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CURRENT STATE OF PUBLIC HEALTH IN THE ARCTIC ZONE OF THE REPUBLIC OF SAKHA (YAKUTIA)

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Abstract: *The article considers the main parameters of environmental pollution in the Arctic zone of the Republic of Sakha - Yakutia (AZRS) and the impact of this process on the health of the local communities. Analysis of the ecological and economic situation indicates that the largest amount of pollutants enters the regional environment as a result of the activities of mining enterprises. The latter is also complemented by the negative role of the energy sector, transport, and reindeer herding. The negative results of anthropogenic activity are enhanced by some natural features of the studied area, such as slow decomposition of pollutants due to low temperatures and their concentration in the upper soil layers due to permafrost. Therefore, the AZRS was targeted for a study of the condition of the public health - both in general and by individual groups (age, occupation, gender, ethnicity). As a result, the main classes of pathologies were identified, and a local pattern of the general situation with the population's disease incidence in this region was compiled. The presented paper also assesses the current state of the regional health care system and proposes some measures to improve its performance.*

Keywords: *Arctic zone of the Republic of Sakha-Yakutia, research, ecological and economic situation, environmental pollution, population morbidity, public health, health care system.*

INTRODUCTION

The Russian Arctic is stretching from the northeastern edge of Fennoscandia to the Bering Strait. Such dimensions determined the presence of significant internal differences within its zonal boundaries. Thus, several specific characteristics allows considering the Arctic zone of the Republic of Sakha - Yakutia as an integral region composed of 13 administrative districts (*ulus* settlements): Abyysky, Allaikhovsky,

Anabarsky, Bulunsky, Verkhnekolymsky, Verkhoyansky, Zhiganovsky, Momsky, Nizhnekolymsky, Olenyoksky, Srednekolymsky, Ust-Yansky, and Eveno-Bytantaysky. The region is well-known for its unique combination of strategic mineral resources: hydrocarbons, diamonds, and noble and rare earth metals. The Bering Strait washing it from the east is of exclusive importance as a natural corridor of the shortest transport route between Europe and the Asia-Pacific region (Lozovskaya, 2019).

At the same time, the AZRS is located halfway across the country and has a high degree of transport isolation from the rest of Russia. Local climate conditions are among the most extreme for human life in the world. Finally, the collapse of the USSR at the end of the XX century and its consequences inevitably led to the collapse of the regional industry; many of the social guarantees used by local residents were canceled. As a result, if in 1990 more than 305.5 thousand people lived in the AZRS, then by 2017 their number decreased to 117.5 thousand. In other words, the region suffered a catastrophic depopulation, the consequences of which will surely be serious and long-lasting. Among other reasons, this process was also aggravated by the difficult ecological and economic situation in the region, its inherent unfavorable biomedical background, and serious problems in the local health care system.

Providing the negative essence of the described situation and the urgency of its correction, the presented article considers the most significant reasons for its very formation, summarizes the results of its study, and formulates proposals to improve the efficiency of regional health care. The main objectives of the study were, as follows: to consider and assess the ecological and economic situation in the Arctic zone of the Sakha Republic in connection with anthropogenic pollution of the natural environment of the region; analyze the public health background in this region and identify its main characteristics; identify the main problems in the current state of regional health care and deliver prospective corrective actions.

MATERIALS AND METHODS

Public health as the science studies the health indicators of a population and its impact factors. One of the main factors affecting the quality of life for the public is the ecological and economic conditions that are formed by the people themselves in the process of their life activities. Consequently, the economy configures the ecological situation, and this, in turn, shapes the public health system. The purpose of this study is to review the ecological and economic situation of the Arctic zone of Sakha (Yakutia) and to identify the features of public health in the territory under consideration due to the influence of the current regional environmental and socio-economic conditions, as well as topical issues in the local health care system. The reference base for the study was represented by scientific literature sources, Rosstat statistical information (materials of governmental Federal State Statistics Service for 2000 - 2019), and also the results of calculations according to the previously proposed and tested methodology by one of the authors.

To assess the ecological and economic situation, the Rosstat statistical database was employed, namely: 'Key indicators of environmental protection' Statistical Bulletin for 2006; Russia in Figures: Socio-economic indicators for 2016; Russia in Figures: Socio-economic indicators for 2019; and 2017 Statistical Yearbook of the Republic of Sakha (Yakutia). Also, particular attention was paid to the official acts such as the State report on the state and environmental protection of the Republic of Sakha (Yakutia) in

2017 and the Strategy for the socio-economic development of the Arctic zone of the Republic of Sakha (Yakutia) for the period until 2030. Since the solution of issues and problems of nature protection and rational use of natural resources depends on the financial support of the latter, the calculations of the economic sufficiency index (ESI) proposed earlier (Stepanko, 2012a; Stepanko, 2013) were carried out. The index was taken as a basic operation of the ratio of the actual volume of financing for environmental protection and the economic optimum proposed by S.I. Kolesnikov (2000). Earlier ESI calculations for the regions of the Russian Far East (Stepanko, 2012b) showed the objectivity of the proposed indicator and the correspondence of the actually existing imbalance in ecological and economic terms.

The basis for the study of the impact of the environmental situation on the health of the local population was the monitoring of public health indicators using available statistical materials, the results of field studies, and their office analysis. The monitoring of the health indicators for 2000 - 2019 was conducted to study the changes in public health and the quality of life of various groups of the people residing in the AZRS. The features of the influence of environmental factors on the indicators of public health were also considered. A geosystem approach was chosen for the presented study due to its decisive importance for the medical-geographical study of natural and socio-economic processes. The study took into account the theoretical and methodological aspects of medical geography: the concept of the natural nidality of human diseases, which provides for the natural determinism of many disorders, and the concept of risk factors for human health, which leads to the environmental conditioning of diseases following the technogenesis and urbanization.

Statistical data on medico-demographic, socio-economic, and environmental indicators served as the basis for the medical-geographical research. The study is based on reliable materials and information sources such as official and departmental statistical, cartographic, stock, literary, and other data collections (2000-2018): Russia's population morbidity in 2014, Russia's population morbidity. Statistical materials (2010-2018); Russia in Figures 2018; The incidence of socially significant diseases in the regions of the Russian Federation (2010-2017); Healthcare in Russia 2015: Statistical collection by Rosstat, Health care in Russia: official statistical data [Electronic source] // Official website of the Federal State Statistics Service (Rosstat). - Access mode: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1139919134734. The following methods were applied as a part of the incubation of research: the geosystem approach and traditional methods of geographical and medico-geographical analysis such as selective-data, analytical, descriptive, comparative, cartographic, geoinformation, ecological-epidemiological, as well as methods of regionalization and territorial typologies.

RESULTS

Analysis of the main environmental and economic indicators of the Arctic zone of the Republic of Sakha demonstrates a clear tendency towards an increase in many economic indicators: gross regional product, industrial and agricultural production index, etc. (State report on the state and environmental protection of the Republic of Sakha (Yakutia) in 2017, 2018; State report on the state and environmental protection of the Russian Federation in 2016, 2017; Key indicators of environmental protection. Statistical Bulletin, 2006; Russia in Figures: socio-economic indicators for 2016, 2016;

Russia in Figures: socio-economic indicators for 2019, 2019; Statistical Yearbook of the Sakha Republic (Yakutia), 2017). The costs of environmental protection and rational use of natural resources have also increased. However, the comparison with the dynamics of the growth of the gross regional product demonstrates their insufficiency to neutralize or significantly reduce the negative impact of production on the regional environment (Fig. 1).

As can be seen from Table 1, the major industrial production facilities are present in almost all administrative units of the region. And although they are placed in the isolated areas, they all still belong to the industries with an increased polluting effect on the environment. Also, they are located in the Arctic ecosystems, which are characterized by low resistance to man-made impacts and slow recovery ability. All this contributes to the formation of an unfavorable ecological situation, which only intensifies over time. According to the results of earlier studies (Stepanko, 2012a; Stepanko, 2013), all the variety of impacts of production (as one of the types of nature use) on the environment can be reduced to three integral indicators: pollution of water resources, air quality problem, and surface disturbance. The air pollution coefficient at different points of sampling ranged from 0.3 to 0.5 (Stepanko, 2012b). That is, the state of the surface layer of the atmosphere within the study area is approximately the same and is generally assessed as unfavorable.

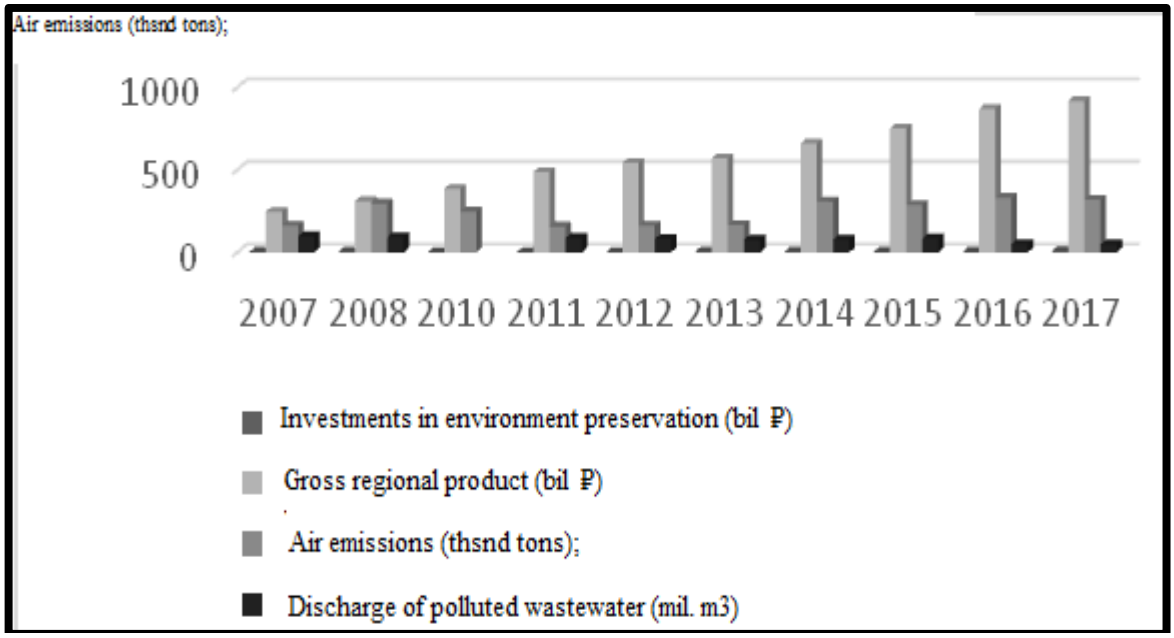

Figure 1. The ratio of some environmental and economic indicators in Sakha (Yakutia)

Table 1. Diversification of economic activities in Sakha (Yakutia)

District(s) (Ulus)	Main types of economic activities	Possible promising economic activities	Industrial hazard classes (existing + possible)
Allaikhovsky	agriculture (reindeer herding), fur-trade and fishing, fish processing; food (dairy)	mining of gold and mammoth ivory, reintroduction of muskox; reindeer herding, fishing and hunting, food, leather and fur production	IV, V
Anabarsky	mining and processing of diamonds; hunting, fishing, domestic reindeer herding; reindeer processing, hunting and fishing products, arts&crafts; air freight (both cargo and passenger); mammoth ivory mining	mining of diamonds, coal, bitumen, reintroduction of muskox; reindeer herding, fishing and hunting, food, leather and fur production, souvenir production, arts&crafts	II, IV, V
Bulunsky	agriculture: reindeer herding, fishing and fur-trade, domestic reindeer herding; trade port facilities (sea port of Tiksi), airport	mining of diamonds, coal, mammoth ivory; reconstruction and modernization of the port of Tiksi; reintroduction of muskox, reindeer herding, fishing and hunting, food, leather and fur production	III, V
Ust-Yansky	tin and gold mining, fish processing, reindeer and fur farming, air freight	mining and processing of gold, tin, coal, mammoth ivory, reindeer herdingy, fishing and hunting, food, leather and fur production	II, IV, V
Nizhnekolymsky	agriculture: reindeer herding, fur farming and fisheries, fish processing; highway construction, port facilities (Zelenomysk River Port), airport; as of 14.04.2006, a border zone was established on a part of the territory of the Nizhnekolymsky district	thermal power stations and highway construction, coal mining, modernization of Zeleniy Mys seaport, reindeer herding, fishing and hunting, food, leather and fur production	III, IV, V

According to the current state of water pollution, the Arctic zone of the Republic of Sakha occupies an intermediate position among the regions of the Far East. The degree of surface disturbance indicates that the rate and growth of the areas of the soil cover disturbance exceed the indicators of its rehabilitation. This discrepancy arose due to the slowed-down process of soil self-restoration and lack of actual activities on land reclamation. It should be noted that the industrial pollution of the AZRS lands is also supplemented by the destructive consequences of overgrazing of domestic animals. Excessive stress on pastures has led to a significant destruction of lichens and shrubs. Animal trampling and damage by cattle (mostly be deer) lead to degradation of the soil layer and the development of permafrost processes as well.

Additional damage to reindeer pastures is caused by tracked transport vehicles that pass by in the off-road conditions of the AZRS. But the most extensive areas of disturbed lands are formed during the mining of placer gold along the floodplains of rivers and streams. That's where bulldozers, large dredges, and excavators remove a rock sheet with a thickness of 3-4 to 15 m and more (Kartamysheva, Vakhrushin, Perevala, Treskova, 2015). In this case, river floodplains, over a considerable extent, turn into rock dumps, which are quickly fettered by permafrost and become practically unsuitable for reclamation.

The consolidated indicator of pollution is one of the constraints on the functioning in a certain area of both the economic structure as a whole and its particular industries (Stepanko, 2012a; Stepanko, 2012b). In this regard, it should be noted that within the Arctic zone of the Republic of Sakha, the parameters of its main environmental impacts have practically no tendency to decrease. The effectiveness of nature conservation in this region is very low. Its financial support remains stably scanty and disproportionately small in comparison with the economic optimum. This is evidenced by the economic sufficiency index of environmental protection (ESI) (Stepanko, 2012b; Stepanko, 2013). (Table 2, Fig. 2), which is the ratio of the actual volume of financing for environmental protection and economic optimum. Table 2 and Figure 2 demonstrate that the rate of ESI increase in the region under study is quite insignificant, and therefore does not affect the improvement of the situation with environmental protection both in the Republic of Sakha as a whole and in its Arctic zone in particular.

Table 2. Dynamics of environmental protection efficiency in Sakha (Yakutia)

Subjects	∑ operating costs + fixed investments in environment preservation and rational natural resource use, mln. ₽ 2013/2014/2015/2016/2017	Economic optimum, mln. ₽ (8% of GRP) 2013/2014/2015/2016/2017 [6]	Gross Regional Product, mln. ₽ 2013/2014/2015/2016/2017	Economic sufficiency index (ESI) of environmental protection (actual/optimal) 2013/2014/2015/2016/2017
Republic of Sakha (Yakutia)	4889.7/10772.3/10314.8/13295.0/11667.2	45530.5/52812.0/59999.0/69488.6/73321.5	569131.6/660150.0/749987.5/868607.0/916518.6	0.1/0.2/0.2/0.19/0.16

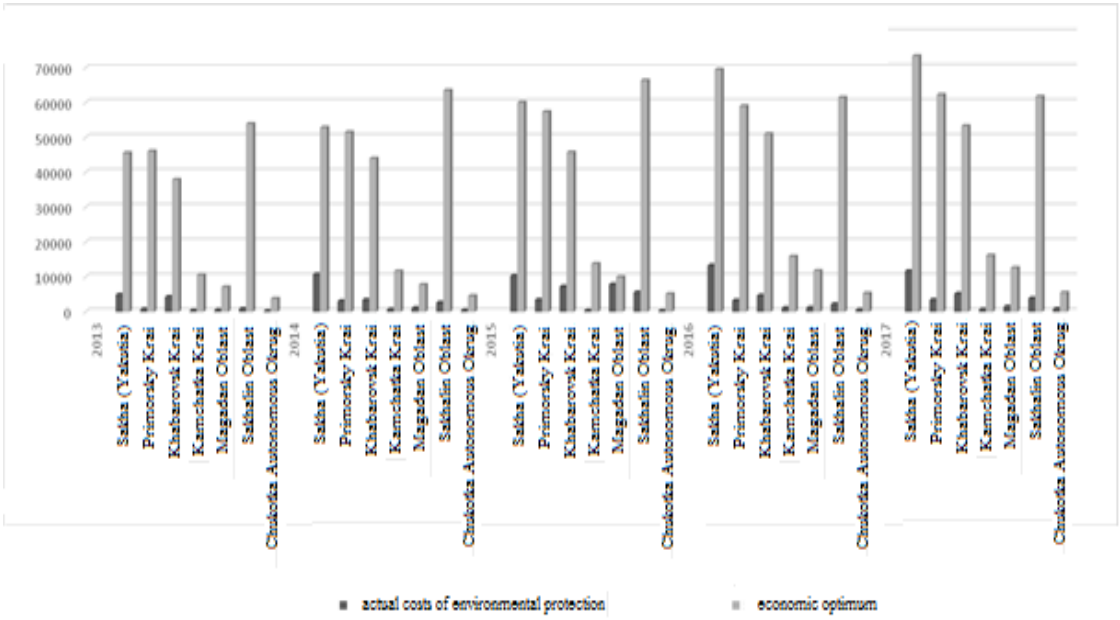

Figure 2. The ratio of actual and necessary costs for environmental protection

The results of the studies conducted in AZRS reflect a tremendously unstable situation in terms of morbidity and mortality. The main part of the causes of death among the population of this region is attributed to cardiovascular diseases (41.8%), neoplasms (15.3%), and external causes (20.7%). From 2000 to 2018, the morbidity in this region increased by 33.4% (for the given period in the Republic of Sakha as a whole - by 23.8%; the all-Russian average - by 6.6%) (Fig. 3). Generally, the incidence rate of the AZRS population is higher than the similar national value by 9.4%, and the all-Russian level by 30.2%.

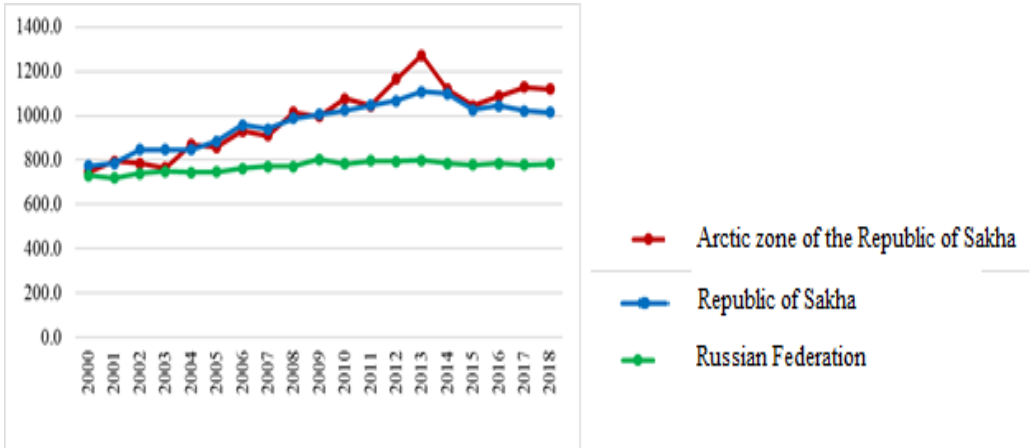

Figure 3. Comparative dynamics of population morbidity in AZRS, the Republic of Sakha, and the Russian Federation in 2000 - 2018, total cases per 1000 residents

The most negative pattern was observed in Ust-Yansky, Srednekolymsky, Eveno-Bytantaysky, Nizhnekolymsky, and Allaikhovsky AZRS districts. The incidence in this area in the period 2000 - 2018 had increased from 40 to 60% (Fig. 4). The highest incidence rate was noted in the Nizhnekolymsky district (1541.5 ‰). The

Verkhnekolymsky and Verkhoyansky districts are characterized by a relatively favorable situation. The dynamics of morbidity here between 2000 and 2018 showed a downward trend (by 17.1% and 21.4%, respectively).

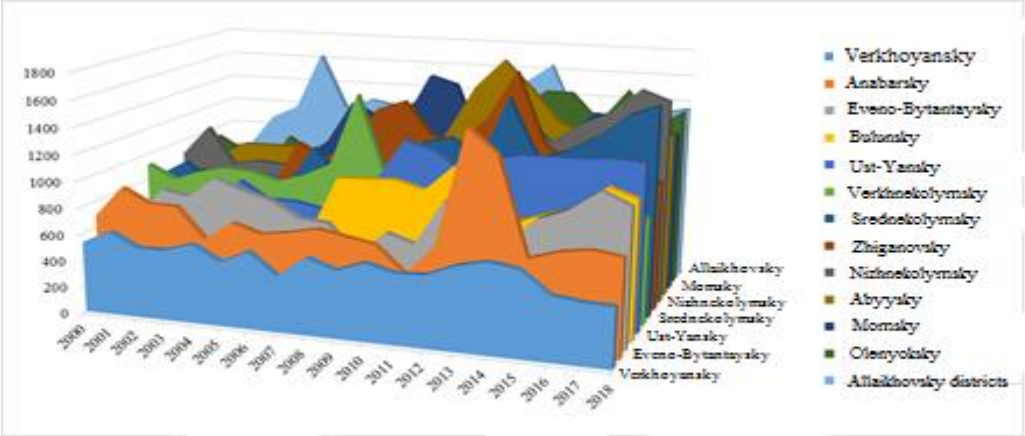

Figure 4. Dynamics of the population morbidity in AZRS in 2000 - 2018 in the form of a three-dimensional diagram with the distribution in ascending order of the total incidence rates, total cases per 1000 residents

The morbidity structure in this region is similar to the gross republican (Fig. 5). By 2018, it was dominated by diseases of the respiratory system (53.4%) (Fig. 3). From 2000 to 2018 the incidence of this class of pathologies in the Republic of Sakha had increased by 40.3%. This figure is 36.9% higher than the All-Russian average; it is followed by traumatic injuries, poisoning and other external causes (11.1%), complications of pregnancy, childbirth and the postpartum period (5.8%), diseases of the digestive system (5.5%), skin and subcutaneous tissue (4.9%). In general terms, this morbidity structure is inherent in the areas of AZRS. The main differences are that, within its limits, there has been an improvement since 2000 in the local situation with the incidence of infectious and parasitic diseases. Still, the incidence rate of digestive system diseases is significantly higher than the national one.

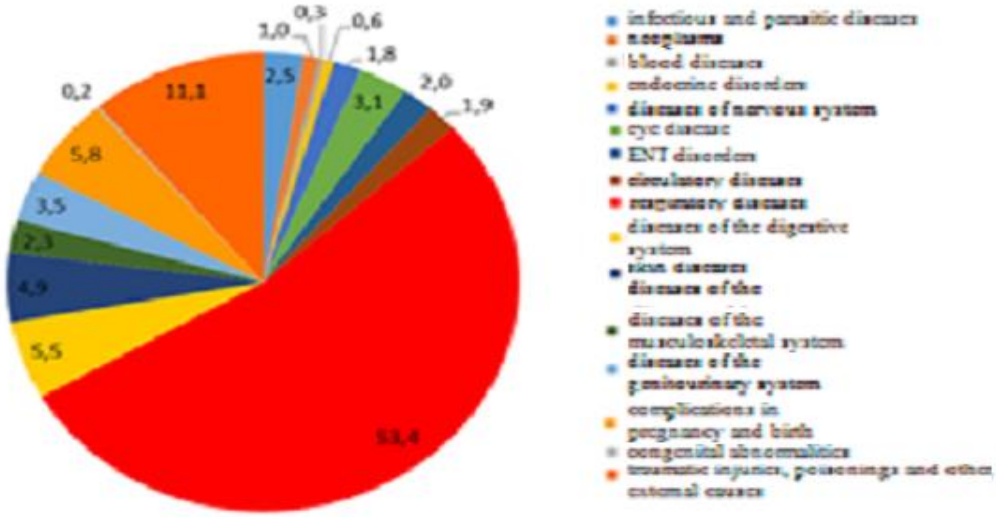

Figure 5. The structure of primary disease incidence of the entire population of the Republic of Sakha (Yakutia) by 2018 in%

Territorial differentiation of the districts of the Arctic zone of the Republic of Sakha in terms of population morbidity seems to appear rather heterogeneous (Fig. 6). According to the analysis of the average long-term incidence rate, the tensest situation has developed in the eastern districts of AZRS (Allaikhovsky, Abyysky, Momsky, Verkhnekolymsky, Srednekolymsky, and Nizhnekolymsky). A history of the long-term above the average level is observed in Zhiganovsky and Olenyoksky districts. Bulunsky and Ust-Yansky districts, despite their relative prosperity, manifest a trend towards a rapid increase in the incidence rate. This situation can lead to the transition of these areas to the group of disadvantaged territories. Some improvement in the situation in terms of morbidity is objectively noted in the Verkhoyansky, Anabarsky, and Bulunsky districts. However, the dynamic features of the morbidity of the AZRS population as a whole show a general negative background with minor fluctuations towards positive changes.

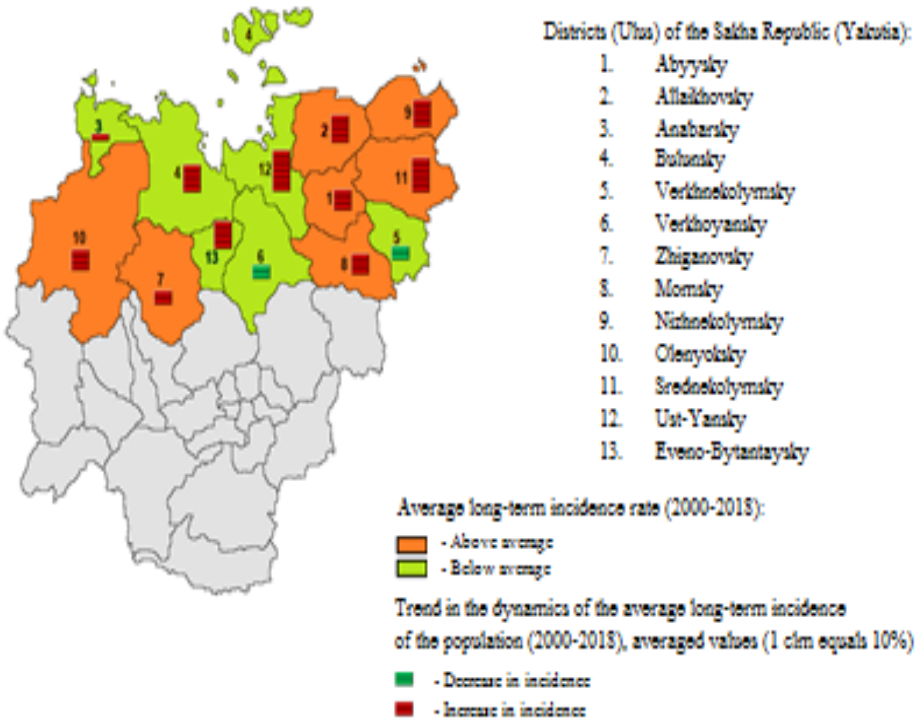

Figure 6. Dynamics and morbidity of the AZRS population in 2000 - 2018 according to average long-term values data increase

Medical problems related to the nutrition of the regional population are also quite urgent. The opportunities for food self-sufficiency in this territory are objectively limited. Therefore, their bulk is delivered to the Arctic zone by Severny Zavoz (deliveries of goods to the Northern Territories) (Non-alternative and necessary, n.d.). Analyzing its logistic schemes goes beyond the scope of this publication; however, it should be noted that in broad terms they look pretty solid. The main problem there appears to be regional-area delivery. The 80% of the inward extension of the AZRS is classified as hard-to-reach, and a number of its consumer facilities are located at a considerable

distance from the bases of external product delivery. At the same time, AZRS does not have a reliable year-round road network. The functioning of various types of transportation is limited by the seasons and complicated by climatic anomalies. Therefore, even the delivery of food products to the Arctic zone can be delayed for up to eight months or more. This explains the high share of consumption of expired products. A separate aspect is the violation of the traditional diet of the indigenous communities, in which the proportion of carbohydrates has significantly increased. A common manifestation of these negative factors is the spread among the AZRS inhabitants (regardless of their ethnicity) of chronic non-communicable diseases: obesity, atherosclerosis, coronary heart disease, arterial hypertension, diabetes mellitus, hepatitis, and vitamin deficiency.

Moreover, the centralized Soviet health care system that had developed in the second half of the XX century was lost along with the collapse of the USSR; the forthcoming reforms significantly reduced the number of small local medical institutions, as well as the number of employees of lower and middle attending personnel. Considering the consequences of these events for AZRS, the provision of the population with medical workers per 10 thousand inhabitants for 2000 - 2017 showed positive dynamics. For mid-level health professionals, this indicator increased from 127.5 specialists to 131.9, and for doctors - from 37.75 to 43.5. However, this shift was not due to an increase in the number of health professionals, but rather to a general decline in the population and subsequent reduction in the number of patients. At the same time, the standard doctors' service density in the Arctic regions is 30% lower than the national average; the region also lacks paramedics and nurses (8.5% lower than average service density for the republic).

Thus, during this time, the number of regional medical institutions of all types has halved (Gogolev, Burtseva, Avrusin et. al., 2019); inpatient bed capacity was reduced from 2597 to 1239. Certainly, the narrowing of the material basis of regional health care negatively affected the results of its work. If in 2000 there were 400 health encounters per specialist per one work shift, then in 2017 - already 490. This increase in workload clearly results in a decrease in the quality of medical care. For 2000 - 2017, the AZRS exhibited sharp (by 1/3) total growth in all categories of diseases from 9.8 health encounters per 1,000 residents to 12.7. An extremely negative indicator of the unfavorable state of the health care system in the studied region is the fact that the life expectancy of its population is five years less than the average for the Russian Federation. Several administrative measures have been recently taken to improve the situation. Thus, a decision was made to increase wages for all categories of health professionals at the expense of the republican budget. Still, a current condition requires serious organizational and technical support, which, in turn, will take into account the inaccessible nature of the region's territory, its harsh climatic realities, and the focal type of its population distribution. Until recently, light aviation was considered a 'universal tool' for delivering medical care to remote settlements. However, it is quite not perfect in this respect, since it strongly depends on weather conditions. Besides, the annual costs of the republican budget for its use amounted up to 1 billion rubles (Tikhonov, 2010).

Against this background, it appears necessary to consider the opportunity of diversifying the delivery and methods of providing medical care to the residents of the remote parts of the region, along with the possibility of restoring the 'old-fashioned' network of medical institutions (district hospitals, rural paramedical and midwifery stations, antenatal clinics, etc.). Recovering health care institutions is a long process in

all respects. Therefore, it is advisable to precede it with the deployment of mini-health centers equipped with several inpatient beds and a center for outpatient consulting. In this case, the assigned physician or paramedic must be equipped, in addition to drugs and medical equipment, with reliable top-notch computer communications. On the one hand, it is essential for emergency calls and traffic monitoring in the event of the need for emergency hospitalization. However, it's later purpose is to organize the telemedicine system by holding a remote consultation with specialists and ensuring their verbal-visual contact with patients.

DISCUSSION

The aggravation of the ecological situation in the region is largely due to its natural features. Low temperatures, prevailing in the Arctic zone, slow down the process of natural physicochemical decomposition of pollutants, as well as their decomposition by microorganisms. Besides, pollutants cannot penetrate the deep soil layers because of the impermeable permafrost, and therefore they are condensed in significant concentrations in narrow surface layers. This way pollutants get to the animals that eat them, and then - to the humans. Consideration of the ecological and economic situation in the Republic of Sakha in terms of its constituent administrative entities may also reveal certain territorial irregularity. At the same time, the general situation with the environmental pollution in the AZRS is more favorable. The exceptions are Bulunsky and Ust-Yansky uluses, where petroleum products are periodically being spilled at the transportation, storage, and distribution facilities.

The mining industry will obviously remain AZRS's specialization branch in the nearest future. Accordingly, all production in the region, its economic and communal infrastructure, will be formed following its requirements. It means that the impact of this industry on the environment will only increase. Several projects aimed at preserving and restoring derelict lands (Table 3) are in the offing at this time, but since the main focus is still primarily the economic interests, it is quixotic to believe that the situation with local environmental conservation will improve. Taking into account the current ecological setting in the AZRS and the unfavorable prospects for the development of the related situation (Table 3 displays not all but only the largest of economic projects), the following most problematic areas can be identified in the studied region. These are Anabarsky, Bulunsky, and Ust-Yansky districts (Fig. 3). It is these territories that are most susceptible to anthropogenic impact, which, according to the AZRS development plans, will only increase.

The conducted research allows drawing the following conclusions:

1. The territory of the Arctic zone of the Republic of Sakha is characterized by the following environmental problems: poor quality of drinking water for human consumption; discharge of untreated sewage; presence of unauthorized solid waste dumps; lack of solid waste disposal; abuse and violation of land resources, mainly of a man-made nature; poor development of the environmental division of nature management.

2. The following differences between the districts of AZRS should be recognized:

- most of them are dominated by traditional types of activity, except for Anabarsky and Ust-Yansky districts; the projected changes in the structural divisions of nature management, aimed at their strengthening, will mainly affect the very same Anabarsky and Ust-Yansky districts.

Table 3. Major investment projects (Strategy for the socio-economic development of the Arctic zone of the Republic of Sakha (Yakutia) for the period until 2030, 2019)

Region	Economic projects	Environmental projects
Sakha (Yakutia)	- Mineral and raw materials industrial cluster 'Ust-Yana' - 'Development of the Tomtorskoye deposit' - Development of hydrocarbon deposits on the shelf of the East Siberian Sea and the Laptev Sea - Establishment of the Chaun-Bilibino power center - Modernization of the port infrastructure of AO 'Sea Port Tiksi' - Modernization of the port infrastructure of OOO 'Zeleniy Mys seaport' - 'Warm Arctic' - 'Coastal landing' - 'Arctic marble' - 'Gifts of the Wild Arctic'	- 'Efficient waste management' - 'Arctic cleanup program' - 'Transparent environment' project - 'Protection of the animal world' project - 'Model territories of the indigenous peoples of the North' - 'Integrated development of northern (domestic) reindeer herding' - 'Resources of the future fisheries'- the introduction of flexible pipes - Efficient autonomous heat sources

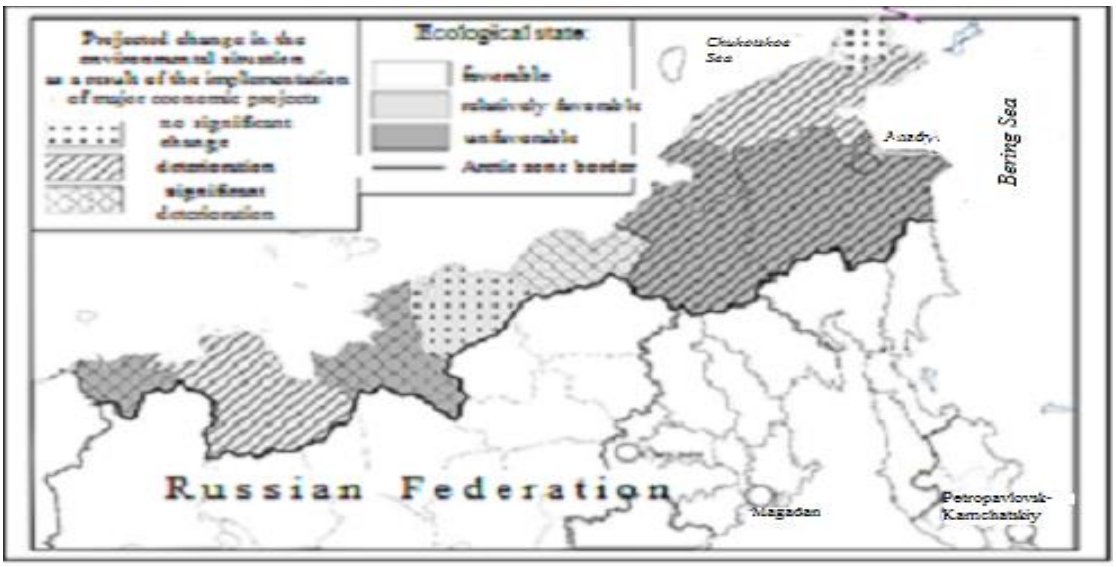

Figure 7. The ecological state of the administrative subjects of the Russian Far East and its projected change

Having regard to the above, the question arises of how the current environmental situation in the Arctic zone of the Republic of Sakha affects the health of local residents. The response to this question is quite urgent since a poor-quality environment is one of the 'starters' for depopulation processes. The impact of the unsatisfactory environment reduces the life expectancy and reproductive abilities of residents and also contributes to their migration outside the ecologically unfavorable territory. This phenomenon is most clearly expressed in regions with extreme natural conditions, where the impact of negative natural and anthropogenic factors on the human body is summed up and therefore gets amplified. The basis for studying this problem in the AZRS was the

monitoring of public health indicators using available statistical materials, field studies, and the results of their office analysis. Therefore, the public health status became the linchpin between the regional natural and socio-economic characteristics, as well as the indicator and criterion of the environmental quality. Thus, the residents' lifestyle acts as an integral factor that determines the state of health (Kosolapov, 1996; Lozovskaya, Stepanko, Izergina, 2014).

Territorial irregularity of ecological and economic conditions in the AZRS caused a variety of differences in the structure and level of adaptation of the population to environmental factors, and as a consequence of this - in morbidity and mortality. This allowed applying a systematic approach in the study, which gives a more accurate forecast of risks to public health and ways to reduce those risks. The results of the monitoring of public health indicators for 2000 - 2019 were employed to study the changes in public health and the quality of life of various groups of AZRS residents. The features of the influence of environmental factors on the indicators of public health were also considered. A medical-geographical analysis of the structural features of health is given (Yakutia outlined the main problems of medical care availability in the northern regions, n.d.)(graphs and map charts 4-8 compiled by A.R. Pogorelov, 2020).

A poor-quality environment is one of the 'starters' for triggering depopulation processes in society. Its effect reduces the life expectancy and reproductive abilities of local residents and also contributes to their migration outside the ecologically unfavorable territory. This phenomenon is most clearly expressed in regions with extreme natural conditions, where the impact of negative natural and anthropogenic factors on the human body is summed up and therefore gets amplified. The health status of the population represents the linchpin between the regional natural and socio-economic characteristics, as well as the indicator and criterion of the environmental quality. Thus, the residents' lifestyle acts as an integral factor that determines the state of health (Kosolapov, 1996; Lozovskaya, Stepanko, Izergina, 2014). It should be noted that the structure of regional morbidity largely depends on the prevailing unsatisfactory ecological and economic situation. This is due to the specifics of the population density when the residents are mainly concentrated in cities and urban-type settlements with a high concentration of production and nearly non-existing full-fledged systems of environmental protection (facilities for the treatment and disposal of industrial and domestic waste).

Given the facts, the problems of this kind are not unique. However, under the subarctic conditions, they are combined with other factors - no less unfavorable for public health. Among them, first of all, should be named the negative impact of harsh climatic conditions on the human body: low temperatures, an extremely uncomfortable annual course of photoperiodicity with a six-month change of day and night, unfavorable wind and atmospheric pressure conditions, magnetic storms. As a result, the AZRS population exhibits a high level of frostbites, colds, hyper- and hypotonic disorders, cardiovascular and endocrine failures, allergic disorders, and tuberculosis diseases. The combination of these diseases produced by the local natural environment with diseases of man-made origin and their mutual pathological intensification creates a special, tremendously tense medical and biological environment (Yakutia outlined the main problems of medical care availability in the northern regions, n.d.).

CONCLUSION

The AZRS region, having great opportunities for further development and attracting investments, is at the same time subject to significant risks. They are formed by the harsh natural conditions of this territory, planetary environmental problems (global warming, thawing of permafrost, etc.), as well as the current ecological and economic situation. Further strengthening of the proposed types of economic activity will lead to an undesirable change in the regional environmental situation, up to irreversible consequences and significant damage to the populations' life activities. Therefore, the priority in projecting the near future activities should be given to those aimed not at industrial development, but the accelerated development in the field of regional environmental protection and public health, including:

- restoration and 'sanitation' of territories exposed to technogenic impact: reclamation of disturbed lands, aerial cleanups from metal and other industrial wastes and unauthorized dumps, establishment and implementation of environmental and resource-saving projects, real active and comprehensive support of the state in the development and maintenance of traditional types of husbandry;
- construction of new and modernization of old (if any) facilities for water supply, sewerage, disposal or recycling of the solid waste following applicable sanitary rules and regulations;
- formation of a holistic medical and biological regional pattern, the development of a set of measures for its improvement concerning both the entire population of the region and its particular groups;
- activities for the restoration of the regional health care system and its transfer to an organizational and technical basis adapted to local conditions.

Implementation of the named measures requires:

- concernment, active participation, and positive help from state and regional bodies;
- adoption of tax incentives and other preferences for business entities that carry out actions to restore and preserve the environment of the Russian Far East, introducing technologies that are environmentally acceptable in the Arctic;
- conduct of large-scale regional studies of the state of public health, complemented by a subsequent package of policies aimed at its improvement;
- adoption and implementation by local authorities of a program for the restoration and modernization of the regional system of delivery of health-care services.

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