Rural settlement in the steppe zone of Russia in the post-Soviet period: adaptation to the current challenges

R Akhmetov, N Sviatokha, I Filimonova

Institute of Steppe of the Ural Branch of the Russian Academy of Sciences, Orenburg, Russia

E-mail: osugeo@yandex.ru

Abstract. The rural population and settlement in Russia's steppe zone, as on the territory of the country on the whole, continually is transformed. This transformation hastened and obtained new features in the post-Soviet period; it became more complex and heterogeneous. Based on the statistical analysis and GIS-technologies, in the paper, we attempted to reveal central tendencies and specifics of the rural population's temporal and spatial dynamics in the steppe zone during the three post-Soviet decades of the country's development. The authors detected a shift of the rural population of the country to the west and south-west. The process of territorial compression leads to a concentration of people in areas with a higher potential for effective development. The main area of the rural population increase and the amount of the rural settlements are North Caucasus. Significant areas of the rural population decline are located in territories less provided by agroclimatic resources in the European part of the steppe zone and its Asian part. Understanding total tendencies and territorial peculiarities of the rural population dynamics and settlement allows forecasting these processes and considering them in the frame of territorial planning and socio-economic development in regions in conditions of the current challenges.

1. Introduction

Despite the ongoing urbanization process globally, the considerable (and rising) population of the Earth lives in rural areas. The character and regional specifics of the rural population dynamics and settlement were determined by numerous socio-economic processes [1].

Specialists of different scientific spheres consider problems of the study of the rural population and settlement. International encyclopedia of human geography defines the whole branch – rural geography tasks: the study of people and landscapes in the non-urban areas and social and economic processes forming the territory [2]. However, as far as a definition of "rural" becomes less definite (due to specifics of statistical accounting, spreading of city life, etc.), borders of "rural geography" become fuzzy.

Meaning, subject matter, and direction of the research in rural geography differ in dependence on a country. Simultaneously, the researchers often concentrate on national subjects. For example, Chinese scientists analyze interconnections between rural population movement and changes in land use [3]; Norwegian experts consider a problem concerning uneven placement of immigrant workers in rural areas of the country [4]; Turkish specialists devote their works to strategies and mechanisms of supporting and restoration of the non-urban region's economy [5]. Also, Russian geographers research the rural population [6–8].
The topicality of this study is conditioned by a specific role of the rural population in Russia's steppe zone, where it is a crossing of the solution of the problems regarding security safety of the country and provision of ecological security stability.

2. Problem setting
The object of the study is the rural population in the steppe zone of Russia.

The principal challenges and factors determining the direction and deepness of adaptation of rural settlement in Russia for the last decades are:

- the complex of processes connected with the transition of agriculture from the planned economy to the market;
- completion of the demographic shift to the modern type of population reproduction in the non-urban area.

The reduction of the rural population, compression of rustic space, skeletonization, and changes in the settlement structure are the consequences of this factor. However, spatial specifics are noticed in the character of these processes' passing.

The primary region of the agricultural production and concentration of the country's rural population is the steppe zone. Under the total area of the steppe zone occupying 5% of Russia's territory, more than a quarter of the rural population of the country lives there.

Understanding the specifics of changes in population settlement in the steppe zone on Russia's background, on the whole, and the analysis of spatial differences inside the steppe zone and revealing of territorial clusters reflecting these differences is the goal of this study.

3. Material and Methods
Materials of a census survey of 1989, 2002, and 2010, and current data of the Federal State Statistical service served as the study's information basis [9, 10, 11, 12].

Geoinformation technologies were used to analyze data. Notably, we used tools of spatial statistics that promote to build a series of analytical maps and gave a quantitative assessment to a row of spatial parameters of settlement (including the calculation of an averaged demographic center of rural settlement, an evaluation of the degree of clustering of territorial units according to indicators of the population dynamics and dynamics of populousness of the habitations).

We revealed a very high spatial clustering based on spatial autocorrelation calculation (the summary index Moran's I). Later, based on "Optimized hot-spots analysis" software ArcGIS Pro, we detected a spatial picture of the cluster's placement of the rural population's dynamics and rural settlement's density. The instrument allowed us to calculate values for each territorial object in a data set, pointing out where objects with high or low values of the analyzed phenomenon clustered themselves. Items with high significance themselves were not a statistically essential hot spot. Values of the analyzed indicator of surrounding objects played the leading role in forming and revealing the cluster. Thus, casual surges of values in the dynamics of the rural population and rural settlements were excluded.

4. Results and Discussion
The settlement system in Russia's steppe zone continues to be formed, changing under the influence of the country's socio-economic transformation, fixing the market relations in agriculture, infrastructure, and technological development. It has considerable differences from the system of rural settling of the rest Russia.

The total rural population without "administrative ruralization" (the process of transformation of a considerable part of urban-type settlements to rural settlements in the examined period) reduced as in the whole in Russia, so in the steppe zone. However, rates of reduction in the steppe zone were lower (figure 1). On the XX-XXI centuries' borders, the steppe zone's rural population even increased, which was connected with large-scale return migrations of the population from Central Asia and Kazakhstan to Russia. The steppe regions placed on the way of this migrants' stream faced its considerable part.
However, after the decrease of migration inflow, the rural population's reduction has resumed in the steppe zone.

![Figure 1](image.png)

**Figure 1.** The dynamics of the rural population in the post-Soviet period.

The density of the rural population in the steppe zone is 11.5 persons at 1 km\(^2\) that is 5.5 times exceed the average Russian indicator. According to a density of a rural settlements network, the differences are lower: on the steppe zone area, this parameter on average is 17.7 and in Russia – 9.1 settlements at 1000 km\(^2\).

The spatial analysis conducted by us showed that in the steppe zone, not placing the rural population, but a density of a network of rural settlements heavily correlates with the quality of natural conditions for agricultural production. It is probably connected with that a network of rural settling is formed, mainly for agrarian activity (figure 2).

A network of settlements in the part of their placing is more conservative than the population settling. In the case of emergence of new types of activity and reduction of the already existing, a change of functional destination of the area, broadening (narrowing) of a set of its functions, the population number changes more quickly in the current settlements than new residential areas are established, or the existing settlements are abolished.

In other words, the settlement system responds at a change of functions, demographic models of the population behavior, as well as a character and intensity of the production primarily by a changing of the population number in existing localities rather than by changing of a framework, "picture" of the population. Thus, a picture of the population placement is more dynamic than the placing of settlements. The first is more operative react to new trends, including those that are not connected with agriculture. In terms of the network of settlements' actual location, the settlement system is more inertial and better preserves the original connection with agricultural activities and, consequently, with the natural zoning and farming resources placement.

One of the manifestations of rural settling's transformation in the post-Soviet period is the process of compression of space. Population in the most degree concentrates on territories with higher potential efficiency of the usage. It, first of all, is areas with high rent of fertility and location.

Politics of underestimation and, in many cases, ignoring of these factors in the settling politics in the Soviet period led to a fact that under the transition to the market relations as well as the abolition of a line of benefits aimed to settle less developed regions and, as a rule, less suitable for life being and economic activity, the rural settlement became compressed corresponding new conditions.
The process of "space compression" is one of the typical current trend of spatial development that represented, in A.I. Treyvish's opinion [13], as two mutually complementary and inalienable tendencies; the growth of connectivity and accessibility of separate regions, in the one hand, and compression of space of developed areas, in the other hand. The second component of this process is usually characterized as unfavorable. In our opinion, we cannot agree with this. Space compression is the manifestation of a total trend for all developed countries to resource use, and in modern economics, on the whole, the priority of intensive forms of developing under extensive, reduction of resources involved in the turnover (not only natural) at the expense of effective use of the best their part. The non-economic and, in our opinion, hard explainable, from the rational point of view, the paradigm of constant development and settlement of new areas and involvement of new resources into the turnover has ruled in the Soviet period. The bright display of this paradigm was the campaign of virgin land reclamation, the negative consequences of which are perceived by the present.

Space compression is a multiplex and poly-scaled process. It represents itself on several levels. On the national level, the rural population concentrated in regions with better conditions for economic activity and life. It has led to the increase of the steppe zone's part in the total number of the rural population in Russia in the current borders from 25.4% to 26.7% for 1989-2019. Besides, a shift of rural population of the country has happened to west and south-west. The process demonstrates a change in a parameter of the averaged demographic center of the rural population in Russia calculated by us. For three post-Soviet decades, this center moved to 300 km to the south-west from the south Bashkiria to Orenburgskaya oblast. Similar processes happen within the steppe zone itself. The averaged demographic center of the rural population in this zone moved to the south-west for a distance of more than 100 km and is located now in Astrakhanskaya oblast.

The factor of a position in changing rural settlement in the steppe zone becomes apparent due to a concentrated rural population near large cities, mainly regional centers, and towns with a population number of more than 100 thousand inhabitants. The advanced growth of the rural population on banks of large rivers, first of all, the Volga River, is noticed.

A calculation of spatial clustering conducted by us showed that the most expressed and stable territory with the rural population's increase and the growth of rural settlement's number is North Caucasus (figure 3). The rest territory of the steppe zone in Russia represents itself a united cluster of reduction of the rural population and a density of the network of settlements. This trend is mainly expressed within more arid areas with chestnut soils in Volgogradskaya and Saratovskaya oblasts (except the Volga regions). The steppe zone's rural population reduces in its Asian part - in the significant amount of steppe administrative areas of Omskaya, Novosibirskaya, Kurganskaya oblasts, and Altai Krai. Here, as opposed to European Russia, negative tendencies in the settlement dynamics were caused not by the quality of agroclimatic resources but an imperfection of geographical location, relatively low development of the region on the whole, and the total out-migration from the Asian part of the country.

Compression of rural space happens on the local structures' level: the rural population of the steppe zone gradually concentrates in larger rural settlements that have better living conditions, and consequently, more viable. The average size of a rural settlement in Russia's steppe zone increased from 803 to 879 residents for the examined period.
Figure 2. A density of rural settlements in the steppe zone in 2019.

Figure 3. An analysis of trends of the dynamics of the rural settlements density in the steppe zone in the post-Soviet period.
5. Conclusion
The process of space compression leads to population concentration on areas and settlements with higher potential efficiency of use and development. It led to the growth of a portion of the steppe zone in the rural population's total number.

Also, there is a demographic shift of the rural population in the west and south-west direction.

On the local level, the rural population in the steppe zone concentrates around points and lines with the most favorable geographical location – large cities/towns, mainly regional centers, and towns with a population number of more than 100 thousand people and along banks of large rivers, first of all, the Volga River.

The central cluster of the rural population's increase and settlements number in the steppe zone is North Caucasus. Considerable areas of reduction of the rural population are located in the European part of the steppe zone less provided by agroclimatic resources for agriculture and the Asian steppe region.

The evolution of the steppe zone's rural structures settling on the local level has happened at the expanse of an increase of a portion of larger settlements and growth of its average size under-expressed reduction of rural settlements.

Understanding of territorial peculiarities of the dynamics of the rural population and steppe zone setting and total trends of these processes allows rapidly forecasting and considering them in frames of territorial planning and programs of socio-economic development of the regions in conditions of the current challenges.

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