FORUM GEOGRAFI
ISSN: 0852-0682 | E-ISSN: 2460-3945

HTTPS://JOURNALS.UMS.AC.ID/INDEX.PHP/FG/

Research article

Urbanisation Dynamics and Socio-Spatial Transformation: Evidence from Samarkand, Uzbekistan

Lutfullo Ibragimov[1], Aigul Sergeyeva[2*], Gulmira Barotova[3], Mirlan Dyldaev[4], Normurod Latipov [5], Bekzod Musayev [6]

[1] Department of Socio-Economical Geography, Faculty of Geography and Ecology, Samarkand State University, Samarkand 140104, Uzbekistan; [2] Department of Physical and Economical Geography, Institute of Natural Sciences, L.N. Gumilyov Eurasian National University, Astana 010000, Kazakhstan; [3] Department of Socio-Economical Geography, Faculty of Geography and Ecology, Samarkand State University, Samarkand 140104, Uzbekistan; [4] Bishkek State University named after K. Karasaev, Bishkek 720044, Kyrgyzstan; [5] Department of Geography, Faculty of Natural Sciences and Medicine, Navoi State University, Navoi 210100, Uzbekistan; [6] Department of Geography, Faculty of Natural Sciences, Samarkand State Pedagogical Institute, Samarkand 140104, Usbezkistan.

[*)] Correspondence: sergeyeva_am@enu.kz

Citation:
Ibragimov, L., Sergeyeva, A., Barotova, G., Dyldaev, M., Latipov, N., & Musayev, B. (2026). Urbanisation Dynamics and Socio-Spatial Transformation: Evidence from Samarkand, Uzbekistan. Forum Geografi. 40(3), 333-349.

Article history:
Received: 29 January 2026
Revised: 13 May 2026
Accepted: 6 June 2026
Published: 20 June 2026

Abstract

Urbanisation in post-Soviet Central Asia has accelerated significantly over recent decades, reshaping demographic structures, land use patterns and socio-economic development trajectories across the region. Considerable attention has been paid to the capital city of Tashkent, whereas the urbanisation dynamics of secondary cities and their surrounding regions remain insufficiently explored in the academic literature. This study addresses that gap by examining urbanisation processes in the Samarkand region of Uzbekistan during the period 2010–2025. Urbanisation trends are analysed through an assessment of the relationships between urban population growth, demographic changes and the socio-economic development of the region. The study is based on official statistical data. The methodological approach includes correlation analysis, together with cartographic analysis and GIS visualisation to identify spatial differences in the level of urbanisation. The results indicate that urban population growth in the Samarkand region is driven primarily not by rural-to-urban migration, but by internal demographic factors such as high fertility rates and a sustained natural population increase ($r = +0.967$ between urban population and births). Urbanisation is closely associated with growth in industrial output ($r = 0.91$); increased investment in fixed capital ($r = 0.88$); and intensified construction activity ($r = 0.89$), together with rising employment and the expansion of the service sector. At the same time, a reduction in agricultural land is observed, particularly in suburban areas, as reflected in the inverse correlation between urbanisation and agricultural land area ($r = -0.69$). The findings demonstrate that urbanisation in the region is following a gradual and internally-driven trajectory. The study highlights the need for coordinated spatial planning and balanced land-use policies to ensure sustainable socio-economic development in the Samarkand region.

Keywords: urbanisation dynamics; urban transformation; socio-spatial transformation; socio-economic development; demographic change; urban expansion; Central Asia.

1. Introduction

At the theoretical level, urbanisation is understood as a complex and multidimensional process through which cities stimulate economic growth, redistribute labour, and concentrate economic activity and population (Fathi Farzaneh & Masoumzadeh, 2023). The effects of urbanisation vary depending on the patterns of urban growth and may differ significantly in terms of economic performance and territorial sustainability (Gross & Ouyang, 2021). While it generates benefits such as flexible labour markets, developed infrastructure, and accelerated innovation diffusion, it also entails challenges including intensified competition, shortages of immobile factors, and growing social inequalities (Tleuberdinova *et al.,* 2024; Kireyeva *et al.,* 2022). Recent global research has highlighted strong linkages between urban expansion, land-use transformation, carbon emissions and institutional governance frameworks, while the concentration of innovation and human capital in urban areas further reinforces economic growth (Li *et al.,* 2019; Wu *et al.,* 2020). In Central Asia, urbanisation processes are largely shaped by Soviet-era urban models, in which cities historically functioned as administrative, industrial and cultural centres. The region occupies a strategically important position between Europe and Asia and possesses significant potential as a transit-oriented space facilitating flows of capital, goods and innovation (Makhanov, 2023; Junussova *et al.,* 2023). Empirical evidence suggests that countries with relatively low levels of urbanisation, such as those in Central Asia, may experience higher marginal returns from urban growth (Adams, 2022). However, with the exception of Kazakhstan, the economies of Central Asian countries remain predominantly agrarian, with a substantial share of the labour force engaged in agriculture, with only a relatively limited degree of urban-industrial transformation (Guo *et al.,* 2022). As a result, many settlements remain at the early stages of urbanisation, in which the development of agglomeration mechanisms and economies of scale is of primary

importance (Martinez *et al.,* 2021; Evans *et al.,* 2021; Dorward *et al.,* 2025). In Uzbekistan, ongoing economic reforms, together with the rapid development of tourism and services, have significantly accelerated urban growth (Jumanazarov *et al.,* 2020; Sergeyeva *et al.,* 2025a).

Samarkand has emerged as one of the country's major urban centres, driven by tourism, education and infrastructure development. Similar dynamics of land-use transformation, functional specialisation and spatial polarisation have also been observed in other regions, such as Bukhara (Sergeyeva *et al.,* 2025b). At the same time, rapid urbanisation has intensified social and environmental pressures, including housing shortages, infrastructure deficits and the expansion of informal settlements, highlighting the need for sustainable and inclusive urban policies (Correia Filho *et al.,* 2022; Veckalne & Tambovceva, 2023). Peri-urban areas are particularly dynamic, as they are experiencing significant land-use change, including the conversion of agricultural land into residential and industrial zones, a process documented through remote sensing and GIS methods across various geographical contexts (Berdikulov *et al.,* 2026).

Global research has made significant progress in understanding urbanisation dynamics across diverse geographical contexts. Studies on China have demonstrated how urban expansion is linked to carbon emissions, economic development and governance transformation (Zhao *et al.,* 2024; Zhang *et al.,* 2022; Yao *et al.,* 2024), while research in Southeast Asia and Latin America has examined land-use transformation, ecosystem services and the socio-environmental consequences of rapid urban growth (Fan *et al.,* 2019; Liu *et al.,* 2021). In European contexts, urbanisation has been analysed in relation to spatial restructuring, centre–periphery dynamics and urban resilience (Gentile, 2018). These studies share a common methodological strength: they integrate demographic, economic and spatial dimensions within a unified analytical framework and apply quantitative methods to identify statistically significant patterns and drivers of urbanisation.

Despite this growing body of global literature, research on Central Asia and Uzbekistan in particular remains comparatively limited in both scope and methodological rigour. Studies on urbanisation in the region tend to examine demographic, socio-economic and spatial dimensions separately, and often lack the quantitative analytical frameworks that have become standard in international research. This gap is especially pronounced for the Samarkand region, where no integrated study combining correlation analysis, GIS-based spatial mapping, and multi-dimensional indicator frameworks has previously been conducted (Tojiyeva & Ibragimov, 2021; Kakharovna *et al.,* 2022). Our study therefore directly addresses this gap by employing an integrated quantitative approach that mirrors methodological standards established in global urbanisation research.

The Samarkand region represents a particularly relevant case study due to its unique combination of historical heritage, favourable geographical location and diversified economic structure, linking agriculture, industry and tourism. Over the period 2010–2025, the region underwent significant transformations, including sustained urban population growth, structural changes in economic activity, and notable shifts in land use (Ibragimov *et al.,* 2024).

The objective of the study is to identify and analyse the key factors determining the nature and direction of urbanisation processes in the Samarkand region and to establish statistically significant relationships between the level of urbanisation and the main demographic, socio-economic and spatial indicators of regional development over the period 2010–2025. It addresses the following research questions: (1) What are the primary demographic drivers of urban population growth in the Samarkand region? (2) How is urbanisation associated with key socio-economic indicators at the regional level? and (3) What spatial patterns of urbanisation differentiation can be identified across the districts of the region?

3. Methods

3.1. Study Area

The Samarkand region is located in the central part of Uzbekistan, within the Zarafshan River valley. The region covers approximately 16,400 km² and borders the Jizzakh, Navoi, Bukhara, Kashkadarya and Surkhandarya regions, as well as Tajikistan to the south-east. Its geographical position has historically supported the development of settlement networks, trade routes, agriculture, tourism and regional economic connections. A map of the study area illustrating the administrative boundaries, urban settlements, and key spatial characteristics is presented in Figure 1.

Administratively, the region includes 14 districts and major urban settlements, including Samarkand city and Kattakurgan city (Table 1). Samarkand city is the regional centre and one of the largest and most historically significant cities in Uzbekistan. By 2025, the population of the region had reached approximately 4.3 million people, making it one of the most densely populated regions of the country.

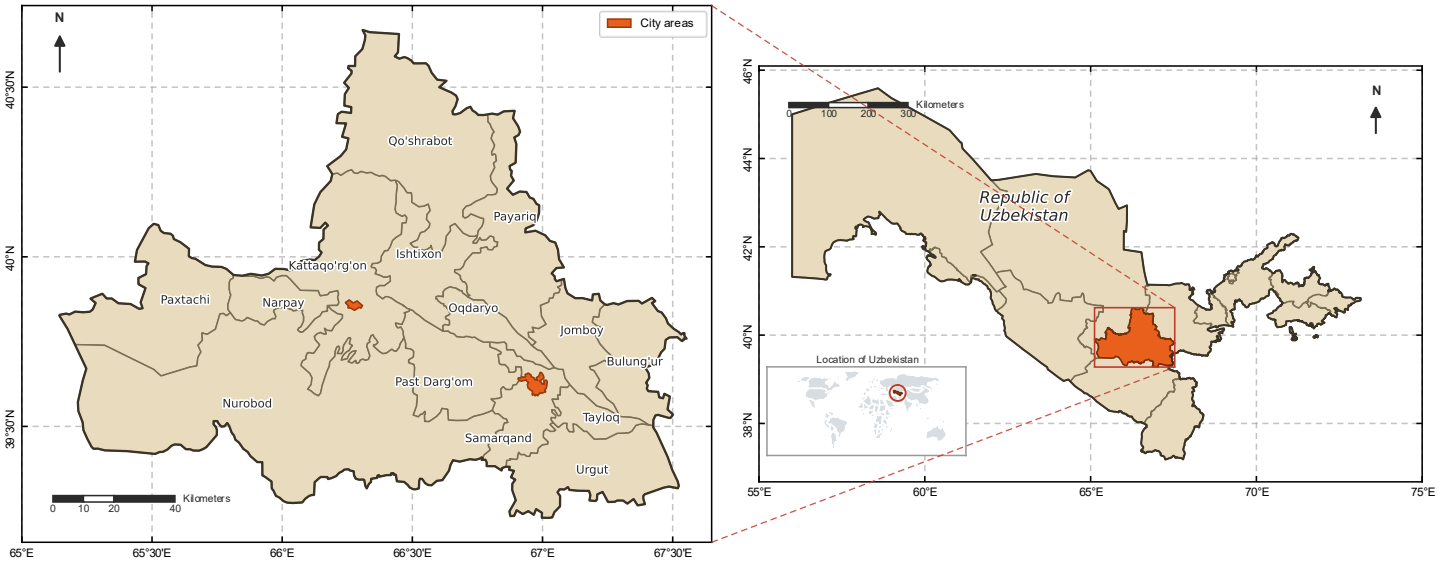

Figure 1. Research Area. Source: Authors' preparation based on official administrative data.

Table 1. Urban Settlements in the Samarkand Region.

Territory	Area (thousand km²)	Districts	Total Cities	Cities of Regional Significance	Small Towns	Mahallas (self-governed)	Rural Settlements	Population (thousand)
Samarkand Region (Total)	16.77	14	11	2	88	1,126	1,899	4,297.5
Samarkand city	0.120	-	1	1	3	215	-	595.8
Kattakurgan city	0.015	-	1	1	1	36	-	95.9
District								
Akdarya	0.389	1	-	-	10	35	105	177.2
Bulungur	0.765	1	1	-	3	55	143	206.9
Jomboy	0.547	1	1	-	5	38	152	194.1
Ishtixon	0.718	1	1	-	12	62	165	282.2
Kattakurgan district	1.393	1	-	-	8	69	172	299.8
Qoshrabot	2.160	1	-	-	2	45	137	144.4
Narpay	0.442	1	1	-	3	57	133	231.6
Payariq	1.287	1	2	-	9	65	210	279.8
Pastdargom	0.870	1	1	-	12	107	162	392.1
Paxtachi	1.376	1	-	-	7	59	132	154.5
Samarkand district	0.432	1	-	-	2	74	91	278.6
Nurobod	4.862	1	1	-	1	39	95	165.8
Urgut	1.120	1	1	-	7	120	115	572.6

Source: Compiled by the authors based on statistical data.

The economy of the region is diversified and includes agriculture, industry, construction, tourism, trade, education and services. The central and south-eastern districts, especially Samarkand, Bulungur, Jambay, Tayloq and Urgut, demonstrate higher population concentration and stronger urban functions. In contrast, the northern and western districts remain more rural and agriculture-oriented. This spatial heterogeneity makes the Samarkand region a suitable case for analysing urbanisation transformation and socio-economic links.

3.2. Data Sources

The empirical foundation of the study was based on official statistical data published by the State Committee of the Republic of Uzbekistan on Statistics for the period 2010–2025 (State Committee of the Republic of Uzbekistan on Statistics, 2010–2025). This time span was selected for two reasons: it captures the full cycle of institutional and economic reforms initiated after 2016, and it is sufficiently long to identify persistent urbanisation patterns and compare development trajectories across different reform phases.

The dataset was compiled to reflect the multidimensional character of urbanisation and was organised into three thematic blocks corresponding to the principal dimensions of analysis: demographic, socio-economic and production–spatial (Table 2). All the indicators were obtained from the State Committee of the Republic of Uzbekistan on Statistics and reflect annual data for the Samarkand region over the period 2010–2025.

Table 2. Indicators Used in the Study, Organised by Analytical Block.

Block	Indicator	Unit
Demographic	Urban population size	Thousands inhabitants
	Rural population size	Thousands inhabitants
	Total residential population	Thousands inhabitants
	Number of births	Individuals
	Number of deaths	Individuals
	Population density	Inhabitants/km²
Socio-economic	Volume of services provided	Billion soums
	Retail trade turnover	Billion soums
	Working-age population	Thousands people
	Number of employed persons	Thousands
	Higher education graduates	Individuals
	Per capita retail turnover	Thousand soums
Production–spatial	Industrial output	Billion soums
	Investment in fixed capital	Million soums
	Construction volume	Billion soums
	Number of small businesses	Units
	Agricultural land area	Hectares

Note: The demographic block captures population dynamics and settlement structure; the socio-economic block reflects labour market conditions and consumer activity; the production–spatial block assesses economic output, investment flows and land-use transformation.

The selection of indicators was informed by contemporary approaches in urban economics and regional studies (Duranton & Puga, 2023; Koster & Thisse, 2024). Those chosen satisfy three practical criteria: they reflect structural changes across demographic, social and economic spheres; they are available as consistent annual time series; and they are widely applied in comparable regional urbanisation studies. In particular, natural population growth, employment, retail turnover, industrial output, investment and agricultural land area have been used as core urbanisation indicators in studies examining post-Soviet and Central Asian contexts (Zhang *et al.,* 2020; Ma & Sun, 2020; Turemuratov *et al.,* 2024), as well as in broader comparative research on urbanisation and socio-economic development (Ciommi *et al.,* 2018; Polinesi *et al.,* 2020). The use of the urban population share as the key urbanisation indicator follows the approach recommended by UN-Habitat and Eurostat (UN-Habitat, 2020; OECD, 2019) and has been adopted in analogous regional-level analyses (Norimov, 2024).

3.3. Data Preprocessing

Before analytical procedures were applied, the dataset underwent multi-stage preprocessing. First, missing observations in the time series were addressed using linear interpolation in order to preserve the continuity of temporal trends. Second, year-to-year changes were examined for each indicator to evaluate temporal stability and identify potential structural breaks or random fluctuations. Third, since the indicators were measured in different units, all the variables were standardised to a comparable scale using z-score transformation. For each indicator x, the z-score was calculated as Equation 1.

$$z_i = \frac{x_i - \bar{x}}{\sigma} \tag{1}$$

where x_i is the observed value in year I; $\bar{x}$ is the mean value over the study period; and σ is the standard deviation. This procedure eliminates the effect of differing measurement scales and allows direct comparison of indicators across groups. Fourth, logarithmic transformation was applied to indicators exhibiting high year-to-year variability – most notably industrial production, construction volume and investment in fixed capital – in order to reduce heteroscedasticity and enhance the stability of temporal dynamics prior to correlation analysis.

3.4. Analytical Methods

Correlation analysis. To assess the relationships between urbanisation level and key demographic, socio-economic and spatial indicators, the Pearson correlation coefficient was employed. For the two variables X and Y observed over n time periods, the coefficient was calculated as Equation 2.

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \cdot \sum_{i=1}^{n}(Y_i - \bar{Y})^2}} \tag{2}$$

where $\bar{X}$ and $\bar{Y}$ are the respective sample means. The coefficient r ranges from −1 to +1, withvalues close to ±1 indicating a strong linear relationship, and those close to 0 indicating the absence of a linear association. The results are presented in the form of correlation matrices for each analytical block (demographic, socio-economic and production–spatial). Following the approach recommended in recent methodological literature (Caminiti *et al.,* 2026; Espey *et al.,* 2024), only the lower triangle of the symmetric matrix is reported in order to avoid redundancy and improve visual clarity. Statistical computations were performed using STATA 17.0.

Spatial analysis. To examine territorial differences in urbanisation and socio-economic development across the 14 districts of the Samarkand region, spatial analysis was conducted using ArcGIS 10.6. The spatial dataset included administrative boundaries, the distribution of urban and rural populations, population density, indicators of natural population change and migration balance, and selected socio-economic characteristics at the district level.

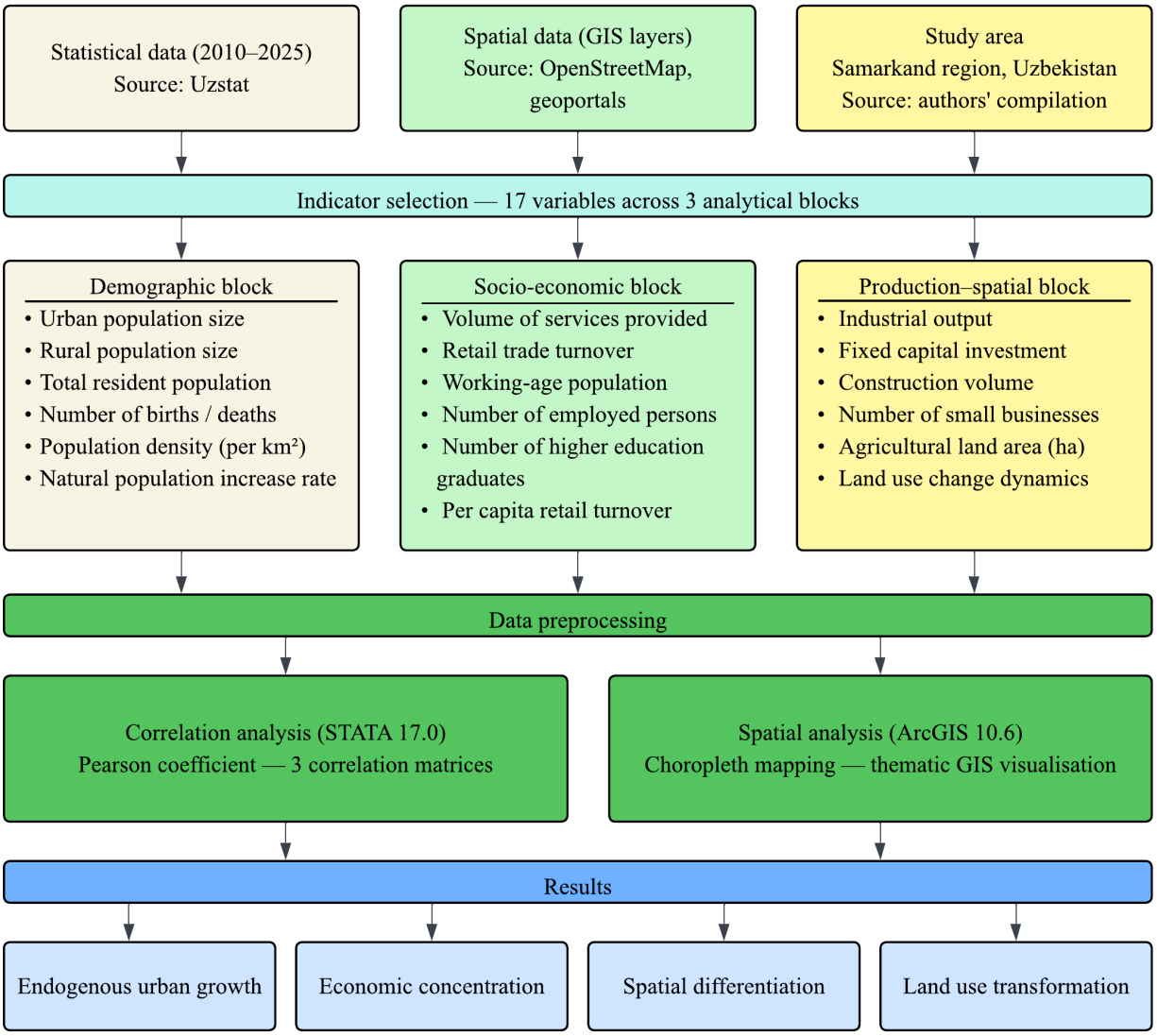

Figure 2. Research Framework.

Thematic choropleth maps were produced for the following indicators: urbanisation level (share of urban population in total district population), population density, natural population increase rate, net migration balance, and projected urbanisation trajectories to 2040. For each mapped indicator, values were classified into five intervals using the natural breaks (Jenks) method, which minimises within-class variance and maximises between-class differences, thereby ensuring that district boundaries reflect meaningful spatial discontinuities rather than arbitrary quantile thresholds. To identify the spatial typologies of districts, a classification was applied based on two dimensions: the level of urbanisation and the dominant demographic dynamic (natural increase versus migration-driven growth). This produced four district types: (1) highly urbanised with sustained natural growth; (2) moderately urbanised with mixed demographic drivers; (3)

predominantly rural with positive natural population growth; and (4) peripheral rural with negative migration balance. The resulting typology is presented cartographically in Figures 3 and 4, and serves as the spatial framework for interpreting the correlation results reported in Section 4. The overall research framework and analytical workflow are summarised in Figure 2.

Population and urbanisation forecasting. To project urbanisation trajectories at the district level up to 2040, the trend extrapolation method was applied based on the annual time series of urban population share for each of the 14 districts over the period 2010–2025. For each district, a linear regression model was fitted to the observed urbanisation trend, and the resulting slope coefficient was used to extrapolate the urban population share forward to 2040 under a baseline scenario assuming continuation of current demographic and economic trends.

The forecasting procedure consisted of three steps. First, the annual rate of change in urban population share was calculated for each district individually in order to account for district-level heterogeneity in urbanisation dynamics, rather than applying a uniform regional rate. Second, linear extrapolation was applied separately for each district using the equation 3.

$$\hat{U}_t = \hat{U}_0 + b \cdot t \quad (3)$$

where Ût is the projected urban population share in year t; Û0 is the observed share in the base year 202; b is the estimated annual rate of change derived from the 2010–2025 trend; and t is the number of years beyond 2025. Third, the resulting district-level projections were mapped using ArcGIS 10.6 and classified into four urbanisation trajectory groups: accelerated urbanisation (projected share exceeding 70% by 2040); moderate urbanisation (50–70%); stable mixed (30–50%); and predominantly rural (below 30%). It should be noted that these projections represent a baseline scenario and do not account for potential policy interventions, economic shocks or structural breaks in demographic trends. They are intended to illustrate spatial tendencies rather than to provide precise quantitative forecasts.

4. Results

4.1. Demographic Factors of Urbanisation

The demographic analysis shows that urbanisation in the Samarkand region is strongly associated with natural population growth. During the period 2010–2025, the total population of the region increased from 3.119 million to 4.315 million. This growth was accompanied by an increase in both urban and rural populations, indicating that urbanisation in the region is not based on rural depopulation, but on simultaneous population growth across settlement types.

All the key demographic indicators showed very high positive correlations with urban population size, as detailed in the time series presented in Table 3. The demographic results confirm that the urbanisation process in the Samarkand region follows an endogenous model. Urban population growth is primarily driven by natural population increase rather than large-scale migration from rural to urban areas. Figure 3 illustrates the district-level distribution of urban and rural populations, providing a spatial reference framework for comparing urbanisation patterns with the statistical relationships identified through the correlation analysis.

In many districts of the Samarkand region, the fertility rate exceeds the mortality rate, resulting in a positive natural population increase. The intensity of natural population change varies across the region and is generally higher in areas with a younger population age structure (Figure 4). The positive natural population growth is associated with several factors: (1) the predominance of a young population; (2) the persistence of traditional reproductive norms, including early marriage; (3) the preservation of rural lifestyles despite the rapid pace of urbanisation; and (4) the fact that urban population growth in the Samarkand region is not accompanied by a sharp decline in the rural population, which helps to maintain an overall positive demographic balance.

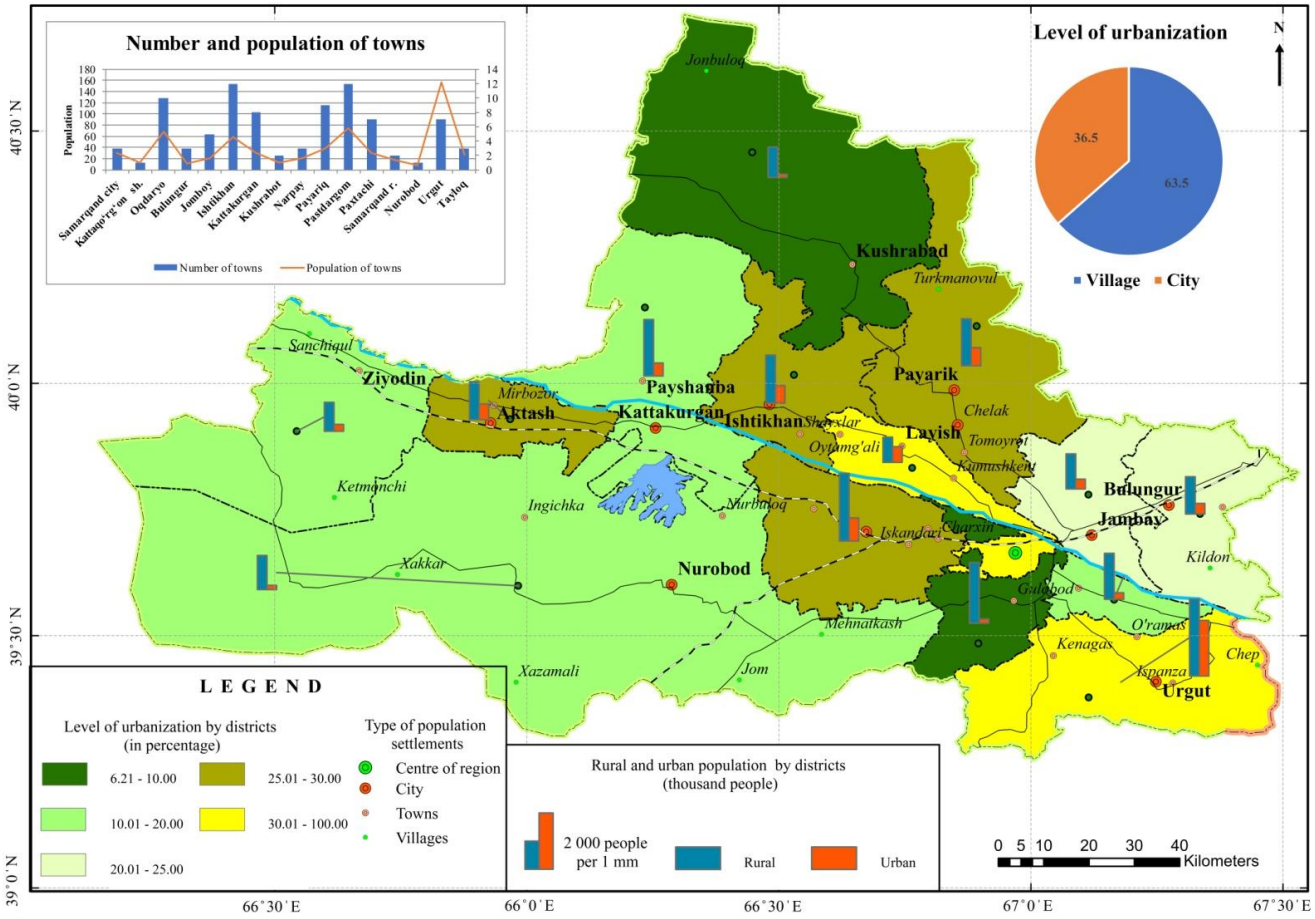

Figure 3. Urbanisation Levels in the Districts of the Samarkand Region.

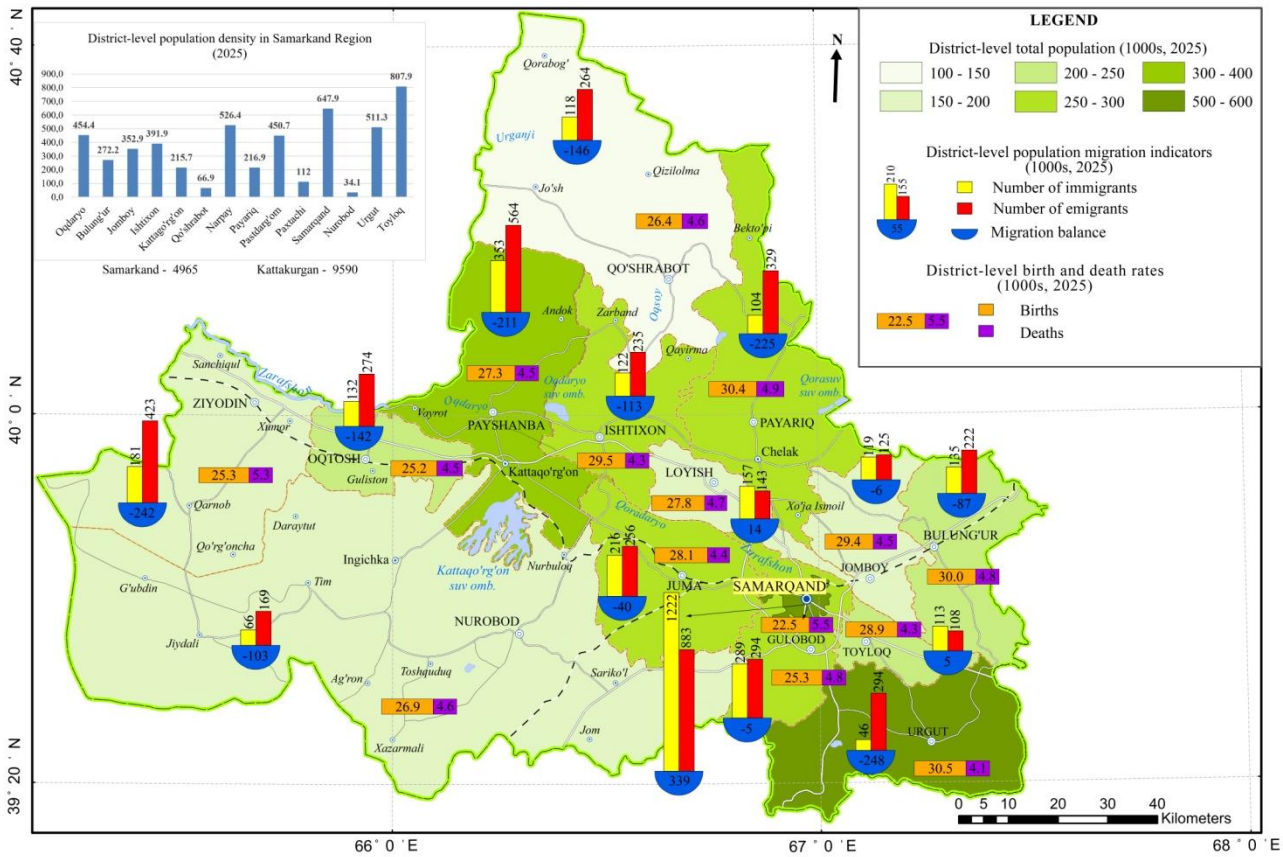

Figure 4. Spatial Distribution of Demographic Indicators in the Samarkand Region (2025).

Figure 4 shows the spatial distribution of demographic indicators in the Samarkand region for 2025, indicating that demographic processes were developing unevenly. In the central and south-eastern districts, population concentration was higher and a positive natural population increase was being maintained. In contrast, the northern and south-western peripheral districts were characterised by lower fertility rates and were experiencing population outflows, which is reflected in a negative migration balance.

The correlation matrix presented in Figure 5 clearly illustrates the nature of the statistical relationships between the size of the urban population and key demographic indicators in the region over the period 2010–2025. These indicate the presence of very strong associations between the variables, confirming the close interdependence between demographic change and urbanisation processes. The correlation matrix shows that very strong statistical relationships exist between the urban population size and the main demographic indicators. Nearly all correlation coefficients exceed 0.9, indicating a synchronous pattern of demographic change in the region during the period under review.

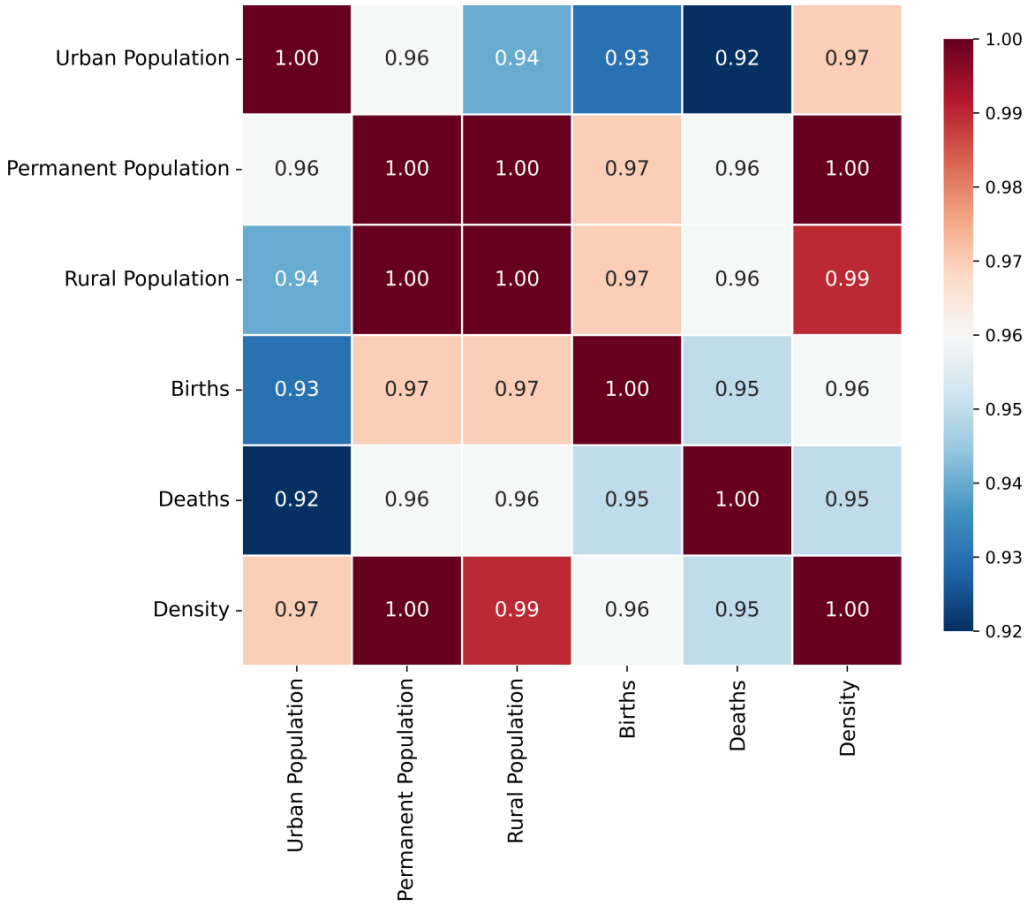

Figure 5. Correlation Matrix Showing Relationships Between Urban Population and Selected Demographic Indicators in Samarkand (2010–2025).

Particularly strong relationships can be seen between urban population growth and total population size, together with population density. This suggests that urbanisation processes in the Samarkand region are mainly developing not through a simple redistribution of population between urban and rural areas, but under conditions of simultaneous demographic growth and increasing settlement density. High correlation values with fertility indicators confirm the key role of natural population increase as one of the principal drivers of urbanisation dynamics.

At the same time, a stable positive correlation between urban and rural population sizes reflects the specific demographic development pattern of the region, in which urban growth is not accompanied by a sharp decline in the rural population. This points to the persistence of close functional linkages between urban and rural territories and to the gradual, evolutionary nature of urbanisation, rather than its abrupt or discontinuous manifestation.

On the basis of the time series presented in Table 3, the relationship between urban population growth and key demographic indicators – total population size, rural population size, numbers of

births and deaths, and population density – was analysed. The assessment was made using the Pearson correlation coefficient.

Table 3. Demographic Factors (2010-2025).

Year	Resident population (1000s)	Village population (1000s)	Number of births	Number of deaths	Increasing population density (1 km^2)
2010	3,119.0	1,958.7	75,213	14,262	186
2011	3,270.8	2,068.2	73,903	14,605	195
2012	3,326.2	2,025.0	74,137	15,002	198.3
2013	3,380.9	2,068.2	82,390	15,227	201.6
2014	3,445.6	2,120.8	87,833	15,381	205.5
2015	3,514.8	2,177.7	88,649	15,895	209.6
2016	3,583.9	2,228.6	88,295	16,146	213.7
2017	3,651.7	2,278.9	89,956	16,661	217.8
2018	3,720.1	2,329.3	98,909	16,254	221.8
2019	3,798.9	2,384.2	100,656	16,444	226.5
2020	3,877.4	2,439.1	101,414	18,404	231.2
2021	4,031.3	2,548.2	110,455	18,808	235.4
2022	4,118.2	2,605.2	111,505	19,272	240.4
2023	4,208.5	2,665.6	113,986	19,388	245.6
2024	4,297.5	2,726.9	110,865	18,854	251
2025	4,315.3	2,738.70	110,900	18,800	256.3

Source: Compiled by the Authors Based on Statistical Data.

The relationship between urban population size and population density was found to be almost maximal ($r \approx +0.97$). This indicates that urban growth in the Samarkand region occurs primarily through the intensification of already developed areas, rather than through active territorial expansion. In other words, cities are "growing inward," concentrating their population within existing settlements. Such a model is consistent with contemporary global trends, in which compact and higher-density urban development is playing an increasingly important role. Based on the provided data, Pearson correlation coefficients (r) were calculated between the key indicators. All correlations were positive and very high ($r > 0.90$), confirming a strong linear interrelationship between the processes. Between urban population size and total population of the region, the correlation coefficient was $r = +0.998$ ($r^2 \approx 0.996$, meaning that 99.6% of the variance is mutually explained). This indicates that growth in the region's total population is almost entirely reflected in the growth of the urban population. Between the urban and rural population sizes, the correlation is also very high ($r = +0.992$, $r^2 \approx 0.984$, or 98.4% of the variance explained). Unlike the classical urbanisation model associated with rural depopulation, the Samarkand region demonstrates parallel population growth in both urban and rural areas.

High fertility rates and sustained natural population growth have generated significant demographic pressure. In cities, these processes are more intense due to increasing population density. In the urban areas of the region, demand for social and economic infrastructure has risen, leading to emerging challenges in the provision of schools, hospitals, kindergartens and employment opportunities. The correlation coefficient between the size of the urban population and the number of births equals $r = +0.967$ ($r^2 \approx 0.935$, i.e. 93.5% of the variance explained). The relationship between the urban population size and number of deaths in the Samarkand region is also very strong ($r = +0.964$, $r^2 \approx 0.929$, or 92.9% of the variance explained), although it is slightly weaker than that observed for births. The absolute number of deaths increased in parallel with population growth; however, relative mortality rates (per 1,000 inhabitants) have declined in recent years, reflecting improvements in living conditions and healthcare quality. The demographic dynamics of the region are characterised by exceptionally strong interrelationships between key indicators, with r values ranging from +0.964 to +0.998. This implies that urban development planning should take into account ongoing natural population increases, rising settlement density, and the need to maintain balanced linkages between urban and rural areas.

These relationships suggest a clear causal chain: sustained high fertility — rooted in the region's young age structure and traditional reproductive norms — generates continuous natural population growth, which in turn increases the absolute size of the urban population without requiring large-scale rural-to-urban migration. Rising settlement density follows as a consequence, as population growth is concentrated within existing urban boundaries, rather than triggering territorial expansion.

4.2. Relationship Between Urban Population Size and Social Factors

The interaction between social factors and urban population growth plays an important role in understanding contemporary urbanisation processes. This subsection examines how the social

characteristics of the region are associated with changes in the size of the urban population. The main social indicators used in the analysis are presented in Table 4.

Table 4. Social Factors (2010-2025).

Year	Volume of services provided by main types of economic activity (billion soums)	Retail turnover (billion soums)	Number of graduates of higher education institutions	Working age population (1000s)	Number of employed (1000s)	Per capita turnover by district (current prices, thousand soums)
2010	1,799.30	1,683	5,971	1,807.50	1,229.9	526.8
2011	2,336.90	2,208.5	6,853	1,894.90	1,269.8	669.6
2012	3,080.70	3,030.1	4,878	1,936.20	1,314.4	903.5
2013	3,983.40	3,846.7	5,299	1,966.20	1,357.3	1,127.00
2014	5,065.90	4,890.1	5,708	1,995.80	1,402.5	1,405.10
2015	5,832.90	6,078.2	5,917	2,024.70	1,443.9	1,712.50
2016	7,200.50	7,605.2	5,986	2,048.10	1,485.1	2,102.10
2017	8,343.20	8,973.5	6,417	2,069.40	1,523.1	2,436.70
2018	10,043.50	11,123.1	6,869	2,092.50	1,463.3	2,965.10
2019	12,786.80	13,877.3	6,842	2,108.20	1,455.8	3,625.20
2020	14,086.10	16,816.8	7,165	2,120.70	1,418.3	4,298.30
2021	18,259.00	19,882	8,528	2,137.10	1,441.3	5,418.70
2022	22,953.60	25,342.5	8,962	2,155.60	1,479.80	6,219.20
2023	29,023.10	30,196.5	15,276	2,155.60	1,504.2	7,252.80
2024	58,875.70	34,963.3	16,218	2,326.3	1,534.7	8,445.00
2025	63,987.40	39,879.2	16,421	2,366.3	1,566.4	8,748.80

Source: Compiled by the Authors Based on Statistical Data.

The strongest relationships were observed between urban population size and indicators such as the volume of services, retail trade turnover, the size of the working-age population, and retail turnover per capita. This suggests that urban growth is accompanied by the active expansion of the service sector, trade and consumer activity, as well as by the concentration of the economically active population.

Figure 6 presents a correlation matrix illustrating the relationships between urban population size and the principal social indicators in the Samarkand region. This indicates that most social characteristics are closely associated with urban population growth, pointing to the integrated and multifaceted nature of urbanisation processes.

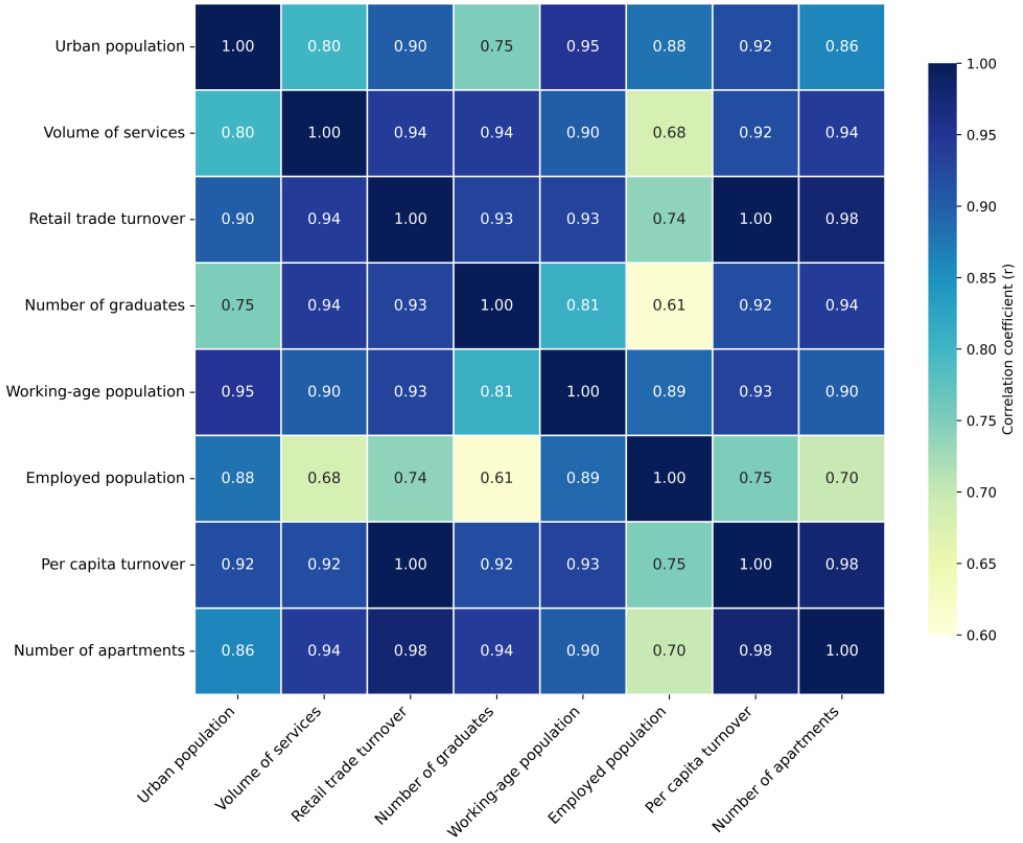

Figure 6. Correlation Matrix Between Urbanisation and Social Factors.

A relatively weaker, yet statistically significant, correlation was observed between the number of higher education graduates and level of urbanisation ($r \approx +0.75$), reflecting the growing importance of educational potential under urban population expansion conditions. The relationship between urban population size and employment remains positive, although somewhat less pronounced ($r \approx +0.88$), which may indicate more complex and heterogeneous processes in the labour market.

The results demonstrate that growth in the urban population of the region is closely linked to socio-economic development and to increases in the quality and intensity of urban life. The correlation matrix demonstrates a strong relationship between the level of urbanisation and key socio-economic indicators. In particular, the growth of the urban population is closely associated with an increase in retail trade turnover ($r \approx +0.90$), indicating a direct link between urban expansion and the development of the consumer market. The correlation analysis indicates that urbanisation processes in the Samarkand region are closely associated with key socio-economic indicators. A strong positive correlation was observed between per capita retail trade turnover and employment levels ($r \approx +0.92$), confirming the role of cities as the main centres of economic activity in the region. Urban population size is strongly correlated with the number of people of working age ($r \approx +0.95$) and with employment levels ($r \approx +0.88$), reflecting the concentration of labour resources in urban areas. Population growth in the cities of the Samarkand region is positively correlated with increasing housing demand ($r \approx +0.86$).

From a cause-and-effect perspective, the direction of these relationships is largely bidirectional. Urban population growth generates demand for retail goods, services and labour, thereby stimulating the expansion of the service sector and the working-age population concentration in cities. At the same time, a growing service economy and rising per capita incomes attract further population inflows and sustain the natural increase, creating a self-reinforcing cycle of urban demographic and economic growth.

4.3. Relationship Between Urban Population Size and Economic Factors

The correlation matrix presented in Figure 7 demonstrates that the growth of the urban population in the Samarkand region is closely associated with the expansion of industrial production, increased investment and construction activity, together with the development of the service sector and small-scale entrepreneurship. Correlation analysis revealed stable and statistically significant relationships between the size of the urban population and key economic indicators, confirming the pronounced city-centred nature of regional development.

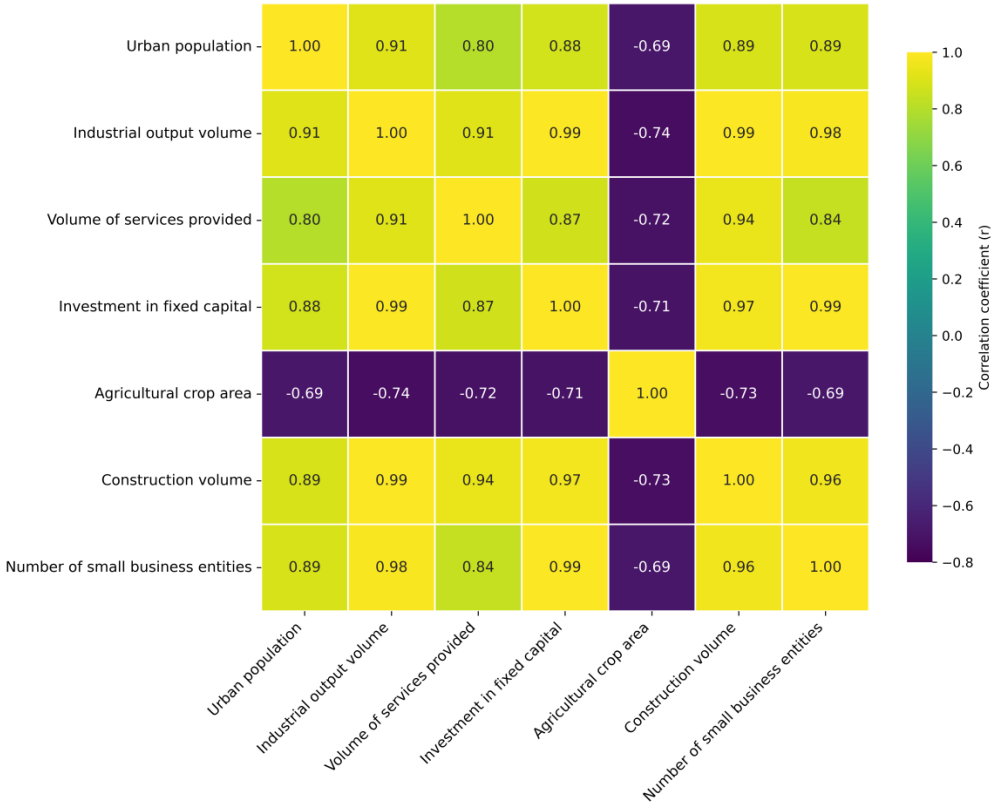

Figure 7. Correlation Matrix Between City Population and Economic Factors.

The strongest relationship was identified between the size of the urban population and industrial output, with a correlation coefficient of r = 0.91. This indicates that urban population growth is primarily accompanied by the expansion of industrial activity in manufacturing sectors oriented towards urban labour markets and infrastructure. A strong positive correlation was also observed between urban population size and the volume of services provided (r = 0.80). This reflects the service-oriented nature of urbanisation and the growing demand for trade, transport, social and household services as the urban population increases. The relationship between urban population size and investment in fixed capital is characterised by a high correlation coefficient (r = 0.88), demonstrating the concentration of investment flows in urban areas. Investments are mainly directed towards industry, construction and infrastructure, thereby strengthening the role of cities as centres of economic growth. Urban population growth is closely linked to an increase in construction activity (r = 0.89). This indicates a direct response by the construction sector to rising demand for housing, production facilities and infrastructure, particularly within cities and their suburban areas. The positive correlation between urban population size and the number of small business entities (r = 0.89) highlights cities as favourable environments for the development of small-scale entrepreneurship. The concentration of population and consumer demand stimulates entrepreneurial activity and contributes to the expansion of the service sector. At the same time, a stable inverse correlation was identified between urban population size and the area of agricultural land (r = –0.69), reflecting structural changes in land use under conditions of urbanisation, whereby agricultural land is gradually replaced by residential development, industrial zones and infrastructure facilities, especially in suburban areas.

Overall, the values of the correlation coefficients indicate that urbanisation in the Samarkand region is accompanied by the concentration of industrial production, investment, construction, services and small businesses in urban areas, while simultaneously leading to a reduction in agricultural land use. This process signifies a profound structural transformation of the regional economy, in which cities are emerging as the primary centres of economic activity and spatial development. The economic indicators used in the study and the corresponding statistical data are presented in Table 5 for the period 2010–2024, as complete data for 2025 were not available at the time of the research.

Table 5. Economic Factors (2010-2024).

Year	Volume of industrial products (billion soums)	Volume of services provided (billion soums)	Investments in fixed capital (million soums)	Area of agricultural crops (hectares)	Volume of construction works (billion soums)	Number of small businesses operating in the region
2010	2,011.2	1,799.30	344	372,824.00	519.7	10,112
2011	2,485.6	2,336.90	407.9	353,246.00	745	10,918
2012	3,222	3,080.70	472.9	331,287.00	926.2	11,117
2013	3,880.1	3,983.40	623.3	360,247.00	1,214.50	11,918
2014	4,966.4	5,065.90	730	364,253.00	1,562.80	12,648
2015	6,095.5	5,832.90	912	360,227.00	2,010.60	12,860
2016	7,446	7,200.50	1,001.60	358,967.00	2,194.90	13,840
2017	9,242	8,343.20	1,189.50	351,249.00	2,342.40	13,981
2018	13,488.1	10,043.50	1,878.30	351,833.00	3,299.00	16,005
2019	15,783.6	12,786.80	2,674.90	328,107.00	4,527.20	19,629
2020	18,383.4	14,086.10	3,746.00	340,750.00	5,755.30	25,643
2021	22,834.3	18,259.00	3,920.70	359,283.00	7,385.70	33,114
2022	29,188.6	22,953.60	4,642.50	336,799.70	8,895.40	40,724
2023	32,955.7	29,023.10	6,177.00	320,047.00	10,177.60	47,943
2024	36,817.3	58,875.70	6,972.10	320,041.00	14,017.10	37,398

Note: Data on investments in fixed capital and agricultural land area for 2025 were not available from official sources at the time the study was conducted. Remaining 2025 indicators are reported in Tables 3 and 4.

The table outlines the key characteristics of regional economic development, which are employed to analyse the relationship between urban population size and economic factors over the study period. The economic development of the Samarkand region during the 2010–2024 period is characterised by growth in industry and the service sector, increased investment and construction activity, together with a gradual transformation of land use. These trends demonstrate a close relationship between urban population growth and the region's key economic factors.

The causal structure underlying these correlations reflects the dual role of urbanisation as both a driver and an outcome of economic concentration. Investment in fixed capital and industrial expansion is partly attracted to cities because of their existing labour supply and infrastructure, making urbanisation a precondition for economic activity. At the same time, economic growth generates employment and income, which sustains population growth and accelerates urbanisation.

The inverse relationship with agricultural land (r = −0.69) represents an irreversible structural consequence: as urban and peri-urban areas expand, agricultural land conversion follows, particularly in districts adjacent to Samarkand city.

4.4. Spatial Differentiation of Urbanisation

GIS-based analysis shows that urbanisation in the Samarkand region is spatially uneven. The highest levels are observed in central and south-eastern districts, especially around Samarkand city and its neighbouring territories. These areas have higher population density, stronger transport accessibility, more developed services, and greater economic activity. This spatial concentration reflects several reinforcing factors: the historical role of Samarkand city as an administrative, cultural and economic centre; superior transport connectivity along the Zarafshan valley corridor; and the agglomeration of educational, healthcare and industrial infrastructure, which attracts both labour and investment flows to the core districts. In contrast, northern and western districts remain more rural and agriculture-oriented. These areas have lower urban population shares, weaker industrial development, and stronger dependence on agricultural land use. This spatial pattern confirms the presence of a centre–periphery structure in the region. The lower fertility rates and negative migration balances observed in these two districts suggest that population outflow is driven by limited local employment opportunities and the gravitational pull of Samarkand city's labour market, rather than by purely demographic factors.

The spatial distribution of urbanisation suggests that Samarkand city functions as the dominant regional growth pole. Surrounding districts are increasingly influenced by suburbanisation, infrastructure development, labour-market integration, and land-use transformation. Peripheral districts, however, remain less integrated into the urban economic system. The spatial pattern also directly reflects the correlation results reported in Section 4.1: the inverse relationship between urbanisation and agricultural land area (r = −0.69) is most pronounced in peri-urban districts surrounding Samarkand city, where residential and industrial expansion has systematically displaced agricultural land since 2010, while peripheral districts have maintained larger agricultural areas precisely because urban expansion pressure there remains limited.

5. Discussion

Urbanisation processes in the Samarkand region are closely interconnected with demographic, socio-economic and spatial conditions. The study findings demonstrate that urban population growth over the period 2010–2025 was driven primarily by natural increases, rather than rural-to-urban migration, with correlation coefficients between urban population size and birth rates reaching r = +0.967. Urbanisation is also closely associated with the expansion of industrial output (r = 0.91), investment in fixed capital (r = 0.88), construction activity (r = 0.89), and the service sector (r = 0.80), while a pronounced spatial differentiation persists between the more urbanised central and south-eastern districts and the predominantly rural northern and western periphery.

From a demographic perspective, the persistence of high fertility rates in the region can be attributed to the predominance of a young population structure, the continuation of traditional reproductive norms including early marriage, and limited progress in gender policy implementation (Agadjanian & Makarova, 2003; Nickayin *et al.,* 2022). These dynamics are consistent with demographic transition theory, whereby regions at intermediate stages of transition experience sustained natural growth prior to the convergence of birth and death rates (Billari, 2022). A particularly distinctive feature of the Samarkand region is the simultaneous growth of both urban and rural populations – a pattern that departs from the classical urbanisation model associated with rural depopulation. In contrast, fertility rates in Kazakhstani cities are lower and urban growth there is largely sustained by migration inflows (Akbar *et al.,* 2025; Seitz, 2021), highlighting structural differences in demographic regimes across Central Asia. The "growth without migration" model observed in the Samarkand region generates sustained pressure on housing, education and healthcare systems, without the compensating effect of rural population decline. The strong positive correlations between urban population size and key economic indicators are broadly consistent with established theoretical frameworks which link urbanisation to agglomeration economies and economic concentration (Henderson, 2003). The concentration of economic activity in urban areas reflects the role of cities as nodes of labour market development, infrastructure investment and consumer demand (Di Clemente *et al.,* 2021). The relatively weaker correlation between urbanisation and higher education graduate numbers (r ≈ +0.75) may reflect structural limitations in translating educational attainment into local economic activity, a pattern observed in transitional economies where skills mismatches constrain returns to human capital investment. The inverse relationship between urban population growth and agricultural land area (r = –0.69) is consistent with findings on peri-urban land-use transformation, whereby expanding urban

boundaries systematically displace agricultural land in suburban zones (Follmann, 2022; Lachininskii *et al.,* 2023; Alikhanov *et al.,* 2024). The spatial analysis reveals that economic activity and population are concentrated in historically established urban centres – a pattern consistent with findings on spatial polarisation in transitional economies (Rogerson & Giddings, 2021).

As presented in Figure 8, forecast projections indicate that Samarkand, Bulungur, Jambay and Ishtikhan districts may reach urban population shares of 70–90% by 2040, forming zones of accelerated urbanisation, while northern and western districts are expected to remain predominantly rural and agriculturally oriented.

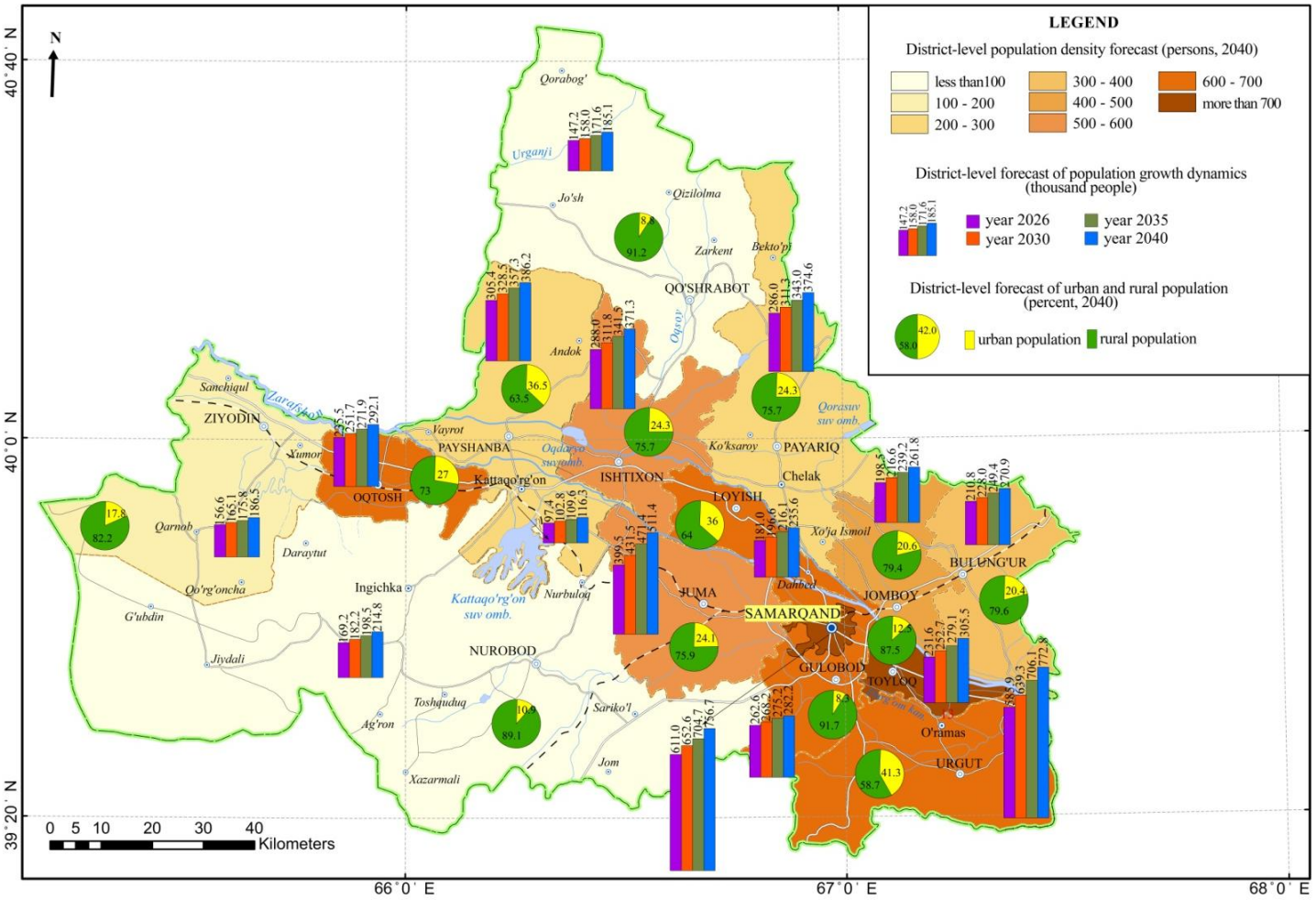

Figure 8. Forecast of Population Density and Population Dynamics in the Samarkand Region up to 2040.

Table 6 provides a comparative overview of the key studies referenced in this discussion, summarising their geographical context, primary urbanisation drivers, and the degree of consistency with the present findings.

From a practical perspective, the findings highlight the need for coordinated spatial planning and land-use regulation, particularly in peri-urban areas where demographic pressure and functional transformation are most pronounced (Pradoto *et al.,* 2024). Investment in urban social infrastructure must be scaled to projected population trajectories, and differentiated regional development strategies are needed to reduce intra-regional inequalities between core and peripheral districts.

The study has several limitations. The analysis relies exclusively on official statistical data, which may not fully capture informal economic activity or unregistered population movements. The use of the Pearson correlation coefficient assumes linear relationships, so non-linear dynamics may therefore remain undetected. In addition, the regional level of analysis does not allow for fine-grained intra-urban examination.

Several directions for future research are identified. First, future studies should incorporate primary field data, including household surveys and expert interviews, to complement official statistics and capture informal dimensions of urbanisation. Second, more advanced spatial econometric methods, such as geographically weighted regression (GWR) and spatial autocorrelation

analysis, would provide a more nuanced understanding of spatial heterogeneity in urbanisation processes across districts. Third, remote sensing and satellite imagery could be integrated to monitor land-use and land-cover changes at higher spatial and temporal resolution, particularly in rapidly transforming peri-urban zones. Fourth, longitudinal panel data models would allow for a more rigorous examination of causal relationships between urbanisation and its demographic and economic drivers. Finally, comparative studies across multiple regions of Uzbekistan and Central Asia would further contribute to the broader theoretical understanding of urbanisation in post-Soviet transitional contexts, enabling cross-regional generalisations and policy learning.

Table 6. Comparative Summary of Referenced Studies on Urbanisation Processes.

Authors (Year)	Region / Context	Urbanisation driver	Key finding	Consistent with this study?
Agadjanian and Makarova (2003)	Uzbekistan	Natural increase; traditional reproductive norms	High fertility drives urban growth in post-Soviet transition	Consistent
Billari (2022)	Global	Demographic transition	Sustained natural growth at intermediate transition stages	Consistent
Akbar *et al.* (2025)	Kazakhstan	Migration-driven urban growth	Urban growth sustained by migration inflows; lower fertility in cities apart from Samarkand	Divergent
Henderson (2003)	Global	Agglomeration economies	Urban concentration linked to economic growth and labour market development	Consistent
Follmann (2022)	Peri-urban zones (global)	Land-use transformation	Expanding urban boundaries systematically displace agricultural land in suburban zones	Consistent
Rogerson and Giddings (2021)	Newcastle, UK	Urban transformation and resilience	Urbanisation linked to spatial restructuring and centre–periphery differentiation	Consistent
Di Clemente *et al.* (2021)	Global	Economic complexity	Cities as nodes of labour market, infrastructure investment, and consumer demand	Consistent
Pradoto *et al.* (2024)	Peri-urban areas	Spatial planning and land-use regulation	Coordinated planning needed in peri-urban zones under demographic pressure	Consistent

6. Conclusion

Urbanisation represents a key dimension of contemporary socio-economic transformation, shaping demographic dynamics, economic activity and spatial development patterns at regional and local levels. This study has provided a comprehensive analysis of urbanisation processes in the Samarkand region of Uzbekistan by examining their demographic, socio-economic and spatial dimensions over the period 2010–2025.

The results demonstrate that urbanisation in the region follows a predominantly endogenous trajectory, driven primarily by sustained natural population growth, rather than by large-scale rural-to-urban migration. As a result, urban population growth is not accompanied by rural depopulation, but instead leads to increasing settlement density and intensified pressure on urban infrastructure and housing systems. Cities in the region function as key centres of employment, trade and service activities, concentrating economically-active population groups and reinforcing the role of Samarkand as a regional growth centre.

The analysis has also revealed pronounced spatial differentiation between urbanisation processes within the region. Urban growth and population concentration are most intensive in the central and south-eastern districts, while northern and western districts remain predominantly rural due to lower levels of economic activity and a strong dependence on agriculture. Forecast results indicate that these spatial disparities are likely to persist and intensify in the coming years, particularly within suburban zones, where land-use change and functional transformation are most pronounced.

From a practical perspective, the findings highlight the need for coordinated spatial planning and balanced land-use policies aimed at managing urban expansion while preserving agricultural land and ensuring the sustainable development of suburban areas. The methodological approach and empirical results of this study may be useful for analysing urbanisation processes in other regions of Uzbekistan and Central Asia that exhibit similar demographic and socio-economic characteristics.

Acknowledgements

The authors express their sincere gratitude to the State Committee of the Republic of Uzbekistan on Statistics and the Administration of the Samarkand Region for providing access to official statistical data and analytical materials used in this research.

Author Contributions

Conceptualization: Ibragimov, L., Sergeyeva, A., Barotova, G., Dyldaev, M., Latipov, N., & Musayev, B.; **methodology**: Ibragimov, L., Sergeyeva, A.; **investigation**: Barotova, G., Latipov, N., & Musayev, B.; **writing—original draft preparation**: Ibragimov, L., Sergeyeva, A., & Dyldaev, M.; **writing—review and editing**: Ibragimov, L., Sergeyeva, A., & Dyldaev, M.; **visualization**: Normurod, L., Barotova, G., & Sergeyeva, A. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

All authors declare that they have no conflicts of interest.

Data availability

Data are available upon request from the corresponding author.

Funding

This research received no external funding.

References

Adams, J. J. (2022). Urbanization, long-run growth, and the demographic transition. Journal of Demographic Economics, 88(1), 31-77. doi: 10.1017/dem.2020.36

Agadjanian, V., & Makarova, E. (2003). From Soviet modernization to post–Soviet transformation: understanding marriage and fertility dynamics in Uzbekistan. Development and Change, 34(3), 447-473. doi: 10.1111/1467-7660.00314

Akbar, I., Sergeyeva, A., Nurgaliyeva, G., Toktaganova, G., Baiburiev, R., Ismailova, M., & Li, Y. (2025). An evaluation for sustainable urban planning of Qonayev City in Kazakhstan through residents' perception. Discover Sustainability, 6(1), 1290. doi: 10.1007/s43621-025-02148-y

Alikhanov, B., Pulatov, B., & Samiev, L. (2024). The detection of past and future land use and land cover change in Ugam Chatkal National Park, Uzbekistan, using CA-Markov and Random Forest machine learning algorithms. Forum Geografi, 38(2), 121-137. doi: 10.23917/forgeo.v38i2.4221

Berdikulov, F., Sergeyeva, A., Ibragimov, L., & Usmanov, M. (2026). The agribusiness of Samarkand's suburbs as a foundation for the city's sustainable food security. *R-Economy*, 12(1), 94-108. doi: 10.15826/recon.2026.12.1.006

Billari, F. C. (2022). Demography: Fast and slow. Population and *Development Review,* 48(1), 9-30. doi: 10.1111/padr.12464

Ciommi, M., Chelli, F. M., Carlucci, M., & Salvati, L. (2018). Urban Growth and Demographic Dynamics in Southern Europe: Toward a New Statistical Approach to Regional Science. *Sustainability*, 10(8), 2765. doi: 10.3390/su10082765

Correia Filho, W. L. F., de Oliveira-Júnior, J. F., dos Santos, C. T. B., Batista, B. A., de Barros Santiago, D., da Silva Junior, C. A., Teodoro, P. E., da Costa, C. E. S., da Silva, E. B. & Freire, F. M. (2022). The influence of urban expansion in the socio-economic, demographic, and environmental indicators in the City of Arapiraca-Alagoas, Brazil. *Remote Sensing Applications: Society and Environment*, 25, 100662. doi: 10.1016/j.rsase.2021.100662

Caminiti, C. M., Fratelli, D., Dimovski, A., Piersanti, A., Ricci, M., Di Pietra, B., & Merlo, M. (2026). Prioritizing light-vehicle electrification cities through real-world pollution-based GIS assessment. *Transportation Research Part D: Transport and Environment*, 153, 105242. https://doi.org/10.1016/j.trd.2026.105242

Di Clemente, R., Strano, E., & Batty, M. (2021). Urbanization and economic complexity. *Scientific Reports*, 11(1), 3952. doi: 10.1038/s41598-021-83238-5

Dorward, N., Fox, S., & Hoelscher, K. (2025). Urbanisation, democracy, and political regime transformations. *Political Geography*, 122, 103382. doi: 10.1016/j.polgeo.2025.103382

Duranton, G., & Puga, D. (2023). Urban growth and its aggregate implications. *Econometrica*, 91(6), 2219-2259. doi: 10.3982/ECTA17936

Espey, J., Keith, M., Parnell, S., Schwanen, T., & Seto, K. C. (2024). Designing policy for Earth's urban future. *Science*, 383(6681), 364-367. doi: 10.1126/science.adi6636

Evans, J., Vácha, T., Kok, H., & Watson, K. (2021). How cities learn: From experimentation to transformation. *Urban Planning*, 6(1), 171-182. doi: 10.17645/up.v6i1.3545

Fan, P., Ouyang, Z., Nguyen, D. D., Nguyen, T. T. H., Park, H., & Chen, J. (2019). Urbanization, economic development, environmental and social changes in transitional economies: Vietnam after Doimoi. *Landscape and Urban Planning*, 187, 145-155. doi: 10.1016/j.landurbplan.2018.10.014

Fathi Farzaneh, A., & Masoumzadeh, S. (2023). Typology of urban theories in expressing the concept of urbanization. *GeoJournal*, 88(2), 1905-1919. doi: 10.1007/s10708-022-10737-x

Follmann, A. (2022). Geographies of peri-urbanization in the global south. *Geography Compass*, 16(7), e12650. doi: 10.1111/gec3.12650

Gentile, M. (2018). Three metals and the 'post-socialist city': Reclaiming the peripheries of urban knowledge. *International Journal of Urban and Regional Research*, 42(6), 1140-1151. https://doi.org/10.1111/1468-2427.12552

Guo, J., Yu, Z., Ma, Z., Xu, D., & Cao, S. (2022). What factors have driven urbanization in China? Environment, *Development and Sustainability*, 24(5), 6508–6526. https://doi.org/10.1007/s10668-021-01714-4

Gross, J., & Ouyang, Y. (2021). Types of urbanization and economic growth. *International Journal of Urban Sciences*, 25(1), 71-85. doi: 10.1080/12265934.2020.1759447

Henderson, V. (2003). The urbanization process and economic growth: The so-what question. *Journal of Economic growth*, 8(1), 47-71. doi: 10.1023/A:1022860800744

Ibragimov, L., Sherxolov, O., Musayev, B., Boboyev, S., Sobirova, M., & Boratova, G. (2024). Industrial development and assessment of its impact in Samarkand region: A GIS mapping-based study. *E3S Web of Conferences*, 590, 06002. doi: 10.1051/e3sconf/202459006002

Jumanazarov, S., Kamilov, A., & Kiatkawsin, K. (2020). Impact of Samarkand's Destination Attributes on International Tourists' Revisit and Word-of-Mouth Intention. *Sustainability,* 12(12), 5154. https://doi.org/10.3390/su12125154

Junussova, M., Maulsharif, M., & Soltybayeva, S. (2023). Developing sustainable infrastructure in central asian cities. *Central Asian Economic Review,* 5, 53-67. https://doi.org/10.52821/2789-4401-2022-5-53-67

Kakharovna, T. S., Kizi, B. S. S., & Sirojiddinovich, K. K. (2022). Urbanization and Geo-Urban Situation in Uzbekistan. *Indiana Journal of Humanities and Social Sciences*, 3(6), 1-5.

Kireyeva, A. A., Nurlanova, N. K., & Kredina, A. (2022). Assessment of the socio-economic performance of vulnerable and depressed territories in Kazakhstan. *R-Economy*, 8(1), 21-31. doi: 10.15826/recon.2022.8.1.002

Koster, H. R., & Thisse, J. F. (2024). Understanding spatial agglomeration: Increasing returns, land, and transportation costs. *Annual Review of Economics*, 16(1), 55-78. doi: 10.1146/annurev-economics-020723-041113

Lachininskii, S. S., Logvinov, I. A., & Vasileva, V. A. (2023). Assessment of urban sprawl of St. Petersburg urban areas based on Landsat satellite images. *Vestnik of Saint Petersburg University Earth Sciences*, 68(3), 471-489. doi: 10.21638/spbu07.2023.303

Li, F., Zheng, W., Wang, Y., Liang, J., Xie, S., Guo, S., Li, X., & Yu, C. (2019). Urban green space fragmentation and urbanization: A spatiotemporal perspective. *Forests*, 10(4), 333. doi: 10.3390/f10040333

Liu, R., Dong, X., Wang, X.-C., Zhang, P., Liu, M., & Zhang, Y. (2021). Study on the relationship among the urbanization process, ecosystem services and human well-being in an arid region in the context of carbon flow: Taking the Manas river basin as an example. *Ecological Indicators*, 132, 108248. doi: 10.1016/j.ecolind.2021.108248

Ma, H., & Sun, Z. (2020). Comprehensive urbanization level and its dynamic factors for five Central Asian countries. *Journal of Geographical Sciences*, 30(11), 1761-1780. doi: 10.1007/s11442-020-1811-y

Makhanov, K. (2023). Soviet and post-Soviet transformations of urban system: case of Kazakhstan from 1979 to 2022. *Eurasian Research Journal,* 5(1), 43-58. doi: 10.53277/2519-2442-2023.1-03

Martinez, R., Bunnell, T., & Acuto, M. (2021). Productive tensions? The "city" across geographies of planetary urbanization and the urban age. *Urban Geography*, 42(7), 1011-1022. doi: 10.1080/02723638.2020.1835128

Nickayin, S. S., Nosova, B., Turco, R., Giacalone, M., & Salvati, L. (2022). Demographic Change and the Urban–Rural Divide: Understanding the Role of Density and Agglomeration in Fertility Transitions. Land, 11(11), 1988. doi: 10.3390/land11111988

Norimov, I. (2024). Developing the Samarkand region urbanization, infrastructure, and modernization. International Journal of Economic Integration and Regional Competitiveness, 1(7), 15-19. doi: 10.61796/ijeirc.v1i7.160

OECD (2019). *Leveraging Megatrends for Cities and Rural Areas*. OECD Publishing.

Polinesi, G., Recchioni, M. C., Turco, R., Salvati, L., Rontos, K., Rodrigo-Comino, J., & Benassi, F. (2020). Population Trends and Urbanization: Simulating Density Effects Using a Local Regression Approach. *ISPRS International Journal of Geo-Information*, 9(7), 454. doi: 10.3390/ijgi9070454

Pradoto, W., Setiyono, B., Wahyono, H., & Choi, M. J. (2024). Peri-urbanisation in Surakarta City and Economic Transformation in the Fast-Growing Region of Sukoharjo Regency. *Forum Geografi*, 38(2), 203-221. doi: 10.23917/forgeo.v38i2.5497

Rogerson, R. J., & Giddings, B. (2021). The future of the city centre: Urbanisation, transformation and resilience – a tale of two Newcastle cities. *Urban Studies*, 58(10), 1967–1982. doi: 10.1177/0042098020936498

Seitz, W. (2021). Urbanization in Kazakhstan: desirable cities, unaffordable housing, and the missing rental market. *International Journal of Urban Sciences*, *25*(sup1), 135-166. doi: 10.1080/12265934.2019.1709534

Sergeyeva, A., Akbar, I., & Karakulov, Y. (2025). Optimization of urban spatial planning considering isochrones of transport accessibility: The case of Aktobe city, Kazakhstan. *Journal of the Bulgarian Geographical Society*, 52, 183-204. doi: org/10.3897/jbgs.e152149

Sergeyeva, A., Dan'shin, A., Akbar, I., Usmonov, A., & Ergashev, A. (2025). Urbanization and Spatial Transformation of Cities in the Bukhara Region in Uzbekistan. *Chinese Journal of Urban and Environmental Studies*, 13(03), 2550017. doi: 10.1142/S2345748125500174

State Committee of the Republic of Uzbekistan on Statistics (2010–2025). Official statistical publications. Tashkent: SCRUS.

Tleuberdinova, A. T., Nurlanova, N. K., Alzhanova, F. G., & Kalmenov, B. T. (2024). Three facets of urban metabolism (case of Kazakhstan). *International Journal of Urban Sustainable Development*, 16(1), 182-198. doi: 10.1080/19463138.2024.2362631

Tojiyeva, Z., & Ibragimov, L. (2021). Labour market and employment in Uzbekistan. *Geografický časopis,* 73(4), 359-374. doi: 10.31577/geogrcas.2021.73.4.19

Turemuratov, O., Byulegenova, B., Pogodin, S., Onuchko, M., & Nurtazina, R. (2024). Urbanization trends in Central Asian Countries: Aspects of extensive and intensive agglomeration growth. *Public Organization Review*, 24(3), 963-986. doi: 10.1007/s11115-024-00766-0

UN-Habitat. (2020). World Cities Report 2020: The value of sustainable urbanization. Nairobi: United Nations Human Settlements Programme.

Veckalne, R., & Tambovceva, T. (2023). Evaluating Urban Sustainability in Uzbekistan: A Novel Formula for Empirical Analysis. *Sustainability*, 15(9), 7035. doi: 10.3390/su15097035

Wu, Y., Yang, Y., Xu, W., & Chen, Q. (2020). The influence of innovation resources in higher education institutions on the development of Sci-tech parks' enterprises in the urban innovative districts at the stage of urbanization transformation. *Land*, 9(10), 396. doi: 10.3390/land9100396

Yao, S., Zhou, Y., & Wu, Y. (2024). Governance transformation among urbanization in China: From hierarchical model to contract-based exploration. *Habitat International*, 149, 103110. doi: 10.1016/j.habitatint.2024.103110

Zhao, J., Chen, W., Liu, Z., Liu, W., Li, K., Zhang, B., Zhang, Y., Yu, L., & Sakai, T. (2024). Urban expansion, economic development, and carbon emissions: Trends, patterns, and decoupling in mainland China's provincial capitals (1985–2020). *Ecological Indicators*, 169, 112777. doi: 10.1016/j.ecolind.2024.112777

Zhang, X., Xu, W., Xiang, X., Zhang, Z., & Cui, M. (2020). Mechanism of interaction between urbanization and resource environment in Central Asia. *Journal of Geographical Sciences*, 30(11), 1723-1738. doi: 10.1007/s11442-020-1809-5

Zhang, B., Zhang, J., & Miao, C. (2022). Urbanization level in Chinese counties: Imbalance pattern and driving force. *Remote Sensing*, 14(9), 2268. doi: 10.3390/rs14092268