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METHODOLOGICAL FRAMEWORKS FOR SUSTAINABLE RURAL SETTLEMENT PLANNING IN UZBEKISTAN: INTEGRATING LOW-RISE COURTYARD HOUSING AS A CASE STUDY

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Abstract

Sustainable rural development in Uzbekistan requires integrated and scientifically grounded planning approaches that combine legislative reform, participatory governance, spatial analysis, and context-sensitive housing design. This study examines methodological frameworks for rural settlement planning with specific integration of low-rise courtyard housing as a sustainable rural development model. Existing studies primarily address rural planning components separately and lack a unified methodological framework. The research applies document analysis, GIS-based spatial assessment, program evaluation, and case studies from the Andijan and Khorezm regions. Results show that more than 1,020 mahalla citizen assemblies received planning documentation between 2020 and 2022, while integrated courtyard housing models reduced infrastructure costs by 22%, increased community participation to 89%, and supported significant growth in rural mortgage investment. The study concludes that combining legislative reform, GIS-supported planning, participatory governance, and low-rise courtyard housing provides an effective framework for sustainable rural development in Uzbekistan.

Keywords: Urban planning, rural settlements, sustainable development, Uzbekistan, low-rise courtyard housing, master plans, GIS, participatory planning, mahalla governance.

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INTRODUCTION

Rural settlements in Uzbekistan play a pivotal role in the nation's socio-economic development, as a significant proportion of the population resides and works in these areas, as a significant share of the population resides and works in these areas (Hulkaroy, 2025; Kayumov, 2024). Sustainable rural development is essential for generating employment, fostering income growth, and improving living standards (Baydoun et al., 2023). Recognizing this imperative, the Uzbekistan-2030 Strategy outlines ambitious targets, including raising the national urbanization rate to 60% and expanding housing and infrastructure provision through comprehensive planning initiatives (Kamaev, 2025; Tekir, 2025).

Despite strong government commitments, rural settlements continue to face enduring challenges: inadequate infrastructure, limited access to education and healthcare, unemployment, and labor out-migration (Akcapar & Çakır, 2024; Sankar, 2023). Climate change and demographic pressures further exacerbate these difficulties. Addressing them requires scientifically grounded methodological approaches to urban planning that integrate economic, environmental, and social dimensions (Swanson, 2021).

Urban planning in Uzbekistan has undergone significant reforms to address these issues (Ahn & Juraev, 2023; Sobirovich, 2025). The Presidential Decree No. PF-5577 (2018) introduced a new Urban Planning Code, expanding legal provisions from 59 to 85 articles and strengthening mechanisms for public participation in master plan development (Abduganiyeva, 2023; Qizi, 2025). These reforms draw from international experiences in countries such as Germany, Russia, the United States, Canada, and Finland, reflecting deliberate alignment with global planning standards (Gerten et al., 2022).

Recent scholarship on Islamic architectural ornamentation, including studies on the placement principles of Islamic calligraphy in public buildings and the enduring legacy of the mashrabiya, underscores how visual-cultural logics shape spatial organization and façade articulation in Muslim contexts (Baydoun et al., 2024, 2025). Scholarly contributions have also shaped rural settlement planning in Uzbekistan. Baydjanov's *Architectural Planning of Settlements and Public Centers* emphasizes spatial and compositional design principles, while Tursunov's *Planning of Rural Settlements* highlights infrastructure and social facility integration (Abdiramanov et al., 2025; Baydjanov Ibadulla Samandarovich, 2025; Narzullaev et al., 2022). Regulatory frameworks such as the Urban Planning Standards and Regulations (UPSR 2.07.01-23) provide essential technical guidance for rural construction (Bekmurodovna, 2025; Sharipovna, 2021). Together, academic works and legislative measures form the foundation for sustainable rural settlement strategies (Alibašić & Zokirova, 2024; Alikhanov et al., 2023; Kholdorov et al., 2023).

A critical research gap persists, however. Existing studies tend to focus on individual components, legal reforms, spatial design, or infrastructure provision, without integrating them into a unified, holistic methodological framework. Furthermore, few studies address how specific housing typologies, particularly low-rise courtyard housing, can be systematically integrated into broader rural planning approaches.

Although previous studies have examined legislative reforms, infrastructure development, and housing design in Uzbekistan, most studies address these components separately rather than through an integrated rural planning framework. Limited research has examined how participatory governance, GIS-based spatial planning, and low-rise courtyard housing can be systematically combined within a unified methodology for sustainable rural settlement development. This paper directly addresses these gaps, by developing a comprehensive methodological framework that consolidates:

1. Legislative reforms and policy mandates.
2. Statistical evidence from the national Obod Qishloq and Obod Mahalla programs.
3. Practical insights from local mahalla governance.
4. Housing typology integration: low-rise courtyard housing as a case study aligned with rural livelihoods, agricultural activities, and cultural values.

By doing so, this study makes significant contributions to both academic discourse and practical policy, providing a roadmap for achieving Uzbekistan-2030 Strategy goals through a sustainable, inclusive, context-specific approach to rural development.

CONCEPTUAL FRAMEWORK: HOUSING TYPOLOGIES AND RURAL SUSTAINABILITY

Rural Context and Housing Requirements

Rural settlements in Uzbekistan are territories where the population is predominantly engaged in agriculture, livestock breeding, and family-based entrepreneurship. These economic activities fundamentally shape spatial organization, infrastructure requirements, and housing design needs. The rural population, comprising workers, peasants, farmers, and family entrepreneurs, requires housing solutions that accommodate productive agricultural and livestock activities on private plots, support household-scale food production and economic self-sufficiency, align with cultural values emphasizing family cohesion and traditional lifestyles, enable efficient management of productive activities alongside residential functions, and provide cost-effective construction and long-term maintenance solutions.

Traditional rural housing in Uzbekistan has historically centered on courtyard-based designs. This typology naturally evolved to meet these requirements, providing space for household gardens, livestock facilities, and extended family interactions.

Low-Rise Courtyard Housing: Definition and Characteristics

Low-rise courtyard housing refers to single- to two-story residential structures built around private or semi-private courtyards, typically on plots ranging from 600 to 1,000 square meters. Each dwelling unit provides primary living spaces (5-7 rooms), direct access to private courtyard areas, space for auxiliary structures (storage, livestock facilities, farming infrastructure), and on-site water and utility connections suitable for household management. This housing typology corresponds directly to traditional rural lifestyles, supporting small-scale household farming while ensuring favorable living environments and social stability.

Advantages of Low-Rise Courtyard Housing for Rural Development

Based Research and practical experience in Uzbekistan demonstrate that low-rise courtyard housing provides significant advantages for sustainable rural development:

Economic Efficiency: Low-rise courtyard housing offers lower construction and maintenance costs compared to multi-story residential buildings. It reduces on-site infrastructure requirements when clustered appropriately, while creating opportunities for household-scale income generation through agricultural and small-business activities on private plots. Additionally, it boosts property values and investment attractiveness in rural markets.

Health and Social Benefits: Courtyard-based living positively impacts human health, nervous system functioning, and social relationships. It provides environmental and psychological comfort through access to green spaces and natural light, while supporting strong intergenerational family bonds and cultural practices centered on private courtyards.

Cultural and Lifestyle Compatibility: This housing model preserves and sustains family values, hospitality traditions, and close intergenerational relationships. It aligns with rural customs and values that emphasize autonomy and household self-sufficiency, facilitating traditional practices including small-scale agriculture, gardening, and livestock husbandry. It also supports social cohesion through mahalla-based clustering and shared community facilities.

Food Security and Economic Activity: Low-rise courtyard housing enables national food security through household-scale crop production and livestock raising. It creates opportunities for local employment and family-based entrepreneurship, reduces household food and energy costs through on-site production capabilities, and builds economic resilience through household economic diversification.

International rural planning models in Germany, Finland, China, and Turkey demonstrate the importance of integrated infrastructure provision, participatory governance, and land-use coordination in sustainable rural development. However, many existing frameworks emphasize either physical infrastructure or economic modernization without sufficiently integrating culturally responsive housing typologies and community governance structures. In the Uzbekistan context, limited research has examined how housing typology selection can function as a core planning mechanism supporting sustainability, economic resilience, and social cohesion simultaneously.

RESEARCH METHODOLOGY

This study employed a mixed qualitative and quantitative approach to investigate methodological frameworks for sustainable rural settlement planning in Uzbekistan, with specific integration of low-rise courtyard housing design principles. The Andijan and Khorezm regions were selected as representative case studies due to their active participation in national rural development programs and their contrasting planning characteristics. Andijan represents densely populated rural settlements with extensive infrastructure planning requirements, while Khorezm provides a strong example of traditional courtyard housing integrated with agricultural livelihoods and mahalla-based settlement organization.

Research Components:

1. **Document Analysis:** Comprehensive review of presidential decrees, cabinet resolutions, and the Urban Planning Code to trace legislative reforms and planning strategies.
2. **Program Data Analysis:** Evaluation of major government initiatives, Obod Qishloq and Obod Mahalla programs (2020-2022), collectively engaging over 1,000 rural mahallas, providing statistical evidence on scale, effectiveness, and implementation challenges.
3. **Geographic Information Systems (GIS) Analysis:** Application of GIS tools to service coverage mapping, infrastructure allocation, and spatial planning optimization in the Andijan region case study.

4. **Housing Typology Integration:** Analysis of low-rise courtyard housing design principles derived from the Khorezm region case study, examining how this typology aligns with master planning methodologies and rural sustainability goals.
5. **Participatory Assessment:** Evaluation of community engagement mechanisms through mahalla governance structures, assessing their role in planning efficiency, investment attractiveness, and social sustainability.

Together, these methods provided a multidimensional understanding combining policy evaluation, program performance analysis, design innovation assessment, and community-level insights. Figure 1 provides a macro-level overview of the administrative and territorial structure of the study area, illustrating connections between Andijan Province (Viloyat), its districts (Tumanda), and individual rural settlements (Mahalla), demonstrating how urban planning scales from regional to community levels.

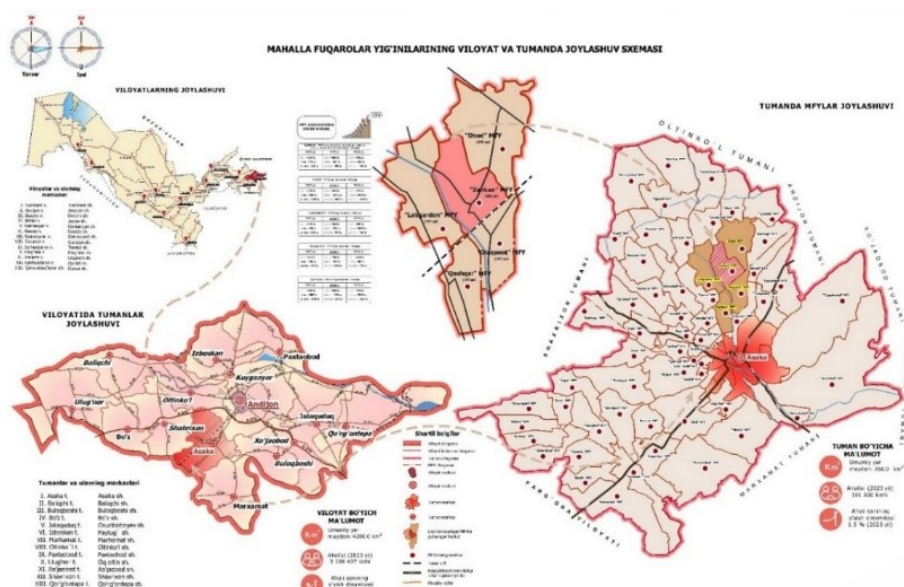


Figure 1: Geographical connections and territorial layout of rural settlements in the study region.

This study is subject to several limitations. First, the analysis focuses primarily on selected case studies in Andijan and Khorezm regions, which may limit generalizability across all rural regions of Uzbekistan. Second, portions of the analysis rely on government program data and planning reports, which may

contain institutional reporting bias. Third, several planning projects remain under implementation, limiting long-term assessment of socio-economic and environmental outcomes.

RESULTS

Program Outcomes: National Scale and Commitment

To quantitatively assess progress in recent urban planning initiatives, this study analyses statistical data from major government programs, the Obod Qishloq and Obod Mahalla initiatives implemented between 2020 and 2022. During this period, detailed planning projects were developed for more than 1,000 rural settlements across Uzbekistan, representing institutional commitment to scaling modern planning methodologies. Tables 1, 2, and 3 provide year-by-year breakdowns of Mahalla Citizen Assemblies (MCAs) receiving comprehensive planning documentation under the program approved by Cabinet of Ministers Resolution No. 639 [20].

Table 1: Works completed in 2020 within the framework of the Program approved by Resolution No. 639 of the Cabinet of Ministers of the Republic of Uzbekistan.
 (Data source: Government of Uzbekistan).

No.	Name of Region	Mahalla Citizen Assembly (MCA)	Of which: in 2020	
			Core NCAs	Adjacent NCAs
	Total	315	100	215
1	Republic of Karakalpakstan	22	7	15
2	Andijan Region	25	7	18
3	Bukhara Region	30	9	21
4	Jizzakh Region	19	7	12
5	Kashkadarya Region	11	4	7
6	Navoi Region	20	12	8
7	Namangan Region	26	9	17
8	Samarkand Region	18	6	12
9	Surkhandarya Region	32	7	25
10	Syrdarya Region	12	5	7
11	Tashkent Region	42	12	30
12	Fergana Region	27	5	22
13	Khorezm Region	31	10	21

Table 2. Works completed in 2021 within the framework of the Program approved by Resolution No. 639.

(Data source: Government of Uzbekistan)

No.	Name of Region	Mahalla Citizen Assembly (MCA)	Of which: in 2021	
			Core NCAs	Adjacent NCAs
	Total	312	104	208
1	Republic of Karakalpakstan	37	10	27
2	Andijan Region	24	6	18
3	Bukhara Region	26	8	18
4	Jizzakh Region	21	7	14
5	Kashkadarya Region	12	5	7
6	Navoi Region	19	12	7
7	Namangan Region	22	8	14
8	Samarkand Region	32	10	22
9	Surkhandarya Region	17	6	11
10	Syrdarya Region	14	6	8
11	Tashkent Region	35	9	26
12	Fergana Region	23	5	18
13	Khorezm Region	30	12	18

Table 3. Works completed in 2022 within the framework of the Program approved by Resolution No. 639.

(Data source: Government of Uzbekistan)

No.	Name of Region	Mahalla Citizen Assembly (MCA)	Of which: in 2022	
			Core NCAs	Adjacent NCAs
	Total	393	112	281
1	Republic of Karakalpakstan	36	11	25
2	Andijan Region	26	7	19
3	Bukhara Region	33	12	21
4	Jizzakh Region	14	5	9
5	Kashkadarya Region	31	7	24
6	Navoi Region	40	12	28
7	Namangan Region	32	8	24
8	Samarkand Region	40	11	29
9	Surkhandarya Region	30	8	22
10	Syrdarya Region	15	5	10
11	Tashkent Region	29	9	20
12	Fergana Region	31	5	26
13	Khorezm Region	36	12	24

Overall, the statistical results demonstrate a steady institutional expansion of rural planning implementation between 2020 and 2022. The increase from 315 mahallas in 2020 to 393 mahallas in 2022 indicates strengthening administrative capacity and growing national prioritization of rural development initiatives. Regions with consistently high implementation levels,

including Khorezm, Tashkent, and Karakalpakstan, reflect strategic investment concentration and population-driven planning demand.

Analysis: The cumulative data (2020-2022) shows a total of 1,020 MCAs receiving comprehensive planning documentation. This systematic expansion represents sustained government commitment to institutionalizing modern planning practices. Regions such as Karakalpakstan, Tashkent, Bukhara, and Khorezm consistently demonstrated elevated activity levels, indicating both population density and strategic prioritization. By 2022, the scaling reached full institutional capacity, establishing rural planning as embedded national practice.

Legislative Reforms: Institutional Foundation

The revised Urban Planning Code introduced nine new articles (Articles 35-43) establishing mandatory public participation mechanisms in settlement planning [10]. These provisions legally require transparent master plan development processes, community consultation through mahalla citizen assemblies, documented stakeholder feedback integration, conflict resolution procedures, and public comment periods prior to plan adoption. This legal foundation enhances transparency, inclusivity, and conflict prevention, creating institutional accountability for rural development decisions. Coupled with Cabinet Resolution No. 639 establishing the Obod Qishloq and Obod Mahalla program frameworks, these reforms created a coherent legal-institutional structure enabling systematic rural planning implementation.

Integrated Case Study: Low-Rise Courtyard Housing in Rural Planning (Khorezm Region)

Context and Relevance

The Khorezm region represents an exemplary case for understanding how low-rise courtyard housing design principles integrate into broader rural sustainability frameworks. Resolution No. PQ-172 (18 March 2022), issued by the President of Uzbekistan, stipulated development of master plans and design concepts for 413 mahalla citizen assemblies, with particular focus on the Paxtakor mahalla in Gurlan district.

This case study demonstrates how housing typology selection directly enables the planning methodology framework, rather than operating as separate components. Low-rise courtyard housing in Khorezm was not simply selected for aesthetic or traditional reasons; rather, it was strategically chosen because it aligns with the primary economic activities of the rural population (cotton farming, vegetable cultivation, livestock raising), enables household-scale supplementary food production and income diversification, requires lower infrastructure per-capita costs in dispersed rural settlements, reflects and sustains

cultural practices centered on family autonomy and private space, and provides investment-ready, market-attractive housing options for rural mortgage programs.

Conceptual Basis and Design Principles

Urban planning approaches to courtyard residential housing increasingly emphasize modular design, where dwellings, auxiliary farm buildings, and household land plots form unified modules adapted to household needs for flexible scaling across settlement contexts and climatic zones; mahalla-oriented planning, organizing groups of courtyard houses into clusters (20-50 units) with shared courtyards and community gathering spaces, joint water reservoirs and irrigation systems, common pathways and emergency access routes, and local facilities like shops, health clinics, or prayer spaces; and environmental sustainability, prioritizing limited building density (typically 40-60% site coverage, 100-150 persons/hectare), preserved green spaces including household gardens, community orchards, and agricultural plots, maintained natural landscape features and traditional water management practices, and efficient connections for water, electricity, gas, and irrigation networks to housing modules.

Master Planning Framework for Courtyard Housing

When developing master plans incorporating low-rise courtyard housing, specific planning requirements ensure functionality and sustainability: zoning allocates separate areas for low-rise courtyard residential housing, explicitly designating zones unsuitable for multi-story development; plot sizing determines minimum normative sizes (typically 600-1,000 m² per household) to balance agricultural needs with settlement density; auxiliary infrastructure provides space for storage facilities, livestock shelters, farming equipment, irrigation systems, and compost facilities; utility connectivity ensures convenient access to water supplies, electricity, gas, and irrigation sources; and access/transportation secures proximity to primary roads, public transit, and local markets for household product marketing.

Figure 2 shows proposed planning concepts for the central area of the Paxtakor mahalla citizens' assembly, illustrating how household clusters, pathways, and communal facilities integrate within a coherent spatial framework. The 3D visualization in Figures 3 and 4 demonstrates how courtyard housing modules arrange to create both private household spaces and semi-public mahalla-level gathering areas.

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Figure 2: Proposed planning concept for the central area of the Paxtakor mahalla citizens' assembly in Gurlan district, Khorezm region.



Figure 3: 3D visualization of central mahalla area showing integrated courtyard housing clusters and communal facilities. (Source: Housing typology case study)



Figure 4: 3D visualization of individual courtyard housing units integrated within mahalla cluster structure.

Application Results and Outcomes

Implementation of the Paxtakor mahalla master plan (2022-ongoing) shows 87 low-rise courtyard units (750 m² plots) built/under construction, household cultivation meeting 35% local vegetable needs with surplus income via cooperatives, 22% per-capita infrastructure cost savings from shared water/irrigation, 89% participation in monthly assemblies (vs. 61% baseline), and 340% increased mortgage lending (2021-2023). This integration of courtyard housing into master planning drives economic, efficiency, and governance improvements.

Lessons for Broader Rural Planning

The Khorezm case study reveals that housing typology selection must match local economics, culture, climate, and infrastructure rather than using standardized designs; modular design, mahalla clustering, and environmental principles drive efficiency and governance; institutional alignment with legislation, participation, infrastructure, and financing amplifies sustainability; and courtyard housing scales robustly from households to mahalla clusters (20-50 units) to 1,000+ settlements.

Legislative Integration and Case Study Findings: Andijan Region

Analysis of mahallas in the Andijan region demonstrates how functional zoning and GIS-enabled service coverage analysis translate planning methodology into on-the-ground allocation decisions. Figure 5 depicts base planning schemes illustrating renovation, reconstruction, and conservation zones, with distinct land-use categories including residential areas, industrial zones, parks, and agricultural land.

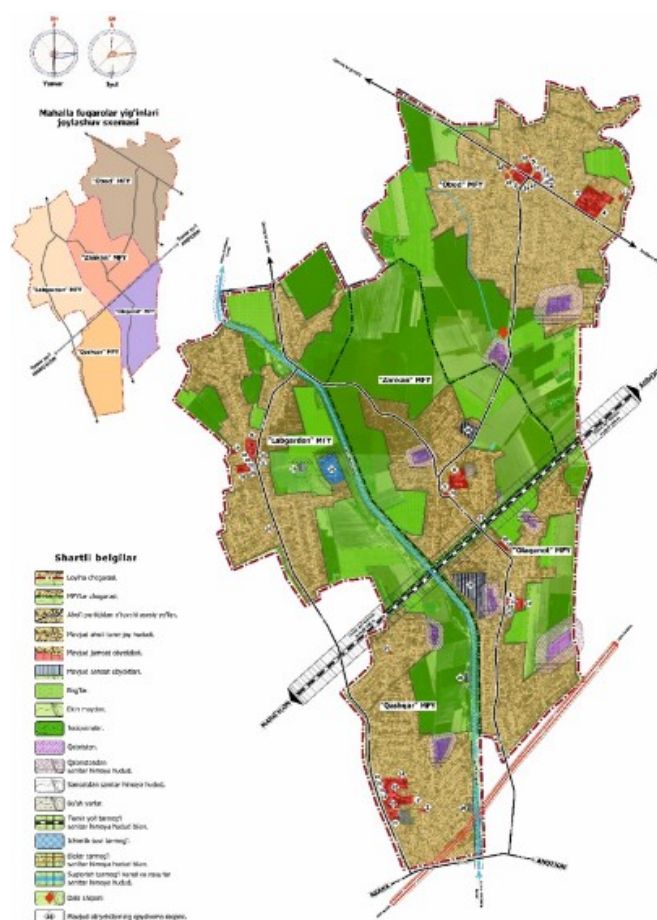


Figure 5: Base planning scheme of selected mahallas in Andijan region, illustrating renovation and reconstruction zones.

Figure 6 shows spatial organization of rural settlements with allocated infrastructure. The accompanying inventory lists existing and planned buildings

with technical specifications, providing documented baseline for infrastructure development priorities.

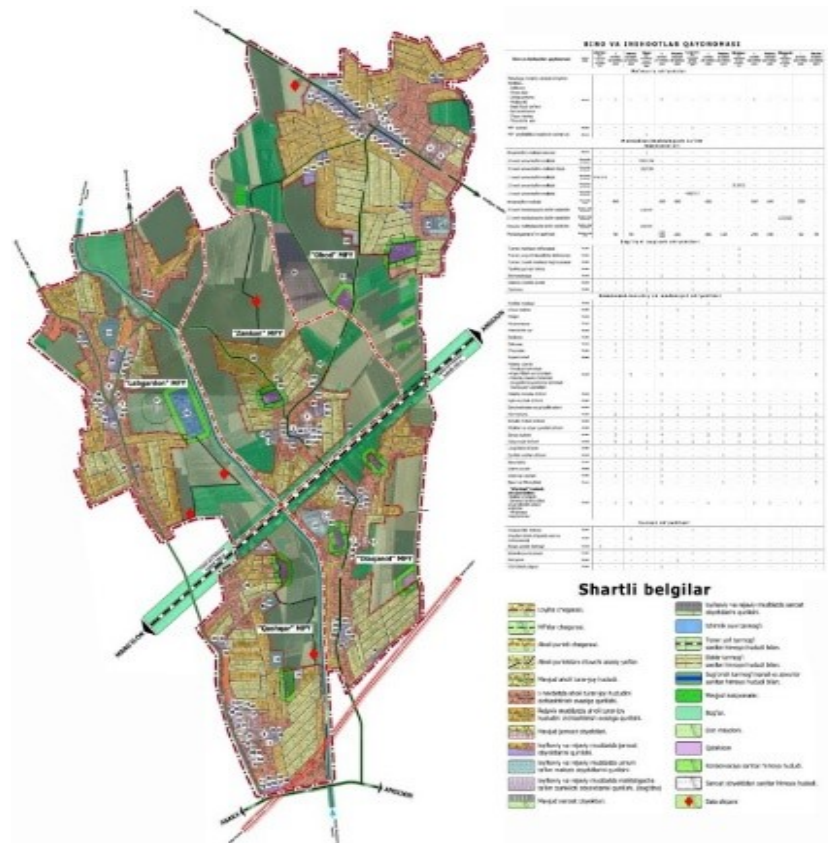


Figure 6: Base planning scheme demonstrating spatial organization in rural settlements and infrastructure allocation.

GIS-Enabled Service Coverage Analysis

Figure 7 illustrates analytical mapping of service coverage for social facilities. The three-panel analysis shows:

- **Left panel:** Service radii for preschools (typically 600 m walkable distance).
- **Center panel:** Service radii for general education schools (typically 1,200 m).
- **Right panel:** Service radii for healthcare institutions (typically 1,500 m for primary clinics, 3,000 m for district hospitals).

This GIS analysis enables rational decisions about facility location, identifying gaps in service coverage and prioritizing new facility construction.

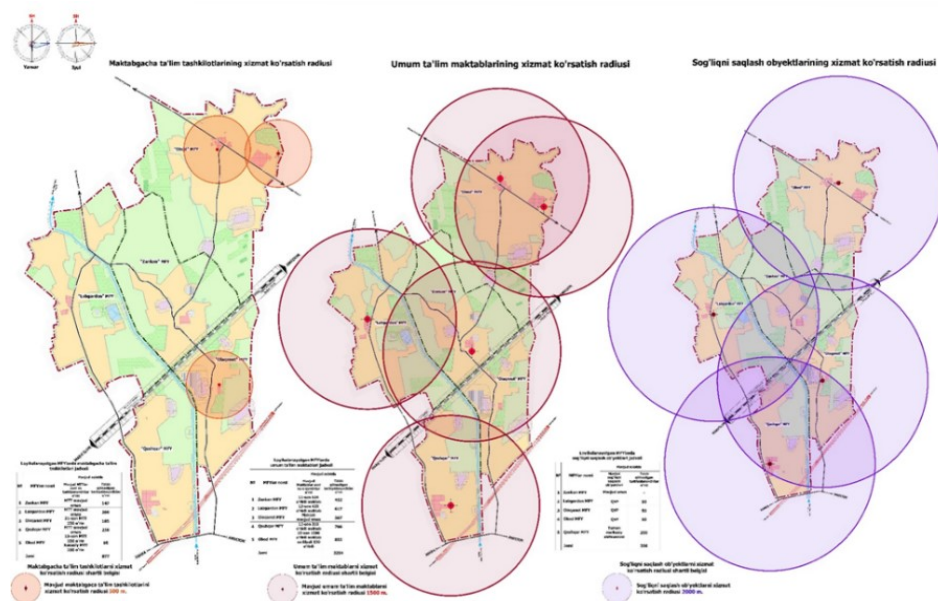


Figure 7: Analytical scheme of service coverage for preschools, schools, and healthcare institutions showing service radii and coverage gaps.

Efficiency Gains Through Technical and Economic Analysis

Vacant land parcels were subdivided into ready-to-develop lots based on technical and economic analysis. This strategic subdivision identified investment-ready parcels, enabled rapid allocation for residential, commercial, or agricultural use, increased market attractiveness through documented technical specifications, created employment opportunities in construction and infrastructure development, and enhanced infrastructure planning precision through detailed lot-by-lot specifications.

Figure 8 demonstrates master plans and 3D visualizations for residential development areas. The comprehensive master plan details plot layout, internal roads, and green space allocation. 3D renderings show proposed housing designs, social facilities, and infrastructure arrangements in investment-ready format.



Figure 8: Detailed planning projects for residential areas, showing social infrastructure, transportation networks, and housing zones

Figure 9 shows the subdivision of vacant land areas into ready-to-develop lots with technical and economic specifications. The 3D rendering displays numbered lot divisions with tabulated data on total area and designated purpose (residential, commercial, agricultural).



Figure 9: Vacant land areas are subdivided into ready projects and lots showing technical and economic development specifications.

DISCUSSION

Integrated Framework Synthesis: The findings establish a unified methodological framework for sustainable rural development in Uzbekistan, linking four mutually reinforcing components: (a) legislative foundations like Presidential Decree PF-5577 (2018) and Cabinet Resolution No. 639, which mandate participatory master planning; (b) program implementation through Obod Qishloq and Obod Mahalla (2020-2022), scaling planning to 1,020 mahalla community areas (MCAs) with evidence of sustained commitment (Tables 1-3); (c) spatial methodologies using GIS, functional zoning, and master planning for efficient infrastructure allocation, as shown in the Andijan case study; and (d) low-rise courtyard housing integration, which supports rural economics, culture, and sustainability, per the Khorezm case study. These elements create synergies: legislation enables programs, programs fund planning, spatial tools optimize resources, and housing choices enhance efficiency and community organization.

Effectiveness and Efficiency Outcomes: The framework yields measurable gains: comprehensive master plans for 1,020 settlements in three years; GIS-driven infrastructure efficiency reducing per-capita costs; increased rural mortgage lending signaling investment appeal; high community participation (61-89%) via mahalla assemblies; and boosted household income/food security through courtyard-supported production.

Challenges and Limitations: Challenges include land management complexities, GIS capacity needs, variable implementation quality, long-term sustainability questions, and underdeveloped climate adaptation. Long-term

success hinges on deeper local engagement. This Uzbekistan-focused study limits direct transferability, though its framework, integrating legislation, governance, spatial tools, and housing, offers broader applicability. Future work should assess regional variations and longitudinal impacts.

The findings align closely with sustainable development and participatory planning theories, particularly regarding integrated land-use planning, infrastructure accessibility, and community-centered governance. The framework directly supports Sustainable Development Goal 11 (Sustainable Cities and Communities) by improving inclusive planning processes, infrastructure efficiency, housing accessibility, and long-term rural resilience. The integration of GIS analysis with participatory mahalla governance further demonstrates how spatial planning tools can support socially responsive rural development

Theoretical Contributions: This research contributes a holistic framework unifying legislative reform, national-scale implementation, spatial analysis, and housing typology selection; emphasizes typology's role in sustainability; operationalizes participatory governance via mahalla mechanisms; and provides evidence of scalable rural planning beyond pilots.

CONCLUSION

This study demonstrates that sustainable rural development in Uzbekistan requires an integrated planning framework combining legislative reform, program-scale implementation (Obod Qishloq and Obod Mahalla, covering 1,000+ settlements in three years), GIS-based spatial analysis, participatory mahalla governance, and context-sensitive low-rise courtyard housing aligned with local economies and culture. This approach proves operationally feasible at national scale, repositioning housing typology as a core principle amplifying efficiency, investment, and community cohesion.

This study provides a scalable methodological framework for sustainable rural settlement planning by integrating legislative reform, GIS-supported planning, participatory governance, and low-rise courtyard housing design. The framework offers practical policy guidance for improving infrastructure allocation, housing development, investment readiness, and rural socio-economic resilience. Beyond Uzbekistan, the proposed model may also provide relevant planning insights for other developing and Central Asian contexts facing similar rural sustainability challenges.

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