Factors causing depopulation of vulnerable regions: Evidence from Kazakhstan, 2009–2019

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The methodology for sampling vulnerable regions in Kazakhstan has not been fully developed. This finding highlights the need for further research in this area. The best adaptability to the current economic system is found in urban agglomerations, city centres, and regions with raw material extraction industries and goods in high demand in the global market. However, Kazakhstan's most vulnerable regions are less developed and competitive. Furthermore, these settlements have become impoverished and are currently on the verge of extinction. Additionally, the pandemic has profoundly changed the structure and level of its development, triggering potential vulnerability issues, particularly in small settlements where resources and supplies are in short supply. The data analysis pinpointed Kazakhstan's most vulnerable regions, which have a deteriorating environmental status and a lack of social and transportation infrastructure. For the last ten years, these regions have been particularly vulnerable. Data analysis indicated that Kazakhstan's most vulnerable regions have a deteriorating environmental status and lack social and transportation infrastructure. These regions have been particularly vulnerable over the last ten years. The solutions to these challenges lie outside the purview of both the urban and rural levels of government and, therefore, necessitate active government involvement.

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Introduction

In many countries, there is an urgent need to support underdeveloped and problematic regions and small communities. Furthermore, these settlements have become impoverished and are on the verge of extinction. Additionally, the pandemic has profoundly changed the structure and level of its development, triggering potential vulnerability issues, particularly in small settlements where resources and materials are in short supply (Nyikos et al. 2021, Antalóczy et al. 2022, Kapás 2022). The intensity of these shocks is determined by developing effective methods to address inequality and economic growth in the poorest rural areas and poverty reduction implications.

Although most nations in transition and developing economies are experiencing significant urbanisation, poverty remains primarily a phenomenon in vulnerable regions (IFAD 2001, Zagyi et al. 2021). Many people reside in small communities and rural areas in nations such as Kazakhstan, Kyrgyzstan, and Uzbekistan. It is projected that these patterns will continue in the near future. The most adapted to the market economy are urban agglomerations, city centres, and regions with raw material extraction industries that produce products in high demand in the global market. As a result, many Kazakh settlements are less developed, more competitive, and even more socially vulnerable. Urban settlements include cities of republican, regional, and district significance, as well as villages located in the territory of their administrative subordination; rural regions include all other settlements, regardless of their administrative subordination. In total, there were 88 cities and 6322 rural settlements in Kazakhstan.

The vast majority of small towns and villages in these areas have a population decline rate that is lower than the average natural population decline in Kazakhstan's cities. This reveals the scarcity of resources, liquid petroleum industrial output, and government assistance. However, the fastest-growing cities in Kazakhstan are those in oil- and gas-producing regions that arose from the settlements of oil workers. Nevertheless, this approach is not ideal for long-term development. Therefore, makes sense to delve deeper into the current situation in Kazakhstan's most vulnerable regions.

Therefore, the problem of inequality in the poorest regions must be addressed as part of a poverty reduction strategy and, more broadly, policies targeted at encouraging their development. Consequently, developing countries must tackle developmental difficulties in identifying ways to develop the poorest regions and their success in reducing poverty levels. A significant effect of poverty reduction in small towns is the delay in migration from small communities to cities. Consequently, the government is less pressured to offer better assistance, enhance educational standards, and provide social services.

According to several studies, impoverished regions have historically lagged behind developed areas in socioeconomic growth and infrastructure development due to negative development conditions (Roselli 2012, Badia-Miro–Ducoing 2014). Other academic researchers have found that economically poor regions have witnessed economic growth and environmental and social problems (Wisner 2002, Villa–McLeod 2002, Beroya-Eitner 2016, Chernova–Gridnev 2023). Several studies have examined the challenges rural areas face and the variables that have influenced their development (Brauer–Dymitrow 2014, Kok–Lu 2016). A variety of calculations distinguishes many studies, and for each specific situation, the selection of the necessary indicators is required.

Little research had been conducted on Kazakhstan's vulnerable regions before this study (from small towns to rural areas). Previous research has primarily focused on Kazakhstan's major cities and regions, which are not overly vulnerable (Kireyeva et al. 2018, Amrin–Nurlanova 2020). However, the essential part of the crisis phenomenon is the crisis that occurs in both urban and rural areas.

In this regard, it is worth noting that there is a scarcity of scientific studies focusing on identifying vulnerable regions and depopulation. The purpose of this study was to bridge this gap.

This study examined the factors contributing to the extinction of Kazakhstan's poorest and most vulnerable regions. First, methods are proposed for assessing the vulnerability level in Kazakhstan's regions. Second, the socioeconomic and infrastructural-ecological conditions of Kazakhstan's regions are examined. Third, the level of vulnerability and rankings of Kazakhstan's studied regions were determined.

Literature review

The importance of studying crisis regions is increasing, and there is growing research on topics such as depressive regions, and the vulnerability of rural areas and settlements, among others.

Depressive regions

The terms vulnerability and depressive regions must be understood separately. The term ‘depressive regions’ was first related to the emergence of a depressed economy. The major markers of the economy's downturn were a high rate of unemployment, an annual increase in non-correlated consumer expenditure and real wages, a reduction in production, and a collapse in export volumes. During the Great Depression, production industries collapsed, resulting in low employment rates (Baines 1992). Despite this, the service industries saw increased employment during the Great Depression. The working hours of adult workers have been decreasing, and unemployment has become more prevalent (Ray et al. 2012). British industry was

prone to such economic downturns, resulting in economic stagnation (Roselli 2012, Badia-Miro–Ducoing 2014).

Additionally, Cole–Ohanian (2002) recognised a reduction in weekly working hours as a critical feature of sectoral economic stagnation. In 1929, the unemployment rate was particularly high in coal-producing areas such as Northern England (12,9 %) and Wales (18,8 %). As a result, one of the main causes of Great Britain's sectoral downturn was increased unemployment, which pushed manufacturing and output to the second place (Cole–Ohanian 2002). Depressive development results from a region's post-crisis development. Depression is defined as a reduction in economic activities. Furthermore, the social indicators of the study region are deteriorating. Compared to other parts of the country, the statistics for the considered region reflect a decline in economic activity (Dulova 2011). Depressive development is difficult to predict because it is conditional. However, they identified risk sensitivity, social reactions, and physical aspects as components of vulnerability. As a result, a depressed region experiences a long period of economic stagnation due to a period of economic recession.

Vulnerability of settlements

Vulnerability is recognised as a major cause of rural land degradation. Vulnerability is the response of a region to various environmental and socioeconomic challenges in some cases (Villa–McLeod 2002, Beroya-Eitner 2016, Dudek–Sedefoğlu 2019). This explains why a broad strategy for understanding and assessing a region's risk is unachievable. However, according to Wisner (2002), vulnerability is the outcome of a region's or settlement's inability to recover from a particular economic collapse, which is seen as inadequate development. In contrast, it also discusses the settlement's ability to adapt to innovation or change (Birkmann 2007).

Rural areas are prone to various economic development processes. This may be either rapid progress or an economic downturn. Rural studies have gone through a development process, mostly concerned with land issues, such as agriculture, until 1950. The focus of rural studies widened rather than switched later in the 1970s. Employment, housing, leisure activities, and other aspects of rural development were all considered. Rural studies in the early 1990s have focused on the socioeconomic development of rural areas. The threat of urbanisation and increasing growth in agriculture have prompted this development.

Graymore et al. (2008), for example, researched the notion of sustainability assessment that can be used to identify key categories of vulnerabilities. Population health, environmental pollution or the state, education, natural resource utilisation, and infrastructure are all aspects of well-being. Employment, population, education, culture, urbanisation, transportation, resource consumption, and other socioeconomic factors influence the quality of life. Ecosystem health measures the availability of natural resources such as air, land, water, and ecosystems. One of the

significant consequences of such an uncontrolled conversion process is the regional environmental quality (Krishnan–Firoz 2021). Furthermore, theories of rural development have focused on vulnerability in terms of three components that can be thought of as a theoretical framework: functional, political-economic, and social vulnerability (Brauer–Dymitrow 2014). As a result, each study is a case study that takes a unique approach to assessing the impact of vulnerable factors, such as location, adaptability, and sensitivity (Kok–Lu 2016).

The pre-depression period must be considered when examining the present concept of depressed regions. As a result, subjective and objective criteria emerged for assessing the development of the region. Both are concerned with the quality of life. Perceptions of socioeconomic development were subjective criteria. Marans–Stimson (2011) surveyed people's opinions on education quality, public transportation enhancements, safety (domestic violence, crime), and environmental issues, such as ecology and green space management. Such case-specific subjective criteria studies are common; as a result, surveys and interviews are the most appropriate research methods in this situation (Marans–Stimson 2011). Haslauer et al. (2014) discussed objective criteria such as the availability and existence of socioeconomic circumstances such as available education, public transportation, and amenities such as power and water. The majority of objective well-being research has been based on secondary data. It is important to remember that objective well-being differs from subjective well-being (Haslauer et al. 2014).

Modern studies have focused on the socioeconomic well-being of the population. For example, secondary education is available in most rural settlements, but the quality is not always good. Low employment, decreased regional competitiveness, environmental difficulties such as land deterioration, and social issues characterise the current depression period (Barabanov et al. 2020, Aritenang 2022). Business development, the employment rate, and exports are all pushed back to the agenda. The population's well-being, as well as the availability of conveniences such as power, clean water, shelter, and location, take precedence. Zerbo et al. (2020) analysed the living situations of individuals in sub-Saharan Africa in their study on urbanisation. Rural areas are dying because of migration from villages to cities due to rapid urbanisation. As a result of poverty, an increasing number of informal settlements are springing up amid unfavourable environmental conditions, including proximity to factories, a lack of piped/clean water, shelters constructed of highly combustible materials, and a densely populated area.

According to Nanor et al. (2021), subjective well-being includes personal preferences and necessities. They discovered that the following factors had a significant impact on happiness: transportation, health status, education, environment, and dwelling type. Objective issues are more common in developing countries than in developed ones (Nanor et al. 2021). Consequently, a vulnerable region is vulnerable to different levels of environmental impact (ecologically sensitive areas, districts, cities, and villages) and has limited infrastructural development.

A methodological review of the literature indicates many ways to assess the depressiveness and vulnerability of settlements. Statistical procedures, such as principal component analysis (PCA) and standardisation (Z-score transformation) within the SPSS computer software, were used to assess vulnerability and aggregate quantitative data (Waly et al. 2021). Data from the remaining administrative units were normalised on a scale of 0 to 1 to depict the relative level of social vulnerability in urban municipalities (Apotsos 2019). For the assessment of social vulnerability, a set of variables was collected and standardised; a test of multicollinearity (Pearson's R) was performed, factor analysis was conducted using Varimax rotation, and Kaiser normalisation was applied (Roncancio et al. 2020).

In addition, based on panel data, discriminant analysis and ordinary least squares (OLS) regression were used in vulnerability analysis (Dore–Narayanan 2020). The weighting-by-tolerance statistic was used to compute the social and economic vulnerability components (Aroca-Jiménez et al. 2020).

Exposure, sensitivity, adaptive capacity indices, and livelihood vulnerability scores were calculated (Singh 2020). To assess inequalities across regions, the maximum and lowest values and determine the arithmetic mean for each indicator were set (Khalimova 2021). The indicators were validated using an expert judgment approach in the assessment of socio-economic and environmental vulnerability. The data were also standardised and divided into sub-indices (Grigorescu et al. 2021). Depending on the degree of vulnerability in each rural community, selected characteristics weighted from 1 to 5 were assigned for the assessment of the vulnerability of rural mining communities.: a) 5p. (major); b) 4p. (high), and c) 3p. (medium), d) 2p. (low), and e) 1p. (very low) (Constantin et al. 2015).

In light of the foregoing, it is clear that depression and vulnerability are responses to a crisis and the ability of a region to cope with it. Nevertheless, the vulnerability criteria were much wider than the depression criteria. Regional vulnerability allows us to study not only economic and social components but also their vulnerability in the context of changing factors of the internal and external environment and, ultimately, to determine the state of vulnerability of the region. Territory vulnerability is characterised by the sensitivity of an object or territory to the impact of certain groups of factors. This study contributes to the literature by conducting a methodology and vulnerability assessment based on a system of comprehensive factors, including social, economic, environmental, and infrastructural indicators.

Moreover, methodologies used to study the vulnerability level of a region differ based on the context of the study. The next section describes the author's survey methodology and data sources, which provide a preliminary understanding of the impact of factors affecting the extinction of the poorest vulnerable regions, using the example of Kazakhstan. This study is the first attempt to sample underdeveloped regions using an integrated approach to show differences between regions. This can give impetus to the government to stimulate the development of not all regions but only vulnerable regions that can and should become the subject of special state support.

Data and methods

The design of methodologies for assessing the level of regional development is the focus of several studies by foreign researchers and international organisations (World Bank, ADB, and UN). The goal of certain methodologies for measuring development trends and regional vulnerability is to identify these factors (Fei–Chenghu 2009, Kiryluk-Dryjska et al. 2020, Fitriani et al. 2021). A unique system of indicators and their application for the analysis of densely populated regions of China, where up to 40 % of the country's population lives and nearly half of GDP is produced, is of interest from the perspective of methodology for assessing the influence of various factors on regional development (Yuan–Chuanwang 2018). However, the statistical accounting system in China has unique characteristics; therefore, this methodology cannot be applied to Kazakhstan. Researchers in Russia have used a wide range of methods. Some of them provide a methodology for evaluating GRP structural indicators, fixed assets, labour resource use, the scientific sphere, and information infrastructure development (Polyakova–Simarova 2014, Kolomak 2020).

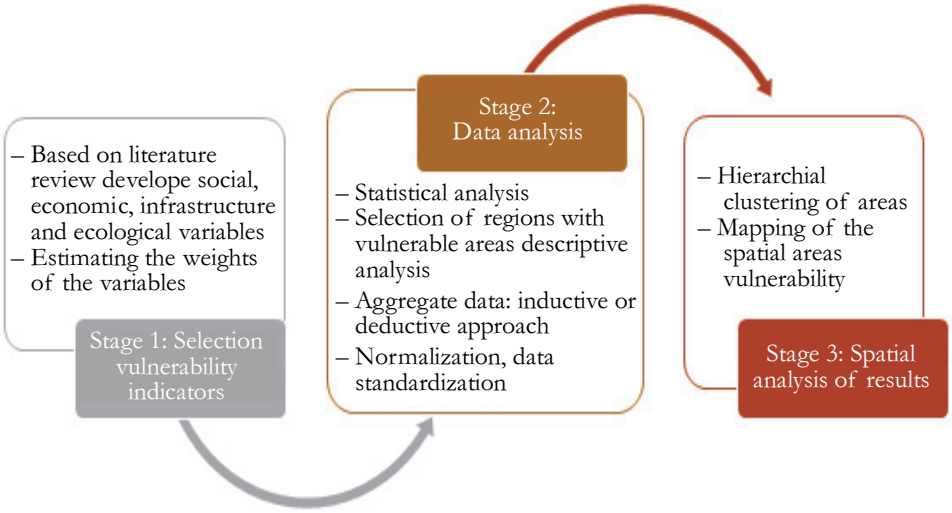
However, these methodological approaches are not sufficiently comprehensive, as they mostly cover environmental and social aspects and do not consider economic and infrastructure development indicators. The analysis of a few applied methods leads to the conclusion that although these methods vary by country, there is no unified method that is acceptable for assessing vulnerable regions. The diversity of existing methods complicates the selection of the most appropriate method for achieving specific goals, such as analysing the growth of diverse regions at various scales and levels. The application of various methodologies and different sets of indicators should be enhanced to identify vulnerable regions early and to increase living conditions while considering economic and infrastructure development. Obtaining incorrect results can hurt the decision-making process in regulating settlement development.

An assessment approach is proposed based on the supplied overview of the research for providing a regional vulnerability level assessment – the comprehensive vulnerability index (CIA) of regions, which comprises social, economic, infrastructural, and environmental factors. Furthermore, the current technique assumes a mix of primary (statistical) and secondary (empirical) data as well as a step-by-step investigation that complements and discloses profound concerns about regional vulnerability. Based on statistical data, the study's most vulnerable regions were selected in the first stage. Additionally, a population survey was conducted in a few regions.

The main stages of the comprehensive assessment of the vulnerability of the regions are presented in Figure 1.

Figure 1

Stages of a comprehensive vulnerability assessment



Based on the literature review, the authors developed a comprehensive system of factors covering social, economic, infrastructure, and environmental indicators. Specific variables showing the vulnerability levels of the regions are highlighted (Appendix Table A1).

Thus, to assess the vulnerability of regions, 34 quantitative indicators were used, grouped into the following key blocks: social (11), economic (11), infrastructural (7), and environmental (5). The weights were established based on expert judgment. Furthermore, for the set of economic indicators, experts established the highest weight, given that for the stable development of regions, the presence and effective functioning of specialised industries and sectors of the economy is necessary. The state of the social sphere, the well-being of the population, the positive dynamics of demographic and migration processes, and the possibility of infrastructure development and solving environmental problems depend on the production of goods and services and the availability of jobs.

Vulnerable regions were identified in this study by aggregating data based on rationing, weighting, and ranking. Using the arithmetic mean method, the intermediate social, economic, infrastructure, and environmental indicators were estimated according to the recommended method.

Furthermore, to normalise the data, a standardised estimate (z), which is a metric that characterizes the distance of values from the average value of the general population, was used. It is calculated for each value according to (1):

$$Z = \frac{x_i - \mu}{\sigma} \quad (1)$$

where Z – standardized assessment, x_i – Initial indicator value, μ – arithmetic mean, σ – standard deviation.

Data normalisation was carried out in the SPSS 25 program by the command 'Analysis => Descriptive statistics => Save standardized values of variables'.

The indicator's integration was carried out by finding the average values of the normalised data for settlements according to Equation (2):

$$m_{\mathrm{i}} = \frac{(x_1+x_2+x_3+\cdots)}{n} \quad (2)$$

where m_i – settlements mean value, x_1 – normalised values of the indicators.

These values were found for all groups of indicators: social, economic, infrastructure, and environmental. Based on the weighting of the indicators by weight coefficients, the composite indices of the vulnerability of the regions were determined according to Equation (3):

$$\mathrm{I}_{\mathrm{m_i}} = \frac{Soc_{m_i}*0.25+Econ_{m_i}*03+Infra_{m_i}*0.25+Ecol_{m_i}*0.2}{4} \quad (3)$$

where I_{m_i} – composite index for settlements, Soc_{m_i} – aggregate value of social indicators, $Econ_{m_i}$ – aggregate value for economic indicators, $Infra_{m_i}$ – aggregate value for infrastructure indicators, $Ecol_{m_i}$ – aggregate value of environmental indicators.

Following computations using the aforementioned formulas, the level of vulnerability in each region was determined using the scale below (Table 1).

Table 1

Scale for quantifying the degree of vulnerability of regions

Base score range	Colour	Type of vulnerability
[≥ –0.4]		High vulnerability
[≥ – 0.2]		Below medium vulnerability
[≥ 0.00]		Medium vulnerability
[≥ 0.2]		Above medium vulnerability
[≥ 0.4]		Low vulnerability

Additionally, the regions were rated using the 'sorting in decreasing order' technique based on the values of the aggregated indicators. Data from the Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, regional departments of statistics, electronic resources of districts, settlements, and other sources were used in the analysis. It should be noted that collecting statistical data for several environmental indicators was difficult because the data for some regions were unavailable.

Study regions

There is an urgent need to stimulate socioeconomic development in many countries. A prosperous country is considered to have an effective regional policy aimed at balancing the activities of any region, from large areas to small settlements. Today, Kazakhstan has become a recognised regional leader and has a strategically important

geopolitical location. Most importantly, Kazakhstan is located in the centre of Eurasia. Kazakhstan's closest neighbours are Russia, China, Uzbekistan, Turkmenistan, and Kyrgyzstan (Figure 2).

Figure 2

General map of Kazakhstan, including neighbouring countries

According to Figure 2, it can be seen that there are 14 regions and three cities of republican significance in Kazakhstan – Nur-Sultan, Almaty, and Shymkent. In addition, there are many settlements in Kazakhstan, consisting of three main types: district, urban, and rural. Urban settlements include republican, regional, and district cities; villages located in the territory of their administrative subordination; and rural areas – all other settlements, regardless of their administrative subordination.

Thus, the following three regions were selected for the case study: Zhambyl, North Kazakhstan, and East Kazakhstan. These regions were chosen for the following reasons:

- The demographic situation has negative trends, a high degree of deterioration of infrastructure facilities, and an unfavourable environmental situation.
- These regions are classified as depressive according to a set of developmental criteria (volume of industrial production per capita below the national average, low incomes of the population, depletion of the resource base, and high unemployment).
- The regions are borderline, geopolitically, and strategically significant, bordering on the nearest neighbouring countries.

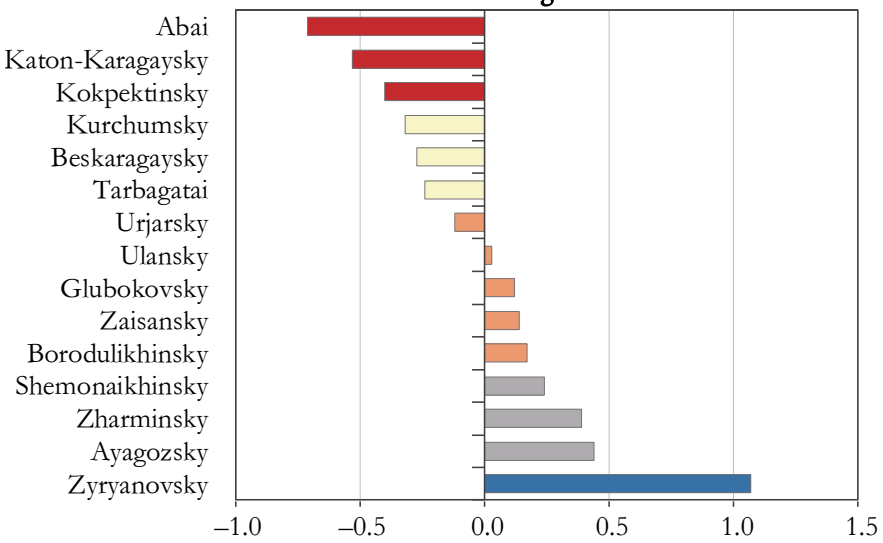
Results and findings

Existing methodological approaches for identifying vulnerable regions to their full extent allows for complete analysis based on the obtained data. A large city or agglomeration is not included in the sample because it is considered the main point of growth and the least vulnerable to the impact of negative factors. Accordingly, problem regions were chosen; these are areas that cannot solve their problems on their own or realise their potential unless the state provides support.

The following regions in East Kazakhstan showed a profound level of depression in terms of social and economic indicators from 2009 to 2019: Abai, Katon-Karagaysky, and Kokpektinsky. Abai, Tarbagataisky, Kurchumsky, Katon-Karagaysky, and Beskaragaysky were selected as the most underperforming regions in terms of their environmental and infrastructure indicators. Surprisingly, the remaining regions exhibit stable patterns in infrastructure and environmental development.

Figure 3

Ranked series of values according to the level of vulnerability in East Kazakhstan regions



Note: The level of vulnerability see in Table 1.
Source: Created based on data from the [1].

Aggregate indicators were obtained based on a sample of the most vulnerable regions in East Kazakhstan. Figure 3 shows the fluctuations in the values of the indicators for East Kazakhstan.

By using aggregate indicators of regional development, it is possible to characterise the development of a region and its relative position more precisely. According to the data, three regions show stable development trends: Zyryanovsky (1,07), Ayagozsky (0,44), and Zharminsky (0,39). Abai (–0,71), Katon-Karagaysky (–0,53), Kokpektinsky (–0,40), and Kurchumsky formed a group with the most susceptible

regions at the same time (–0,32). The lowest standard of living in the country was observed in vulnerable zones. Furthermore, the vulnerability of the region has a significant impact on the quality of life and poverty of the local population.

The most negative factor, when analysed, was the intensification of migratory processes, both within the country and within a developed region, as well as abroad, due to the aforementioned causes. Furthermore, there is a lag in socioeconomic indicators from other 'central' regions of the country, as well as inadequate infrastructure (the main problems are roads, provision of water, heat, sewerage, and electricity).

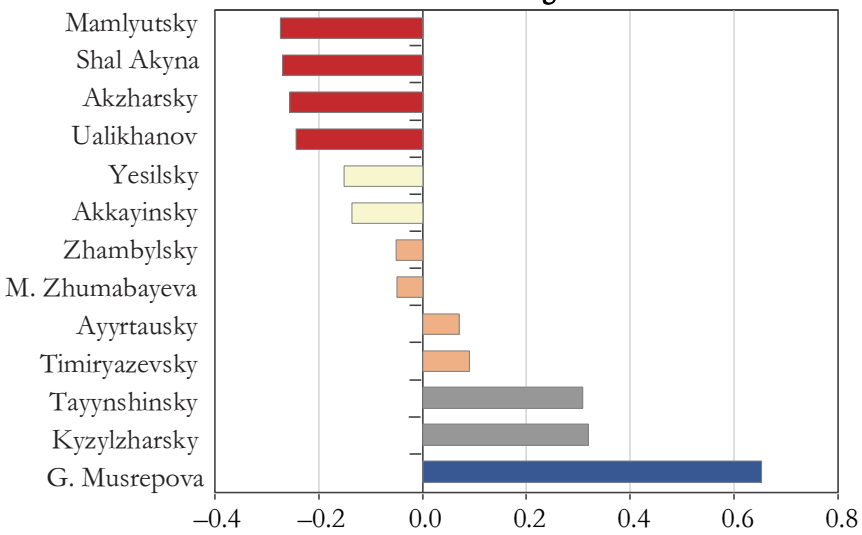
Most people in North Kazakhstan are employed in agriculture, a practice that is developing according to data. However, the remaining indices did not show any positive trends. Based on the analysis of quantitative data from 2009 to 2019, many regions in North Kazakhstan were identified as having low socioeconomic indicators: Shal Akyna, Esilsky, Akzharsky, Mamlyutsky, Ualikhanovsky, and Akkayinsky.

Consequently, in recent years, changes in environmental and infrastructure indicators, as well as the availability of transportation links to other cities and regions, have resulted in new challenges in several areas of North Kazakhstan. According to the analysis of infrastructural and environmental development, the Mamlyutsky, Kyzylzhar, Akzharsky, and Ualikhanov settlements have a high level of vulnerability. As a result, these areas have the unsatisfactory infrastructure and face environmental challenges. There are housing issues as well as water, heating, and lighting problems.

Figure 4 shows aggregate indicators of the North Kazakhstan regions.

Figure 4

Ranked series of values according to the level of vulnerability in North Kazakhstan regions



Note: The level of vulnerability see in Table 1.
Source: Created based on data from the [1].

The data for the selected indicators were obtained from a sample of the most vulnerable regions of North Kazakhstan. Mamlyutsky (–0,28), Shal Akyna (–0,27), Akzharsky (–0,26), and Ualikhanovsky were identified as the most vulnerable regions using a comprehensive set of criteria (–0,24). G. Musrepova (0,65), Kyzylzharsky (0,32), and Tayynshinsky (0,65) all demonstrated consistent developmental trends (0,31). Along with these unique problems, there are some common problems present in all vulnerable regions (in comparison with large cities), such as low living standards, limited local budgets, low salaries, inflation, and outdated production methods. Outmigration is a problem, especially in Russia's neighbouring regions or within the country. This is because these regions differ from other developed cities in terms of their administrative structure, location, and distance. Hence, a portion of the population has migrated to enhance their quality of life.

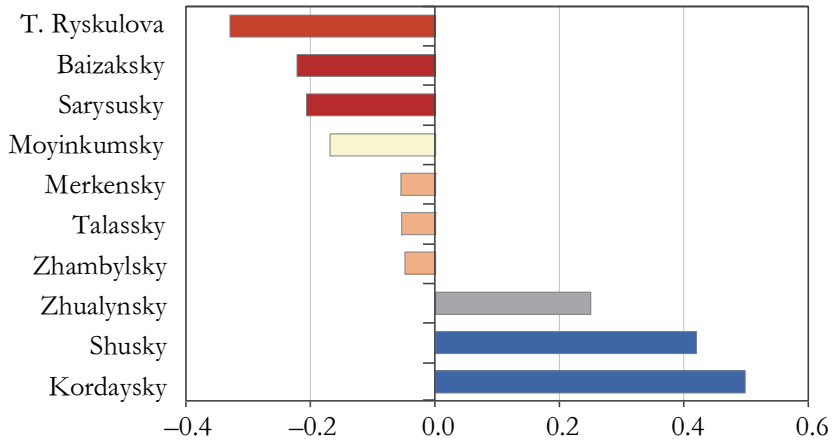
Based on the data analysis from 2009 to 2019, Sarysusky, Talassky, Moyinkumsky, Zhambylsky, and Zhualynsky were recognised as regions with low levels of social and economic development. The following regions had poor infrastructure and environmental problems: Zhambyl, Ryskulov, and Bayzaksky.

Figure 5 depicts aggregate indicators for the above-mentioned regions.

Aggregate indicators were derived from a sample of the most vulnerable regions in Zhambyl. The data presented do not reflect a critical situation in the region but rather reflect disparities in residents' living standards. According to the system of selected indicators, the data analysis allowed the identification of vulnerable regions with the lowest indicators: T. Ryskulova (–0,33), Bayzaksky (–0,22), and Sarysusky (–0,21). Kordaysky (0,50), Shusky (0,42), and Zhualynsky (0,50) all showed good growth patterns (0,25).

Figure 5

Ranked series of values according to the level of vulnerability in Zhambyl regions



Note: The level of vulnerability see in Table 1.
Source: Created based on data from the [1].

The regional distribution in more detail is represented in Figure 6.

Following the approval of the proposed approach, it was feasible to establish that there are underdeveloped territories in all three regions with poor socioeconomic conditions, infrastructure, and environmental problems.

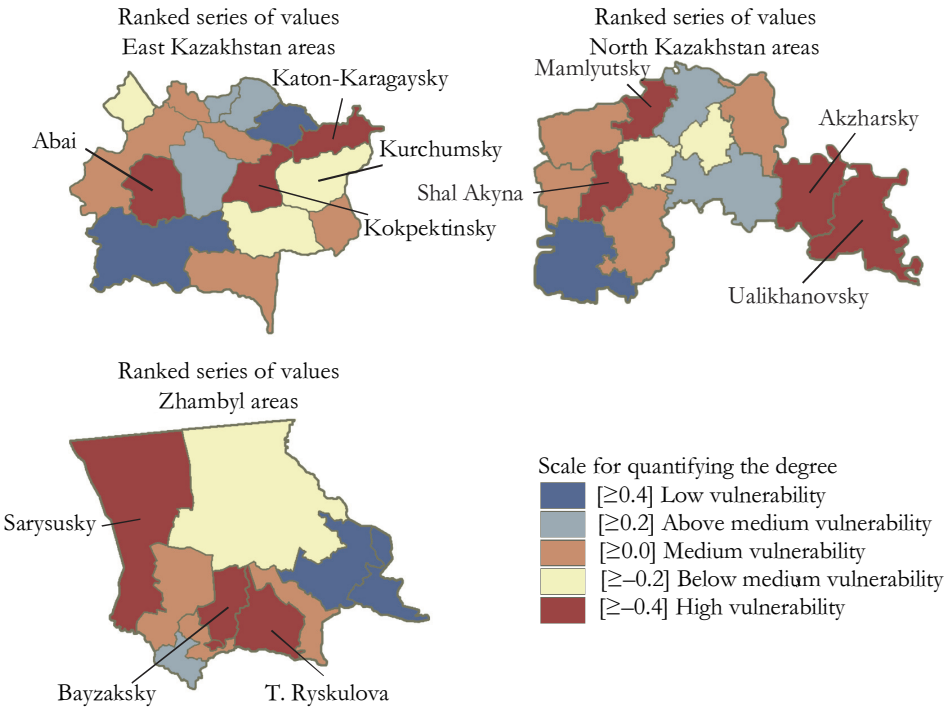
Firstly, an empirical study revealed the following regions as being the most vulnerable:

– Abai, Katon-Karagaysky, Kokpektinsky, and Kurchumsky in East Kazakhstan,
– Akzharsky, Mamlyutsky, Shal Akyna, and Ualikhanovsky in North Kazakhstan,
– Sarysusky, Talassky, Moyinkumsky, and Zhualynsky in Zhambyl.

Second, disadvantaged territories exist in all three zones and are defined by poor socioeconomic conditions as well as general infrastructure and environmental problems. This enables a positive assessment of the territory's development opportunities in terms of development potential, presence of traffic flows between cities and regions, available resources, use of available resources, modernisation of production, and infrastructure development.

Figure 6

Regional distribution of vulnerability, 2009–2019



Source: Created based on data from the [1].

Discussion

The results show that regional vulnerability in Kazakhstan is driven by the contrast between developed and underdeveloped areas, a product of the infrastructural and ecological development of settlements, urban growth, and social and economic development of the country.

CIA Kazakhstan reflects this reality by showing that most municipalities at risk of vulnerability are located in the northern and eastern border areas of Russia and China. It should be noted that the border regions of the country are in a special position. The proximity of regions to the border largely determines the specifics of their development as peripheral territories relative to the centre. Such regions, far from the centre of decision-making, are often characterised by poorer life conditions, underdeveloped infrastructure, low population density, and migration growth, especially of able-bodied youth, and as a result, an ageing population.

The lack of infrastructure and investment (Lee et al. 2021) in development initiatives in these areas influences citizens' internal migration to urban areas. At the regional level, mega-policies have dominated the system of inter-regional flows, presenting a host of challenges for the balanced development of regions (Islyami 2020). In addition, problems associated with the ecological environment due to urbanisation have begun to act as a deterrent to the economic development of the Kazakhstani regions (Huang et al. 2020).

Several reasons and obstacles influence the development of Kazakhstani settlements; in addition to conventional settlements, new ones have emerged, the impact of which is difficult to quantify. These include the deterioration of the epidemiological situation and the imposition of quarantine measures, climate change, and the move to a digital economy, although internet resources are scarce in many small settlements.

In other countries, the authors employed official statistics and empirical data obtained through quantitative and qualitative research methods to assess the vulnerability of regions. Regular surveys were conducted in the current study to examine the community's socioeconomic conditions (Sarthak et al. 2015). Furthermore, personal wealth, income, age, built environment density, employment in extractive industries, infrastructure reliance, and other factors affect societal vulnerability (Cutter et al. 2003).

Our research results complement previous studies on regional development and reflect in detail the vulnerability levels of intra-regional settlements in Kazakhstan.

The first region with vulnerable settlements is East Kazakhstan, bordering China and Russia, which are important strategic partners for Kazakhstan. In this region, settlements are still precarious in terms of socioeconomic development. Specifically, it is actually in the districts of Abai, Katon-Karagaysky, and Kokpektinsky. The challenge is most serious in the demographic situation, marked by negative trends in

population reproduction and migration patterns. There has been a steady increase in migration outside the city, despite a drop in the birth rate. Poor infrastructure provision (roads, water, gas, heating, and electricity) is a key cause of the increased vulnerability of single-industry towns and settlements. The main issues impeding the development of vulnerable East Kazakhstan regions are a high degree of deterioration of engineering and social infrastructure as well as a heavy environmental burden on the region's territory. Additionally, environmental and man-made risks pose a danger to the lives of inhabitants.

The second most vulnerable area is in North Kazakhstan, an area of the northern macroregion that borders Russia. Known for its agriculture, it employs more than 60% of the population in the region. The number of rural settlements in the Akzharsky, Mamlyutsky, Shal Akyna, and Ualikhanovsky districts was unevenly distributed. The main sources of pollutants for North Kazakhstan are energy and industrial firms as well as transportation (environmental factors). Currently, the following environmental issues exist in the settlements (small towns and villages) of North Kazakhstan: the presence of residual uranium deposits; the problem of separate collection, sorting, and processing of solid household waste; the formation of spontaneous waste dumps in settlements; deterioration of sewerage networks and treatment facilities; and the lack of sewerage systems in the small towns of Tayinsha, Mamlyutsky, Bulaevo, and Sergeevka. Several communities in the region are already facing extinction due to population loss. Agriculture employs most people because its per capita is twice that of the industry. Except for manufacturing and processing agricultural products, there is virtually no industrial production. Housing commissioning per capita also suggests that no new housing is built or commissioned in Bulaevo. As in the rest of the region, there is a population outflow problem in the city, primarily to Russian border territories or within the region and country.

The second most vulnerable area was the Zhambyl area. Leading industries (manufacturing, transportation, communications, and agriculture) provide socioeconomic stability in the Zhambyl region, a region considered to have vulnerable districts. The fact that more than 60 % of the population lives in rural areas is a unique aspect of this region. Negative trends in population reproduction and migratory dynamics characterise the demographic conditions in the districts Sarysusky, Talassky, Moyinkumsky, and Zhualynsky. Lack of labour, degradation of working and living conditions, and a desire to gain education are the primary causes of population reduction in these vulnerable areas. Unemployment is a key problem in the Zhambyl settlements selected for analysis. Furthermore, the ecological situation in the Zhambyl region has deteriorated. This is because of emissions from factories and other enterprises that damage the environment with chemical and industrial waste during operations. Automobile exhaust emissions also contribute to environmental air pollution.

Conclusions

A lack of resources, low industrial output, and lack of government support resulted in the depopulation of Kazakhstan's vulnerable regions. According to existing data, there are significant inequalities among Kazakhstan's regions when considering factors such as living standards and quality of life. Moreover, there are significant regional variances in terms of earnings. Most critical issues confronting the most vulnerable rural regions are widespread and systematic.

Based on the research findings, we can construct a set of conclusions to enhance policies to combat depopulation in Kazakhstan's vulnerable rural regions.

First, the following objects were chosen, considering the coverage of several Kazakhstani regions: Zhambyl, North Kazakhstan, and East Kazakhstan. These regions were chosen for the following reasons: the demographic situation is marked by negative trends (lower population density, negative migration balance, etc.), which are classified as underdeveloped based on development criteria (volume of industrial production per capita below the average republican level, low population income, depletion of the resource base, high unemployment), a high degree of wear and tear of engineering and social infrastructure, and unfavourable economic conditions.

Second, despite recent increases in nominal average monthly earnings in all studied settlements in the Zhambyl, North Kazakhstan, and East Kazakhstan regions, this indicator remains below the republic's average, indicating a drop in real income. This means that the population's wage growth rate appeared to be lower than the country's inflation rate, which was caused by the economic crisis and impact of the COVID-19 pandemic.

Third, an analysis of aggregated indicators from 2009 to 2019 revealed that the following settlements had the highest levels of vulnerability: Abai (–0.71), Katon-Karagaysky (–0.53), Kokpektinsky (–0.40), T. Ryskulova (-0.33), Mamlyutsky (–0.28), Shal Akyna (–0.27), Akzharsky (–0.26), Ualikhanovsky (–0.24), and Bayzaksky (–0.21). These are underdeveloped regions with poor environmental conditions and inadequate social and transportation infrastructures. The regions mentioned in the study have been in a precarious situation for the past ten years. Solving the challenges of these vulnerable rural communities demands the active participation of state authorities who are beyond the authority of local regional administrations. The importance of this study is determined by the necessity for theoretical understanding, extensive analysis, and the development of an appropriate strategy for the growth and support of these settlements.

Furthermore, specific vulnerable regions in need of special state assistance were identified in the selected regions. At the same time, favourable evaluations of territorial opportunities within a current economic specialisation, resource potential, transportation infrastructure, and traffic patterns between cities and regions are achievable. In this study, we defined a set of indicators using which the authorities may track the progress and results of their work. The acquired results are preliminary in nature and are intended to serve as a foundation for future research.

Appendix

Table A1

Selected variables showing the vulnerability level of the regions

Indicators	Unit measurements
Social	
Population	people
Population density	persons/sq km
Fertility rate	ppm ‰
Population mortality rate	ppm ‰
The rate of natural increase (decline) of the population	ppm ‰
Population migration balance	people
Average monthly nominal wages of one employee	tenge
Employed population	people
Unemployment rate	%
The number of health care institutions (hospitals, outpatient clinics, medical assistant points, etc.)	units
The number of educational institutions – preschool organizations (nurseries, kindergartens, mini centres), schools, colleges, universities	units
Economic	
Industrial production per capita	thousand tenge
Agricultural production per capita	thousand tenge
Construction work per capita	thousand tenge
The volume of services provided by enterprises and organizations of the service sector per capita	thousand tenge
The share of small businesses in the total volume of products (works and services)	%
Retail turnover per capita	thousand tenge
Wholesale turnover per capita	thousand tenge
Commissioning of housing per capita	sq. m
Availability of fixed assets per capita	thousand tenge
Total investment per capita	thousand tenge
Local budget per capita	thousand tenge
Infrastructure	
The density of the road network	km per 1 ha
Passenger turnover of all types of transport	million passenger-km
Freight turnover of all types of transport	million tenge/t-km
Gasification level	%
Share of housing with water supply	%
Share of housing equipped with central heating	%
Share of dilapidated housing	%
Environment	
Volumes of emissions into the atmosphere of pollutants without treatment per capita	kg
The volume of removed solid waste per capita	tons
The share of utilized toxic (hazardous) waste at city enterprises	%
Per capita investment in environmental protection and rational use of natural resources	thousand tenge
Access to clean water - the proportion of the population provided with drinking water from decentralized sources of water supply	%

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