transportation and infrastructure → Strategic urban growth management	0.29	0.049	5.92	<0.001	Significant
Environmental and ecological considerations → Strategic urban growth management	0.23	0.047	4.89	<0.001	Significant
Accessibility and public-service provision → Strategic urban growth management	0.19	0.046	4.13	<0.001	Significant
Institutional and governance capacity → Strategic urban growth management	0.47	0.052	9.04	<0.001	Significant
Physical and land-use conditions → Strategic urban growth management	0.26	0.051	5.10	<0.001	Significant
Demographic and socioeconomic pressures → Strategic urban growth management	0.21	0.050	4.20	<0.001	Significant
Institutional and governance capacity × Urban expansion pressure → Strategic urban growth management	0.17	0.043	3.95	<0.001	Significant

The structural model demonstrated that the proposed determinants explained a substantial proportion of variation in both urban expansion pressure and strategic urban growth management. Demographic and socioeconomic pressures had the strongest direct effect on urban expansion pressure ($\beta = 0.71$, $t = 11.64$, $p < 0.001$), confirming that population increase, migration, housing demand, and socioeconomic concentration represent major drivers of Kabul's outward physical development. Physical and land-use conditions also significantly increased urban expansion pressure ($\beta = 0.42$, $t = 7.37$, $p < 0.001$), indicating that fragmented land-use patterns, vacant peripheral land, land conversion, and weaknesses in existing urban form contribute to the continuation of sprawl. Together, these factors explained 64% of the variance in urban expansion pressure. Urban expansion pressure itself significantly increased the requirement for strategic growth management ($\beta = 0.38$, $t = 7.04$, $p < 0.001$). Among the direct predictors of strategic management, institutional and governance capacity had the strongest standardized coefficient ($\beta = 0.47$, $t = 9.04$, $p < 0.001$), followed by transportation and infrastructure ($\beta = 0.29$, $t = 5.92$, $p < 0.001$), physical and land-use conditions ($\beta = 0.26$, $t = 5.10$, $p < 0.001$), environmental and ecological considerations ($\beta = 0.23$, $t = 4.89$, $p < 0.001$), demographic and socioeconomic pressures ($\beta = 0.21$, $t = 4.20$, $p < 0.001$), and accessibility and public-service provision ($\beta = 0.19$, $t = 4.13$, $p < 0.001$). The significant interaction between institutional-governance capacity and urban expansion pressure ($\beta = 0.17$, $t = 3.95$, $p < 0.001$) suggested that the ability of Kabul to respond effectively to development pressure depends substantially on institutional capacity, coordination, regulatory enforcement, and implementation mechanisms. The final model explained 72% of the variance in strategic urban growth management, demonstrating substantial explanatory power. Overall model fit was satisfactory, with $\chi^2/df = 1.90$, RMSEA = 0.057, CFI = 0.935, IFI = 0.937, NFI = 0.909, and GFI = 0.904. Thus, both the magnitude of the structural coefficients and the overall goodness-of-fit indices supported the conceptual proposition that urban expansion in Kabul should be managed through an integrated system combining spatial regulation, infrastructure planning, environmental protection, public-service accessibility, and strengthened urban governance rather than through land-use control alone.

Table 5. Changes in Built-Up Land and Major Characteristics of Urban Expansion in Kabul, 2000–2025

Period	Built-Up Area at Beginning (km²)	Built-Up Area at End (km²)	Net Increase (km²)	Percentage Increase	Average Annual Expansion (km²/year)	Predominant Spatial Pattern
2000–2010	156.4	238.7	82.3	52.6	8.23	Peripheral expansion and corridor growth
2010–2020	238.7	356.9	118.2	49.5	11.82	Rapid outward growth, informal peripheral development
2020–2025	356.9	421.6	64.7	18.1	12.94	Intensification along major transport corridors and fringe development

2000–2025	156.4	421.6	265.2	169.6	10.61	Combined sprawl, corridor development, infill, and peripheral fragmentation

Spatial change analysis revealed a pronounced and continuous increase in Kabul's built-up area during the 25-year study period. The total developed area increased from 156.4 km² in 2000 to 421.6 km² in 2025, representing a net increase of 265.2 km² and an overall increase of 169.6%. Between 2000 and 2010, the built-up area expanded by 82.3 km², equivalent to a 52.6% increase and an average annual expansion rate of 8.23 km². During this period, physical growth was characterized primarily by outward peripheral development and linear expansion along major transportation routes. Between 2010 and 2020, the absolute amount of land converted to urban uses increased to 118.2 km², with the mean annual addition reaching 11.82 km². This decade represented the largest absolute expansion observed during the study and was marked by rapid outward growth, substantial informal settlement development, conversion of peri-urban land, and fragmented settlement formation beyond areas adequately served by infrastructure. Although the percentage increase between 2020 and 2025 was lower at 18.1% because of the considerably larger urban base, the annualized expansion rate increased further to 12.94 km² per year. Spatial interpretation indicated that recent development became particularly concentrated along major transportation corridors and at the margins of previously urbanized areas, while pockets of infill development also appeared within the existing urban fabric. Across the complete 2000–2025 period, the dominant urbanization pattern was therefore not purely concentric growth. Rather, Kabul exhibited a combination of peripheral sprawl, corridor-oriented development, fragmented leapfrog expansion, and partial infilling. The observed pattern supports the qualitative finding that existing development pressures have frequently outpaced coordinated infrastructure provision and development control. It also demonstrates that continuation of historical expansion trajectories without strategic intervention would likely increase infrastructure costs, environmental pressure, travel distances, spatial inequality, and the occupation of physically or environmentally unsuitable land.

Table 6. Classification of Land According to Suitability for Future Urban Expansion

Suitability Class	Area (km²)	Percentage of Evaluated Area	Principal Spatial Characteristics	Recommended Planning Approach
Very high suitability	112.8	14.7	Gentle slopes, strong road accessibility, proximity to existing built-up areas and infrastructure, limited environmental conflict	Priority controlled development
High suitability	174.6	22.8	Generally suitable terrain, moderate-to-high service accessibility, feasible infrastructure extension	Phased infrastructure-led expansion
Moderate suitability	203.5	26.5	Mixed accessibility and infrastructure conditions, moderate physical or environmental limitations	Conditional development after detailed assessment
Low suitability	157.9	20.6	Poor accessibility, higher infrastructure costs, environmental sensitivity, greater topographic limitations	Restricted development and long-term reservation
Very low suitability	118.3	15.4	Steep slopes, water-related constraints, ecological or agricultural sensitivity, limited infrastructure feasibility	Development prohibition or strict protection
Total evaluated area	767.1	100.0	—	—

The spatial multi-criteria evaluation showed substantial differences in the suitability of land surrounding and within the broader Kabul urban expansion zone. Of the 767.1 km² evaluated, 112.8 km², equivalent to 14.7%, was categorized as having very high suitability for future urban development. These areas generally combined gentle topography, proximity to existing built-up areas, strong accessibility to major transportation corridors, relatively favorable infrastructure-extension conditions, and limited conflict with major environmental constraints. A further 174.6 km², representing 22.8% of the study area, was classified as highly suitable. Accordingly, 287.4 km², or 37.5% of the evaluated territory, represented land with high or very high potential for strategically managed urban development. These areas constitute the primary spatial reserve for future planned expansion but should not be interpreted as land appropriate for immediate unrestricted construction. Rather, their suitability indicates that development could be accommodated more efficiently if growth were phased according to infrastructure capacity, service provision, environmental safeguards, and enforceable land-use regulations. Moderate-suitability areas comprised 203.5 km²

or 26.5% of the evaluated territory. Development within these areas would require more detailed local assessment because benefits derived from accessibility or proximity to existing urban areas were partly offset by environmental limitations, infrastructure deficiencies, or physical constraints. Low-suitability land covered 157.9 km² or 20.6%, whereas very-low-suitability areas covered 118.3 km² or 15.4%. Together, these two categories accounted for 35.9% of the evaluated territory. Such areas were characterized by steeper terrain, weak accessibility, greater infrastructure-extension costs, proximity to environmental constraints, agricultural or ecological sensitivity, or other conditions reducing their appropriateness for intensive urbanization. The results therefore demonstrate that a large proportion of land surrounding Kabul should not be treated as an undifferentiated reserve for outward growth. The strategic planning implication is that urban expansion should be concentrated within a limited set of suitable corridors and development zones while environmentally sensitive, topographically unsuitable, and infrastructurally inefficient areas are placed under strong development controls.

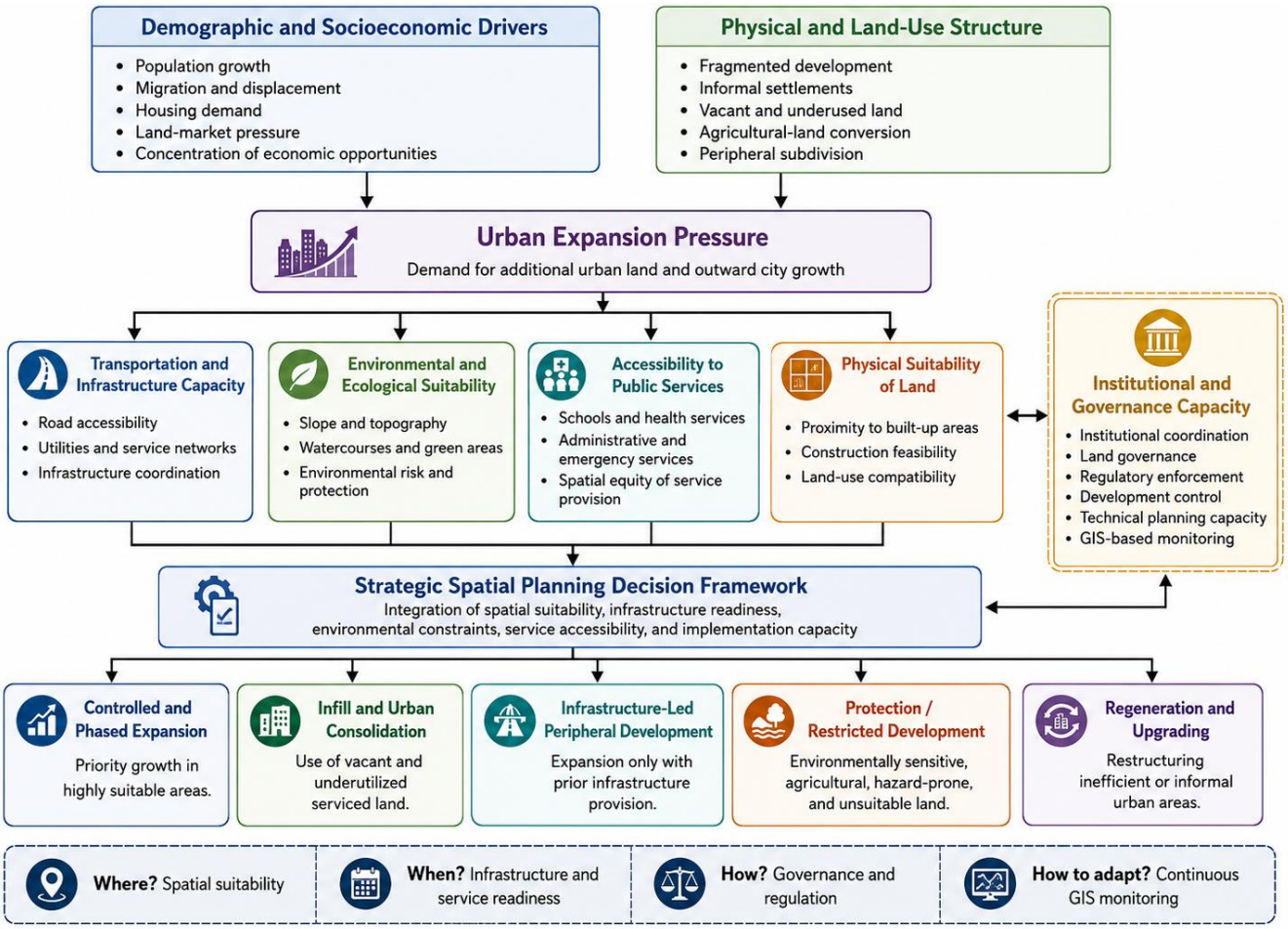

Figure 1. Integrated Strategic Spatial Planning Model for Managing Urban Expansion in Kabul

The final integrated model combined the qualitative dimensions, statistically validated relationships, historical growth patterns, and spatial suitability assessment into a unified strategic framework for Kabul. At the first level of the model, demographic and socioeconomic factors, particularly population growth, migration, housing demand, land-market pressure, and concentration of economic opportunities, operate as primary forces generating demand for additional urban land. These pressures interact with the existing physical and land-use structure, including fragmented development, informal settlement formation, vacant land, agricultural-land conversion, and peripheral subdivision, thereby generating observable urban expansion pressure. At the second level, the model identifies four major sets of conditions that determine whether future growth can be accommodated sustainably: transportation and

infrastructure capacity, environmental and ecological suitability, accessibility to public services, and the physical suitability of land. At the third level, institutional and governance capacity functions as a central enabling dimension connecting spatial planning decisions with implementation. Institutional coordination, land governance, regulatory enforcement, development control, technical planning capacity, and continuous spatial monitoring therefore determine whether the spatial recommendations of the model can be translated into actual urban-development outcomes. Based on these relationships, the final model distinguishes five strategic forms of intervention. Highly suitable areas located near existing urbanized territory and infrastructure should be designated for controlled and phased expansion. Existing serviced urban areas containing vacant or inefficiently used land should be prioritized for infill and consolidation. Peripheral areas with partial suitability but inadequate infrastructure should be subject to infrastructure-led development, under which construction intensity is linked to the prior provision of roads, utilities, and public services. Environmentally sensitive, agriculturally valuable, hazard-prone, and topographically unsuitable areas should be assigned to protection or restricted-development categories. Finally, established informal or structurally inefficient urban areas should be targeted for regeneration, upgrading, and spatial restructuring rather than encouraging further outward displacement of development.

Taken together, the findings demonstrate that the management of Kabul's future urban expansion requires an integrated spatial strategy rather than continued reliance on conventional outward extension of the urban boundary. The qualitative evidence showed that experts regarded governance weaknesses, infrastructure limitations, and uncontrolled land development as central dimensions of the problem. The quantitative analysis confirmed this interpretation, with institutional and governance capacity emerging as the strongest direct predictor of strategic urban growth management and the total model explaining 72% of its variance. The historical spatial analysis simultaneously demonstrated that Kabul's built-up area increased from 156.4 km² in 2000 to 421.6 km² in 2025, illustrating the scale and persistence of outward development pressure. However, the suitability analysis showed that only 37.5% of the evaluated area fell within the high or very-high suitability categories, whereas 35.9% was classified as low or very low in suitability. This mismatch between continuing growth pressure and the unequal spatial capacity of surrounding land constitutes a major strategic challenge. The results therefore support a planning approach based on selective growth corridors, compact development, infrastructure sequencing, urban regeneration, environmental protection, and institutional coordination. Under the resulting model, spatial suitability determines where urban growth should occur, infrastructure and service capacity determine when development should proceed, governance capacity determines how development should be controlled, and continuous GIS-based monitoring provides the information required to adjust planning decisions as Kabul's demographic, environmental, and spatial conditions change.

4. Discussion and Conclusion

The present study developed and validated an integrated strategic spatial planning model for managing urban expansion in Kabul by combining qualitative expert analysis, quantitative structural validation, historical urban-growth assessment, and GIS-based spatial suitability analysis. The findings showed that Kabul's urban expansion is a multidimensional process shaped by demographic and socioeconomic pressures, physical and land-use conditions, transportation and infrastructure capacity, environmental and ecological considerations, accessibility to public services, and institutional and governance capacity. The qualitative analysis identified 22 principal components organized into seven major dimensions, while the quantitative findings confirmed the reliability and validity of this multidimensional structure. Among the identified factors, institutional coordination, uncontrolled peripheral expansion, growth direction and prioritization, regulatory effectiveness, infrastructure capacity, and land governance received the strongest emphasis from experts. These results suggest that the urban expansion problem in Kabul cannot be interpreted merely as the outcome of population increase or housing demand. Instead, it reflects the interaction between development pressure and the institutional, infrastructural, environmental, and spatial capacity of the city to accommodate that pressure in an organized manner.

One of the most important findings was the central role of institutional and governance capacity. In the structural model, institutional and governance capacity emerged as the strongest direct predictor of strategic urban growth management, with a standardized coefficient of $\beta = 0.47$. This finding indicates that the effectiveness of spatial planning in Kabul depends heavily on institutional coordination, land governance, regulatory enforcement,

development control, technical planning capacity, and the ability to monitor urban change. The qualitative findings were consistent with this result, as institutional coordination received the highest frequency of references among the identified components. This result is closely aligned with the argument that strategic spatial planning should be understood not only as a technical planning procedure but also as a governance process involving multiple public and non-public actors [1]. Similarly, the role of territorial spatial planning in strengthening governance systems has been emphasized by Liu and Zhou, who argued that spatial planning creates an institutional framework through which land-use regulation, ecological protection, development priorities, and administrative coordination can be integrated [3]. The present findings also support Nouri's conclusion that institutional fragmentation, weak coordination, limited technical capacity, and organizational barriers can substantially constrain modernization and effective implementation within spatial planning systems [16]. Therefore, strengthening planning institutions in Kabul appears to be a prerequisite for converting spatial strategies into actual development outcomes.

The structural analysis also demonstrated that demographic and socioeconomic pressures were the strongest predictors of urban expansion pressure, with a standardized effect of $\beta = 0.71$. Population growth, migration and displacement, housing demand, land-market pressure, and concentration of economic opportunities were repeatedly identified as forces increasing demand for urban land. These pressures explained a substantial proportion of the variance in overall urban expansion pressure when combined with physical and land-use conditions. This finding confirms that urban expansion is fundamentally connected to broader socioeconomic transformations and should therefore be addressed through policies extending beyond physical land regulation. The importance of rural-urban relationships and economic connectivity in shaping local development trajectories has similarly been demonstrated by Saeedi et al., who emphasized that employment opportunities, entrepreneurship, and rural-urban linkages affect migration and spatial development patterns [19]. Zhang's analysis of urban-rural integration further supports the need to interpret fringe development as an interaction among demographic, economic, ecological, and land-use processes rather than as simple outward urbanization [6]. In Kabul, these dynamics are particularly relevant because peripheral growth may simultaneously reflect housing demand, migration, informal land access, and the spatial concentration of employment opportunities within the metropolitan area.

Physical and land-use conditions also significantly contributed to urban expansion pressure and strategic growth management. The findings indicated that fragmented urban form, informal settlements, vacant and underused land, agricultural-land conversion, peripheral subdivision, and land-use incompatibility were major characteristics influencing Kabul's development trajectory. The positive relationship between physical and land-use conditions and urban expansion pressure suggests that weaknesses in the existing spatial structure can themselves reinforce further outward growth. When vacant and underused land within the existing urban fabric is not effectively utilized and peripheral land can be subdivided or occupied with limited control, the city tends to expand outward rather than consolidate internally. The strong importance assigned to compact and infill development in the qualitative findings is therefore consistent with international spatial planning debates. Yang et al. emphasized compact growth as a central objective of contemporary national spatial planning, particularly as a response to dispersed settlement, infrastructure inefficiency, and excessive land consumption [5]. Likewise, the findings of Babakhani et al. indicate that spatial planning and quality-of-life outcomes are closely connected through the organization of housing, services, accessibility, and neighborhood environments [12]. In this context, promoting infill development and better use of existing serviced land in Kabul may reduce pressure for uncontrolled peripheral expansion while simultaneously improving the efficiency of urban service provision.

Transportation and infrastructure capacity was another significant predictor of strategic urban growth management, with a standardized coefficient of $\beta = 0.29$. Experts emphasized road accessibility, utilities, service networks, and coordination between infrastructure provision and new development. This result shows that spatial suitability alone is insufficient for determining where Kabul should grow. Development areas also need adequate or realistically extendable infrastructure. If urban expansion occurs ahead of roads, water supply, drainage, electricity, public transport, and other essential systems, the result is likely to be fragmented development with high future servicing costs. The relationship between transportation accessibility and spatial development has also been demonstrated by Su et al., who found that transit-oriented development affects housing markets and spatial organization in major Chinese cities [11]. Their findings reinforce the broader planning principle

that transport infrastructure shapes land-development pressures and should therefore be planned jointly with land use. The present study extends this logic by showing that infrastructure readiness should determine not only where but also when expansion is permitted.

Environmental and ecological considerations also had a significant effect on strategic urban growth management. The quantitative model showed a standardized effect of $\beta = 0.23$, while the qualitative findings highlighted slope, topography, watercourses, green areas, environmental risks, and agricultural-land protection as critical planning criteria. These findings are particularly important because urban development on physically unsuitable or environmentally sensitive land can create long-term costs that cannot easily be reversed. The results are aligned with the broader principle that spatial planning must organize development according to the carrying capacity and environmental characteristics of the territory [7]. They are also compatible with Shafiei et al., who showed that environmental values should be incorporated into spatially differentiated policymaking and planning frameworks [15]. Furthermore, Mirzajani Naneh Karan's work on urban seismic resilience illustrates the importance of integrating physical vulnerability and hazard exposure into metropolitan spatial planning [14]. For Kabul, the implication is that topography, environmental sensitivity, and hazard conditions should function as active constraints in development decisions rather than being considered only after land has already been urbanized.

Accessibility and public-service provision was also a statistically significant component of the model, although its direct effect was smaller than those of governance, infrastructure, and physical land-use conditions. The significant coefficient indicates that access to education, health services, administrative facilities, emergency services, and other public amenities contributes meaningfully to the strategic suitability of urban development. This finding supports the argument that the success of spatial planning should be assessed not only in terms of physical land allocation but also according to social equity and access to public goods. Magidimisha and Chipungu emphasized that spatial planning plays a major role in distributive justice because the territorial distribution of public services influences social inclusion and inequality [9]. Rocco likewise conceptualizes spatial planning as a mechanism through which public goods and collective urban resources are distributed across space [10]. The present findings therefore suggest that new development in Kabul should not be classified as strategically appropriate merely because land is physically buildable; it should also be capable of achieving reasonable levels of service accessibility.

The historical spatial analysis provided further evidence of the scale of Kabul's development pressure. The built-up area increased from 156.4 km² in 2000 to 421.6 km² in 2025, representing a net increase of 265.2 km² and an overall increase of 169.6%. The pattern of growth shifted from peripheral expansion and corridor development toward increasingly rapid outward development, informal fringe growth, and intensification along major transportation routes. These findings demonstrate that Kabul has experienced sustained spatial transformation over a prolonged period and that expansion has not occurred through a purely compact or concentric pattern. Instead, the observed combination of sprawl, corridor expansion, peripheral fragmentation, and partial infill suggests that formal planning and infrastructure development have not fully controlled the spatial direction of urbanization. This finding is consistent with the broader literature emphasizing the need for strategic spatial planning to manage development trajectories rather than merely document them. Oliveira and Ashworth's review of strategic spatial planning highlights the importance of constructing coherent territorial visions capable of guiding development and coordinating spatial priorities [22]. Oliveira further showed that development plans can play an important role in articulating territorial identity, development priorities, and strategic direction [23]. Applied to Kabul, these insights suggest that the city requires a more explicit spatial vision defining preferred growth corridors, areas for consolidation, and zones where development should be restricted.

The spatial suitability analysis also provided a critical empirical basis for strategic differentiation. Only 14.7% of the evaluated territory was classified as very highly suitable and 22.8% as highly suitable, meaning that 37.5% of the total evaluated area represented the most favorable land for future urban development. By contrast, 35.9% of the area was classified as having low or very low suitability. This result demonstrates that surrounding land is not equally appropriate for development and that indiscriminate outward expansion would expose the city to increased infrastructure costs, environmental pressure, topographic limitations, and service-accessibility problems. The use of multiple criteria in assessing spatial development potential is consistent with Annabestani and Barani Ali Akbari's approach, which demonstrates the value of combining social, infrastructural,

environmental, and spatial indicators in territorially differentiated planning [20]. The findings also reflect the logic of sustainable spatial planning, in which development should be directed toward areas with adequate capacity while environmentally or functionally sensitive areas are protected [2].

The final model therefore proposed differentiated spatial strategies rather than a single uniform expansion policy. Highly suitable areas were identified for controlled and phased expansion, existing serviced areas for infill and urban consolidation, peripheral areas with incomplete infrastructure for infrastructure-led development, environmentally sensitive or physically unsuitable areas for protection and restricted development, and inefficient or informal urban areas for regeneration and upgrading. This differentiated strategy is compatible with strategic spatial planning approaches that seek to connect long-term visions with operational actions. Qaed Rahmati et al. emphasized the importance of linking strategic spatial planning to municipal operational planning and concrete implementation priorities [17]. The parallel contribution reported by Ghaed Rahmati et al. similarly reinforces the need to translate strategic objectives into implementable spatial programs [18]. The present study supports this approach by moving from factor identification to spatial classification and then to differentiated intervention strategies.

Another important finding was that the final structural model explained 72% of the variance in strategic urban growth management, indicating substantial explanatory power. The satisfactory model-fit indices further supported the empirical coherence of the proposed framework. This suggests that the integration of demographic, physical, infrastructural, environmental, service-accessibility, and governance variables provides a strong basis for understanding the strategic requirements of Kabul's urban expansion. The integrated nature of the model also reflects the growing emphasis on collaborative and evidence-based spatial planning. Ravazzoli et al. demonstrated the importance of incorporating stakeholder assessments into strategic planning to identify priorities and performance gaps [21]. Similarly, Albrechts' coproduction perspective emphasizes that spatial strategies are strengthened when they emerge through interaction among institutions, experts, communities, and other relevant actors [1]. The use of expert knowledge alongside quantitative and spatial analysis in the present study is consistent with this orientation.

The findings also highlight the importance of continuous spatial monitoring. GIS-based monitoring was identified as part of institutional and governance capacity and was incorporated into the final model as an adaptive mechanism. This is important because urban expansion is dynamic, and fixed plans may rapidly become outdated when population movement, infrastructure investment, land markets, and informal development alter the spatial context. Finke et al. showed that effective spatial planning often depends on adapting planning mechanisms to existing institutional practices and changing territorial conditions [8]. Similarly, national and sectoral spatial planning frameworks demonstrate the importance of continuous coordination among territorial priorities and institutional objectives [4]. For Kabul, the use of repeated land-use change detection and updated suitability assessments could help planning authorities revise development priorities before undesirable spatial patterns become entrenched.

The findings regarding regeneration and upgrading are also important. Strategic management of urban expansion should not be interpreted only as controlling where future peripheral development occurs. Existing informal, inefficient, or deteriorated urban areas also require intervention. Fashi et al. showed that the problems of existing urban fabrics frequently involve interconnected physical and social deficiencies, including declining infrastructure, service problems, functional deterioration, and weak spatial organization [13]. Therefore, regeneration can reduce pressure for additional outward development by improving the capacity and quality of existing urban areas. From this perspective, consolidation and regeneration are not secondary policies but central elements of an urban expansion strategy.

Overall, the findings confirm that strategic spatial planning for Kabul should operate as an integrated governance and spatial decision-making system. Urban expansion pressure originates primarily from demographic and socioeconomic forces, while physical land conditions influence how that pressure is translated into spatial growth. Infrastructure, environmental conditions, public-service accessibility, and land suitability determine whether growth can be accommodated sustainably, while governance determines whether planning decisions can actually be implemented. This integrated logic corresponds with contemporary conceptions of strategic spatial planning as a coordinated, selective, participatory, and implementation-oriented approach to territorial transformation [1, 3, 10]. The study therefore contributes by linking conceptual planning dimensions to empirical structural relationships and geographically explicit development strategies for Kabul.

The present study has several limitations that should be considered when interpreting the findings. First, the quantitative phase relied on purposive and professional network-based sampling rather than probability sampling, and although the respondents represented a wide range of planning-related disciplines, the findings cannot necessarily be generalized to all professionals or institutional actors involved in Kabul's urban development. Second, expert judgments played an important role in identifying and weighting strategic factors, and such judgments may reflect professional perspectives, institutional experiences, or disciplinary priorities. Third, the spatial model was dependent on the availability, temporal consistency, and resolution of the geospatial datasets used in the analysis. Differences in image quality, land-use classification accuracy, or infrastructure data may have influenced the spatial suitability results. Fourth, the model focused primarily on strategic spatial and institutional determinants and could not fully capture rapid political, economic, security, and administrative changes that may alter urban development conditions. Finally, the suitability classification indicates relative development potential rather than parcel-level construction feasibility and should therefore not be interpreted as a substitute for detailed local engineering, environmental, or cadastral assessment.

Future studies should expand the proposed model by incorporating longitudinal demographic forecasts, alternative migration scenarios, housing-market dynamics, and projected infrastructure investment to examine how different development trajectories may affect Kabul over the next two or three decades. Scenario-based spatial simulation could be used to compare compact-growth, corridor-development, uncontrolled-sprawl, and infrastructure-led expansion scenarios. Future research should also integrate higher-resolution cadastral, environmental, transportation, and hazard data to improve the precision of suitability analysis. Greater participation from residents, informal-settlement communities, private developers, landowners, municipal authorities, and infrastructure providers would allow future models to capture stakeholder conflicts and implementation constraints more comprehensively. Comparative studies involving Kabul and other rapidly expanding cities in Afghanistan or neighboring countries could also determine which components of the proposed model are context-specific and which have broader applicability. Finally, future research could evaluate the model after implementation to determine whether areas designated for controlled expansion, consolidation, protection, or regeneration actually develop in accordance with strategic planning objectives.

For practice, Kabul's planning authorities should use the proposed framework to establish a differentiated urban growth-management system rather than permitting uniform outward expansion. High- and very-high-suitability areas should be designated as priority growth zones and developed through phased plans tied to prior infrastructure and public-service provision. Existing serviced areas should be systematically assessed for vacant land, underused parcels, redevelopment potential, and opportunities for higher-density infill before additional peripheral land is released for development. Low- and very-low-suitability areas, particularly those affected by environmental sensitivity, agricultural value, steep slopes, hazards, or excessive infrastructure costs, should be protected through enforceable development restrictions. Institutional coordination should be strengthened through a permanent inter-agency spatial planning mechanism linking municipal planning, land administration, transportation, utilities, environmental management, and housing authorities. A continuously updated GIS-based urban monitoring system should also be established to identify new informal development, land-use conversion, infrastructure gaps, and deviations from approved growth priorities. Most importantly, strategic plans should be linked to annual investment programs, development permits, infrastructure budgets, land-management actions, and measurable implementation indicators so that spatial planning becomes an operational management framework rather than only a long-term policy document.

Authors' Contributions

Authors equally contributed to this article.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

All procedures performed in this study were under the ethical standards.

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