

Spatial Patterns of Population Growth and Demographic Change: A Historical–Geographical Assessment of Countries Worldwide

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Abstract

Understanding long-term population dynamics is essential for evaluating demographic transformation and regional development across the world. This study examined the spatial patterns of population growth and demographic change using a historical–geographical perspective based on a global dataset comprising 234 countries and territories from 1970 to 2022. A quantitative, retrospective research design was employed using publicly available secondary data. Descriptive statistics, continental comparisons, historical trend analysis, and Pearson correlation analysis were performed in Python to evaluate relationships among population size, population density, growth rate, land area, and world population share. The findings revealed a continuous increase in the global population over the study period, accompanied by substantial geographical variation across continents. Asia recorded the largest population and highest average population density, whereas Africa exhibited the highest average demographic growth rate. Correlation analysis indicated a moderate positive relationship between land area and total population, while population growth rate showed only weak associations with geographical variables. These results demonstrate that demographic change is characterized by distinct spatial patterns influenced by multiple regional factors rather than geographical extent alone. The study contributes to historical geography by integrating temporal demographic trends with comparative spatial analysis and provides valuable evidence for population studies, regional planning, and sustainable development. Future research should incorporate socioeconomic, environmental, and migration-related variables to improve understanding of global demographic dynamics.

Keywords: Population growth, Demographic change, Historical geography, Spatial analysis, Population distribution

1. Introduction

Demographic change and population growth have always been identified as one of the most important factors of social, economic and geographical changes in the world. The regional population size, structure and spatial distribution has been profoundly affected by fluctuations in fertility, mortality, migration and urbanisation, which impacts regional development, the use of resources and the sustainability of the environment. The widely accepted explanation for shifts in population growth as societies move through various stages of economic and social development is the demographic transition theory (Warf, 2026). Technological progress, industrialization and achievements in medicine have also been closely related to historical demographic changes, so that the population trends have changed significantly over time (Grinin & Grinin, 2023). So knowledge of demographic evolution is becoming more important in the assessment of long term geographical changes and supporting sustainable development planning.

The increase in the global population during the last five decades has been tremendous with significant inter-country and inter-continental variations. Although many developing areas still experience high population growth rates, many developed countries have stabilized or started to decline. These countervailing population trends mean much for the labour market, urbanisation, infrastructure needs, environmental stewardship, and public policy (Fischer, 2025; Poot, 2026). Population studies are therefore an excellent source of evidence on the question of regional disparities and the demographic problems that affect socioeconomic developments. Population geography takes this knowledge one step further by explaining the spatial differences in demographic characteristics, including how population distribution, settlement, land availability, and regional development are related (Hazen et al., 2023).

Recent progress in spatial analysis and geospatial technology has been aiding the capacity to explore the study of demographic processes across spatial scales. Geographical studies are increasingly adopting a temporal-spatial approach to help account for the population differences between regions and the population change since the past. Geographical analysis's significance in understanding demographic changes has also been further emphasized in the evolution of urban spatial structures, regional planning and population concentration (Dadashpoor & Saeidi Shirvan, 2026). Likewise, spatio-temporal analytical methods have proven to be highly useful in the analysis of geographical phenomena that are inherently complex, combining historical trends with spatial distribution patterns (Norlund et al., 2026; Chen et al., 2025). As global databases of demographics become more available, it is also possible to make comparative evaluations between countries, thus allowing to view demography change both historically and geographically.

The studies so far have made significant contributions to the knowledge of demographic transition, population distribution and regional development. Warf (2026) discussed the theory behind the demographic transition and Fischer (2025) highlighted the critical role of demographic diversity in the relationship between developed and developing economies. Grinin and Grinin (2023) pointed to the importance of technological development in long-term demographic evolution, while Misra et al (2025) talked about methodology to conduct population studies and demographic policy analysis. In the field of human geography, Hazen et al. (2023) highlighted the importance of population geography in the context of sustainable

development and social equity, and Dadashpoor and Saeidi Shirvan (2026) discussed population growth and spatial structure of cities. A number of macro-comparative studies have also shown the potential of the global data set for studying socio-economic and geographical variation. Zhang et al. (2024) leveraged geospatial information with a global scope to assess regional developments, while Wahl et al. (2025) highlighted the need for accurate demographic data for evidence-based policy decisions. Comparative studies by Rasoanaivo (2025) and Sarkodie et al. (2024) also highlighted the importance of comparative studies to comprehend areas of geographical variation and regional development paths.

However, the majority of studies have been limited to a specific country, region or demographic aspect (urbanisation, health, environmental change, economic development). Long-term historical population trends combined with geographical comparative analysis at a relatively large number of countries is still limited. Moreover, there are very few studies that focus on all four population measures – population growth, population density, spatial distribution, and geographical variation – in a single study based on one global dataset across several decades. Such a shortcoming can be solved in order to have a wider understanding of the global demographic transformation and regional population dynamics, and to contribute to historical geography and comparative geographical studies.

Thus, this study is focused on analyzing the historical trends of population growth from 1970 to 2022 with the use of demographic data from 234 countries and territories. The study aims in particular to describe and compare spatial patterns of population distribution, population density and demographic growth rate between continents and to assess the correlation between population size and growth rate, population density and geographical characteristics based on a worldwide demographic data set.

2. Materials and Methods

2.1 Study Design

This study adopted a quantitative, retrospective and cross sectional research design to examine the past trend of population growth and demographic shifts on the international scale. A comparative historical–geographical approach was used, using demographic indicators over various decades to see temporal trends and spatial variation. The study aimed to gain an insight into the disparities of population distribution, density and growth in the various regions of the world based on secondary demographic data.

2.2 Data Source

The study was conducted using publicly available World Population Dataset that provides information on population and geography for 234 countries and territories (Banerjee, 2022). Historical estimates of population (1970, 1980, 1990, 2000, 2010, 2015, 2020 and 2022) and geographical parameters like continent, capital city, land area, population density, annual growth rate, and percentage share to the global population are included. These variables offer a broad and comprehensive way of analysing long-term change and geographical differences between countries.

2.3 Study Variables

Demographic and geographical variables related to the dynamics of the population were used in the analysis. The population estimates for 1970-2022 were used to study the demographic evolution, and the population density, annual growth rate, land area, continent and percentage of the world population were utilized to investigate geographical variation and demographic characteristics of the region. Throughout the study, countries and/or territories were the main unit of analysis.

2.4 Data Preparation

The data was systematically pre-processed before statistical analysis to guarantee the quality of data and analytical consistency. Duplicate observations have been checked and removed as needed and the names of variables and data formats have been harmonized for computation analysis. For numerical variables the completeness and consistency of the data were checked, while for categorical variables the accuracy of the classification was checked. Additional checks were performed with the data to look for missing or conflicting data and only validated data were included in the final analysis.

2.5 Statistical Analysis

The statistical analysis was carried out in Python (version 3.x), with Pandas, NumPy, Matplotlib and SciPy library. Descriptive statistics such as mean, standard deviation, minimum and maximum values were calculated to summarize the demographic and geographical characteristics. The population trend was examined longitudinally, comparing historical population values for the census years available. The population size, density and growth rate were compared using a continental analysis. The correlation between population, land area, population density, growth rate and world population percentage were done by Pearson correlation analysis. Line, column and scatter plots were created to demonstrate temporal trends and the spatial demography patterns graphically. For statistical findings, $p < 0.05$ was considered as significant when it was applicable to inferential analyses.

3. Results

3.1 Descriptive Characteristics of Global Population and Geographical Variables

The data set included 234 countries and territories and covered all inhabited continents, as well as historical population data from 1970 to 2022. Descriptive analysis revealed that there was a large amount of variation in the demographic and geographical characteristics. There was significant long term demographic growth with the average population rising from 15.79 million in 1970 to 34.07 million in 2022. There was a large variation in population density between countries, reflecting significant spatial variation in human settlement patterns. Similarly, the wide distribution of land areas is illustrative of the geographical diversity of the data.

Table 1. Descriptive Statistics of Population and Geographical Variables (n = 234)

Variable	Mean	Standard Deviation	Minimum	Maximum
Population (1970)	15,786,908.81	67,795,090.00	752	822,534,463

Population (2022)	34,074,414.71	136,766,400.00	510	1,425,887,337
Growth Rate	1.01	0.01	0.91	1.07
Population Density (per km ²)	452.13	2,066.12	0.03	23,172.27
Area (km ²)	581,449.38	1,761,841.00	1	17,098,242

The geographical differences across the global dataset are clearly shown in Table 1 where there is a considerable variation of country populations, land area and population density. The global population has been steadily growing from 1970 to 2022 as shown in Figure 1.

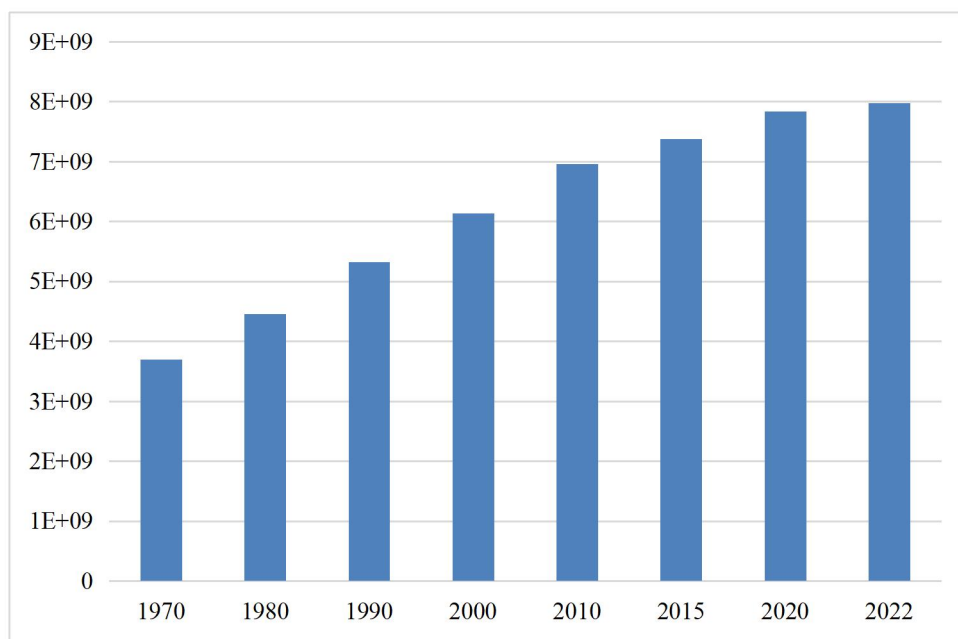


Figure 1. Historical Trend of Global Population Growth (1970–2022)

3.2 Continental Comparison of Population Growth and Density

Geographical differences were found in demographic characteristics in the continental comparisons. Asia had the highest average population density (1,025.02 persons/km²) and largest population (4.72 billion) in 2022. The average population growth rate of Africa (1.02) shows a continuous increase in population. Europe and North America saw relatively weak demographic growth, while South America and Oceania continued with relatively moderate demographic growth. The results show that historic population dynamics have been different on different continents, with different demographic and geographical backgrounds. Table 2 gives the comparative continental statistics.

Table 2. Continental Comparison of Population Characteristics

Continent	Countries (n)	Total Population (2022)	Mean Growth Rate	Mean Density (per km ²)
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Africa	57	1,426,730,932	1.02	125.05
Asia	50	4,721,383,274	1.01	1,025.02
Europe	50	743,147,538	1.00	663.32
North America	40	600,296,136	1.00	272.76
Oceania	23	45,038,554	1.01	132.54
South America	14	436,816,608	1.01	20.97

Table 2 shows that there are very distinct differences between the continent in total population, population density and demographic growth, highlighting the spatial variation in population distribution across the globe. The comparative distribution of average population density of the continents is shown in Figure 2, which shows that Asia has the maximum population density with respect to land area.

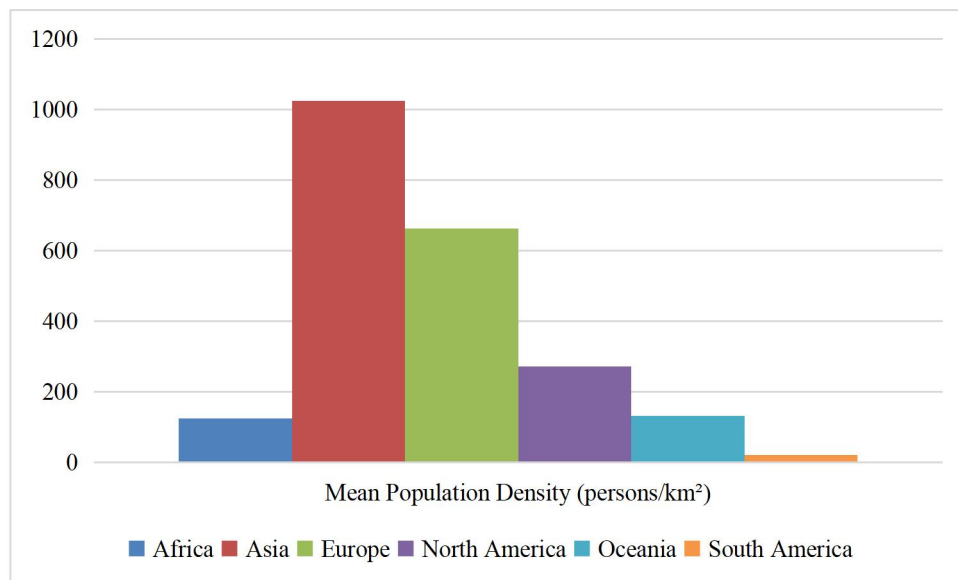


Figure 2. Continental Distribution of Population Density

3.3 Association Between Demographic and Geographical Variables

Correlation analysis was used to assess the correlation between the important demographic and geographical indicators. There was a moderate positive correlation between land area and total population ($r = 0.453$) which means that larger countries tended to have larger populations. Weak relationships between the growth rate and population size and density indicate that recent demographic growth depends on factors other than geographical scales. However, as would be expected, the world population percentage was almost perfectly positively associated with the total population since it is derived from national population totals. The correlation matrix is given in Table 3.

Table 3. Correlation Matrix of Demographic and Geographical Variables

Variable	Population (2022)	Growth Rate	Population Density	Area (km ²)	World Population %
Population (2022)	1.000	-0.021	-0.028	0.453	1.000
Growth Rate	-0.021	1.000	-0.069	0.001	-0.021
Population Density	-0.028	-0.069	1.000	-0.062	-0.028
Area (km ²)	0.453	0.001	-0.062	1.000	0.453
World Population %	1.000	-0.021	-0.028	0.453	1.000

From Table 3, it can be seen that the land area is moderately positively associated with the total population while the population growth rate is weakly associated with geographical variables. Figure 3 shows spatial variation in population growth and density at country level, which reveals that there is a high level of demographic variation across countries in the world.

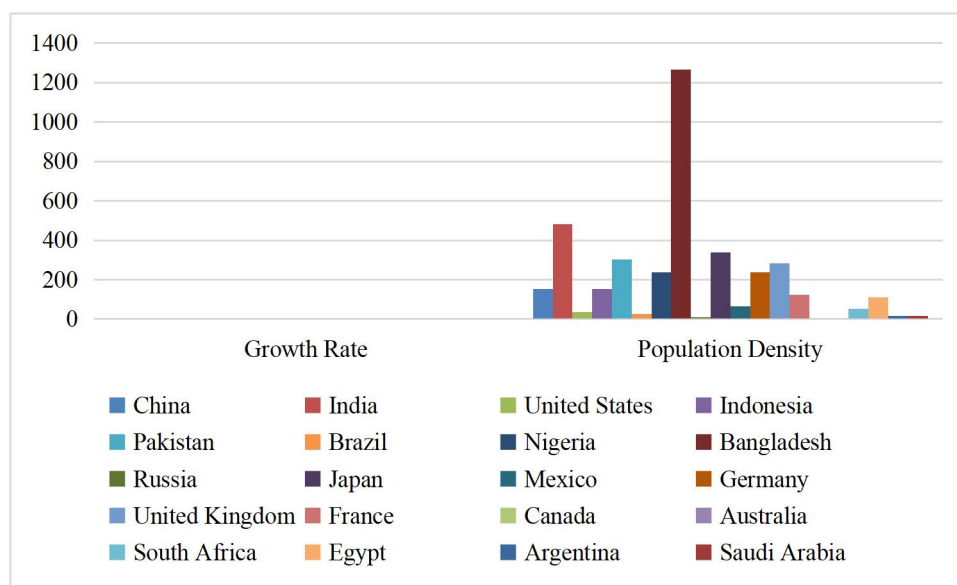


Figure 3. Country-Level Spatial Distribution of Population Growth and Population Density

4. Discussion

The current research offers a historical–geographical evaluation of population growth and demographic change in 1970–2022 for 234 countries and territories. The results indicate a steady rise in population over the period of study, with significant spatial variations in the

regional distribution, population density and population growth rates. While Asia was the most populous continent, the greatest demographic growth rate was found in Africa, showing different demographic transition stages among different regions. These observations are in line with the demographic transition theory, which describes the various population growth rates that countries can have based on their socioeconomic development and epidemiological trajectory (Livi-Bacci, 2025). The population growth seen during the historical period in this study also concurs with past demographic research which shows that healthcare, technology and economic growth are responsible for the long term population growth.

The comparative geographical analysis showed great variation in demographic attributes of the continents underscoring the significance of geography in population studies. There was a high concentration of countries with high population densities in Asia, and several countries in Oceania and North America have comparatively low densities, but wide land areas. These findings confirm the idea that when considering the distribution of populations, available land is not the only factor; the economy, urbanization, and the environment are also important. Woods and Rees (2023) report similar geographical variation and highlight the importance of spatial demographic models for uncovering regional differences in terms of population structure and settlement patterns. Similarly, Long (2022) showed land-use changes and geographical movements of humans are important to population distribution and regional development.

The differences in the demographic growth rates observed further reflects the diversity of population dynamics at the global level. The growth rates of Africa were generally higher than those of Europe and North America, which is related to the differences in the stages of the demographic transition, fertility and mortality. The similar results were reported by Ventsiv (2023) who found demographic processes as the basis of regional development and socioeconomic planning. In the same way, the population growth can have a wide range of implications, such as the needs of educational infrastructure and long-term regional planning, as highlighted by Aidarkhanova et al. (2025). The results indicate that countries with high population growth rates need to make informed choices about infrastructure, healthcare, education, and the management of their natural resources to achieve sustainable development.

The correlation analysis revealed that land area was moderately positively correlated with total population but population growth rate had only weak geographical relationships. This implies that geographic extent is not the only indicator of demographic growth and that in the recent past socioeconomic, political and environmental factors might have been more important determinants of population growth. These findings align with the geographical analysis carried out by Qiu et al. (2025), which indicates that the regional characteristics are complex, and they relate to the demographic growth and decline and not only the geographical extent of the region. Similarly, Chen et al. (2022) identified significant demographic spatial heterogeneity in rural China, meaning that the demographic change in rural areas is influenced by local social and economic factors.

The study also illustrates the importance of the combination of historical demographic data and geographical analysis for studying long-term population transformation. Spatial indicators coupled with temporal data on population can provide a more holistic picture of global population change than country-specific analysis or analysis of short-term population change. The integrated approach is also facilitated by recent developments in human

geography in terms of quantitative geography and geospatial analytical techniques. Wang et al. (2024) emphasized the growing use of artificial intelligence in the field of geospatial analysis of large-scale geographical data, which allows for more comprehensive analyses of spatial demographic trends and geographic disparities. Likewise, Zhang et al. (2022) showed that spatial analytical methods can yield information about the distribution of the population and population qualities in the regions, which may not be obvious from simple statistical analyses.

The present study has several limitations, although it covers a large geographical area. Most of the data available is at the country level, and therefore does not reflect within-country spatial variation or socioeconomic factors like migration, fertility, mortality, income or urbanisation. Moreover, the available data did not include environmental or policy factors which could affect demographic change. Going forward, environmental, socioeconomic and geospatial data should be combined with demographic data to better account for processes driving global population dynamics. The use of Geographic Information Systems (GIS), remote sensing and GeoAI analytics might complement the analysis of spatial demographic processes and evidence-based regional planning.

The overall results indicate that population growth over the last decades has been geographically highly uneven, both within and between continents, highlighting the need for integrating demographic and geographical information in the analysis of population change in the long term. The study not only enriches the pool of historical–geographical studies with a global comparative viewpoint of demographic phenomena, but also offers valuable data for future studies on sustainable regional development, population planning and spatial demographic analysis.

5. Conclusion

This study offers a thorough historical–geographical evaluation of global population growth and demographic change over the period from 1970 to 2022 for 234 countries and territories. These results indicate a steady growth of the world's population and show a high spatial variability in population density, growth rates and regional distribution. Asia continued to be the most populous continent with Africa showing the most dynamic demographic growth, reflecting a range of demographic trends across world regions. The analysis also revealed that the total population is moderately correlated with land area, while recent population growth is correlated with a wider array of demographic and socioeconomic factors and not just land area. The study combines the historical populations and comparative geographical analysis, providing important insights on global demographic transformation and regional population dynamics. The results of these are relevant to the study of historical geography and population studies, with the aim of giving credit to the planning of regions and sustainable development. Future research needs to include socioeconomic, environmental, migration and geospatial variables to better understand the drivers of demographic change and to reinforce the evidence-based policy-making process for fast changing population systems.

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