Resilience of Arctic Communities: Socio-Economic Aspect

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Abstract. The study investigates factors that directly or indirectly affect the development of settlements in the North-East of the Russian Arctic. The study highlights the specific features of the Arctic settlements of the Northeast, as well as factors that will be considered in the development of a methodology for assessing the resilience of Arctic communities to economic shocks. The main focus is on the investigation of demographic processes in the Northeast Arctic, since it is human capital that determines the resilience of settlements to economic shocks. According to the results of the analysis, it was found that the key trend is the migration outflow, and the factors constraining it are the growth of wages, the presence of a minimum improvement of housing, in particular, heating and guarantees of social support. Therewith, such a factor as the presence of traditional trades and occupations does not contribute to a decrease in the migration outflow. This study was performed to further develop the concept of resilience and form a methodology for assessing the resilience of the economic and social system of an Arctic settlement to economic shocks. In the future, this methodology makes provision for the construction of a model with factors and indicators that determine the resilience of the socio-economic system of the Arctic settlement in the North-East of Russia (as exemplified by the Bulunsky district of the Republic of Sakha (Yakutia)) to economic shocks.

Keywords: Migration, human capital, correlation analysis, Tiksi, Arctic zone of the Russian Federation.

INTRODUCTION

Arctic settlements that have experienced significant environmental, economic, demographic or social shocks need a high level of resilience to withstand the accompanying shocks. Local communities, faced with shocks and changes, understood this through the lens of their knowledge, beliefs and experience. Giving meaning to shocks leads to identity-preserving narratives that are associated with premises for resilience. The narrative approach is based on this. These prerequisites for resilience are identified in local narratives by combining local science with the concept of resilience through systems thinking. One of the working hypotheses of this study is that a systems analysis of resilience will tactfully combine community knowledge with external knowledge. The results of this analysis will be translated into options for action at the local, regional, national, and circumpolar levels.

The inhabitants of the Arctic have faced many changes throughout their centuries-old history and have always adapted to them. The modern Arctic is changing faster and is constantly facing not only environmental, but also complex political, economic, social, and infrastructural changes. Most of these changes occur under the influence of external factors and, as a rule, are the result or consequence of events and processes that took place outside the Arctic. For example, globalisation, geopolitical and economic challenges, sanctions, technology development, digitalisation, extraction of natural resources, and finally, one of the latest – COVID-19 pandemic, and as

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a result, COVID crisis. In the context of global changes of our time, it becomes necessary to search for new approaches to solving the problem of increasing the viability of socio-economic systems of strategically important Arctic regions of Russia. And the ultimate purpose of the functioning of any such system is to ensure the quality of life of the population.

One of the problems of the development of socio-economic systems of the Arctic regions that leads to negative changes (often irreversible changes) is the migration outflow of the population. In the Russian Arctic, the role of migration in the development of the population in certain periods of time is decisive in comparison with natural increase. The study of the specific features of the development of the Arctic region of Yakutia, primarily demographic development, analysis of the factors of the migration outflow of the population of the Arctic zone of the Republic of Sakha (Yakutia) constitutes the basis for the development of a factor model for assessing the resilience of the socio-economic system of the Arctic settlement in the North-East of Russia to economic shocks. The variability in the Arctic and the resilience of the Arctic systems are currently a global priority. The problem of the resilience of the Arctic systems is one of the most important in modern Arctic science, including in economic science.

The viability of the socio-economic systems of the Arctic regions of Russia is not just a multifaceted, but also an overly complex problem, including issues of geopolitics, economics, ecology, and climate. This is a scientific problem, on the solution of which the security and socio-economic development of the Russian Federation will largely depend. Currently, one of the key challenges is the lack of modern approaches to the development of the Russian Arctic economy, ensuring sustainable development of Arctic settlements (all the more ensuring sustainable development from the standpoint of preserving the unique natural systems and traditional living conditions of the indigenous peoples of the North). Furthermore, this problem is aggravated by the rapidly changing conditions of modern reality – the turbulence of the world economy (deepening geopolitical problems, the COVID crisis, deterioration of the world situation, the application of sanctions, etc.); changes in the environment, climate, melting of permafrost; scientific and technological progress, including the progress of technologies for the extraction of minerals, etc.

Notably, no comprehensive scientific research on this subject matter has been carried out in the North-Eastern Arctic of Russia. Insufficient methodological elaboration of the issues of development of the concept of resilience of the Arctic systems to economic shocks is noted.

LITERATURE REVIEW

Russian scientific literature does not contain studies that comprehensively cover the issues of improving the sustainable development of the Arctic zone of Russia, from the standpoint of preserving unique natural systems and considering the specific features of the local level and the “subsistence economy”. As for the north-eastern part of the Arctic zone of Russia, currently only certain aspects of the development of the eastern sector of the Russian Arctic are highlighted in domestic and foreign scientific literature. Research in this area is limited to certain subjects – resource availability, development features of the indigenous small-numbered peoples of the North, population migration, etc. (Zamyatina and Pilyasov 2017). As A.N. Pilyasov fairly pointed out, the problem lies not only in the absence of generalising complex works, but also in the fundamental impossibility of applying foreign theories of regional science to Arctic conditions due to the dominance of other development factors, other socio-economic processes; as well as in the fractional, non-conceptual nature of most of the research conducted in the Arctic, Northern Europe, Canada, and the USA (Zamyatina and Pilyasov 2017).

In this regard, at present, for a number of reasons, including the above-mentioned, there is no opportunity to implement foreign research experience in the field of “Arctic” regional development in the Russian reality. The theoretical and methodological issues developed in the study are based on the articles of foreign and Russian researchers in the field of the theory of resilience, the theory and practice of spatial development regulation, the regional economy of the northern, Arctic regions, financial regulation of territories.

Russian economic science has created a significant groundwork in the study of the socio-economic development of the Arctic regions. The research of the implementation of national policy in the Arctic, the modernisation of its economy is the subject of the articles of leading Russian scientists (Lazhentsev 2019; Lukin 2014; Pavlenko *et al.* 2019; Pilyasov 2015; Selin and Bashmakova 2013; Tatarkin 2014) and others. Problems associated with the development of an economic system focused on ensuring sustainable

development of the economy of the northern, arctic regions of the Russian Federation are considered in the scientific articles of (Lexin and Porfiriev 2017; Kryukov and Kryukov 2019; Nikulkina 2018; Skripnyuk *et al.* 2015) and others. The research by (Voronina *et al.* 2019; Gordyachkova *et al.* 2018; Gordyachkova and Pechetova 2018; Romanova 2019; Sukneva and Nikulkina 2017; Sukneva and Laruelle 2019; Fauser and Lytkina 2017; Shelomentsev *et al.* 2018) and others covers the issues of the quality of life of the population and the regulation of demographic processes in the Arctic.

The importance of Arctic resilience research has been most fully substantiated in a scientific report by the Arctic Council (Carson and Peterson 2016). "Resilience" is a relatively new term, despite the fact that it has been used for a long time in various fields of science (for example, in ecology and cybernetics, it was studied in detail back in the 1970s (Massey 2002; Kane and Vanderlinden 2015; Makhnach 2016)). Currently, the term "resilience" is used in sociology, anthropology, psychology, pedagogy, political science, medicine, economics, etc. The intersection of many scientific directions creates the preconditions for the development of "updated" theories, new scientific concepts. In recent years, the concept of resilience has received a new impetus for development in the social sciences – in research in the field of social psychology, international and financial and economic policy, national security, corporate risks, regional and urban planning, etc. (Makhnach 2016).

In any interdisciplinary research article, there is a need to harmonise the concept and terminology, which requires the discussion of different opinions and their understanding in the development of a general concept and interpretation of the terminology. Resilience issues (concept, essence and meaning, features, principles, models) in various scientific disciplines are considered in the studies of foreign and Russian scientists (Bogdanov 1989; Razumovsky and Khazov 1998; Savenkov 2002; Wardekker *et al.* 2010; Alexander 2013; Barroca *et al.* 2013; Davoudi *et al.* 2013; Linkov *et al.* 2014; Lekh 2014; Kane and Vanderlinden 2015; Makhnach 2016; Meerow *et al.* 2016; Wardekker *et al.* 2016; Wardekker 2018; Bruneckiene *et al.* 2019; Ilgen *et al.* 2019; Yemelianova 2019; Marschütz *et al.* 2020).

Research on resilience is mostly interdisciplinary. The term "resilience" is relatively new in modern science, it is used in various scientific disciplines and has no unity in interpretation and understanding. Notably, in the Russian-language literature there is no unity in translations and transliterations of the term "resilience". The variety of approaches to the concept and creation of models of viability is explained not only by interdisciplinarity, but also by the variety of schools and areas of research. The analysis of scientific opinions allowed to determine the understanding of this term for this study. In general, "resilience" refers to the ability of a system to return to its original state, the ability to overcome shocks and adapt to new conditions. And this is the same for all sciences (biology, psychology, sociology, economics, etc.) and objects (personality, group, system, environment, etc.) (Castles and Miller 1993; Resilience Alliance… 2010; Alexander 2013; Kane and Vanderlinden 2015; Carson and Peterson 2016; Makhnach 2016; Meerow *et al.* 2016; Wardekker 2018; Bruneckiene *et al.* 2019, etc.). It is important to note a difference – "all resilience is relative; it exists only in relation to a particular environment" (Bogdanov 1989). In this regard, one of the objectives of the project is the further development of the term "resilience", the shaping and refinement of the terminology used to develop a methodology for assessing the resilience of the socio-economic system of Arctic settlements to economic shocks.

Understanding and definition of the term "resilience" is based on various approaches and scientific directions. The basis was the concept of resilience used in the reports of the Arctic Council (Carson and Peterson 2016), and based on the developments of the Resilience Alliance (2010). This approach considers resilience as a property of a socio-ecological system, the functions of which arise from the interactions and interdependencies of social and ecological subsystems. "Resilience: The capacity to cope with stress and shocks by responding or reorganizing in ways that maintain essential identity, function and structures, as well as the capacity to navigate and shape change, including transformational change" (Carson and Peterson 2016).

The following definition, which is used in this article, was proposed by a group of scientists studying the resilience of the socio-economic system. In this study, an economic shock is understood as "an unplanned change in operating conditions or in the economic, political, social and/or natural environment; a phenomenon or event in a regional, national, or international economy that, if neglected or managed in the light of this development strategy, could have a sudden and significant negative and/or, if possible, positive impact on the development of the system"

(Bruneckiene *et al.* 2019). "A socio-economic system's resilience to economic shocks includes both the interrelated abilities and possibilities of its economic entities to use its dynamic capacities and infrastructure, maintain the expected development of its economy now and in the future, be left intact or else affected in the least possible manner by an economic shock, and subsequently reach the previous state of the economy before the economic shock in the shortest time by implementing a recovery, renewal, or reorientation strategy" (Bruneckiene *et al.* 2019).

The next approach, which is of scientific interest within the framework of this study, was proposed by researchers at the University of Michigan. "Urban resilience refers to the ability of an urban system and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity" (Meerow *et al.* 2016). It is important to note that economic and social changes are dominant in the Russian Arctic, the impact of which even exceeds that of climate change (Pilyasov 2015; Sukneva and Nikulkina 2017). The huge Arctic territories of Russia predetermine a significant differentiation of socio-economic processes (Zakharchuk and Trifonova 2018; Larchenko and Kolesnikov 2017; Nikulkina 2018).

Post-Soviet geodemographic processes, globalisation, territorial integration are described by the emergence of an urban environment in the Arctic. There is an evolution of the way of life of the society and the migration of rural residents to urban centers. They influence demographic balances and the formation of new spatial demographic redistributions (Sébastien *et al.* 2016). Migration is becoming a principal factor in demographic development, the formation of the population of the Arctic territories (Sukneva and Laruelle 2019). Migration processes have an impact on the change in the quality of life of the population and the associated economic activity in the territory of the Russian Arctic (Voronina *et al.* 2019).

In modern conditions, the problems of human capital accumulation and the quality of life of the population remain the main Arctic challenges for modern Russia (Lukin 2014; Gordyachkova *et al.* 2018; Voronina *et al.* 2019). There is a threat that the population of the Russian Arctic will not only be unable to become a factor of socio-economic development, but will simply be unable to maintain the infrastructure of the economy of the Arctic zone of Russia, which will significantly weaken its economic presence in the Arctic. At present, the strategic resources of the Arctic zone of the Russian Federation are not only natural resources and the transport system (Northern Sea Route), but also human capital.

Human capital makes up the basis that determines the potential of social production systems. Human capital in the Arctic is one of the key elements of the vitality of the Arctic systems. In this study, the viability of the system in which society (state, person) is included must be considered as a form of manifestation of its activity and adaptability (Razumovsky and Khazov 1998). And to increase the adaptive potential of the viability of systems, it is important to understand what processes create or destroy this or that element of viability. The Arctic Council document identifies seven interrelated elements of resilience: natural, social, financial, cultural and human capital, infrastructure and knowledge (Carson and Peterson 2016). It is necessary to understand what features of the system underlie its balance or optimality, what factors affect this optimality. To answer these questions and solve the main tasks of the above scientific project, this study analysed the demographic situation of the Bulunsky district of the Republic of Sakha (Yakutia), as well as an analysis of the factors of the migration outflow of the population of the Arctic zone of the conditions and very significant Arctic territories.

MATERIALS AND METHODS

This study is the first of a series of scientific articles, united by one common theme within the framework of an ambitious international scientific project Sense Making, Place attachment and Extended networks as sources of Resilience in the Arctic, SeMPER-Arctic (hereinafter referred to as "SeMPER-Arctic") (International project (a project of fundamental scientific research), implemented within the framework of the Belmont Forum for Joint Research Activities "Viability of the Rapidly Changing Arctic Systems (SID Arctic II)"). The scientific project is being implemented by an international interdisciplinary group of scientists from Russia, France, Norway, Sweden, the Netherlands. The Consortium of Scientists "SeMPER-Arctic" suggests that the implementation of a scientific project will give an answer to what it means to be a resilient Arctic settlement in the 21st century. The project will conduct three case studies at pilot sites in the Arctic:

on the west and east coast of Greenland, on the Laptev Sea coast in north-eastern Russia (Uummannak on the west coast of Greenland, Ittokkortoormiit on the east coast of Greenland and Tiksi in the Republic of Sakha (Yakutia), Russia).

The key problem of the development of socio-economic systems of the Arctic regions of Russia, leading to negative, irreversible changes, is the migration outflow of the population (which is especially typical for the North-East of Russia). In the Russian Arctic, the role of migration in the development of the population in certain periods of time is decisive in comparison with natural growth. For joint research, a region with the most extreme climatic conditions and a significant share of the territory belonging to the Arctic zone of Russia was selected. As noted at the beginning, it is the Bulunsky District that is the pilot site in the Russian Arctic, where a case study will be conducted. In this regard, demographic processes in this area are of particular interest.

The main methods in the study were the dialectical method, systematic approach, comparative economic analysis, expert and historical-logical analysis, as well as correlation analysis based on data from the Territorial Body of Federal State Statistics for the Republic of Sakha (Yakutia), which allowed to confirm or clarify the direction and tightness the relationship between the indicators of the migration outflow of the population and the system of factors grouped by content (economic, social, housing and communal services, etc.) based on a paired linear correlation coefficient. The procedure for analysing the influence of factors on the migration loss of population from settlements in the Arctic zone of the Republic of Sakha (Yakutia) included testing the hypothesis of the influence of a particular factor on the migration rate.

The empirical basis for the analysis included open data on the municipal regions of the Arctic zone of the Republic of Sakha (Yakutia) for the period from 2010 to 2017. To analyse the direction and degree of influence of factors explaining the migration of the population, a correlation analysis was performed, according to the results of which paired linear correlation coefficients were calculated. During the study, the articles of foreign and Russian scientists, publications in periodicals related to the subject matter were used. The information base of the study was statistical data and analytical materials from various departments of the Russian Federation and its subjects, as well as the Territorial Body of the Federal State Statistics Service for the Republic of Sakha (Yakutia).

RESULTS AND DISCUSSION

Factors Influencing the Sustainable Development of the Northeast Arctic

Even though the Arctic region has received close public attention due to changes in the environment, they are only one of many factors affecting the inhabitants of the region. Social, political, economic transformations are a much more powerful driving force. All subsystems interact with each other, but, in general, they occur independently of each other and the will of society: local changes in nature in a particular settlement occur as a result of global changes, they cannot be eliminated locally, the same can be said about social, political, and economic changes that were not decided by the local community.

In modern conditions, the socio-economic systems of the Arctic settlements of Russia are developing under the influence of various external and internal factors that must be considered upon developing a methodology for assessing the resilience of the socio-economic system of the Arctic community to economic shocks. When developing a model of the resilience of the socio-economic system of the Arctic settlement of the North-East of Russia to economic shocks, it is necessary to consider the specific features of these settlements, as well as the factors influencing the economy of the Arctic settlements of this region. The most significant specific features of the development of Arctic settlements in the North-East of Russia in comparison with the European part of the Arctic territories of Russia are as follows (Nikulkina 2018):

– poor development of infrastructure, primarily transport (and, as a consequence, dependence on the “Northern Supply Haul”);

– extremely low population density and high dispersion of settlement;

– lower level of socio-economic development;

– lack of large city-forming industrial enterprises;

– little exploration of the north-eastern Arctic (low level of geological and geophysical knowledge, including the Arctic shelf – the shelf of the seas of the eastern arctic sector – Laptev, Chukotka, and East Siberian);

– low level or complete absence of scientific and technological potential.

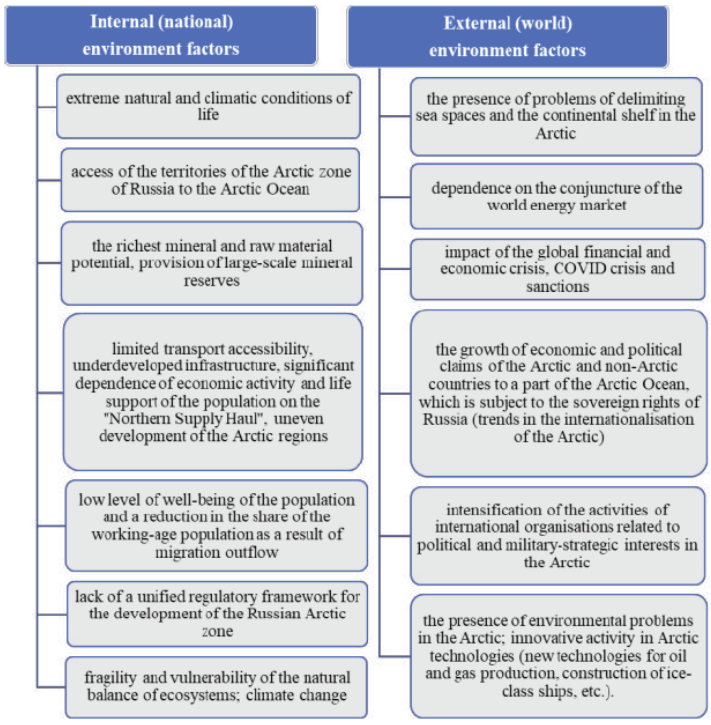

Figure 1: Internal and external factors that significantly affect the development of the Arctic and are considered in the development of the methodology for assessing the resilience.

Source: compiled by authors.

The analysis of the current state and trends in the socio-economic development of the Arctic zone of the Russian Federation allowed to identify and systematise the factors that significantly affect the sustainable development of the North-Eastern Arctic (Figure **1**).

The presented factors, directly and indirectly influencing the development of the Arctic settlement, are classified into factors of the internal and external environment (Nikulkina 2018). External factors include factors that are developed under the influence of the global environment, on which Russia has a weak influence, but which must also be considered when assessing the resilience of socio-economic systems to economic shocks (exogenous factors). The factors of the internal environment include factors that are developed within a settlement (district, region, country), which have an exclusively “Arctic” specificity and can significantly affect the economy of an Arctic settlement (endogenous factors). Moreover, some factors are permanent, and some are temporary.

The Demographic Situation in the North-East of the Arctic as the Basis of the Resilience of the Socio-Economic System

The share of the Arctic zone in the Republic of Sakha (Yakutia) accounts for 52.2% or more than 1.5 million sq. km. territory in which only 7.2% of the population lives, which is 67.7 thousand people as of the beginning of 2019. This territory is the place of traditional residence of the indigenous peoples of the North. The list of places of traditional residence and traditional economic activity of the indigenous peoples of the Russian Federation includes 70 settlements in 21 regions of the Republic of Sakha (Yakutia), of which 49 settlements or 70% are located in the Arctic regions. As the results of the All-Russian population censuses indicate, the number of indigenous peoples of the North of Yakutia has increased.

In the region, the industries of specialisation are the traditional use of natural resources (reindeer husbandry, hunting and fishing), as well as the mining industry: large projects for the development of minerals are being implemented. In particular, the Verkhne-Munskoye diamond deposit (Oleneksky Evenkiy national region), the Tomtorny rare-earth metal deposit in the Buranny area (Oleneksky Evenkiy national region), the alluvial tin deposit on the Tirekhtyakh brook (Ust-Yansky region), the Prognoz silver deposit (Verkhoyansk region), the deposit alluvial diamonds with associated gold and platinum (Anabarsky and Oleneksky regions, in the future Bulunsky and Zhigansky).

Since 1990, the population of the Arctic regions of the republic has decreased by more than 2 times, and the migration loss has increased by 1.5 times. The main reason for the decline in the population was the decline in migration. Migration losses are associated with the departure of the population outside the republic, as well as in the central regions of Yakutia. Negative population dynamics are typical for all Arctic regions. The largest migration losses (41.0%) were recorded in the Ust-Yansky region, where the reduction and liquidation of mining industries led to the closure of entire villages. The migration outflow undoubtedly influenced the decrease in the birth rate, since more than 70% of those who left the Arctic were migrants of working age, of which about a third were young people aged 16-29. Evaluating the data of recent years – the period when the national policy in the Russian Federation turned towards the Arctic (Figure **2**), the tendency of slowing down of migration processes is clearly traced. However, it is too early to talk about solving this problem.

Previous studies, including materials from two sociological surveys of the population within the framework of Arctic expeditions, indicated that the main reasons for the migration outflow of the population from the Arctic regions of Yakutia are dissatisfaction with working and living conditions, housing conditions, lack of work, the desire to give children a good education (Sukneva and Nikulkina 2017). In other words, the key factors of the migration outflow of the population are as follows: tension in the labour market; underdeveloped social infrastructure; change in the life preferences of the population.

While on the subject of the first factor, it should be noted that the unemployment rate in most districts, except for Nizhnekolymskiy, exceeds the national average (7.4%). For example, in Bulunsky district the unemployment rate is 15.6%. Moreover, the economic motives for migration are predominant. The problem of unemployment, coupled with the remoteness and inaccessibility of most settlements, determine the presence of such a problem as alcoholism, which directly affects the most important characteristic of the quality of life of the population – living safety. The share of crimes committed in a state of alcoholic intoxication is significantly higher than the national average, which is 36.6%. Only in one district – Nizhnekolymskiy, this indicator is below the national average, which is determined by the relatively low level of unemployment.

The second factor is the level of development of social infrastructure, which partly allows to smooth out the negative impact of extreme climatic conditions of life. Its most vital component – housing conditions – is much worse than in Yakutia as a whole. The share of dilapidated housing in the Arctic is almost 87% higher than the republican indicator, and in some regions this indicator is 4.7 times exceeded, which is critical, considering the extremely difficult climatic conditions. Moreover, even the existing housing does not meet modern requirements – there is no improvement (centralised heating, cold and hot water supply, sewerage). The share of comfortable housing is only 15.6%, and in 7 out of 13 districts there is none at all (Gordyachkova *et al.* 2018). Thus, the migration outflow reduces the demographic and labour potential

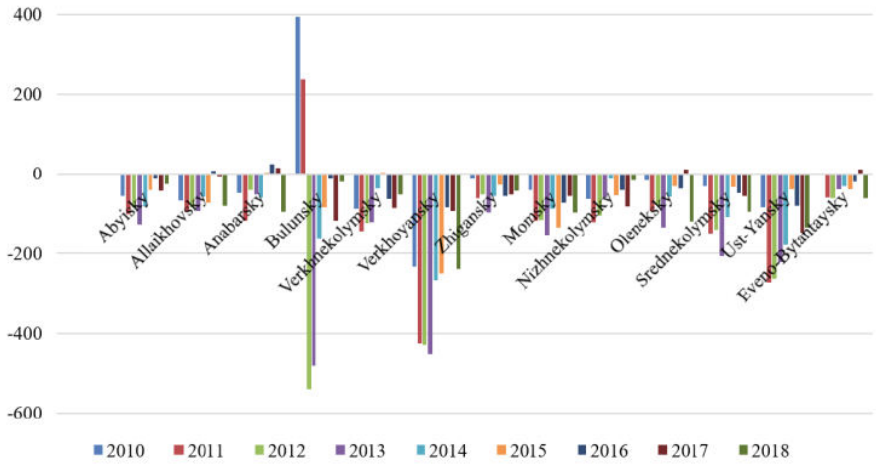

Figure 2: The absolute indicators of migration (increase/decrease) of the population in the Arctic zone of the Republic of Sakha (Yakutia) in 2010-2018.

Source: compiled by authors based on (Demographic Yearbook of the Republic… 2019).

of the Arctic territories, and the qualitative features of the population deteriorate. This negatively affects the resilience of the socio-economic system of Arctic settlements.

Demographic Processes in Bulunsky District of the Republic of Sakha (Yakutia)

Bulunsky district is in the Arctic zone of the Russian Federation, it is part of the Republic of Sakha (Yakutia). The territory covers 223.6 thousand sq. km, which is 7.2% of the total area of the republic. The district is distinguished by an extremely low population density, the population density is 8 times lower than the average republican indicators, in the rating of the republic's districts it ranks 33rd out of 36. Population migration had a significant impact on the formation of the population and the demographic situation in the district. The ongoing changes in the population of the region are mainly determined by migration processes, which are of a clearly expressed economic nature. The change in the vector of migration flows in the early 1990s had a negative impact on the dynamics of the population of the region; it was the migration outflow that caused a sharp decrease in the number of residents.

In the 2000s, the negative impact of migration persisted, although the scale of migration decline has noticeably decreased. Over the 30-year period, the population of the district has decreased by half, while the number of residents of the settlement of Tiksi has decreased by 57.2%, the population of rural settlements of the district has decreased by 33.7%. In the last decade, there has been a trend towards population stabilisation in the dynamics of the population. Thus, the population of Tiksi has slightly increased since 2015, including due to the relocation of rural residents to the administrative center of the district (Figure **3**).

As of January 1, 2020, there are 8.513 people permanent residents in the district, or 0.9% of the population of the Republic of Sakha (Yakutia). More than half of them live in the administrative centre of the Tiksi village (4.793 people). Of the 6 rural settlements

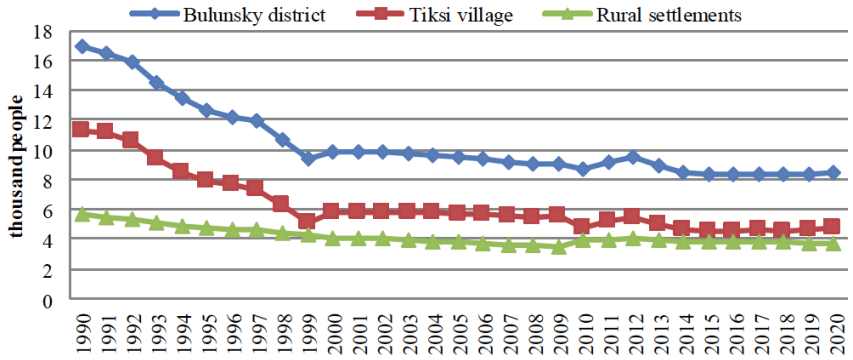

Figure 3: Dynamics of the population of Bulunsky district, thousand people.

Source: compiled by authors based on (Demographic Yearbook of the Republic… 2019).

Table 1: Population of Bulunsky Municipal District as of January 1, 2020

Territories	Total population, people	Share in population, %
Bulunsky municipal district	8.513	100.0
Urban settlements	4.793	56.3
Tiksi village	4.793	56.3
Rural settlements	3.720	43.7
Borogonsky nasleg	495	5.8
Bulun national (Evenk) nasleg	1.204	14.1
Bykovsky national (Evenk) nasleg	514	6.0
Siktyakh nasleg	283	3.3
Tyumetinsky nasleg	753	8.8
Khara-Ulakhsky nasleg	471	5.5

Source: compiled by authors based on (Demographic Yearbook of the Republic… 2019).

Table 2: Dynamics of Demographic Indicators of Bulunsky District, per 1.000 Inhabitants

Indicators	2000	2005	2010	2015	2016	2017	2018
Number of births	14.6	11.9	15.2	14.0	14.1	14.3	11.4
Number of deaths	9.9	10.1	12.0	8.6	8.1	8.0	8.2
Natural growth	4.7	1.8	3.2	5.4	6.0	6.3	3.2
Number of marriages	6.4	7.4	5.9	6.8	6.8	6.8	4.1
Number of divorces	5.7	3.3	4.0	2.6	3.7	4.3	3.6
Migration gain	-41.6	-14.3	43.7	-9.9	-1.4	-14.1	-3.1

Source: compiled by authors based on (Demographic Yearbook of the Republic… 2019).

(3.720 people), the most numerous is the Bulun national (Evenk) nasleg, which accounts for 14.1% of the district's population (Table **1**).

Positive dynamics of natural increase is an inherent feature of demographic processes in Bulunsky district. The number of births per 1.000 inhabitants exceeds the number of deaths. There is a decrease in the marriage rate of the population with a simultaneous decrease in divorce rate. One of the specific features of the birth rate in the Arctic regions of the republic is a considerable proportion of illegitimate births, which is significantly higher than the national average. Thus, if in 2018, the share of illegitimate births in the republic was 32.5%, in Bulunsky district it was 47.4%, while 69% of all first-borns were born to mothers who were not in a registered marriage.

The general indicators of the number of deaths per 1.000 inhabitants of Bulunsky district are at the level of the national average values. The main causes of mortality in the population are diseases of the circulatory system and external causes, including murders and suicides; mortality from these classes of causes in the Arctic is noticeably higher than the national average. Thus, in 2018, the mortality rate from external causes per 100 thousand population in Bulunsky district was 143.9, which is significantly higher than the indicator for the republic as a whole – 122.6. Migration flows on the territory of the district have a negative balance, while the intensity of migration decline has noticeably decreased in size. At the end of 2018, it amounted to 3.1 per 1.000 inhabitants, for comparison, in 2000 its size reached 41.6 ppm (Table **2**).

The processes of birth and death, as well as migration movements have formed the population of the region, which is described by a deformed age structure towards the prevalence of men (there are 900 women per 1000 men). A significant gender gap is noted in the active working and reproductive age of 25-39 years. In older age groups, there is an imbalance with an excess of the female population. The contraction of the age pyramid is noticeable in young ages 15-24, which is a consequence of the demographic pit of the 90s of the last century, when there was a significant reduction in the birth rate of the population. Currently, this fact adversely affects the birth rate, because the reduction in the number of potential mothers directly affects the number of births (Figure **4**).

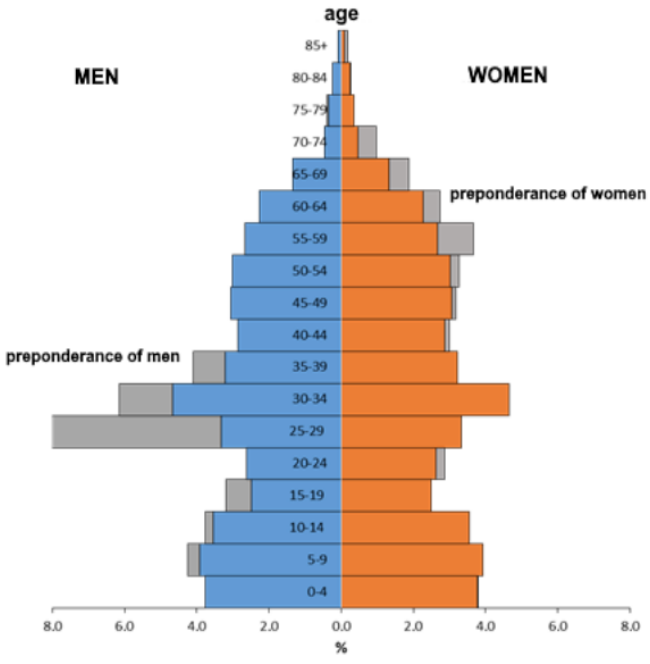

Figure 4: Age pyramid of the population of Bulunsky district, 2018, %.

Source: compiled by authors based on (Demographic Yearbook of the Republic… 2019).

During the period between the 1989 and 2010 censuses, noticeable changes took place in the ethnic composition of the population of the Arctic economic zone. The number of once numerous representatives

of Slavic nationalities has decreased: Russians – by 53.675 people (4.8 times), Ukrainians – by 15.771 people (11 times), Belarusians – by 1.700 people (8 times), which is determined by economic motives and migration outflow outside the republic. In the same census period 1989-2010, the number of representatives of the indigenous small-numbered peoples of the North increased: the Evens – by 3.361 people, the Evenks – by 2.202 people, the Yukaghirs – by 356, the Chukchi – by 154. The number of Dolgans increased by 517 people between the censuses of 2002 and 2010. According to the 2010 All-Russian Population Census (RPC), the total number of indigenous peoples was 39.936, of which 20.326 or 51% live in 13 Arctic regions. According to the results of the 2010 All-Russian Population Census, the ethnic composition of the population of Bulunsky District is described by the predominance of representatives of indigenous nationalities, while in the village of Tiksi more than half of the inhabitants are Russians and Ukrainians (54.8%) (Table **3**).

Thus, the demographic processes in Bulunsky district are described by a decrease in the population, the share of the working-age population has decreased, and the proportion of the population over working age is increasing. There is a decrease in the birth rate of the population. If the prevailing trends in the migration outflow and natural increase continue, the population decline in Bulunsky District will continue. The decline in the population in the Arctic is not only a demographic and economic problem, but also has an ecological and cultural aspect. This is conditioned by the extinction of the original culture of the northern peoples, including their traditional crafts, which for centuries have been integral components of the resilience of Arctic settlements.

Correlation Analysis of Demographic Processes in the North-East of the Arctic

The most crucial factor determining the demographic situation in the North-eastern Arctic, as studies have shown, is the migration outflow of the population. It seems appropriate to establish the factors influencing the migration outflow with the use of the correlation analysis. When studying the mechanism of migration, the factors of pull and push should be considered, as they have an economic, social, and other nature. The theory of push-pull factors was put forward in 1966 by the American scientist E. Lee (1966), in which the factors influencing the decision to

Table 3: National Composition of the Population of Bulunsky District According to the All-Russian Population Census – 2010, %

Nationalities	Urban and rural population			Urban population			Rural population		
	both sexes	men	women	both sexes	men	women	both sexes	men	women
Bulunsky district	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Russians	28.9	31.6	26.0	48.4	51.3	45.2	4.1	5.2	3.0
Evenks	25.0	31.7	17.7	10.9	13.2	8.2	42.8	56.6	28.9
Yakuts (Sakha)	23.4	22.7	24.2	17.9	16.4	19.5	30.5	31.2	29.9
Evens (Lamuts)	14.0	3.9	25.0	8.3	2.6	14.8	21.3	5.7	37.0
Ukrainians	3.7	3.6	3.7	6.4	6.1	6.7	0.2	0.2	0.2
Buryats	0.6	0.7	0.4	0.7	0.9	0.4	0.4	0.4	0.5
Tatars	0.5	0.5	0.5	0.8	0.8	0.9	0.0	0.0	0.0
Chukchi	0.4	0.8	0.0	0.7	1.3	0.0	0.0	0.0	0.0
Kyrgyz	0.3	0.2	0.3	0.5	0.4	0.6	0.0	0.0	0.0
Uzbeks	0.1	0.1	0.0	0.1	0.2	0.0	0.0	0.0	0.0
Dolgans	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.1	0.2
Armenians	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0
Other	2.3	3.2	1.4	3.8	5.1	2.3	0.5	0.6	0.3
Unspecified	0.8	0.9	0.7	1.4	1.6	1.2	0.0	0.0	0.0

migrate were divided into four groups (region of departure, region of arrival, interfering circumstances, personal factors). Therewith, it is possible to identify factors that pull and push the population in each region.

Migration theories, which economics operates on, are to a certain degree based on sending and attracting factors. For example, according to neoclassical economic theory, a person strives to get the maximum benefit at the lowest cost. Migration flows must be regulated by supply and demand in the labour market: territories with high demand and limited labour supply must provide high wages. But economic factors are not always significant in making decisions about migration for the population. Therefore, critics of neoclassical economic theory put forward the theory that poor people should migrate to rich regions. To assess the influence of factors affecting the change in the population of the Arctic zone of the Republic of Sakha (Yakutia), a system of indicators was determined and classified according to their content: general economic, housing, social, and describing traditional types of activity (Table **4**).

The analysis of the results obtained in relation to general economic factors (Table **5**) allowed to draw the following conclusions.

The influence of the investment factor is manifested for most regions with a weak-moderate tightness of communication, and the direction of communication is ambiguous: for some regions, an increase in investment leads to an increase in the outflow of the population (Abyisky, Allaikhovsky, Zhigansky, Momsky, Oleneksky), and for others – to a decrease (Anabarsky, Bulunsky, Nizhnekolymsky). The influence of the wage factor is mainly described by the opposite direction of the relationship, i.e., an increase in wages leads to a decrease in the migration outflow of the population. The strongest connection is observed in the Verkhnekolymsky, Verkhoyansk regions, in other regions, except for Bulunsky, Zhigansky, Oleneksky, Srednekolymsky and Even-Bytantaysky, the connection is moderate.

The unemployment rate affects the migration outflow of the population in Bulunsky, Verkhnekolymsky, Verkhoyansky, Nizhnekolymsky, and Eveno-Bytantaysky districts, and the direction of the interrelation is ambiguous. Thus, in Bulunsky, Verkhoyansky, Nizhnekolymsky, and Eveno-Bytantaysky districts, there is a direct relationship – an increase in the level of general unemployment leads to an increase in the migration outflow of the population, and in Verkhnekolymsky, a reverse relationship (with an increase in the unemployment rate, the migration outflow of the population decreases). Since the main activities of the indigenous population of the Arctic zone are reindeer herding, horse breeding and fishing, the indicators presented in Table **6** play a significant role in the analysis.

The calculated pair correlation coefficients in this group of factors in most cases have a positive value,

Table 4: Grouping Factors – Explanatory Variables

Group	Factors
Economic	Fixed capital investments from all sources of financing, thousand roubles
	Nominal wages, roubles
	General unemployment rate, %
Traditional activities	Livestock of cattle in farms of all categories, heads
	Livestock of deer in farms of all categories, heads
	Fish catch, tonnes
	Livestock of horses in farms of all categories (at the end of the year), heads
Housing and utilities	The share of the total area of the housing stock equipped with a water supply system, %
	The share of the total area of the housing stock equipped with drainage, %
	The share of the total area of the housing stock equipped with heating, %
Social	Number of outpatient polyclinic organisations, units
	The volume of social payments and taxable cash income of the population (per capita), roubles
	Residential buildings commissioning, sq. m total area

Source: compiled by authors.

Table 5: The Direction and Strength of the Relationship between the Indicator of the Migration Outflow of the Population of the Arctic Zone of the Republic of Sakha (Yakutia) and the Explanatory Factors of the Group of Economic Factors

No	Municipal district	Investments in fixed assets from all sources of financing, thousand roubles	Nominal wages, roubles	General unemployment rate, %
1	Abyisky	0.43	-0.42	-0.05
2	Allaikhovsky	0.49	-0.55	0.37
3	Anabarsky	-0.38	-0.35	-0.36
4	Bulunsky	-0.27	-0.28	0.87
5	Verkhnekolymsky	0.07	-0.57	-0.55
6	Verkhoyansky	-0.10	-0.65	0.84
7	Zhigansky	0.35	0.24	-0.38
8	Momsky	0.42	-0.16	0.21
9	Nizhnekolymsky	-0.48	-0.62	0.62
10	Oleneksky	0.29	-0.07	-0.15
11	Srednekolymsky	0.05	-0.23	0.31
12	Ust-Yansky	-0.03	-0.47	0.06
13	Eveno-Bytantaysky	0.14	-0.04	0.64

Source: compiled by authors.

Table 6: The Direction and Strength of the Relationship between the Indicator of the Migration Outflow of the Population of the Arctic Zone of the Republic of Sakha (Yakutia) and the Explanatory Factors of the Group of Factors of Traditional Activities

No	Municipal district	Livestock of cattle in farms of all categories, heads	Livestock of deer in farms of all categories, heads	Fish catch, tonnes	Livestock of horses in farms of all categories (at the end of the year), heads
1	Abyisky	0.67	0.54	-0.37	0.73
2	Allaikhovsky	-0.52	0.51	-0.27	0.57
3	Anabarsky	-	-0.11	-0.52	-0.11
4	Bulunsky	0.13	0.09	0.58	0.17
5	Verkhnekolymsky	0.75	0.03	0.53	0.51
6	Verkhoyansky	0.55	0.70	-	0.38
7	Zhigansky	-0.008	0.004	-0.33	-0.46
8	Momsky	-0.02	0.12	-0.11	0.64
9	Nizhnekolymsky	0.13	0.04	0.49	0.11
10	Oleneksky	0.21	0.48	-0.09	0.55
11	Srednekolymsky	0.46	0.26	-0.55	0.26
12	Ust-Yansky	0.43	-0.37	0.23	0.45
13	Eveno-Bytantaysky	0.24	-0.02	-	-0.01

Source: compiled by authors.

which means that there is a direct relationship between the indicators, and this, in turn, leads to the conclusion that an increase in the number of cattle, deer, horses and fish catch does not lead to a decrease in the migration outflow of population. However, for some municipal districts, the development of traditional activities leads to a decrease in the migration loss of the population. For example, in the Allaikhovsky region, cattle breeding, in Ust-Yansky – deer, in Anabar, Allaikhovsky, Srednekolymsky regions – fishing, and in

Table 7: The Direction and Strength of the Relationship between the Indicator of the Migration Outflow of the Population of the Arctic Zone of the Republic of Sakha (Yakutia) and the Explanatory Factors of the Group of Housing Factors

No	Municipal district	The share of the total area of the housing stock equipped with a water supply system, %	The share of the total area of the housing stock equipped with drainage, %	The share of the total area of the housing stock equipped with heating, %
1	Abyisky	-0.65	-0.65	-0.59
2	Allaikhovsky	-0.25	-0.38	-0.35
3	Anabarsky	0.43	0.43	-0.50
4	Bulunsky	0.10	0.10	-0.31
5	Verkhnekolymsky	0.12	-0.10	-0.21
6	Verkhoyansky	0.68	0.69	-0.59
7	Zhigansky	-0.24	0.44	-0.12
8	Momsky	0.01	0.16	-0.73
9	Nizhnekolymsky	-0.31	0.50	0.27
10	Oleneksky	-0.31	-0.31	-0.30
11	Srednekolymsky	-0.008	-0.87	-0.10
12	Ust-Yansky	0.36	0.35	-0.19
13	Eveno-Bytantaysky	0.41	0.41	-0.20

Source: compiled by authors.

Zhigansky – horse breeding. Housing factors, which are also very important for the Arctic zone, are represented by indicators of the share of the area of the housing stock equipped with water supply, drainage, heating (Table **7**).

Most of the correlation indicators are negative, indicating an inverse relationship between indicators of migration and living conditions. It should be especially noted that the importance of the factor of the specific weight of the areas of the housing stock equipped with heating – all indicators have a negative value, i.e., an increase in the proportion of dwellings with heating leads to a decrease in the outflow of the population. In Abyisky and Verkhoyansky districts, there is a strong connection between migration and the factors of housing comfort, since in these areas the indicators of water supply, drainage and heat are the lowest in the Arctic zone.

Next, the influence of social factors on the migration behaviour of the population is assessed. The indicators of the number of educational and medical institutions were not included in the analysis, since their values practically did not change in dynamics (Table **8**).

Notably, most of the correlation indicators for the factor of the volume of social benefits have a negative value and indicate a weak-moderate relationship with the indicators of population migration, i.e., an increase in the volume of payments and the amount of income of the population leads to a decrease in the migration loss of the population. The commissioning of residential buildings leads to a decrease in the migration outflow in Verkhnekolymsk and Momskom rayons. In other cases, the relationship between the indicators is either practically absent or weak. Thus, of all the factors that were included in the analysis, the number of factors that reduce the migration outflow of the population include: wages (a group of economic factors); heating in dwellings (group of factors of housing and communal services); social support (group of social factors). Factors of the development of traditional types of activity either have a weak connection or do not contribute to a decrease in the migration flow from the territories of the Arctic zone of the Republic of Sakha (Yakutia).

CONCLUSIONS

Thus, the most serious problem of the development of socio-economic systems of the Arctic regions of Russia, leading to negative, irrevocable changes, is the migration outflow of the population (which is especially inherent in the North-East of Russia). In the Russian Arctic, the role of migration in the development of the population in certain periods of time is decisive in comparison with natural growth. In Bulunsky district,

Table 8: The Direction and Strength of the Relationship between the Indicator of the Migration Outflow of the Population of the Arctic Zone of the Republic of Sakha (Yakutia) and the Explanatory Factors of the Group of Social Factors

No	Municipal district	The volume of social payments and taxable cash income of the population (per capita), roubles	Residential buildings commissioning, sq. m total area
1	Abyisky	-0.61	0.02
2	Allaikhovsky	-0.55	0.03
3	Anabarsky	-0.4	0.01
4	Bulunsky	-0.44	-0.17
5	Verkhnekolymsky	-0.42	-0.66
6	Verkhoyansky	-0.58	-0.23
7	Zhigansky	0.30	0.05
8	Momsky	0.04	-0.52
9	Nizhnekolymsky	-0.52	-0.52
10	Oleneksky	-0.08	-0.11
11	Srednekolymsky	-0.18	0.68
12	Ust-Yansky	-0.46	0.37
13	Eveno-Bytantaysky	-0.04	0.31

Source: compiled by authors.

which is a pilot site of the project, over the past thirty years, the population has decreased by half, primarily due to the migration of the Slavic population outside the republic, despite the fact that there is a positive dynamic of natural growth in the district. Therewith, the marriage rate decreases, and the proportion of illegitimate births increases. This tendency also indicates the deep processes of transformation of the Arctic communities, which can both negatively and positively affect resilience. The main reasons for the migration outflow of the population from the Arctic regions of Yakutia are tension in the labour market, underdeveloped social infrastructure, and changes in the life preferences of the population. The latter circumstance may also indicate a decrease in the resilience potential of Arctic communities.

The results of the correlation analysis indicate that the presence and development of traditional types of crafts and activities do not contribute to a decrease in migration outflow. All identified trends can have a very negative impact on the resilience of Arctic settlements in the North-East of Russia, if an active national policy is not developed and implemented, aimed at the integrated development of the Arctic region. The presented results are the initial stage of a comprehensive study of the resilience of Arctic settlements in the North-East of Russia in order to further develop the concept of resilience and form a methodology for assessing the resilience of the socio-economic system of an Arctic settlement to economic shocks. The result of further research should be a factor model that will allow to assess the resilience of the socio-economic system of the Arctic settlement to economic shocks. This model will be created based on research materials in Tiksi, Republic of Sakha (Yakutia), Russia.

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