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Research Article

Economic base and demographic change in Mongolia's small rural towns (2015–2023)

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Abstract

This study examines the spatial and economic dimensions of 247 small rural towns across Mongolia between 2015 and 2023, focusing on the interplay between traditional mainstay economic base types, livestock herding, sown area, enterprise activity (including mining, business, etc.), and changes in total population and age structure. We track demographic outcomes as changes in total population and the working-age share; component processes (births, deaths, migration) are not decomposed. Nonetheless, the spatial patterns we observe near transport corridors and mining towns are consistent with net in-migration. Drawing on economic base theory and functional rurality, the research uses standardized spatial datasets to classify settlements and track population structure in relation to economic specialization and infrastructure access. The findings reveal that livestock remains the most widespread economic base, particularly in central and western Mongolia, though increasingly vulnerable to environmental shocks. Enterprise activity has expanded significantly, especially in towns with access to rail and road networks, contributing to labor retention and demographic growth. Sown area intensity has remained concentrated in traditional grain-producing regions, with only modest expansion observed in some central and western provinces. Towns dependent on a single economic base, especially livestock or aging mining, experienced working age population decline, while towns with diversified or infrastructure-linked economies showed demographic resilience. These results contribute to the understanding of rural transformation in Mongolia and offer insights for targeted, decentralized development planning. Findings highlight the need for coordinated investment in diversified local economies to support demographic sustainability in small rural towns.

Key words: Enterprise, livestock, rural development, sown area, spatial analysis

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1. Introduction

Mongolia covers approximately 1.56 million km^2, making it one of the most sparsely populated countries in the world, with a 2023 population of around 3.5 million and a density of just 2.2 people per km^2 (NSO 2023a). The country's rural landscape is characterized by unevenly distributed small towns, which range from well-equipped regional hubs to isolated and underserved settlements. This disparity poses serious challenges for equitable infrastructure, public services, and economic development (Enkhtamir and Pirisi 2024).

In many remote settlements, sparse populations and vast distances reduce the viability of investment in education, healthcare, roads, and market access, which in turn fuels rural inequality and accelerates rural-to-urban migration, particularly towards Ulaanbaatar, the capital city of Mongolia. A World Health Organization (WHO) supported study found that rural Mongolians face significantly longer travel times and higher out-of-pocket costs for outpatient care than urban residents (Yiengprugsawan et al. 2021).

While Mongolia's official definition of rurality relies on administrative boundaries classifying all areas outside Ulaanbaatar and the 21 aimag (province-level administrative unit in Mongolia) centers as rural, recent research advocates for a functional classification that emphasizes access to services and infrastructure rather than strict geographic labels (Gankhuyag et al. 2021; Myagmarsuren et al. 2021; Bai et al. 2023). Within this framework, rurality exists on a continuum: some soum (sub-provincial administrative unit, similar to a district) centers, while officially rural, provide public services and economic functions akin to small urban towns, whereas others remain service-poor and marginalized (Bai et al. 2023; Enkhtamir and Pirisi 2024).

This study focuses on three primary components of local economies: livestock herding, sown area, and enterprises. These sectors were selected based on their widespread presence, quantifiable nature, and central role in rural economic activity. In contrast, sectors such as tourism, public services, and general business services were deliberately excluded for several key reasons.

First, livestock remains the cornerstone of rural Mongolia. It is not only the primary source of household income for many families, but also a culturally embedded and spatially dominant form of land use. Similarly, crop production, though more geographically concentrated, represents a critical axis of food production and local trade, particularly in arable regions. Enterprises, which include small businesses such as local shops, manufacturing units, and service providers, reflect the extent of economic diversification and entrepreneurial activity within a town.

Second, the sectors excluded from the analysis—namely, tourism, the public sector, and business services—do not consistently represent a primary or dynamic economic base across most small towns. Tourism is highly localized and seasonal, with a limited number of well-known destinations. Public services, including education and healthcare, are essential for social well-being, but do not function as growth engines. Their presence is often uniform, centrally funded, and non-market in nature. Including these would risk overestimating the economic dynamism of towns where state employment is the default rather than a competitive strength.

Finally, the selection of these three sectors is driven by data availability and analytic clarity. Livestock numbers, sown area, and enterprise counts are consistently collected and reported across towns, allowing for longitudinal and comparative analysis. This consistency enables the study to construct a more grounded and actionable typology of local economies.

However, very few studies integrate these dimensions into a spatial-economic analysis of a small-town system. To address this gap, our research poses the following questions:

- (1) Which types of economic activity most commonly define the economies of Mongolia's small rural towns?

- (2) In what ways do different economic bases influence where people live and how populations are distributed?
- (3) How do demographic changes and spatial patterns connect to the kind of economy or resources available in each town?

This study offers a comprehensive perspective on Mongolia's small rural-town economies and aims to support evidence-based decentralized development policy by combining functional rurality, economic base analysis, and spatial demographic profiling.

2. Theoretical framework

2.1. Economic base theory and structural change

Economic base theory, formalized by North (1955), distinguishes basic (export-oriented) economic activities, those that bring income into a region, from non-basic (local-serving) sectors such as retail and services. This framework has been widely applied in regional planning to understand how external demand drives local economic growth (Williams 1996; Hoover and Giarratani 1999). Regions overly reliant on a single export sector are especially vulnerable to external shocks unless a diversified local economy can buffer such risks.

Contemporary economic geography models reinforce this understanding. Bohr et al. (2024) show how structural change reallocates labor away from agriculture toward concentrated industrial sectors, creating spatial disparities and uneven regional capacities for adjustment. Jeleskovic and Loeber (2023) show how industrial clusters in small regions drive regional gross domestic product (GDP) growth, with both direct and spillover effects in spatial econometric modeling.

Together, these frameworks help conceptualize how resource-dependent towns (e.g., in Mongolia) can either diversify their economic base toward long-term resilience or remain vulnerable to boom-bust cycles.

2.2. Central place theory and small town roles

Central place theory conceptualizes towns as hierarchical service centres in a spatial system—smaller settlements offer everyday goods and services, while larger towns provide specialized functions. Recent analyses of urban–rural interactions extend this foundational concept to the global South, demonstrating how smaller towns mediate access to markets, healthcare, education, and economic opportunities for dispersed rural populations (Cattaneo et al. 2021).

Empirical studies may confirm that small towns may play critical roles in regional rural economies. In South Africa, research reviews show that intermediary towns sustain surrounding agricultural areas by functioning as nodes for trade, services, and market linkage, even amid demographic change (Dorosh and Thurlow 2013). In Iran, a case study of Zahedshahr illustrates how modest-sized towns facilitate the sale of agricultural surplus, host administrative and educational services, and bolster livelihoods in adjacent rural villages (Ebrahimzadeh et al. 2012).

This theoretical lens is extremely relevant to Mongolia's small, enterprise-driven towns. As rural herding and cropping persist, these towns can an-

chor surrounding livelihoods, integrating local economic activity with essential services. Understanding them through central place theory highlights their potential for enhancing rural connectivity, diversifying economies, and strengthening demographic resilience in Mongolia's sparsely populated regions.

2.3. Integrating comparative theory: a mixed-economy enterprise model

Finally, economic development literature highlights the importance of mixed economy models, where state, private, and communal sectors work together to strengthen resilience in resource-dependent towns. Studies from contexts such as Inner Mongolia and Australia show that towns with a combination of local services, agriculture, and resource industries are better able to absorb economic shocks (Sneath 2000; Haslam McKenzie 2016). When enterprise activities are rooted locally and profits are reinvested in the community, economic leakages are reduced and livelihoods become more stable. This mixed economy perspective, grounded in economic base theory, spatial development, and resilience research, provides a strong foundation for interpreting the results and shaping the comparative discussion in this study.

3. Methodology

Fig. 1 presents a structured overview of the study's methodological design, broken into three sequential and interlinked clusters: Study area selection (section 3.1.), Data collection (section 3.2.), and Data analysis: GIS-based mapping and descriptive spatial profiling (section 3.3.). Each cluster reflects a core stage in the research design, from conceptual grounding to statistical modeling.

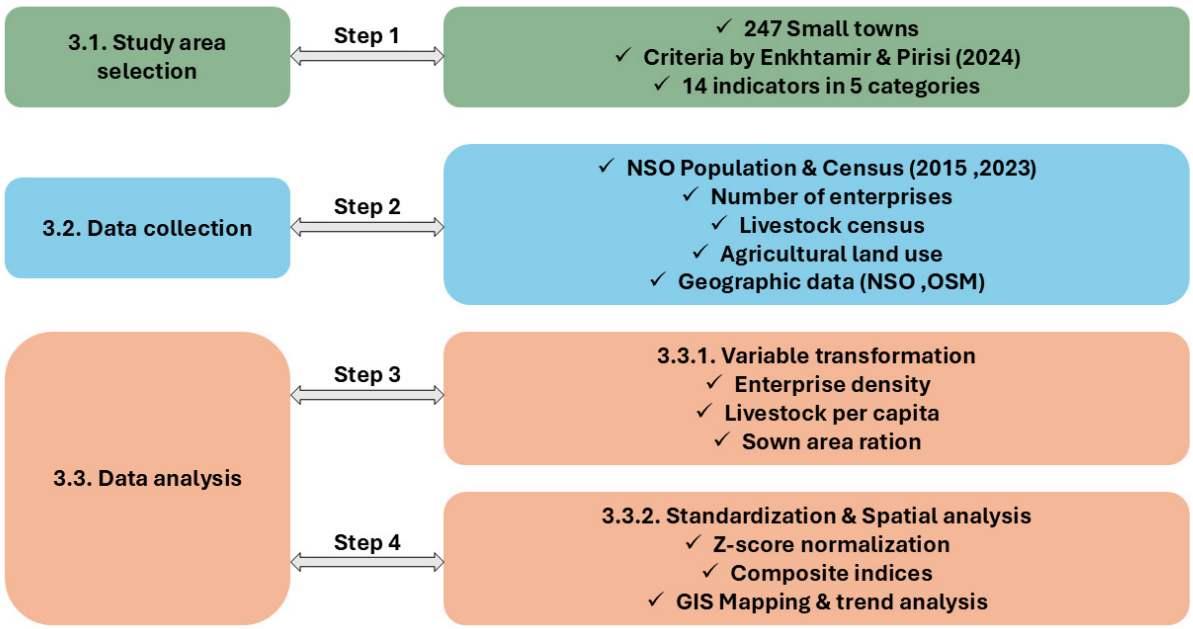

Figure 1. Methodological framework for analyzing economic base and demographic change in Mongolia's small rural towns.

3.1. Study area selection

This study focuses on 247 settlements across Mongolia identified as potential small rural towns, defined as 2,000–15,000 residents, based on their functional characteristics and public service availability. These settlements are primarily soum and aimag centers, strategically distributed throughout Mongolia's vast rural and semi-rural landscape. Their designation as small rural towns is grounded in criteria established by Enkhtamir and Pirisi (2024), who assessed these locations using a comprehensive set of 14 indicators grouped into five categories: population and employment, governance and location, health infrastructure, trade and services, and education and cultural facilities. A comprehensive list of the 247 small rural towns analyzed in this study is provided in Suppl. material 1.

These settlements are geographically diverse, reflecting Mongolia's varied topography and settlement patterns, and represent a cross-section of administrative regions from all 21 provinces. Although the typology of small rural towns developed by Enkhtamir and Pirisi (2024), based on levels of service availability, was used to guide initial town selection, it was not applied directly in subsequent analyses. Instead, the full sample of 247 towns was treated as a functionally representative dataset for analyzing demographic and economic base variation across rural Mongolia.

Agriculture in Mongolia accounted for approximately 14% of the national GDP in 2015; however, this figure declined to 9.79% by 2023, reflecting structural shifts toward other sectors, such as mining and services. While agriculture still employs about one-third of the national labor force, only 0.8% in 2015 and 1.1% in 2023 of the population were directly engaged in cropping activities, such as grain and vegetable farming. In contrast, engagement in pastoralism, primarily herding, declined from 13.1% in 2015 to 8.68% in 2023, highlighting a gradual contraction of traditional livelihoods due to rural outmigration, climate stress, and economic diversification (NSO 2023b).

Livestock herding remains culturally vital but is increasingly vulnerable to climate-related shocks, particularly dzuds (severe winter disasters causing mass livestock mortality), harsh winters that cause mass animal mortality. The 2023–2024 dzud alone resulted in the death of 7.1 million livestock, significantly disrupting rural livelihoods and reinforcing structural risks to herding economies (U.S. News 2024). Land degradation further compounds these challenges, as recent estimates, over 70% of Mongolia's pastureland suffers from some degree of desertification (The Diplomat 2024). Wheat and other grain crops, while critical for national food security, are constrained by soil erosion, harsh climatic conditions, and subsidy policies that neglect long-term sustainability. A study on Mongolian wheat growers found that current subsidies do not significantly promote the adoption of sustainable agricultural practices, such as minimum tillage, crop rotation, and compost use (Puntsagdorj et al. 2021). Meanwhile, mining has emerged as a major economic driver in southern rural small towns in Umnugovi and Dornogovi provinces. Although mining boosts local GDP and export earnings, its benefits often bypass local herder communities, causing environmental degradation, including loss of pastureland, and contributing to rural–urban migration (Xu et al. 2019; Shugatai et al. 2021; Batdelger and Zagdbazar 2022).

Despite the centrality of these sectors, there remains limited understanding, particularly at the sub-provincial level, of how economic bases, demographics, and spatial factors interact within Mongolia's rural small towns. Previous studies have explored public service provision, highlighting how soum centers operate as functional service hubs based on a multi-indicator framework covering education, healthcare, trade, and governance capacity (Enkhtamir and Pirisi 2024). Other research has examined internal migration, identifying rural-to-urban movement as largely driven by climate shocks, particularly dzuds, and the economic draw of Ulaanbaatar (Roeckert and Kraehnert 2022). Additional studies on infrastructure distribution assess disparities in road connectivity and spatial accessibility, especially in remote soum centers, which impact service access and economic integration (Gankhuyag et al. 2021).

3.2. Data collection

This study primarily relies on secondary data obtained from national statistical sources, covering the period from 2015 to 2023. We use 2015 as the earliest year with available, comparable data across the three focal sectors and demographic change, and 2023 as the latest year for which these data are available. The core datasets were collected from the National Statistics Office (NSO) of Mongolia, which provides comprehensive and standardized data on population, economic activity, and land use across the country. Population statistics, in-

Table 1. Data sources list.

Domain	Dataset (exact name)	Provider	Variables	Spatial unit	Years	How used
Demography	Population and housing census + annual small-area updates	NSO	Total population; working-/non-working-age	Soum / town	2015–2023	Structure and change analyses
Enterprises	Registered enterprises by settlement (size classes)	NSO	Counts; small/ medium/large	Soum / town	2015–2023	Enterprise density; base profiling
Livestock	Annual livestock census (by species)	NSO	Horses, cattle, camels, sheep, goats	Soum / town	2015–2023	Pastoral intensity; base profiling
Agriculture	Sown area by crop group	NSO	Grain, vegetables, other	Soum / town	2015–2023	Crop intensity; base profiling;
Geo/base layers	Administrative boundaries; coordinates; transport	NSO Geographic Database; General Department of Geography, Geodesy and Mapping; OpenStreetMap	Boundaries, settlement points, roads/ rail	National level, province→ soum/ town	Mapping base	Map geocoding and layout
Sampling frame	14-indicator small-town identification	Enkhtamir and Pirisi (2024)	Service-readiness indicators	247 towns	2023	Defines study universe;

cluding total population and workforce data (working age, non-working age) at the rural small-town level, were derived from the 2015–2023 Population and Housing Census and subsequent annual updates (Table 1). These data were essential for understanding the demographic structure of each small rural town and its surrounding hinterlands.

3.3. Data analysis: GIS-based mapping and descriptive spatial profiling

3.3.1. Variable transformation

Ensuring comparability across towns with different population sizes and land areas, we convert raw indicators into standardized ratios that capture functional characteristics. Specifically:

- Enterprise density: registered enterprises divided by town population (business activity per capita).
- Livestock per capita: aggregate five-species headcount (horse, cattle, camel, sheep, goat) divided by population (pastoral intensity).
- Sown-area ratio: cultivated land area divided by total land area (extent of crop-based land use).

These transformed variables serve as inputs to statistical summaries and to GIS-based mapping for descriptive spatial profiling. Demographic outcomes are analyzed as changes in total population and the working versus non-working-age shares; because town-level component data (births, deaths, moves) are unavailable, we treat working-age change as a migration-sensitive proxy rather than a direct estimate of net migration.

3.3.2. Standardization and GIS-based mapping

All transformed indicators were normalized using Z-score standardization (Talukder et al. 2017; Sau et al. 2023) to ensure unbiased comparison across variables that differ in scale or units. The Z-score for each observation was calculated using the following formula (eq. 1):

$$Z(X_{it}) = (X_{it} - \mu_X) / \sigma_X \quad \text{(eq. 1)}$$

Where:
i indexes towns and *t* indexes years
X is the observed value for a given town,
μ is the mean of the variable across all towns, and
σ is the standard deviation.

This transformation ensures that all indicators share the same scale, enabling direct comparability among variables such as livestock per capita, enterprise density, and sown area ratio across Mongolian small rural towns, regardless of their original units or distributional differences. Z-score normalization preserves relative variability and manages scale disparities efficiently, making it especially suitable for datasets with skewness or extreme values, which are common in rural economic indicators.

In alignment with these best practices standardization (Talukder et al. 2017; Sau et al. 2023), this study applies Z-score normalization to livestock per capita, enterprise density, and sown area ratio across 247 rural small towns in Mongolia. This process supports the construction of composite economic base indices and spatial typologies while ensuring methodological transparency and statistical comparability. By adopting this normalization technique, the study strengthens its capacity to detect structural differences in rural economies and enhances the robustness of spatial and demographic analysis.

Following standardization, the resulting dataset was used to:

- Construct composite economic base indices, allowing each town to be categorized according to its dominant economic orientation (livestock, enterprise, or sown area).
- Generate GIS-based maps to visualize distribution patterns and describe regional clustering visually across 2015 and 2023.
- Support descriptive spatial profiling by linking economic structure to demographic change, particularly shifts in the working-age and non-working-age population.

Together, these steps enabled a structured and replicable approach to understanding Mongolia's rural small-town economies in both spatial and statistical terms.

3.3.3. Composite economic base indices: construction and classification

Sector indices: For each town i and year t (2015, 2023), we compute three standardized sector scores (Z-scores):

I^{E}_{it} (Enterprises; registered enterprises per capita);
I^{S}_{it} (Agriculture / sown area; cultivated land share);
I^{L}_{it} (Livestock; five-species headcount per capita).

Classification (solo/mix/undefined):

Let p be the number of sectors with positive Z-scores among (I^{E}_{it}, I^{S}_{it}, I^{L}_{it}).

Reducing labels driven by tiny fluctuations around zero, we apply a near-zero buffer, $\varepsilon = 0.10$; a sector is treated as positive only if its Z-score is > 0.10.

- Undefined: if none of the three sector Z-scores exceed +0.10 ($p = 0$), no label is assigned.
- Solo (sector): if exactly one sector exceeds +0.10 ($p = 1$), the label is that sector.
- Mix (top sector): if two or three sectors exceed +0.10 ($p \geq 2$), the label is the sector with the largest Z-score ("top sector").

4. Results

4.1. Dominant economic bases by sector and small rural towns

4.1.1. Livestock (2015–2023)

In 2015, livestock was the dominant economic base in central Mongolia, with the highest per capita herd densities in several rural small towns shown as dense green (Fig. 2). These small rural towns averaged about 3,150 residents

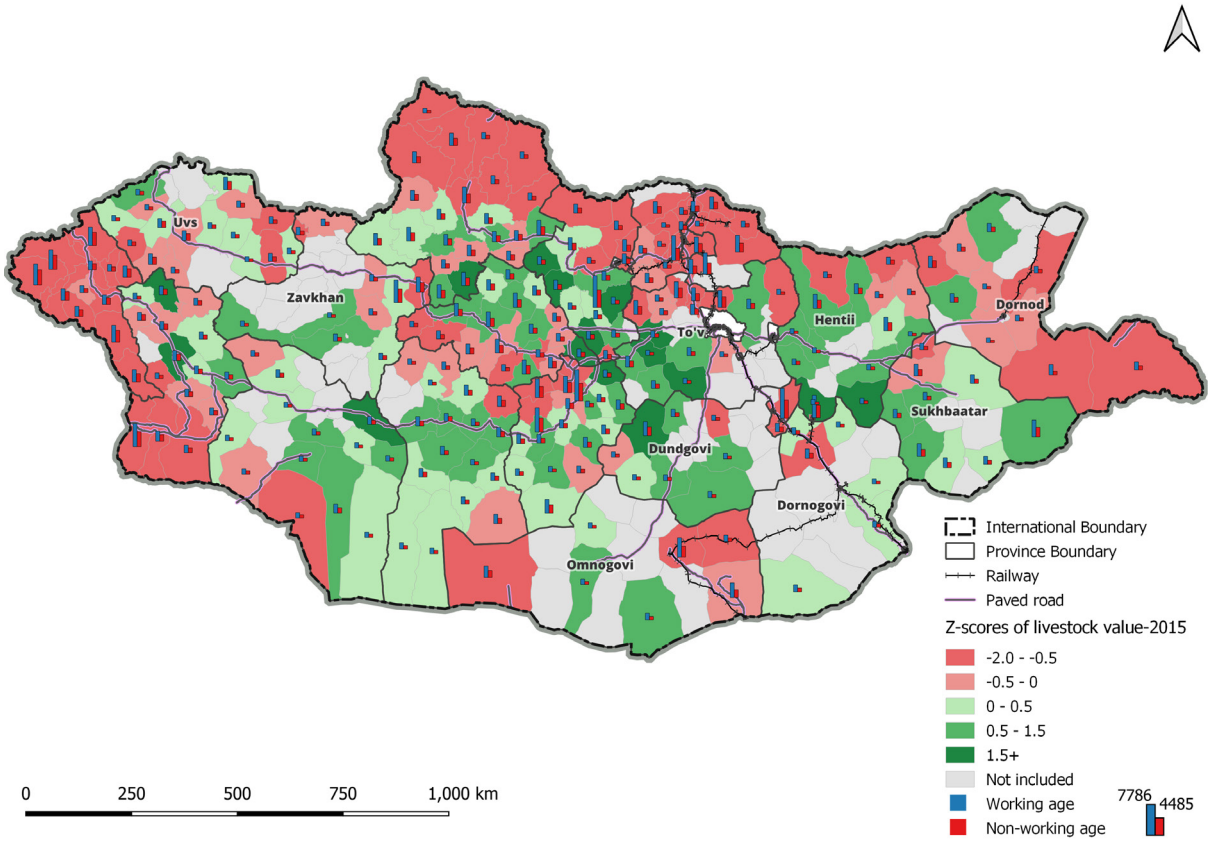

Figure 2. Spatial distribution of livestock and population structure by age group in 2015 (Adapted from NSO 2015a).

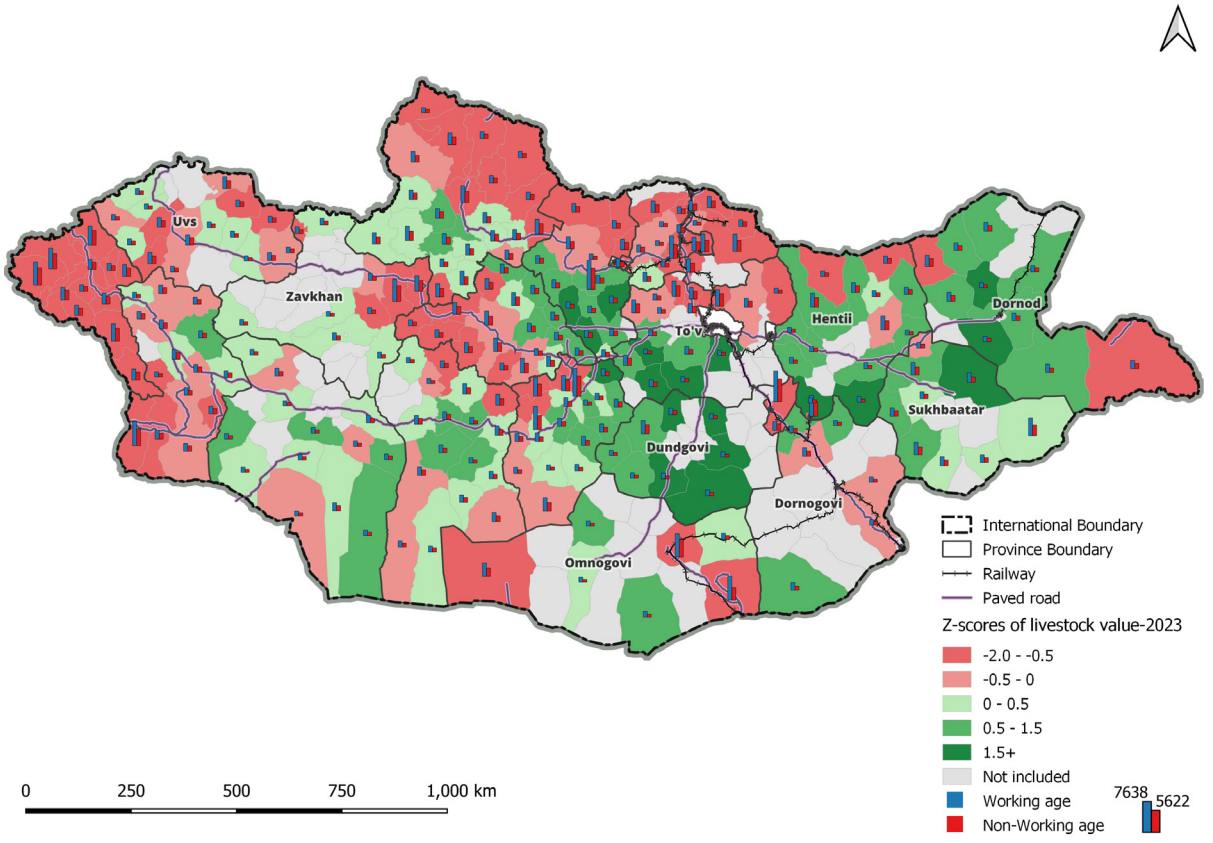

Figure 3. Spatial distribution of livestock and population structure by age group in 2023 (Adapted from NSO 2023c).

and 1,990 working-age inhabitants (63.2% working-age), indicating strong pastoral specialization and heightened exposure to environmental shocks such as dzuds and to market volatility. In the Gobi region, including Umnugovi and Dornogovi, small rural towns showed low livestock intensity because arid conditions constrain pasture availability. In 2023, central-region livestock intensity largely persisted, while western rural small towns such as Zavkhan and Govi-Altai provinces showed a modest decline that appears as lighter map shades (Fig. 3). The eastern region recorded a clear rise in livestock activity, with newly highlighted deep-green towns averaging about 2,420 residents and 1,490 working-age inhabitants (61.6% working-age) and sustaining reliance on herd-based livelihoods. Over 2015–2023, the average town population fell by 23.2%, the working-age count fell by 25.1%, and the working-age share declined by 1.6% points.

4.1.2. Enterprises (2015–2023)

In 2015, enterprise activity was moderate and concentrated in mining zones and along the Orkhon and Selenge industrial corridor (Fig. 4). These small rural towns with deep green shade averaged about 5,230 residents and 3,930 working age inhabitants (75.1% working-age), indicating that enterprise based economies supported local labor markets through resource extraction, transport links, and access to regional trade infrastructure. In 2023, enterprise development expanded east and south along major rail and road corridors, reinforcing the central role of transportation in enabling business growth (Fig. 5). These enterprise intensive towns with deep green shade averaged about 8,670 residents and 5,120 working age inhabitants (59.1% working-age), suggesting a strong association between enterprise activity, infrastructure access, and labor retention compared with more remote or mono sectoral towns; from 2015 to 2023, average residents increased by 65.8%, working-age residents by 30.3%, and the working-age share fell by 16.1%.

4.1.3. Sown areas (2015–2023)

In 2015, agricultural activity was concentrated in northern and eastern rural small towns within Mongolia's grain belt, shown as deep green in (Fig. 6). Typical centers averaged about 3,500 residents and 2,200 working-age inhabitants (62.9% working-age). Notable examples occurred in Bulgan, Tuv, Selenge, Darkhan-Uul, Dornod, and Khentii provinces, while most southern and western rural small towns showed low agricultural intensity, reflecting continued pastoral dominance. In 2023, the overall pattern persisted with core hubs in the traditional grain areas (Fig. 7). Average town size was about 3,490 residents and 2,090 working-age inhabitants (59.9% working-age), with new agricultural small rural towns emerging Bulgan, Arkhangai, and Uvs provinces—indicating localized growth in cultivation even as the south and far west largely remained outside the agricultural core; from 2015 to 2023, average residents decreased by 0.3%, working-age residents by 5.0%, and the working-age share fell by 3.0%.

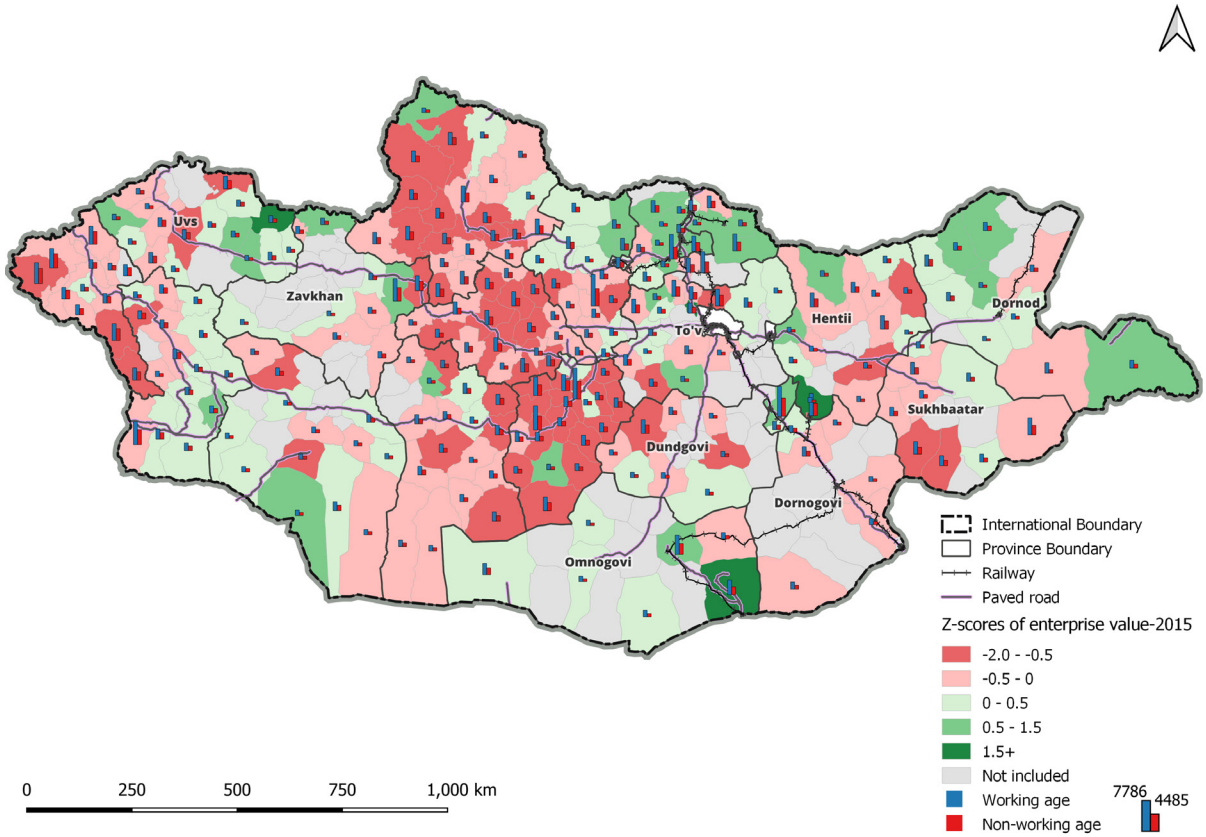

Figure 4. Spatial distribution of enterprises and population structure by age group in 2015 (Adapted from NSO 2015b).

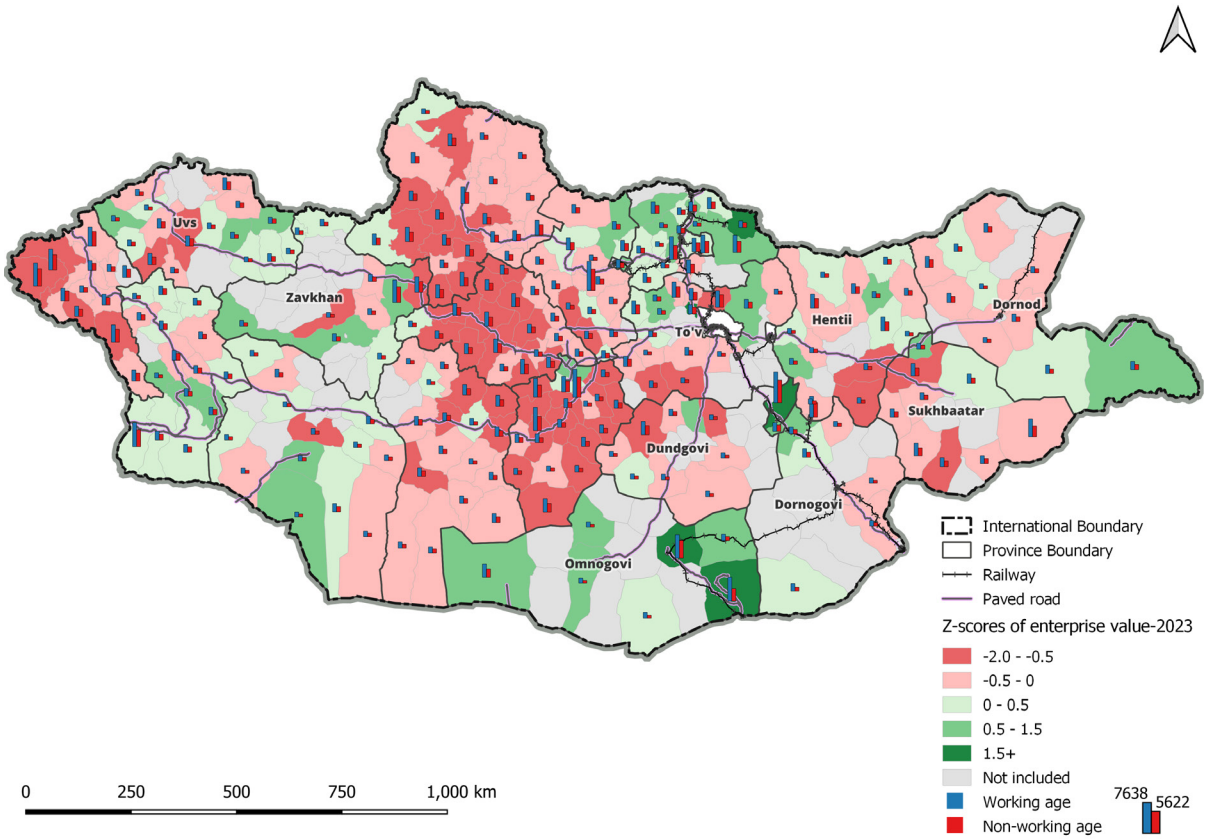

Figure 5. Spatial distribution of enterprises and population structure by age group in 2023 (Adapted from NSO 2023d).

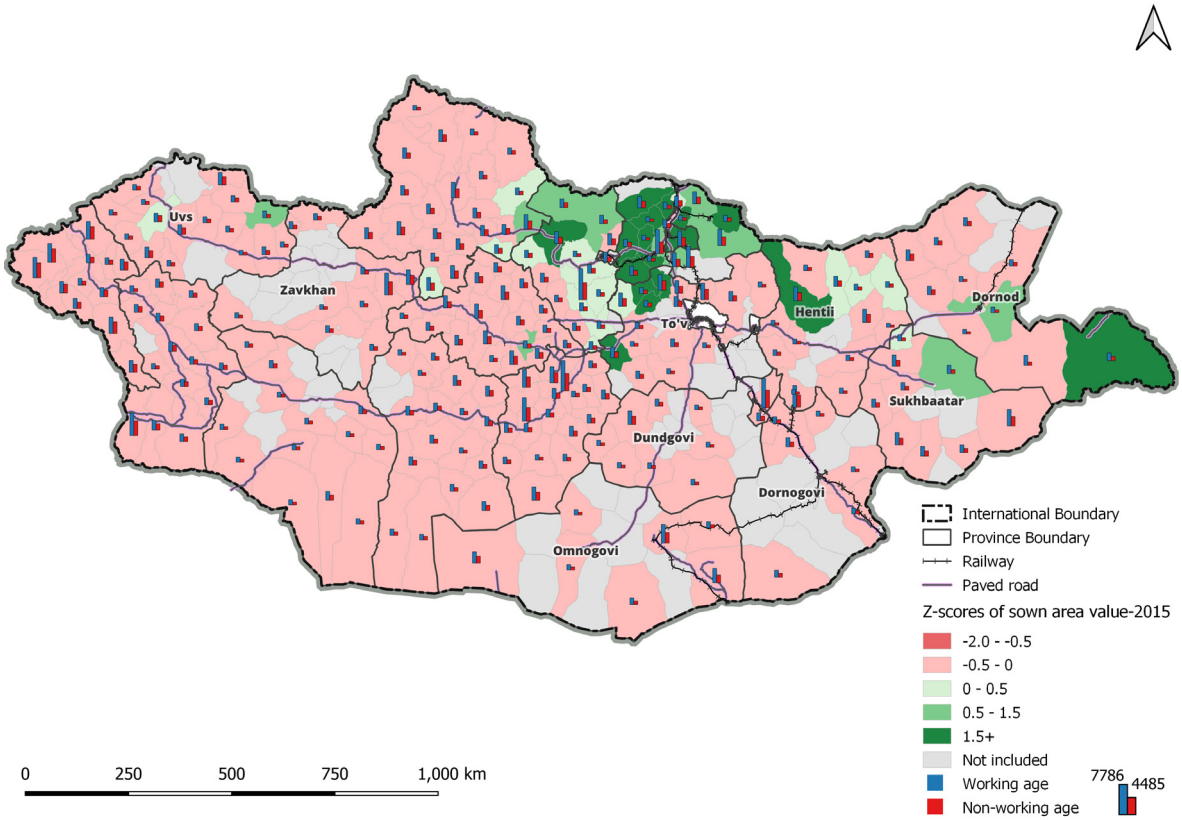

Figure 6. Spatial distribution of sown area and population structure by age group in 2015 (Adapted from NSO 2015c).

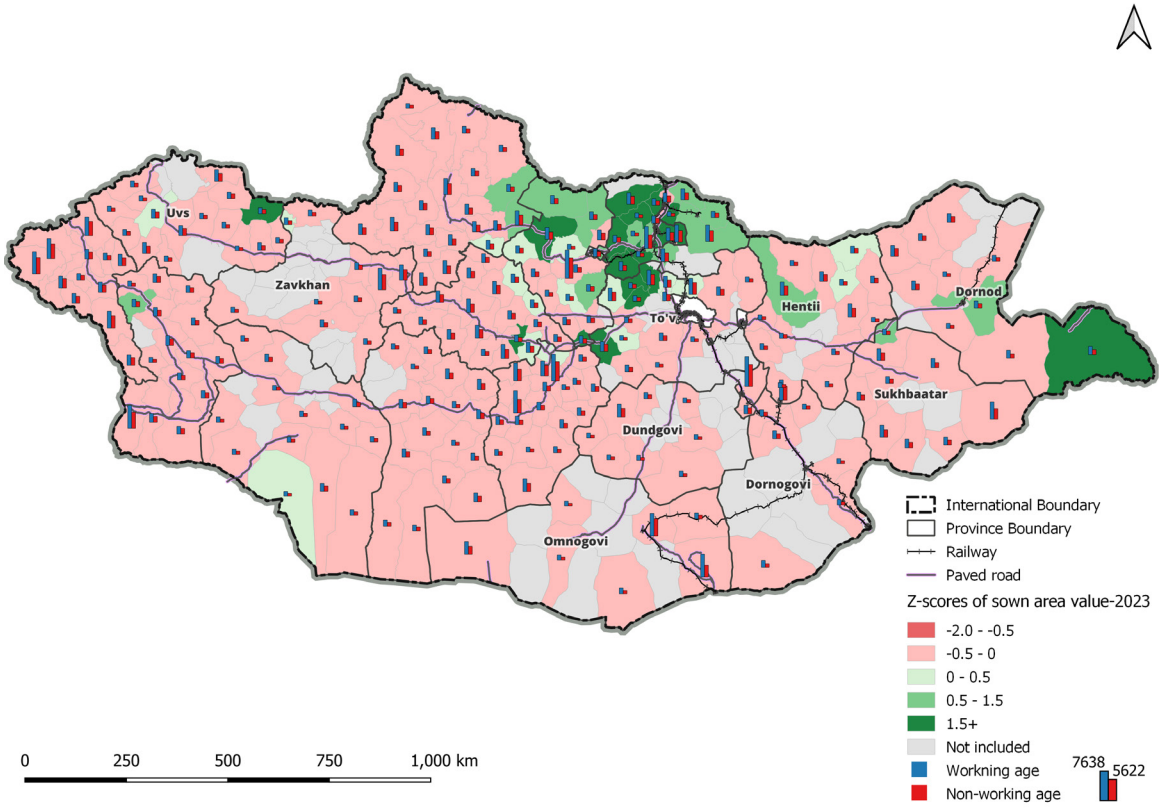

Figure 7. Spatial distribution of sown area and population structure by age group in 2023 (Adapted from NSO 2023e).

4.2. Economic base types and working age change

Between 2015 and 2023, working-age gains clustered in corridor and resource-linked towns (Fig. 8). Khanbogd, Tsogttsetsii, Gurvantes, Norovlin, Bayantumen, and Bulgan each registered increases above 15%, with most of these places closely tied to mining. The same small rural towns also recorded rises above 50% in non-working age cohorts, indicating simultaneous growth among youth and elderly groups. Towns near major roads, railways, or borders generally moved up by 5% to 15% in working-age population, while many western settlements rose only 0 to 5% and saw about a 25% increase in non-working age residents. Small rural towns with a single economic base, especially livestock, agriculture, or older small-scale mining, commonly declined by more than 10% in working-age population, reflecting out-migration from mono-sector settings.

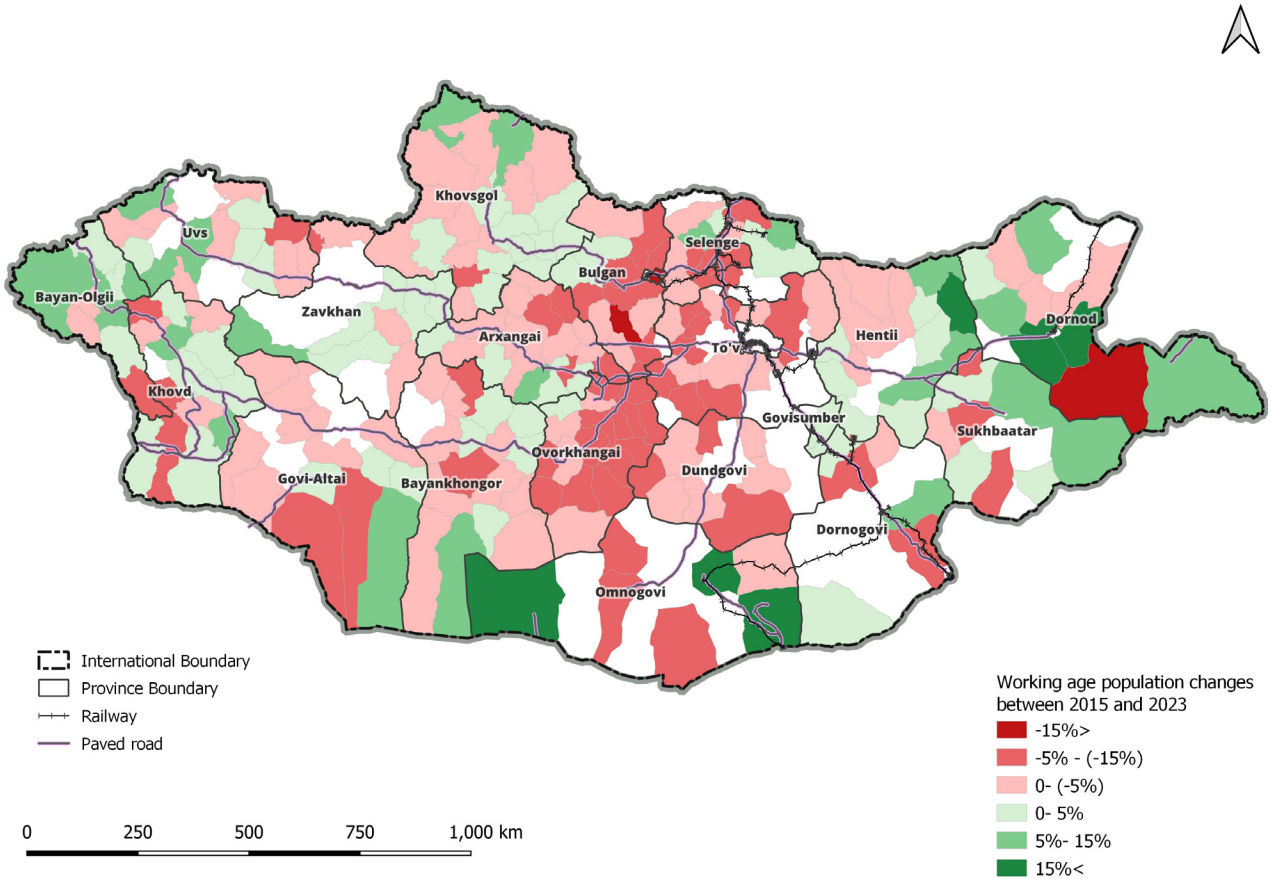

Figure 8. Working age population changes between 2015 and 2023 (Adapted from NSO 2023a).

Fig. 9 links these outcomes to economic structure. Solo economies, particularly livestock and crop-based, tended to lose working-age population, with livestock towns showing declines close to 25% and agriculture towns declining by about 6% relative to 2015. Mixed economies anchored by enterprise were more likely to maintain or increase working-age shares, especially along transport corridors. Demographic dependency was highest in livestock towns, moderate in agriculture towns, and lowest in enterprise-oriented towns. Together, the figures indicate that diversification and connectivity align with stronger labor re-

tention, whereas single-based, climate-sensitive economies face continued demographic contraction. Because natural increase alone is unlikely to generate these short-period differences in the working-age cohort, we interpret the gains near corridors and mining sites as consistent with net in-migration/retention and the declines in mono-sector towns as consistent with net out-migration.

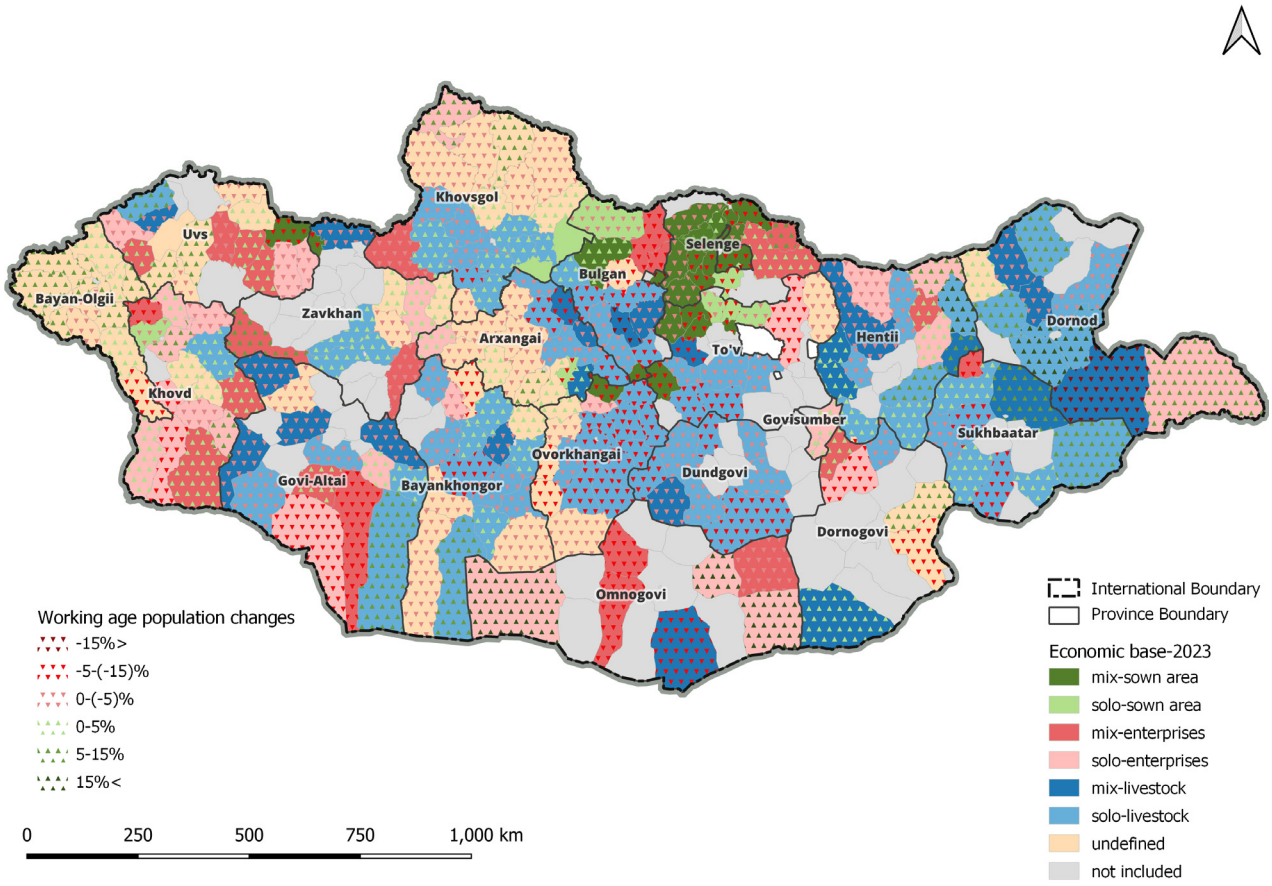

Figure 9. The economic base of the working-age population changes between 2015 and 2023.

5. Discussion

Our results show that small rural towns specialized in climate-sensitive livelihoods are more likely to lose working-age residents, while small rural towns with enterprise activity and corridor access retain them more effectively (Figs 8–9). Comparable results are reported for Inner Mongolia, where working-age retention concentrates along extraction and logistics routes and weakens in pastoral zones exposed to ecological stress (Xu and Wu 2016; Zhou et al. 2022). Kazakhstan's resource towns exhibit similar dependence on single-industry configurations, with population stability improving when local economies diversify beyond extraction (OECD 2017). In Mongolia, mining-linked income gains do not reliably anchor settlement, which aligns with our result that enterprise ecosystems and accessibility—not resource endowment alone—support demographic stability (Amartuvshin et al. 2021; Narantungalag 2025).

Results also indicate higher demographic dependency where livelihoods hinge on livestock or cropping without complementary services. This corresponds to findings that climate shocks and market distance weaken labor attachment in pastoral systems (Xu et al. 2019; The Diplomat 2024) and that corridor-linked enterprise environments are associated with stronger local labor markets (Gankhuyag et al. 2021; Bai et al. 2023). Evidence from Canada and Australia shows that extraction towns relying on non-resident labor models face difficulty retaining working-age cohorts and sustaining civic infrastructure, a pattern consistent with our small rural towns results, where employment is not embedded locally (Ryser and Halseth 2010; Marais et al. 2018).

In contrast, small rural towns that rely solely on livestock or farming, particularly in remote areas, remain vulnerable to climate shocks, labor out-migration, and limited access to services. These structural vulnerabilities are compounded by gaps in infrastructure investment and uneven public service provision (Koulov 2018; Bai et al. 2023). For example, insufficient support for sustainable agricultural practices constrains resilience even in towns with clear potential for cropping expansion (Puntsagdorj et al. 2021).

Implication from the results: the international record supports our interpretation that diversification plus connectivity convert economic activity into resident employment and lower demographic dependency in small rural towns, whereas single-base economies remain vulnerable (Klosterman 1990; Wang and Vom Hofe 2007). Accordingly, policies that expand corridor-linked enterprise ecosystems, supplier networks, and workforce skills are more likely to translate accessibility into population stability, while climate-risk management and non-farm income options are necessary in livestock- and crop-dependent small rural towns (Puntsagdorj et al. 2021; Bai et al. 2023; Enkhtamir and Pirisi 2024).

6. Conclusion

This study indicates that Mongolia's small rural town economy has undergone clear spatial change and shifts in total population and the working-age share between 2015 and 2023, strongly associated with the type of economic base and the degree of infrastructure access. In this paper, demographic change refers specifically to changes in total population and the working-age share; we do not decompose fertility, mortality, and migration components directly. Among the 247 small rural towns analyzed, those reliant solely on livestock or aging mining activity experienced a measurable decline in working-age population and service resilience, while towns with diversified economies—especially those along road and rail corridors—retained or grew their labor force.

Three main patterns emerged. First, livestock remains the most widespread economic base, but its demographic viability is increasingly undermined by climate shocks, land degradation, and labor outmigration. For livestock-dominant towns, climate-exposed and seasonal incomes increase migration push factors, particularly for working-age adults seeking stable earnings and services. Second, enterprise-based towns, including those with active small businesses and mining-adjacent industries, exhibited higher retention of working-age population and greater demographic stability. We interpret the association between enterprise density and working-age retention through a labor-market mecha-

nism: diversified firms generate steadier year-round employment and service demand, which anchors households locally. Third, sown-area intensity remains limited to a few central and western small rural towns, but with untapped potential if policy frameworks for sustainable agriculture improve.

These findings support the utility of economic base theory in explaining demographic sustainability in sparsely populated regions. They also extend the theory by incorporating spatial connectivity and service access as critical intervening variables. Mongolia's experience echoes global patterns observed in other resource-dependent regions such as Inner Mongolia, northern Canada, and Kazakhstan, where mono-functional towns often face boom-bust cycles, demographic decline, and underutilized infrastructure.

Strategic differentiation is essential from a policy standpoint. In the short term, targeted investment in small and medium-sized enterprises, core public services (such as education and healthcare), and basic local infrastructure can help stabilize towns with latent economic potential. Over the longer term, regional development strategies should prioritize the creation of diversified economic zones alongside key transport corridors—integrating local enterprise, sustainable agriculture, and secondary service hubs. Without coordinated interventions at both levels, rural–urban disparities are likely to widen, and many towns may struggle to retain working-age populations and maintain essential services.

Limitations: We use official, harmonized town-level datasets; while consistent, they do not let us disentangle migration from natural change, so working-age change is used as a migration-sensitive indicator, and findings should be read as descriptive associations rather than causal effects. We also focus on three measurable activities (herding, sown area, registered enterprises) at two points in time, which omits other livelihoods and short-term dynamics that could shift classifications. At the same time, the indicator-based typology and GIS workflow are transparent and reproducible, which is the study's main methodological contribution.

Future research could usefully examine demographic patterns beyond 2023 and incorporate local perspectives to complement quantitative analysis. It may also be helpful to explore how migration and employment trends differ by gender and age. As Mongolia continues to face spatial disparities and environmental challenges, ongoing monitoring and context-sensitive strategies will be important for supporting demographic stability and promoting balanced, resilient rural development.

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Additional information

Conflict of interest

No conflict of interest was declared.

Ethical statement

No ethical statement was reported.

Use of AI

AI-assisted tools (e.g., Grammarly, ChatGPT) were used solely for grammar and language correction. No AI tools were used for content generation, data analysis, or interpretation of results.

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Author contributions

Conceptualization: NE. Data curation: NE. Methodology: NE. Supervision: GP. Visualization: NE. Writing - original draft: NE. Writing - review and editing: GP.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

Supplementary material 1

List of the studied small towns and provinces with some major characteristics

Authors: Nomin Enkhtamir

Data type: Table, Excel

Explanation note: Additional information about the studied small towns and provinces in Mongolia.

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