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CARTOGRAPHIC ANALYSIS OF THE SPATIAL CHARACTERISTICS OF DEMOGRAPHIC PROCESSES IN ANDIJAN REGION

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Abstract. *This article examines the spatial characteristics of demographic processes in Andijan region based on cartographic analysis and Geographic Information System (GIS) technologies. The study analyzes the territorial distribution of population, population density, natural growth processes, and migration flows, identifying their spatial variations.Using a cartographic approach, the uneven distribution of demographic indicators across districts and the specific features of urbanization processes were highlighted. The results show that population density is highest in Andijan city, Asaka, and Shahrixon districts, which is closely related to industrialization and socio-economic development. In contrast, relatively lower demographic growth rates were observed in some rural areas. The study demonstrates that GIS technologies are an effective tool for spatial analysis, mapping, and identifying territorial differences in demographic processes. The analysis of migration processes indicates that both internal and external labor migration significantly influence the demographic structure of the region.*

Keywords:*demographic processes, cartographic analysis, GIS technologies, population density, migration, urbanization, territorial disparities, geographic analysis*

INTRODUCTION

Andijan region is considered one of the most densely populated areas of Uzbekistan and has significant scientific and practical importance in studying the development and territorial differences of demographic processes. Population growth, natural increase, migration activity, urbanization processes, and the formation of labor resources directly influence the socio-economic development of the region. Therefore, analyzing demographic processes from a spatial perspective and creating their

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cartographic representation is one of the most relevant issues today.

Geographic Information Systems (GIS) and modern cartographic methods provide the opportunity to analyze demographic indicators at the territorial level, identify existing differences, and assess future development trends. Through cartographic analysis, it is possible to examine spatial changes in key demographic indicators such as population distribution, density, birth and death rates, migration flows, and the level of urbanization. The main objective of this study is to analyze the territorial characteristics of demographic processes in Andijan region using cartographic methods, identify regional differences in population development, and assess the factors influencing their formation.

Main Part.

The formation of demographic processes in Andijan region is closely related to natural-geographical, historical, and socio-economic factors. Located in the Fergana Valley, the region is characterized by high population density and limited land resources. These factors significantly influence the spatial distribution and settlement patterns of the population.

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Cartographic analysis shows that population size and density are relatively high in Andijan city, Asaka, Shahrixon, Andijan, and Qo‘rg‘ontepa districts. This is due to the concentration of industrial enterprises, developed transport infrastructure, and a wide network of service sectors. In contrast, Ulugnor and Bo‘ston districts have lower population density, which is explained by their agricultural specialization and relatively low level of urbanization.

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Natural population growth is one of the main drivers of demographic development in the region. Birth rates are high in most districts, and the large share of young population contributes to continuous population increase. Cartographic representations show that higher birth rates are mainly observed in rural-dominated districts. Mortality rates, however, do not show significant spatial variation.

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Migration processes also have a strong impact on the demographic situation. Internal migration flows are mainly directed toward cities and industrial centers, while external migration is dominated by labor migration. As a result, a decrease in the working-age population is observed in some districts. Migration maps created using GIS technologies allow for the identification of population movement patterns and assessment of regional demographic challenges.

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The urbanization process is actively developing in Andijan city and major district centers. Population growth in urban areas stimulates the development of housing construction, transport systems, and social infrastructure. Cartographic analysis shows significant differences between highly urbanized areas and agricultural districts in terms of population structure, employment, income levels, and access to social services.

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The use of cartographic methods in analyzing demographic indicators helps identify existing problems and development opportunities at the district level. As a result, a data base is formed for making scientifically grounded decisions in population distribution, labor resource management, social infrastructure development, and regional planning. A deeper study of demographic processes in Andijan region is essential for ensuring sustainable regional development.

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Literature Review

The study of demographic processes from a spatial perspective is one of the key directions of economic and social geography. Analysis of population growth, distribution, migration, and urbanization using cartographic methods allows for identifying regional development patterns. Research in this field demonstrates the effectiveness of Geographic Information Systems (GIS) and cartographic modeling in analyzing demographic processes95.

A. Soliyev, who studied population geography in Uzbekistan, emphasizes that "population distribution and demographic development are key indicators reflecting the natural and socio-economic potential of a region."96 This idea is particularly relevant to Andijan region, where uneven population distribution highlights territorial development disparities.

In studies on cartographic analysis of demographic processes, the importance of GIS technologies is widely recognized. According to V. Tikunov, "modern geographic information systems are among the most effective tools for spatial analysis of complex demographic data."97 This approach is widely used in analyzing population size, density, and migration indicators.B. Akhmedov notes that "population growth and structural changes are closely linked to economic development and vary across regions." This is clearly observed in Andijan region, where industrialized and urbanized areas differ significantly from agricultural districts.

Among foreign researchers, P. Haggett states that "cartographic representations allow the identification of spatial differences and explain spatial patterns of demographic processes."98 This approach is widely used in the visualization and analysis of demographic data. R. Johnston emphasizes that "migration flows are directly related to the level of economic development and labor market conditions, and their geographic analysis is essential for regional policy formation." This provides a strong theoretical basis for studying internal and external migration in Andijan region.

95 Akhmedov B.A. Population Geography and Basics of Demography. – Tashkent: Innovatsiya-Ziyo, 2020. – 256 p.

96 Soliyev A. Social and Economic Geography of Uzbekistan. – Tashkent: Universitet, 2014. – 320 p.

97 Tikunov V.S. Geoinformatics. – Moscow: Akademiya, 2019. – 368 p.

98 Haggett P. Geography: A Global Synthesis. – Harlow: Pearson Education Limited, 2001. – 833 p.

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The reviewed literature shows that studying demographic processes using cartographic methods plays an important role in understanding regional development. However, comprehensive GIS-based studies of demographic indicators at the district level in Andijan region are still limited. This research aims to fill this gap99.

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Results

During the study, demographic processes in Andijan region were analyzed using cartographic methods and Geographic Information System (GIS) technologies. The results revealed significant spatial differences in population size, density, natural increase, and migration indicators across districts.

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It was found that population size and density are highest in Andijan city, Asaka, Shahrixon, and Andijan districts. This is mainly due to the presence of industrial enterprises, developed transport infrastructure, and a wide service sector. In contrast, Ulugnor and Bo‘ston districts have relatively low population density.

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GIS-based thematic maps clearly showed uneven population distribution across the region. High values were observed in central and industrial areas, while lower values were found in peripheral rural districts. As a result, a strong correlation between the level of regional development and demographic conditions was identified.

99 Qayumov A., Soliyev A. Fundamentals of Economic and Social Geography. – Tashkent: Tafakkur, 2018. – 284 p.

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Analysis of natural population growth showed that birth rates remain high in the region and the proportion of young people is significant. In some rural districts, birth rates exceed the regional average, which may contribute to further population growth in the future. Mortality rates, however, do not show significant spatial differences across districts.

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Table 1.

Spatial Analysis of Demographic Processes in Andijan Region Using GIS

Aspect	Findings	Regional Differences / Explanation
Population distribution	Uneven distribution across the region	Higher concentration in urban and industrial areas
High population density areas	Andijan city, Asaka, Shahrixon, Andijan district	Due to industrial development, transport infrastructure, and service sector expansion
Low population density areas	Ulugnor, Boston districts	Mainly rural, less industrialized, weaker infrastructure
GIS analysis results	Thematic maps show clear spatial disparities	Central and industrial zones have high density; rural areas have low density
Natural population growth	Relatively high birth rates and a large share of youth population	Some rural areas exceed regional average birth rates, indicating future population growth
Mortality rate	Relatively stable across regions	No significant spatial differences observed
Migration trends	Internal migration toward Andijan city and	Out-migration reduces working-age population in some districts

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	industrial centers	
External migration	Mainly labor migration	Influences labor force distribution in rural areas
Urbanization impact	Strong correlation between urbanization and demographic growth	Urban areas show higher economic activity and population concentration
Overall conclusion	Strong territorial differentiation of demographic processes	GIS and cartographic methods are effective for analysis and forecasting

The analysis of migration processes revealed that internal migration flows are mainly directed toward Andijan city and major industrial centers. In external migration, labor migration dominates. This situation has led to a decrease in the proportion of the working-age population in some districts.

Cartographic analysis identified a clear differentiation of territories based on their level of demographic development. In highly urbanized areas, both population size and economic activity are high, while in agricultural districts, specific patterns of demographic growth have been formed.

Overall, the study results demonstrate significant spatial variation in demographic processes across Andijan region. GIS technologies and cartographic methods have proven to be effective tools for assessing demographic indicators, identifying territorial disparities, and forecasting future development trends.

Conclusion

The study analyzed the spatial characteristics of demographic processes in Andijan region using cartographic methods and Geographic Information System (GIS) technologies. The results showed significant differences across districts in population size, population density, natural increase, and migration indicators. In particular, Andijan city, Asaka, and Shahrixon districts were identified as areas with high population density, which is directly associated with their economic potential and level of urbanization.

Cartographic analysis clearly revealed territorial disparities between population distribution and demographic development. The use of GIS technologies made it possible to accurately assess the spatial distribution of demographic indicators, migration directions, and population growth dynamics. The study also found that while natural population growth remains relatively high in the region, labor migration significantly influences the demographic structure of certain districts.

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The obtained results confirm the importance of a territorial approach in managing population distribution and demographic development in Andijan region. Moreover, GIS-based cartographic materials serve as an important source of information for territorial planning, efficient allocation of labor resources, development of social infrastructure, and improvement of demographic policy. In the future, wider use of modern geoinformation technologies is recommended for forecasting demographic processes and developing regional development strategies.

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