

Spatiotemporal Patterns and Influencing Factors of Population Distribution in Gansu Province over the Past 25 Years: Postprint

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Abstract

Population distribution represents the spatial manifestation of population within a specific time frame and geographical scope, influenced by various factors including social, economic, natural, and policy elements. The population distribution in Gansu Province exhibits an unbalanced state. Taking 86 counties in Gansu Province and Jiayuguan City as a total of 87 research units, and based on permanent population data, this study analyzes the spatiotemporal pattern changes of population distribution characteristics, density variations, distribution structure index, Gini coefficient, and center of gravity migration in the study area between 1990 and 2015. Using counties as research units and selecting 12 natural and socio-economic factors, the Partial Least Squares (PLS) method was employed to analyze the factors influencing the spatial pattern of population distribution in Gansu Province. The study reveals: (1) Over the past 25 years, significant spatial disparities in population distribution have emerged in Gansu Province, forming a pattern of “dense in the southeast and sparse in the northwest” ; (2) In terms of population density changes, compared with 1990, among the 87 research units in Gansu Province in 2015, 67 counties experienced population density increases, while 20 counties experienced decreases; (3) The trend toward more balanced provincial population distribution is strengthening; (4) The center of gravity of population distribution is gradually shifting toward the northwest; (5) The formation of Gansu Province’s population distribution pattern is simultaneously influenced by both natural and socio-economic factors, though socio-economic factors exert the greatest influence.

Full Text

Abstract

Population distribution is affected by natural, social, economic, and political factors, which are manifestations of the spatial distribution of a population over a certain period. Based on 87 research units in 86 counties and Jiayuguan City in Gansu Province, China, this study analyzes the distribution characteristics, density changes, distribution structure index, Gini coefficient, and gravity center transfer from 1990 to 2015. Using the county as the research unit, 12 natural and socioeconomic factors were selected, and the factors affecting the spatial patterns of population distribution in Gansu Province were analyzed using the partial least squares (PLS) method. The study found: (1) Over the past 25 years, there have been significant differences in the spatial distribution of population in Gansu Province, forming a pattern of “sparse in the southeast and dense in the northwest.” (2) From the perspective of population density changes, compared to 1990, among the 87 research units in Gansu Province in 2015, 67 counties belong to the rapid increase and slow increase types, while 20 counties belong to the rapid reduction and slowdown types. (3) The development trend toward a balanced population distribution for the entire province has increased. (4) The gravity center of population distribution has gradually moved in the northwest direction. (5) The formation of population distribution patterns in Gansu Province is affected by both natural and socioeconomic factors; however, the level of social and economic development is the main factor affecting population distribution patterns.

Keywords: population distribution; spatiotemporal evolution; influencing factor; partial least squares; Gansu

2 Data and Methods

2.1 Data Sources

Population data from 1990 to 2015 were obtained from the “Gansu Statistical Yearbook” and “China County Statistical Yearbook.” The county was used as the research unit, with data from 86 counties and Jiayuguan City in Gansu Province. The study area covers approximately $4.54 \times 10^5 \text{ km}^2$, with a population of 2.59×10^7 .

2.2 Methods

2.2.1 Population Density Classification The population density classification method was used to analyze spatial patterns, where $x \in [0,1]$ represents the classification parameter. The Lorenz curve and Gini coefficient were employed to measure the equilibrium of population distribution.

2.2.4 Spatial Analysis ArcGIS software was used for spatial analysis of population distribution patterns from 1990 to 2015. The gravity center model was

applied to analyze the migration trends of population distribution. The gravity center calculation follows the formula $G = 1 - (W_i + 1)$, where W_i represents the weight of unit i .

[Figure 4: see original paper] Population distribution equilibrium index of Gansu Province from 1900 to 2015

Influence factors and effects of population density change in Gansu Province from 1990 to 2015

Partial least squares regression (PLS) was used to analyze the influencing factors of population distribution patterns. The PLS method can effectively handle multicollinearity among variables and is suitable for analyzing the relationship between population distribution and its driving factors.

[Figure 3: see original paper] Population density change types in Gansu Province from 1990 to 2015

The analysis selected 12 influencing factors including natural conditions (elevation, slope, climate, etc.) and socioeconomic indicators (GDP, urbanization rate, transportation accessibility, etc.). The coordinates of the study area range from (104°7 E, 35°51 N) to (101°2 17 E, 37°21 20 N).

VIP and BETA values of population density change factors in Gansu Province from 1990 to 2015

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