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Issue Article

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ON THE IMPORTANCE OF THE SYMBIOSIS OF THE NORTHERN SEA ROUTE AND THE RAILWAY FOR THE EFFECTIVE IMPLEMENTATION OF THE DEVELOPMENT STRATEGY OF THE RUSSIAN ARCTIC

Abstract*: in the article, the authors drew the attention of the leaders of the Russian Arctic regions to the need for a symbiosis of the sea route and the railway, which is possible with a large-scale modernization of two Siberian railway arteries. The first stage of the project (2016-2020) worth 562.4 billion rubles. (reduced as a result of the audit to 520.5 billion rubles) provides for an increase in the carrying capacity of the BAM and the Trans-Siberian Railway in the direction of seaports and border crossings of the Far East to 124.9 million tons (+66.8 million tons compared to 2018) . In 2022 alone, Russian Railways will spend 30 billion rubles on the development of the Eastern railway range. At the second stage (2021-2025), it is necessary to build 1,310 km of additional main tracks, 32 sidings and reconstruct 29 stations, as a result of which cargo transportation along highways will increase to 182 million tons, and by 2025, according to the new order of the president, up to 200 million tons. In total, it is planned to spend about 493.2 billion rubles for these purposes, but these costs will be justified, since the throughput of goods using the Northern Sea Route will increase significantly.*

Key words*: infrastructure, strategy, development, cost, profitability, financial condition, profit, value of TEP, economic potential, accessibility, priority, preferences.*

Language*: English*

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Introduction

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The Government of the Russian Federation develops and approves a unified action plan for the implementation of the Fundamentals of State Policy in the Arctic and this Strategy, which should reflect all stages of the implementation of this Strategy.

The implementation of this Strategy is ensured by coordinated actions of federal government bodies, executive authorities of the constituent entities of the Russian Federation, local authorities, state academies

of sciences, other scientific and educational organizations, funds for supporting scientific, scientific, technical and innovative activities, public organizations, state corporations, state companies, joint-stock companies with state participation and the business community.

To implement this Strategy, it will be necessary to make changes to the state program of the Russian Federation "Socio-economic development of the Arctic zone of the Russian Federation", other state programs of the Russian Federation, state programs of the constituent entities of the Russian Federation, as well as to the development plan for the infrastructure of the Northern Sea Route for the period up to 2035.

The solution of tasks in the field of military security, protection and protection of the state border of the Russian Federation is ensured through the implementation of measures provided for by the state armament program within the framework of the state defense order and state programs of the Russian Federation.

General management of the implementation of this Strategy is carried out by the President of the Russian Federation.

The tasks, functions, procedure for coordinating the activities and interaction of state authorities, local authorities and organizations in the implementation of this Strategy are determined in accordance with the legislation of the Russian Federation.

The implementation of this Strategy is carried out at the expense of the budgets of the budgetary system of the Russian Federation, including at the expense of funds provided for the implementation of the state program of the Russian Federation "Socio-economic development of the Arctic zone of the Russian Federation", and extra-budgetary sources.

The strategy for the development of railway transport in the regions of the Arctic and Eastern Russia has long been in development by the Russian government. State. In 2020, by Presidential Decree No. 645 of October 26, 2020, work began on the implementation of the "Strategy for the Development of the Arctic Zone until 2035". It affects the areas of healthcare, science, education, housing construction, investment, oil and gas production, ecology, etc. The problem of the strategy is one thing - there is no profitable way of transportation for citizens working in the Arctic. The air route is expensive for one person (the average price of a Moscow-Magadan ticket is about 70,000 rubles), sea transport is expensive, long and highly dependent on the time of year and weather. For motorway transport, there are no opportunities to create and maintain road infrastructure. That's why, Of all existing, the most economically and socially beneficial transport is the railway. The prospect of creation is clear on the face. Only under the condition of doing, initially, well. We offer three development options from the solution options -The first implies the usual principle based on the "raw material appendage", i.e. export of energy resources as an economic base. In the future, according to this principle, it will be possible to increase cargo turnover by almost one and a half times, and passenger turnover by 1.16 compared to the previous year.

The second option is already innovations in the development of the country, in which most of the exports will be industrial products made in Russia, which will also make it possible to implement the most ambitious project of the Strategy - the construction of the North Siberian Railway for almost 1900 km. The second most important is the project of the road "Ural Industrial - Ural Polar". Big changes are also expected in Eastern Siberia, where the construction of three canvases will be completed at once. Also, the modernization of old roads and the laying of detours of railway junctions to ensure the safety of passengers and increase throughput are to be carried out.

And in case of failure of the implementation of the first and second development options, a third option is provided. It involves the modernization of the existing communication system and, based on it, the construction of new routes.

It is planned to dynamically expand railways by at least 16,000 km by 2035, freight turnover will increase by more than 1.5 times, and passenger traffic - by 1.33 times.

The Great Northern Route or the North Russian Eurasian Railway, which would connect the main industrial regions of the Urals and Siberia with the seaports of the Arctic Basin by the shortest route, has been an unrealized dream of state-minded Russian industrialists, transport workers and economists for a century and a half.

The need to create ports in directions independent of Europe was well understood by our ancestors, evidence of which is the creation of ports on the coast of the seas of the Arctic Ocean from the semi-legendary Mangazeya to Arkhangelsk and Kola.

However, the Russian politicians of the modern era not only failed to develop the infrastructure in the Arctic that was created with blood and sweat during the Soviet period, but actually brought it to destruction. Fortunately, the strategic mistake was recently recognized, and in recent years, interest in the Arctic has shown itself with renewed vigor.

In accordance with the "Strategy for the development of maritime activities of the Russian Federation until 2035", developed by the State Federal Research Institution "Council for the Study of Productive Forces" (SOPS) and approved by the Decree of the Government of the Russian Federation of December 8, 2010 No. 2205-r, the port infrastructure of Russia must process at all regional sea routes at least 1.1 billion tons of foreign trade cargo. Moreover, a significant increase in capacity in accordance with the previously adopted "Fundamentals of the State Policy of the Russian

Federation in the Arctic for the period up to 2025 and beyond" should be provided mainly through the construction of new and modernization of existing ports on the coast of the seas of the Arctic Ocean.

A doubling of the volume of cargo transshipment through Russian ports from the current level (535.5 million tons in 2021) will also require a doubling of the transportation capacity of railway transport, and, consequently, a serious development of its transport infrastructure, including in the northern direction.

Based on the fact that the Trans-Siberian Railway is currently largely loaded, and the transportation of export coal from Kuzbass to Western ports is characterized by signs of collapse, it is necessary to create a new transport complex based on a new railway line in the main latitudinal direction, which brings cargo flows to seaports like the Arctic and the Pacific basins. And this is exactly the idea, which is already more than 150 years old.

Main part

The idea of building the Great Northern Railway, connecting the future ports of the Arctic and Pacific Oceans, was formed over a century and a half.

Already in 1906, for a more convenient, short and cheap exit of goods from Siberia and the Urals to the Western European market, bypassing St. Petersburg and the Baltic ports, a number of projects were proposed to create a highway through the Urals to one of the bays on the Arctic coast of the European part of Russia, in particular to such as the Indian Bay. The problems of creating a seaport on the Indiga River, connecting it by rail with the Urals and Siberia were actively discussed in the 20s and 40s of the 20th century.

At first, however, preference was given to the Arkhangelsk port due to the centuries-old experience of its operation, as well as the limited technical and economic capabilities of the country to create an additional transport hub. With all the preference for the Arkhangelsk option, even its staunch supporters agreed that over time, the creation of a new seaport serving the export potential of the Urals, Siberia and the North-East of Russia would become an economic necessity.

With the beginning of the Second World War, the situation of the First World War was repeated, when the northwestern ports were cut off by enemy troops. Twice the governments of the country had to urgently look for safety options and turn to the idea of building a port in the Indiga Bay, which is very instructive. However, neither the tsarist nor the Soviet state succeeded in building a new port and a railway to it under military conditions.

The concept of the transport-geographic development of Siberia and the North for the new conditions was developed by the Institute of Economics and Organization of Industrial Production (IEOPP) of the Siberian Branch of the Russian Academy of Sciences under the guidance of Doctor of Economics. Bandman M.K. towards the end of the 1980s.

New Russia received a project that included: completion of the construction of the Baikal-Amur Mainline (BAM) and its transformation into a link in the intercontinental transport bridge "Asia-Pacific Region (APR) - Western Europe" (Tokyo - Dublin); reconstruction of the Trans-Siberian Railway and its transformation into a specialized international-class highway "Trans-Asian Railway", as well as the completion of the construction of the North Siberian Railway (Sevsib) with the commissioning of the Nizhnevartovsk-Ust-Ilimsk section and its connection with a seaport in the southeastern non-freezing part of the Barents Region seas.

According to the developers, this highway (code name - the North Russian Eurasian Railway) should become the axis of the future northern latitudinal transport corridor and the basis for the integration of the Urals, Siberian and Far Eastern problem regions of the resource type. The creation of this highway with a new port in Indiga Bay (in the 30s of the last century - the Northern Gate project) will connect the port of Vanino on the coast of the Sea of Japan with the ports of the White (Arkhangelsk) and Barents Seas. The western link of this highway Ivdel - Indiga with a length of 1200 km (Barentskomur) will give Russia a new sea access to world markets through the western sector of the Arctic Ocean, and the middle link - Ivdel - Khrebtovaya with a length of 3400 km (Sevsib) - access to the BAM (Khrebtovaya - Vanino 4358 km).

Passing entirely through the Russian territory at a considerable distance from the state borders of Russia, near the promising oil and gas bearing territories of Western and Eastern Siberia, the highway can significantly increase the efficiency of the BAM, as well as the national and transport security of the country.

The organizing idea of the Barents Sea project is a geostrategic and feasibility study for the construction of the Ural-Komi-Barents Sea (Indiga) railway, which can not only combine the richest oil and gas reserves of the Siberian North, the unique metallurgical production of the Urals, ore , coal and timber resources of the Komi Republic, but also to open the shortest direct export route for these resources from the continental depths of the Asian part of Russia to the coast of the Barents Sea.

According to Academician V. V. Alekseev, “this road, bringing the heart of continental Asia closer to Western Europe, will create a completely new geo-economic configuration and an inter-civilizational perspective for that set of strategic problems that is today characterized as the “northern dimension” of European integration.”

To solve this problem, scientists of the Siberian and Ural branches of the Russian Academy of Sciences finalized the ideas of Siberian industrialists

and developed a special scientific program "Problem regions of the resource type: economic integration of the European North-East, the Urals and Siberia", which presents the goals and conditions for the integration of neighboring, but transport-disconnected regions. The problematic regions of the Komi Republic, the Sverdlovsk and Tyumen regions, the Krasnoyarsk Territory, the Nenets, Khanty-Mansiysk, Yamalo-Nenets and Taimyr Autonomous Okrugs, as well as the Arctic and Trans-Siberian transport corridors were chosen as the main objects of study. The conducted studies demonstrate a deep synthesis of historical and economic analysis of regional integration processes in the powerful resource-industrial continental core of Russia, which is still rare in science. The detailed analysis given in this work turned out to be extremely useful, since historical experience even today speaks much more about the real background of regional interests and the peculiarities of Russian spatial thinking than the most daring, but abstract projects.

It is also obvious that the new highway, thanks to the reduction in the cost of transportation by reducing the distances for the delivery of goods, will significantly contribute to the development of foreign economic relations of the regions.The development of the country's transport potential is one of the priority tasks of modern Russia, in connection with this, the "Strategy for the Development of Railway Transport until 2035" has been developed. It notes that rail transport is the basis of the country's transport infrastructure. A number of goals for the development of Russian railway transport have been identified:

build a modern, efficient and developed transport infrastructure;

increase the availability of transport services for the population of the country;

increase the level of competitiveness, as well as realize the country's transport potential;

strengthen the integrated security and sustainability of the transport system;

improve the investment situation and give impetus to the development of market relations in the transport complex.

The creation of the North Siberian Railway is an urgent task today, as this will allow us to use new territories of our country, expand the exchange of resources with the regions, which will positively affect the economic situation as a whole.

It is assumed that the Sevsib will pass from Nizhnevartovsk through Bely Yar, Lesosibirsk, Karabula to Ust-Ilimsk, from where there is an exit to the BAM.

This idea was supported by the Institute of Economics and Trade of the Siberian Branch of the Russian Academy of Sciences due to the fact that the construction of the highway allows:

open access to large deposits of Siberia;

shorten the way to the Far Eastern ports;

unload the Trans-Siberian Railway.

It is much easier to resolve issues with the foundation of a parallel to the Trans-Siberian main line in the northern part of the country than to lead a technological branch from each production to the main line. The plans are to leave container and passenger transportation on the Trans-Siberian, thereby giving it the opportunity to become an international high-speed highway, due to the fact that it runs closer to the eastern part of the country. In the future, with the development of other lines, it is planned to connect them to a large highway. The only direction that will not be properly covered is the west.

But if the planned Barents Sea (Barents Sea - Komi - Ural) highway is included in the Northern Siberian Railway, which will be able to redirect the export of products from enterprises in such regions as the Republic of Komi and the Perm Territory from the ports of Ukraine and the Baltic countries to the northern ones closest to them, then this direction will be enabled.

The creation of the North Siberian Railway, according to Leonid Reznikov, Deputy Governor of the Tomsk Region, during the VIth International Forum "Transport and Transit Potential", will bring a significant multiplier effect (taking into account the payback period, it will be about 40 trillion rubles, which is 2, 9 times higher than investments in the development of railway transport).

This will create infrastructural prerequisites for the development of the rich natural resources of the northern regions of the European and Asian parts of the country, which, as a result, will increase the country's transport and raw material security. In the analysis of the Institute of Economics and Trade of the Siberian Branch of the Russian Academy of Sciences, its role was assessed by solving the problem of the national economic level in the options "with the Northern Siberian" and "without the Northern Siberian".

With the presence of the Northern Siberian Railway, the average annual rates of gross output in Russia as a whole and its European part will be higher than without the Northern Siberian Railway (Table 1).

Table 1. Average annual growth rates of gross output, %

Territory	Without SevSib	With SevSib
Russia as a whole	5	6.1

european part of Russia	4.5	6.4
Asian part of Russia	6.4	5.7

A similar situation is expected for individual industries (Table 2). In the "with SevSib" option, the coal industry in the European part of the country hardly increases production, and the incoming new needs are covered with coal from Kuzbass and from the Kansk-Achinsk fuel and energy complex. In the variant "without the Northern Siberian Railway", production costs increase to increase coal production in the European part of the country and reduce the likelihood of an increase in the level of the entire economy, all the main decisive branches of industry.

In the option with Sevsib, the funds of the European part of the country are intended for the growth of more profitable industries here - mechanical engineering, light industry, and ferrous metallurgy. At the same time, in the Asian part of Russia, there is an opportunity to apply economies of scale - to carry out production at new large fields.

Table 2. Annual growth rates of gross output by sectors (%) and territories

Industry	European part		Asian part	
	without SevSib	with SevSib	without SevSib	with SevSib
Coal	8	0.2	2.5	8.3
Energy	0.4	2.1	3.8	3
Non-ferrous metallurgy	5.1	6.9	3.7	6.5
Ferrous metallurgy	2.7	2.5	8.4	2.8
woodworking	7	9	3	12
Light industry	0.9	5	1	2.4
mechanical engineering	9.5	11.5	12.1	12.4

The processing complexes of the European part of the country are more interested in the creation of SevSib, since it is they who receive a stable resource base of the Asian part of Russia, also using it as a guarantee against price fluctuations of the corresponding resources on the world market. Thus, the construction of the North Siberian Railway is one of the main priorities in the development of the transport system of Siberia and the economy of the whole of Russia.

The SevSib project can be compared with similar railway lines, for example, with the Canadian Pacific Railway, which is located in a similar climate zone (Table 3).

Table 3. Comparative evaluation of the North Siberian and Canadian Pacific Railways

	Length, km	Cost, billion dollars
North Siberian Railway	2002	6-12
Canadian Pacific Railway	14000	6

CanadianPacificRailway (CP) is the second largest Class I railroad in terms of revenue and route miles. During 2020, CP transported intermodal containers (22% of revenue), chemicals, plastics and crude oil (14%), grain (24%), coal (10%), fertilizers

and potash (10%), automotive industries, products (6%) and a wide range of other goods.

Canadian Pacific Railway is a paradigmatic example of long-term sustainable business performance and shareholder value creation that has been achieved in core assets.

This comparative analysis makes it possible to construct a hypothesis that the project to create the North Siberian Railway will be no less effective than the Canadian railway.

Back in October 2007, the administration of the Krasnoyarsk Territory announced that it was ready to begin construction of the first section of the Sevsib - the connecting branch of Karabul - Yarka. The cost of the bridge across the Angara and the road, 44 km long, will be about 5.1 billion rubles.

It is noted that SevSib is able to bring even greater returns to the region than the construction of the Boguchanskaya hydroelectric power station, an aluminum plant, a pulp and paper mill, a manganese mine and other facilities of this project.

As a result, it can be noted that in addition to such important aspects as the development of new territories, the unloading of the Trans-Siberian Railway, which is especially talked about today, or the creation of new routes for export, first of all, this is a significant contribution to the development of railway infrastructure, which, according to the state plan , should become the key to the successful development of not only the Siberian region, but Russia as a whole.

Nevertheless, the Sevsib was included in the Strategy for the development of railway transport until 2035 (in its maximum version), but in a greatly curtailed form - only up to Nizhnevartovsk.

And this is a fundamental shortcoming of the project - the closeness of the highway in the western direction. It is not worth counting on the existing line Surgut - Tyumen - Sverdlovsk - it is overloaded and will not take on several tens of millions of tons of additional cargo traffic. The strategy does not envisage the development of the Sevsib in a western direction for the period after 2035.

It makes no sense to build a "castrated" Sevsib. All its multiplier effects will be fully manifested only as part of a single railway line - the North Russian Eurasian - provided that it includes all three blocks: BAM, Sevsib and Barentskomur.

The most probable point of connection between the Barentskomur and the Sevsib is Ivdel (Polunochnoye station), which makes sense to reach from Kolpashevo through Tobolsk (a major port on the Irtysh and the former capital of the Siberian Territory), and not through Nizhnevartovsk. From Tobolsk, the highway should be built through Ustye-Akha and directed to Ivdel along the eastern bank of the river. Tavda. In this case, the Sevsib will be shortened by the segment Bely Yar - Nizhnevartovsk (538 km), and the capital of the Khanty-Mansiysk Autonomous Okrug may be connected to the Russian railway network via Salym (200 km). The missing sections of the connecting line should be included in the railway construction plans.

The Barents Sea will solve the problem of implementing large-scale interregional projects in the problematic resource regions of Russia and, above all, the Ural region, whose reserves have become significantly depleted as a result of intensive two centuries of exploitation.

In the strategic building of a model of transport development in the Arctic, I consider the task of laying a railway from the station. Sosnogorsk to Indiga Bay and the creation of a base seaport there. This will ensure the shortest passage of large-scale cargo from the south of the industrial Urals, from Siberia, Kazakhstan, Asian countries to the Northern Sea Route and further westward - to the countries of Northern Europe and America (east coast), eastward - to the Asia-Pacific countries, Canada and America (west coast), which is also part of the establishment of the Northern Sea Corridor agreed within the Barents Council, and the seaport of Indiga will be developed as the “Northern Gate” of the EU-funded Northern Sea Corridor (NMC) project.

The total length of the railway section Ivdel - Indiga is about 1200 km, the section of the new transport construction of the railway, according to preliminary estimates, is about 1000 km, which is about 250 km less than under the Belkomur project. If we take into account the fact that the branch of the railway Sosnogorsk - Troitsko-Pechorsk was deliberately built with the prospect of continuing to the station. Polunochnoe (project of the 60s, that is, it was more modern than Belkomur), then the conclusion follows that the initial construction of the railway to Indiga Bay is more expedient.

A tangible plus in favor of Indiga is that the distance of exporting goods by rail from the Urals, Siberia, Kazakhstan, the Far East to this seaport is 350-400 km shorter than along Belkomur, which also implies significant savings on the construction of the railway itself and its operation (by about 15–20%).

The construction of the Sosnogorsk-Indiga railway is already included in the Transport Strategy of the Russian Federation for the period up to 2035, however, neither the road nor the port was included in the Federal Target Program "Development of the Russian transport system for 2020-2025" and, accordingly, are not provided with funding. The need to build this railway in conjunction with the creation of a new seaport in Indiga Bay is beyond doubt - the potential cargo-generating base of the area of gravity to the port can range from 15 million tons of cargo in 2018 to 120 million tons in 2035.

The new multi-profile seaport Indiga, in combination with the new Sosnogorsk-Indiga approach line, as part of the Barentskomur railway, will become a basic element of sustainable socio-economic development not only in the Nenets

Autonomous Okrug. In terms of its significance and scale, this project goes beyond the regional framework, since it will be able to make a significant contribution to the formation of a backbone transport network in the North-East of the European part of Russia.

Such an arrangement of railway branches solves the social problems of the regions of the Russian Arctic. As already mentioned, the Tobolsk direction is considered the most preferable option for the withdrawal of Siberian cargo to the Barents Sea, although there are options for continuing the Sevsib through Nizhnevartovsk, Surgut, Khanty-Mansiysk, and the Ob region with a subsequent exit through Nyaksimvol to Troitsko-Pechorsk. But the last option is possible if the project "Ural Industrial - Ural Polar" is implemented.

The Tobolsk option is also attractive in that it is possible to create a large transport hub in its area at the intersection of a railway, road and large river artery, which is part of the Ob water transport system serving an area of about 3 million km (also in the Tobolsk area towards the European part of Russia passes a number of main oil and gas pipelines). This option is also preferable because it will make it possible to create a large transport and logistics center to ensure the "northern delivery" and the polar highway Salekhard - Igarka - Norilsk. Also important is such a moment as the release of the overloaded section of the Tyumen-Yekaterinburg railway from the transport flows of the Khanty-Mansi Autonomous Okrug.

Belkomur or Barentskomur?

The western part of the North-Russian Eurasian Railway provides access to seaports in two directions: Belkomur - to the port of Arkhangelsk and Barentskomur - to the port of Indiga.

There has been a long-standing struggle between these areas, today it is unfolding for state investments in projects: in the first case, to modernize the Arkhangelsk port complex with the construction of a new large port area (Dry Sea) and a railway to it with a length of 1251 km (Belkomur project), in in the second case, the creation of a new port of Indiga and the construction of two sections of the railway to it 612 km and 412 km, respectively (Barentskomur project).

Also such cities as Yakutsk, Megino-Andan, Ust-Nera, Moma, Coal, Ust-Oloy, Dachny, Anyui, Amguzma, Ioniveem, Uzlen and others. These cities have a huge potential for the production of products in demand for the inhabitants of the Arctic zone. This railway branch will ensure the sustainable development of the industrial rise of these cities and the regions in which they are located, and the solution of social problems will follow.

The North-Russian Eurasian Railway from the Pacific port of Vanino (Vanino-Sovetsko-Gavansky industrial and transport hub) to the proposed port of Indiga in the southeastern part of the Barents Sea (hereinafter referred to as the Vanino-Indiga mainline) structurally consists of three sections: Baikal-Amur Mainline (BAM), North Siberian (Sevsib) and Barents Mur. A general view of the new highway is shown in Figure 1.

Picture 1. General scheme and components of the North Russian Eurasian Railway

BAM has already stitched together our vast spaces with “steel stitches”, connecting Taishet and the port of Sovetskaya Gavan. Even in its current state, the BAM with a length of 4287 km (and together with branches - 5.5 thousand km) is one of the largest railway lines in the world. BAM runs north of the Trans-Siberian Railway, branching off from it in Taishet, crosses the Angara in Bratsk, the Lena in Ust-Kut, goes around the lake. Baikal from the north, then passes through Tynda, crosses the Amur at Komsomolsk-on-Amur and ends on the Pacific coast at Sovetskaya Gavan.

BAM has branches, the most important of which is the Amur-Yakutsk Mainline (AYAM) with a length of 1078 km, as well as: to Ust-Ilimsk (215 km); to the Chineyskoye field (66 km); to the Bamovskaya station (179 km), to the Elginskoye coal deposit, to the Izvestkovaya station (326 km); to Chegdomyn (16 km); to the Volochaevka station (351 km), to the Cherny Mys station, where the construction of an underwater tunnel to Sakhalin Island began.

The State Duma of the Russian Federation supported the project for the development of the Baikal-Amur Mainline for the period up to 2025 (the BAM-2 project), pointing out that the sustainable development of the regions of the Far East and Transbaikalia, as well as the solution of federal and regional tasks for the use of the resource, industrial and transit potential of the East of the country are possible only with the implementation of a comprehensive infrastructure project for the reconstruction of BAM. According to the calculations of the developers, the total load on the Northern Latitudinal Railway by 2025 will be 106.8 million tons per year.

The construction of the second section of the North-Russian Eurasian Mainline - the Sevsib - in contrast to the BAM is still only provided for by the Transport Strategy until 2035.

Although by the beginning of the 1980s on the Sevsib route, it would seem that everything was ready for action. A serious impetus was given to the project in 1983 by the Ministry of Transport Construction of the USSR. On his behalf, the Central Research Institute of Transport Construction (TsNIITS) of the Ministry carried out cameral tracing of the Sevsib. In the terms of reference, the need to build a highway was justified by the following words: “At the moment, the Siberian railway network is excessively overloaded. About 70% of rail freight traffic is carried out on lines with a traffic density exceeding 70 million tons per kilometer. In a number of sections there are "bottlenecks" that significantly limit the possibility of increasing cargo turnover. In this situation, the transport network cannot ensure the development of the expected increase in traffic.”

Government decrees officially recognized the completion of all necessary work to substantiate, prepare and develop a program for the development of this region and the construction of the North Siberian Railway. But the year 1991 struck, then the August crisis of 1998 happened, which led to a halt in the project and gave the opponents of the Northern Siberia a pretext to promote the development program for the Lower Angara region.

In this version, the highway will bypass the Vasyugan swamps and pass through the newly discovered unique Bakcharsko-Kolpashevskoye iron ore deposit of the West Siberian iron ore basin, which will make it possible in the near future to provide the Kuznetsk and West Siberian Iron and Steel Works with Bakchar ore and replace the raw materials supplied to the plants from Kovdorsky (?!), Mikhailovsky, Korshunovsky and Kachkanarsky mining and processing plants.

Having received a connection with the Sevsib, the Barents Sea will solve the problem of implementing large-scale interregional projects in the problematic resource regions of Russia and, above all, the Ural region, whose reserves have been significantly depleted as a result of intensive two centuries of exploitation.

In the strategic building of a model of transport development in the Arctic, I consider the task of laying a railway from the station. Sosnogorsk to Indiga Bay and the creation of a base seaport there. This will ensure the shortest passage of large-scale cargo from the south of the industrial Urals, from Siberia, Kazakhstan, Asian countries to the Northern Sea Route and further westward - to the countries of Northern Europe and America (east coast), eastward - to the Asia-Pacific countries, Canada and America (west coast), which is also part of the establishment of the Northern Sea Corridor agreed within the Barents Council, and the seaport of Indiga will be developed as the “Northern Gate” of the EU-funded Northern Sea Corridor (NMC) project.

The total length of the railway section Ivdel - Indiga is about 1200 km, the section of the new transport construction of the railway, according to preliminary estimates, is about 1000 km, which is about 250 km less than under the Belkomur project. If we take into account the fact that the branch of the railway Sosnogorsk - Troitsko-Pechorsk was deliberately built with the prospect of continuing to the station. Polunochnoe (project of the 60s, that is, it was more modern than Belkomur), then the conclusion follows that the initial construction of the railway to Indiga Bay is more expedient.

A tangible plus in favor of Indiga is that the distance of exporting goods by rail from the Urals, Siberia, Kazakhstan, the Far East to this seaport is 350-400 km shorter than along Belkomur, which also implies significant savings on the construction of the railway itself and its operation (by about 15–20%).

The construction of the Sosnogorsk-Indiga railway is already included in the Transport Strategy of the Russian Federation for the period up to 2035,

however, neither the road nor the port was included in the Federal Target Program "Development of the Russian transport system for 2020-2025" and, accordingly, are not provided with funding. The need to build this railway in conjunction with the creation of a new seaport in Indiga Bay is beyond doubt - the potential cargo base of the area of gravity to the port can range from 15 million tons of cargo in 2020 to 120 million tons in 2035 (Figure 2).

The creation of a port transport hub in Indiga will turn hundreds of mineral deposits in the Nenets Autonomous Okrug, previously "locked" in vast expanses of tundra and taiga, into profitable and economically more attractive for investors, both domestic and foreign.

The new multi-profile seaport Indiga, in combination with the new Sosnogorsk-Indiga approach line, as part of the Barentskomur railway, will become a basic element of sustainable socio-economic development not only in the Nenets Autonomous Okrug. In terms of its significance and scale, this project goes beyond the regional framework, since it will be able to make a significant contribution to the formation of a backbone transport network in the North-East of the European part of Russia.

Figure 2. Scheme of the railway line Barentskomur on the territory of the Nenets Autonomous Okrug

As already mentioned, the Tobolsk direction is considered the most preferable option for the withdrawal of Siberian cargo to the Barents Sea, although there are options for continuing the Sevsib through Nizhnevartovsk, Surgut, Khanty-Mansiysk, and the Ob region with a subsequent exit through Nyaksimvol to Troitsko-Pechorsk. But the last option is possible if the project "Ural Industrial - Ural Polar" is implemented.

The Tobolsk option is also attractive in that it is possible to create a large transport hub in its area at the intersection of a railway, road and large river artery, which is part of the Ob water transport system serving an area of about 3 million km (also in the Tobolsk area towards the European part of Russia passes a number of main oil and gas pipelines). This option is also preferable because it will make it possible to create a large transport and logistics center to ensure the "northern delivery" and the polar highway Salekhard - Igarka - Norilsk. Also important is such a moment as the release of the overloaded section of the Tyumen-Yekaterinburg railway from the transport flows of the Khanty-Mansi Autonomous Okrug.

The western part of the North-Russian Eurasian Railway provides access to seaports in two directions: Belkomur - to the port of Arkhangelsk and Barentskomur - to the port of Indiga.

There has been a long-standing struggle between these areas, today it is unfolding for state investments

in projects: in the first case, to modernize the Arkhangelsk port complex with the construction of a new large port area (Dry Sea) and a railway to it with a length of 1251 km (Belkomur project), in in the second case, the creation of a new port of Indiga and the construction of two sections of the railway to it 612 km and 412 km, respectively (Barentskomur project).

Which of the projects is the most profitable and promising?

Large-scale development of the Arkhangelsk seaport is hindered by many circumstances. First of all, this is the shallow water of the mouth of the Northern Dvina River, where the port complex is located, which necessitates the constant performance of a large amount of dredging to maintain the fairways and berths. Also, there is practically no possibility of increasing the carrying capacity of received vessels - the limit of their deadweight is 10-12 thousand tons. Although in the planned new area of the port (Dry Sea), located at the exit from the mouth 60 km from the city, it is possible to receive ships of a larger carrying capacity - up to 150 thousand tons, but this is due to large dredging and construction of additional transport infrastructure linking the port with the city.

Another negative factor hindering the significant development of the Arkhangelsk port is the need to provide icebreaking assistance to ships for most of the year. The situation is exacerbated by the fact that the neck of the passage from the White Sea to the Barents Sea between the Kola Peninsula and the Mainland is clogged with ice for most of the year, driven here by currents and pushed out of the northern rivers. Due to these two circumstances alone, the costs of maintaining normal navigation in the port of Arkhangelsk are estimated to be several times higher than in Murmansk and even in the supposed more northerly port of Indiga, not to mention the fact that the distance of ice assistance from the port of Arkhangelsk is about 4 times longer, than from Indiga (about 800 km versus 200 km).

In addition, the development of the Arkhangelsk port is counterproductive for organizing transportation to the East.

Vice-President of the Komi Republican Association of Independent Experts Vladimir Andrianov, since 1971, having been engaged in the justification of the logistics of the development of mainline railways in the European North of Russia, in collaboration with well-known transport specialists in relation to the Belkomur project, in particular, indicates the following:

“A significant drawback (minus) in the emphasis on the use of Belkomur appears after an audit review of the technical condition of existing railways in the Arkhangelsk-Grigorievskaya (Gorkovskaya railway) and Indiga-Polunochnoye zones. The creators of Belkomur either do not have reliable and complete information, or deliberately keep silent about some facts. Let's consider them specifically.

The railway line from Arkhangelsk to Karpogor was built as a deliberately lightly loaded, dead-end logging route. The construction technology and the equipment used in the late 40s do not allow using it without a radical reconstruction. From this it follows that this section of the new railway line will have to be built practically from scratch, since over the 70 years of its operation, the technical conditions of the main railway construction and operation have changed dramatically. Approximately the same technically obsolete are the railway lines from Vendinga (Ertom), located on the border of the Komi Republic and the Arkhangelsk region, to Mikun station and further to Syktyvkar. These are also dead-end, underutilized and technically obsolete railways with an underdeveloped industrial infrastructure. As a matter of fact,

Due to these reasons, the capital investments in the construction of the highway, interpreted by the current developers of the Belkomur project, should be increased by two to three times compared to those currently presented. Now let's look at the same indicators of the Barents Sea project. In terms of depth, the situation in Indiga Bay is even better than in Murmansk - the carrying capacity of ships there will not be limited by depths, and the construction of the port will not require significant dredging. In addition, the coastline from Cape Svyatoy Nos (the mouth of the Indiga River) to Cape Barmin or Bolshoi Rumyachniche, more than 40 km long, is completely free and suitable for the construction of a giant port of any capacity with a developed port infrastructure. For this site, the excess of the coastline above sea level is 8-12 m, which guarantees its stable operation in the event of an increase in the level of the World Ocean, predicted as a result of global warming. Whereas the Arkhangelsk port, along with St. Petersburg and Ust-Luga, is subject to such a threat.

The analysis of ice maps carried out since 2000 shows that the movement of ships without icebreaking escort in the western direction is possible 7-8 months a year, in the eastern direction - 4-5 months. The duration of icebreaking navigation in this area is explained by the influence of the warm current of the Gulf Stream and the systematic destruction of ice in the Indiga Bay by tidal wave energy. A big plus in favor of Indiga, as already mentioned, is that the distance of delivery of goods by rail from the Urals, Siberia, Kazakhstan, the Far East to this seaport is 350-400 km shorter than to Arkhangelsk (savings in the construction of a railway roads).

Another significant advantage of Barentskomur over Belkomur is that the organization of export-import operations through the port of Indiga makes it possible to reduce the sea route of ships by 500–600 km in the western direction and by more than 1000 km in the eastern direction. And this significantly reduces

the annual transportation costs of cargo owners and reduces the investment payback of the project. Obviously, in general, the Barents Sea is a more profitable and promising project, which, if not today, then in the future, is destined to become the final link of the railway lines - the meridional West Ural and the latitudinal North Russian Eurasian. This will ensure a stable connection between the port of Indiga on the Arctic coast and the port of Vanino on the Pacific coast, as well as many problematic regions of the resource type of the Russian North (Figure 3).

Modernization of BAM and Transsib will pay off with interest. In the coming years, Russia needs to "make a real breakthrough in the development of the country's transport infrastructure. Among the priorities is a large-scale modernization of the BAM and the Trans-Siberian Railway, an increase in their throughput capacity in 2025 to over 200 million tons of cargo per year." This task was set by President Vladimir Putin in his circulation on the occasion of the 45th anniversary of the start of construction of the Baikal-Amur Mainline. He expressed confidence that the current generation of railway workers, builders, workers, engineers will be able to adequately continue the work begun by their predecessors.

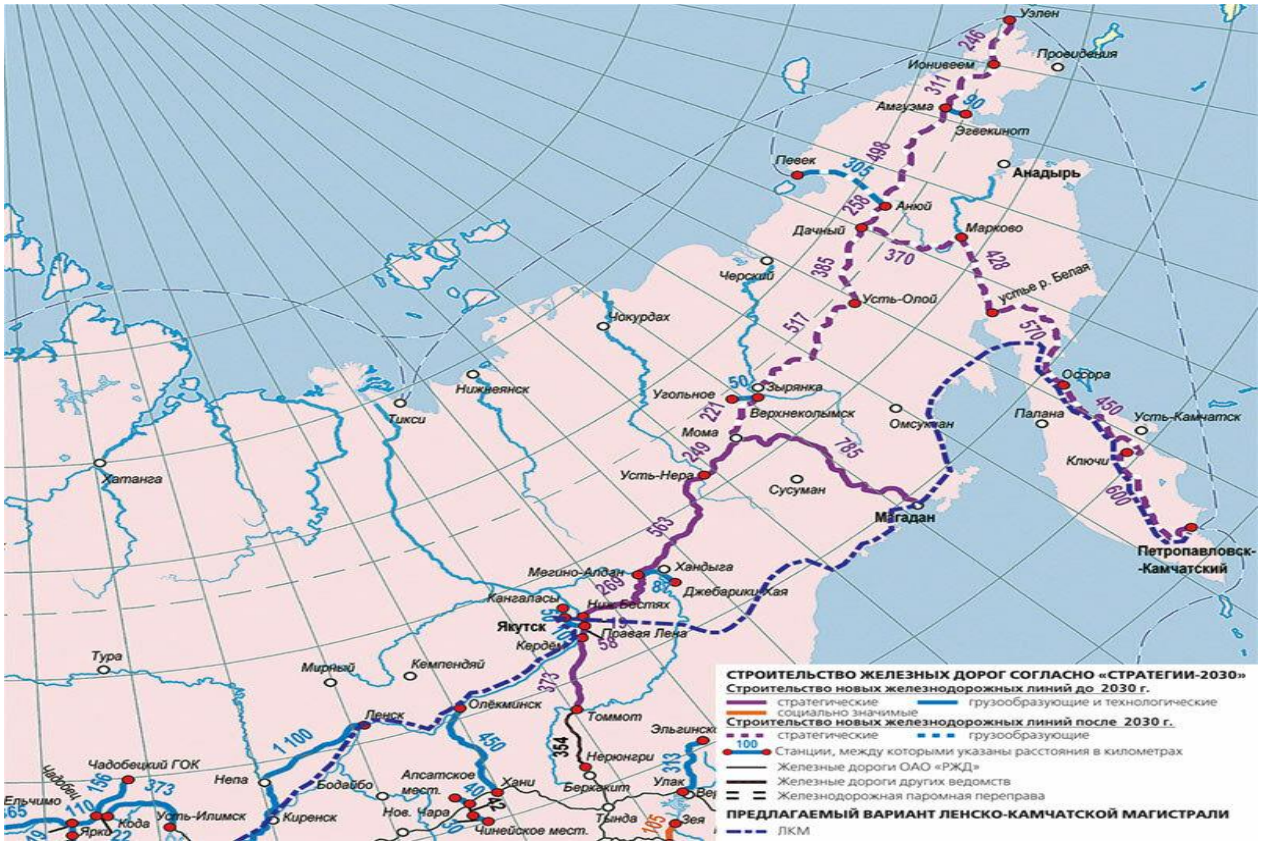

Figure 3. Scheme of the construction of the North Russian Eurasian Railway.

Today BAM is almost 4 thousand km of railway lines from Taishet to Sovetskaya Gavan. The highway has about 200 stations and sidings, crosses 11 large rivers and seven mountain ranges. More than 2,000 bridges have been built here, 10 tunnels have been built, including the recently built longest in Russia (over 15 km) Severomuysky tunnel. The whole country worked on such a large-scale object. "The builders of the route, new cities and towns, surveyors, railway workers, bridge builders and tunnelers, volunteers, inspired by a common idea, worked for the future, accomplished a real feat day after day," V. Putin emphasized (Figure 4).

Now the country enjoys the fruits of their labor, loading the Far Eastern ports with Siberian products, the cargo turnover of which is growing by leaps and bounds due to the reorientation of business to the Asia-Pacific region (APR). Since 2008, "the busy North-West began to lose traffic volumes, which turned around 180 ° and began to load the Trans-Siberian and BAM. The Far East was not ready for such growth, and in just a few years, the throughput and carrying capacity reached the maximum limit values, "says Pavel Ivankin, chairman of the expert council of the Institute for the Study of Railway Transport Problems (Figure 5).

From 2004 to 2020, the volume of transshipment in the Far Eastern ports really increased by almost 3 times (from 70 million to 200 million tons), and this is far from the limit. But the problem is that further growth will hit the "bottlenecks" of the railway. Today, "we have a surplus of port facilities and a shortage of infrastructure," concludes the deputy. General Director of the Managing Port Company Irina Olkhovskaya.

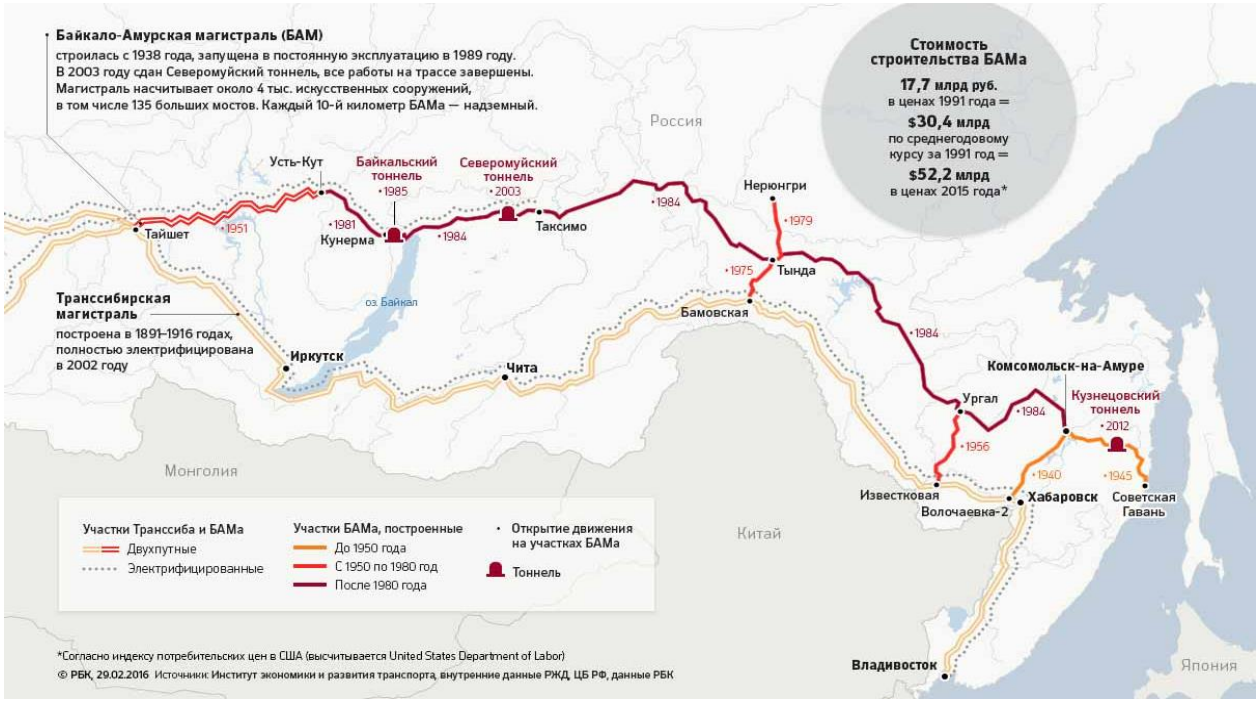

Figure 5. How the Baikal-Amur Railway (BAM) was built

Indicative in this regard was 2017, when the farmers of Western Siberia gathered a record harvest, but faced difficulties in exporting grain. There were simply not enough wagons. Moreover, there is no objective need to drive Siberian grain to distant lands to overloaded Azov-Black Sea or Baltic ports, when the Asia-Pacific region with its largest importers (Indonesia, Japan, China, South Korea) is nearby. Therefore, "it is very promising for us to increase the volume of transportation [to the Far East] by rail," emphasizes Gleb Popovtsev, deputy of the Legislative Assembly of the Novosibirsk Region.

The same situation with coal. Today, the Kemerovo region, which produces 60% of Russian coal, and the south of Yakutia, where coal deposits of coking grades are located, are limited in its transportation to the Asia-Pacific region, where the world's largest importers (China, India and Japan) are concentrated. "If the capacity [of the railway] increases, [then] coal production will increase, the taxable base will increase. This is an impetus to the further development of the coal industry and the economy of Kuzbass as a whole," Oleg Tokarev, head of the Department of the coal industry of the region, is sure. Infrastructure is also needed not only for commodities, but also those subject to containerization.

The second tempting prospect is to become a key transit link in Chinese-European trade by land, which primarily, of course, concerns rail container traffic. So far the dynamics are good. "A few years ago, we could only assume that almost 600,000 containers would go through Russia. To date, this result has been achieved. We see an increase of an additional 30% compared to the previous year," said Oleg Belozerov, Chairman of the Board of Russian Railways, speaking at the International Railway Congress in Vienna.

But you can't stop there. "Now it is very important for us that we make the following decision, move forward, continue construction, develop BAM and the Trans-Siberian Railway. This will give us a job, give us the opportunity to move faster, give a new impetus to the Russian economy," said the head of the Ministry of Transport, Yevgeny Dietrich. By the way, if the composition from China to the EU is full, then in the opposite direction it is half empty, which gives additional opportunities to domestic producers.

Let us recall the milestones of the large-scale modernization of the BAM and the Trans-Siberian Railway, which were determined by V. Putin - an increase in their throughput in 2025 to over 200

million tons of cargo per year. To achieve such a result, it is necessary not only to build additional tracks, tunnels and interchanges, but also to increase the speed of movement. "Containers will be delivered from Vladivostok to the western border of Russia in 7 days," the president said in his last year's address to the Federal Assembly, and in his May decree he set the task of increasing the volume of transit container traffic by 4 times by 2025. Without a doubt, it will not be possible to do this without a large-scale modernization of the two Siberian railway arteries, but the investments will pay off with interest.

The first stage of the project (2013-2020) worth 562.4 billion rubles. (reduced as a result of the audit to 520.5 billion rubles) provides for an increase in the carrying capacity of the BAM and the Trans-Siberian Railway in the direction of seaports and border crossings of the Far East to 124.9 million tons (+66.8 million tons compared to 2012) . This year alone, Russian Railways will spend 30 billion rubles on the development of the Eastern railway range.

"In order to increase cargo traffic, it is planned to put into operation more than 45 km of new second tracks on the BAM sections. Open traffic on the stages Lena Vostochnaya - Predlensky and Delbichinda - Daban. It is also planned to reconstruct three stations: Vikhorevka, Bayronovka and Meget," the press service of the East Siberian Railway (VSZhD) notes (Figure 6).

Figure 6. Modernization scheme of the Baikal-Amur Railway (BAM)

True, it will be difficult to meet the deadlines due to the accumulated backlog. "At the end of 2020, Russian Railways did not complete a number of facilities. For example, in accordance with the passport of the project "Development of the BAM and Trans-Siberian Railway", in 2020, 11 sidings and 78 km of additional tracks were to be built. At the end of the year, only one object was accepted (reconstruction of the subgrade at the section of the western BAM "Khani – Tynda")," the Accounts Chamber concluded following the results of the audit. However, the head of Russian Railways, O. Belozerov, assures that the project will be completed on time.

At the second stage (2021-2025), it is necessary to build 1,310 km of additional main tracks, 32 sidings and reconstruct 29 stations, as a result of which cargo transportation along highways will increase to 182 million tons, and by 2025, according to the new order of the President, up to 200 million tons. In total, it is planned to spend about 493.2 billion rubles for these purposes.

Russian Railways has already begun developing project documentation for the construction and modernization of a total of 84 facilities as part of the second stage of the modernization of BAM and the Trans-Siberian Railway. Particular attention is paid to the 15-kilometer Severomuysky tunnel. Today, it can only pass 16 trains per day (22 including detours). By reducing the interval and strengthening the traction power supply at the mountain pass section, it is possible to get on 27 pairs of trains weighing up to 6300 tons. This is the maximum, but it is too little. The introduction of digital technologies, for example, interval control of train traffic, which are successfully used on the Moscow Central Circle, can expand the "bottleneck" of BAM by 15-20%.

But only the construction of a new tunnel can radically solve the problem. Moreover, state finance may not even be needed here. "We intend to implement this project at our own expense, and we take all the risks," said Mikhail Umrikhin, a representative of the Sibanthracite company, and estimated its cost at 60 billion rubles, and the timeframe at 5 years.

One way or another, without a modern infrastructure, neither "sew" the country, nor unleash

the economic potential of Siberia and the Far East, nor diversify foreign economic relations for sure. In addition, by increasing the capacity of the railways, "we will build the largest transport corridor from the Asia-Pacific countries to the EU states. Russia will take a key place in the global traffic flows," Viktor Zubarev, State Duma deputy from the Krasnoyarsk Territory, justifiably emphasizes.

Today, every educated person understands that the Arctic is not just Russia's tomorrow, it is its future, its chance to remain a great maritime power, using its geographical and strategic position to extract economic benefits and increase its influence in the world. And scientists, specialists in the transport industry have a great responsibility to determine specific scientifically based directions for the economic development of Russia and the use of its Arctic resources, including transport.

The entrance to the Severo-Muisky Tunnel provides an increase in freight traffic throughout the country (Figure 4).

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Conclusion

Let us recall the milestones of the large-scale modernization of the BAM and the Trans-Siberian Railway, which were determined by V. Putin - an increase in their throughput capacity in 2035 to over 200 million tons of cargo per year. To achieve such a result, it is necessary not only to build additional tracks, tunnels and interchanges, but also to increase the speed of movement. "Containers will be delivered from Vladivostok to the western border of Russia in 7 days," the president said in his last year's address to the Federal Assembly, and in his May decree he set the task of increasing the volume of transit container traffic by 4 times by 2025. Without a doubt, it will not be possible to do this without a large-scale modernization of the two Siberian railway arteries, but the investments will pay off with interest.

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Issue Article

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ON THE PROSPECTS FOR STRATEGIC MANAGEMENT OF SUSTAINABLE DEVELOPMENT OF THE AGRICULTURAL SECTOR OF THE ECONOMY IN THE REGIONS OF THE RUSSIAN ARCTIC

Abstract*: in the article, the authors, after analyzing the methodological and practical provisions on the strategic management of the sustainable development of the agricultural sector of the Russian Arctic regions, proposed the following recommendations for their implementation, namely:*

the need for strategic management of agriculture is due to overcoming the crisis situation in the industry;

the stages of strategic management of the agricultural sector are proposed, including trends, problems and risks of development, SWOT analysis, formulation of a strategic goal, scenario forecast of results, substantiation of priority areas of development, creation of an effective mechanism for the implementation of the Strategy.

The authors believe that the key problems of the development of agriculture in the regions of the Russian Arctic are:

destruction of the material and technical base of the industry due to lack of investment;

increase in depreciation of fixed assets; a sharp reduction in cultivated agricultural land, livestock and poultry, and the number of employees;

deterioration of agricultural land;

the narrowness of the sphere of application of labor due to the reduction of agricultural production and the underdevelopment of non-agricultural activities;

shortage and low quality composition of managers, specialists and cadres of mass professions;

low wages; underdevelopment of engineering, social, innovation and market infrastructure, which allowed them to identify the strategic goals of agricultural development;

ensuring high and sustainable growth rates of agricultural production;

complete self-sufficiency of the population with potatoes and vegetables of the open ground of the local assortment;

increasing self-sufficiency in livestock products;

bringing the level and quality of life of the peasants closer to the urban population.

Key words*: infrastructure, financial condition, stable TEP, agrarian economy, social and economic development, innovations, priorities, profit, investments of regions.*

Language*: English*

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Introduction

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Currently, the northern village and the agricultural sector of the Russian Arctic are experiencing a systemic crisis. There is a reduction in the number of rural population, degradation of infrastructure and production potential. In the agricultural sector, especially in the rural periphery, the production of all types of agricultural products is falling. Overcoming the crisis requires the need for strategic management of rural areas and the agricultural sector. The need to develop a strategy for the sectors of the economy of the country and its regions is provided for by the Federal Law "On Strategic Planning in the Russian Federation". On the basis of the conducted studies, methodological approaches to the strategic management of sustainable development of agriculture are proposed. Trends in the development of the agricultural sector, its problems and risks are revealed. Conducted strategic analysis, based on the study of the external and internal environment, the strengths and weaknesses, opportunities and threats for the development of the agricultural sector of the Russian Arctic regions are assessed. The goals of the Strategy were defined, providing for a sustainable growth of agricultural production and increasing self-sufficiency in crop and livestock products. As a priority goal of the long-term development of the industry, it is planned to overcome the disproportion in the standard of living of the urban and rural population. To achieve the stated goals, priority areas for the development of agriculture were identified and (Syktyvkar, Russia) a scenario forecast of the results was made. It has been established that the most acceptable is the optimistic scenario based on innovative modernization, a multi-structural agrarian economy, sustainable development of rural areas, rational within the regional distribution of agro-food production, development of cooperation and integration, improvement of economic relations in the agro-industrial complex. The mechanism of the Strategy has been developed, including the instruments of regulatory, legal, organizational and financial support. The obtained methodological and practical recommendations can be used by regional and municipal authorities of the Republic of Komi in the development of strategies for sustainable socio-economic development of the agricultural sector.

A fruitful life in a harsh climate is possible with good nutrition. The lack of fresh food here has a depressing effect on a person and sharply reduces his ability to work. Own agricultural production in the regions of the North is aimed at providing the population with meat, milk, sea, river and lake fish, eggs, vegetables, wild plants. These food products are indispensable in the rational nutrition of residents in extreme natural conditions, and are also medicines. The preservation of agricultural production will help solve the problems of employment of indigenous ethnic groups, preserve their historical way of life, contain prices for imported food, sustainable development of rural areas, ensure the country's food sovereignty, and reduce population migration from the regions of the Russian Arctic.

In the course of market reforms in the countryside and in the agrarian sector of the northern region, such problems as the deterioration of the demographic situation, the level and quality of life, the growth of poverty and unemployment, the reduction of social and engineering infrastructure, the reduction in the accessibility of the rural population to social benefits (education, health care, culture, consumer services), the destruction of the material and technical base, a sharp reduction in the production potential in agriculture, the fall in the production of agricultural products.

The change in the negative situation necessitates the search for new mechanisms for the development of the countryside and the leading branch of the rural economy - the agricultural sector. Long-term strategic management is an effective way of stabilizing and sustainable socio-economic development of the agricultural sector.

In the countries of North America and Western Europe, long-term planning and forecasting of the agrarian sector has been widely developed. When forecasting, many methods are used, including methods of economic and mathematical modeling. In the United States, strategic plans for the development of agriculture are developed by the Department of Agriculture. In the US agrarian strategy in the 21st century, the main goals of agricultural development are four: the production of an abundance of high-quality agricultural products at affordable prices; maintaining a favorable economic climate for farmers; maintaining the family form of farming as the basis of the production system; ensuring a high standard of living for rural residents.

In foreign countries, programming is used as a strategic approach to the development of rural areas. The most complete and complete picture of the models and concepts of rural development in Western Europe, the implementation of this policy with the

help of state support instruments was carried out by Francesco Mantino.

Currently, in the country as a whole and in the regions of the Russian Arctic in particular, there is no strategy for the development of the agricultural sector. According to I. G. Ushachev, it is necessary to develop and adopt a Strategy for sustainable socio-economic development of the agro-industrial complex of Russia. The regulatory framework for the development of an industry strategy is the Federal Law "On Strategic Planning in the Russian Federation".

It is proposed to develop methodological and practical recommendations for the strategic management of sustainable socio-economic development of the agricultural sector of the Russian Arctic regions.

Strategic management as a scientific direction in relation to socio-economic systems arose in 1960–1970, the main functions of which are the analysis of challenges and threats of the external environment, the setting of strategic goals and the choice of the most effective means of achieving the set goals.

The new encyclopedia defines strategy as “a way of using means and resources aimed at achieving a certain goal and taking into account the conditions of the external environment”. With regard to the agricultural sector, the strategy can be viewed as a system of measures aimed at achieving specific goals and results in the face of challenges and threats from the external environment.

In economic science, the opinion has taken root that planning and forecasting are management functions.

The Federal Law "On Strategic Planning in the Russian Federation" considers strategic planning in the sectoral and spatial aspect. In Art. 19 of the law "Sectoral strategic planning documents of the Russian Federation" it is noted that sectoral strategic planning documents determine the development of a particular sector of the economy and can be the basis for the development of relevant state programs of the Russian Federation and its constituent entities, target program documents of state corporations, state companies and joint-stock companies with government participation. The process of strategic management of the socio-economic development of the agricultural sector includes several successive stages:

at the first stage, trends in the development of agriculture are considered, its state is analyzed, key socio-economic problems and risks are identified;

at the second stage, a strategic (SWOT) analysis is carried out, based on a study of the external and internal environment, strengths and weaknesses, opportunities and threats to the development of the agricultural sector are assessed;

at the third stage, the goals and objectives of the long-term development of agriculture are determined;

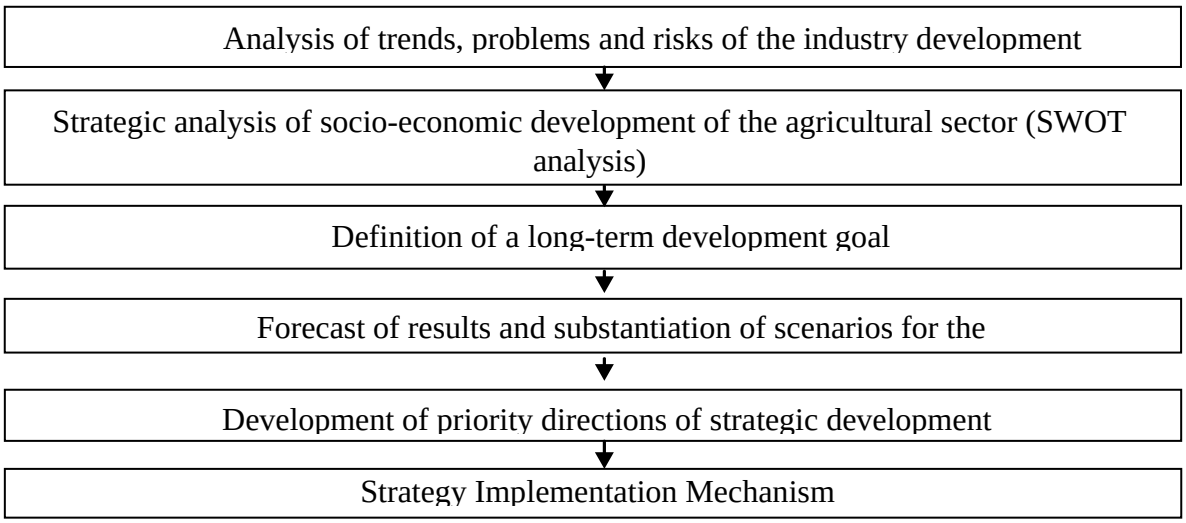
at the fourth stage, a long-term forecast of results is made based on scenario options for the development of the industry;

at the fifth stage, priority directions for the development of agriculture are substantiated;

at the final stage, in order to achieve the set goals, a mechanism for implementing the Strategy is being developed.

The sequence of stages of strategic management of the socio-economic development of the agricultural sector is shown in Figure 1.

Strategic management of the sustainable development of the agricultural sector includes four levels: federal, regional, municipal, level of organizations and farms. For each level of strategic management of agriculture, characteristic problems, factors and conditions that ensure the competitiveness of manufactured products are studied, specific strategic goals and strategic directions of development are determined.



Picture 1. Stages of strategic management of socio-economic development of agriculture

Main part

The development of strategic management of sustainable socio-economic development of the agricultural sector of the Russian Arctic regions is based on the documents of the Russian Federation that determine the state policy in the agro-industrial complex: Doctrine of food security of the Russian Federation (2001); State program of the Russian Federation "Development of agriculture and regulation of agricultural products, raw materials and food markets for 2020-2025" (2012); State program of the Russian Federation "Development of the fishery complex for 2020–2025" (2014); Strategy for the development of the food and processing industry of the Russian Federation for the period up to 2025 (2012); The concept of sustainable development of rural areas of the Russian Federation for the period up to 2020 (2010); FPC "Sustainable Development of Rural Territories of the Russian Federation for 2014-2020 and the period up to 2025" (2013); Strategy for sustainable development of rural areas of the Russian Federation until 2035 (2015); Fundamentals of the state policy for the use of the land fund of the Russian Federation for 2020–2025 (2012); FTP "Development of melioration of agricultural lands in Russia for 2020–2025" (2013). The strategic management of the agricultural sector is also based on the provisions of the State Program of the Republic of Komi "Development of agriculture and regulation of agricultural products, raw materials and food markets, development of the fishery complex of the Republic of Komi for 2025-2030-2035". The agrarian sector in the narrow sense refers to agriculture. In a broad sense, this concept is identified with the agro-industrial complex (AIC) and its subdivision - the food sector. The agro-food sector of the Russian Arctic regions, which includes agriculture, processing of its products, hunting, fishing, fish farming, picking mushrooms and berries, does not occupy a leading position in the economy. Now the share of agriculture accounts for 1.5% of the gross regional product, 0.4% of investments in fixed capital, 1.2% of the average annual number of people employed in the economy. But at the same time, agriculture performs a variety of economic functions (production, socio-demographic, cultural, environmental, recreational, spatial and communication, social control, political). In the history of the development of agriculture in the regions of the Russian Arctic, the most favorable years were the 1960s–1980s. The analysis of the dynamics of indicators of the efficiency of agricultural production using regression equations showed that in the regions of the Russian Arctic the average annual growth rate of gross output per capita, indicators of crop yields, milk yield, average daily gain in live weight of pigs exceeded similar indicators in the North-West (Figure 2).

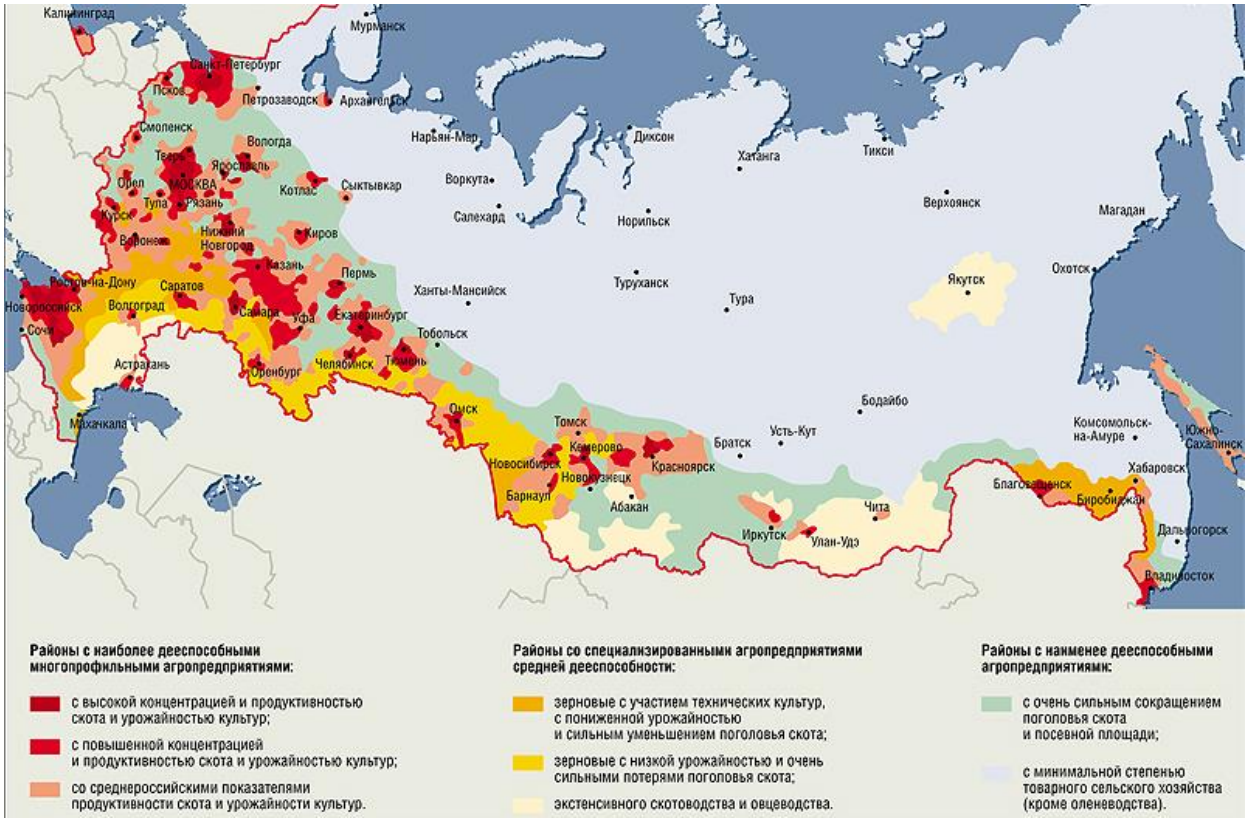
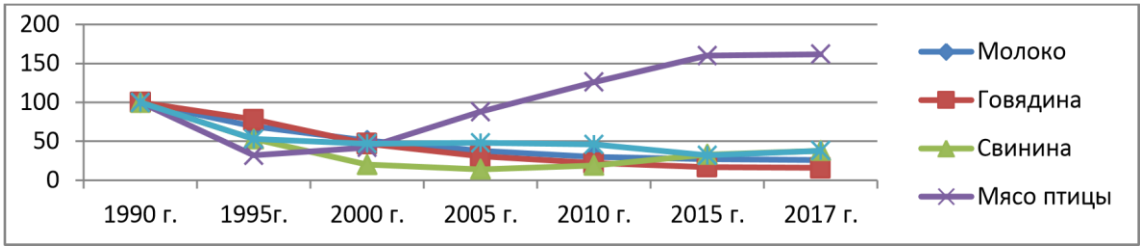


Figure 2. Characteristics of agricultural enterprises in the Russian Federation

In the regions of the Russian Arctic, the rates of increasing the volumes of poultry and pork were the highest. For 1970–1990 with a general increase in meat of all kinds by 2.4 times, the production of poultry meat increased by 10.8 times, pork - by 4.2 times. This is the result of a program for the industrial development of poultry and pig breeding.

The market transformation of the agrarian economy was accompanied by a sharp decline in livestock production, especially in the 1990s. (Figure 2). For 1990–2020 the production of cattle meat decreased by 6.6 times, pork - 2, milk - 3.8, eggs - 2.7 times. There was only an increase in the production of poultry meat (59%) due to the development of poultry meat.



Picture. 2. Dynamics of livestock production in all categories of farms in the Russian Arctic regions for 1990–2020 (1990 - 100)

Table 1. Production of livestock products by municipalities of the regions of the Russian Arctic, thousand tons

Products	*Peripheral regions*		*suburban areas*		*Other areas*		*urban districts*	
	1990	*2020*	*1990*	*2020*	*1990*	*2020*	*1990*	*2020*
Meat (live weight)	*12.8*	*2.0*	*21.5*	*29.3*	*6.8*	*1.2*	*11.9*	*2.3*
Milk	*62.9*	*14.0*	*51.3*	*20.1*	*44.5*	*9.9*	*48.4*	*10.6*
Egg, million pieces	*1.9*	*1.7*	*99.4*	*110.4*	*2.9*	*2.6*	*261.2*	*22.6*

The highest rates of reduction in livestock production were observed in the peripheral regions of the Russian Arctic regions (Table 1).

As can be seen from the above data, in 2021, compared with 1990, meat production here decreased by 6.4 times, milk - by 4.5 times, eggs - by 11%. In agricultural producers of suburban areas, the increase in meat was 36% and eggs - 11%. The steady decline in the production of beef and veal has affected the decline in its share in the total meat production. The share of cattle meat decreased from 36.5% in 1990 to 8.9% in 2017, while poultry meat increased from 24.1% to 61.0%.

A model of a free market without taking into account the mentality of the peasants, the features of functioning. In the regions of the Russian Arctic for 1990–2020 the number of agricultural organizations decreased by 4.3 times, the number of employees in them - by 7.8 times. The sown areas decreased by 3.2 times, including potatoes - 20, open ground vegetables - 35 times. During the years of reforms, the number of cattle decreased by 8.3 times, including cows - 7.2, pigs - 2.3, poultry - 2.2, deer - 1.5 times. During this period, in agricultural organizations, the production of potatoes decreased by 33.6 times, vegetables - 6.2, cattle meat - 15.8, milk - 4.8, eggs - 2.7 times. In the households of the population, an increase in milk production was observed until 2000, meat - until 1995. The decline in crop and livestock production was due to a reduction in sown areas and livestock. In 2020 compared with 1990, the sown area in all categories of farms decreased by 2.7 times, the number of cattle - by 5.3 times. A particularly significant reduction in crops and livestock was observed in the rural periphery (Table 2). In peripheral areas, these indicators decreased by 4.2 and 6.2 times, respectively.

The agricultural production of the city district of Vorkuta suffered very seriously. For 1990 - 2020 milk production decreased by 3.5 thousand times, meat - by 6.8 times. During these years, auxiliary farms of industrial enterprises were liquidated. In the city of Vorkuta in 1990, there were seven agricultural enterprises and more than 20 subsidiary plots. They contained 9.5 thousand goals. cattle, including 4.8 thousand cows. There were more than 7 thousand goals. pigs. 13.6 kg of meat, 80 kg of milk and 6.4 kg of greenhouse vegetables were produced per capita. By 2020, only one agricultural enterprise remains in

Vorkuta. The number of cows was reduced to 2 heads, pigs - to 281 heads.

Table 2. Agricultural lands and livestock by municipalities of the Russian Arctic regions

Indicators	*Peripheral regions*		*suburban areas*		*Other areas*		*urban districts*	
	1990	*2020*	*1990*	*2020*	*1990*	*2020*	*1990*	*2020*
Agricultural land, thousand ha	*143.7*	*24.5*	*93.6*	*28.3*	*104.3*	*22.3*	*55.9*	*20.1*
including arable land	*18.7*	*5.5*	*26.6*	*13.4*	*30.8*	*11.1*	*18.4*	*8.4*
Hayfields and pastures	*125.0*	*17.2*	*67.0*	*12.0*	*73.5*	*7.4*	*37.5*	*9.3*
Sown area, thousand ha	*21.2*	*5.0*	*28.2*	*13.4*	*33.7*	*10.6*	*17.5*	*8.2*
Number of cattle, thousand heads	*56.3*	*9.1*	*42.8*	*10.7*	*25.2*	*6.2*	*32.3*	*4.1*
including cows	*22.8*	*4.4*	*17.8*	*4.8*	*9.7*	*2.8*	*13.9*	*2.3*
Pigs, thousand heads	*17.9*	*0.6*	*44.5*	*35.6*	*29.0*	*1.8*	*33.6*	*1.9*
Sheep and goats, thousand heads	*21.2*	*5.8*	*8.9*	*2.6*	*12.1*	*3.6*	*3.3*	*1.1*
Reindeer, thousand heads	*41.0*	*9.91)*	-	-	-	-	*82.7*	*83.8*

Agrarian reforms were accompanied by a decrease in the coefficient of food self-sufficiency. For 1990 - 2020 the level of self-sufficiency of the population for meat and meat products decreased from 39 to 35%, for milk and dairy products - from 40 to 24%, for eggs - from 94 to 55%, for potatoes - from 68 to 51%, for vegetables increased from 16 to 21%.

In connection with the implementation since 2006 of the priority national project "Development of the Agro-Industrial Complex", a number of positive trends have emerged in the agricultural sector. As a result of the growth in investment volumes, a number of investment projects have been implemented. For 2010 - 2020 additional premises for cattle for 3.8 thousand and for pigs for 1.23 thousand cattle places were introduced. In the regions of the Russian Arctic, the implementation of measures to improve living conditions in rural areas continues.

However, the current socio-economic state of the agricultural sector, primarily peripheral (remote) rural areas, is characterized as unstable, which can take on an extremely negative form associated with the elimination of agricultural production and the reduction of the inhabited rural area. The main economic problem of the agricultural sector remains the extremely unsatisfactory state of its material and technical base due to investment insufficiency. In the first half of the 1990s. the volume of investments in the fixed capital of agriculture decreased by 2.1 times. In the last 17 years, there has been no steady growth in investment. In 2020, they are 16% lower than in 2016. During the years of market transformations, the depreciation of fixed assets has almost doubled and reached 46%. In most rural areas, the fixed assets of the industry are worn out by 70-80%. The rate of commissioning of individual production capacities decreased sharply due to new construction, expansion and reconstruction. If the commissioning of premises for cattle in 1990 was 2.8 thousand places, then on average for 2017–2020. - 0.6 thousand

Purchase of technical means has significantly decreased. As a result, the tractor fleet for 1990 - 2020. decreased by 12 times, sowing machines - 14.2 times, balers - 5.7 times, forage harvesters - 4 times, potato harvesters - 18.1 times, machines for applying solid organic fertilizers - 39.1 times, machines for applying liquid organic fertilizers - 13.8 times, milking machines - 10.2 times, the volume of energy capacities - 7.7 times.

The multiple reduction in the acquisition of technical equipment had a negative impact on their renewal. The implementation of the national project "Development of the Agro-Industrial Complex" (2006) contributed to some improvement in the ratio of the coefficients of renewal and disposal of equipment (table 3).

The existing equipment is catastrophically outdated. The data of the 2020 All-Russian Agricultural Census showed that in agricultural organizations, only 11% of tractors have a life of up to 4 years, 68% of equipment - 9 years or more. In farms and individual entrepreneurs, the indicators of the age structure are slightly better: the share of tractors under the age of 4 years is 21%, and 9 years and more is 43%.

An extremely small proportion of agricultural producers in the Russian Arctic regions use innovations. The results of the 2020 agricultural census show that only 1.8% of agricultural organizations and 0.3% of farms and individual entrepreneurs used the drip irrigation system; individual feeding of livestock - 12.3 and 7.3%, the

method of cage-free poultry keeping - 1.8 and 3.5%, treatment facilities on farms were owned by 19.3% of agricultural enterprises and 3.5% of peasant farms and individual entrepreneurs, the system of water disposal and treatment of industrial effluents - in 24.6 and 3.8%.

Table 3. Coefficients of renewal of the main types of equipment in agricultural organizations of the regions of the Russian Arctic

Type of equipment	*1990*	*1998*	*2000*	*2007*	*2009*	*2011*	*2013*	*2015*	*2017*	*2020*
			Refresh rate							
Tractors of all brands	*10.0*	*2.0*	*5.0*	*1.6*	*3.1*	*6.3*	*2.8*	*3.8*	*1.3*	*4.1*
Forage harvesters	*16.1*	*4.4*	*4.1*	*4.8*	*9.1*	*11.8*	*5.8*	*3.5*	*2.0*	*14.3*
Potato harvesters	*19.6*	*0.5*	*2.2*	-	-	*31.3*	-	*7.1*	*9.1*	-
Milking machines	*14.3*	*2.0*	*1.7*	*2.0*	-	*3.1*	*1.1*	*4.4*	*6.1*	*5.2*
			Retirement rate							
Tractors of all brands	*9.4*	*11.3*	*10.0*	*7.6*	*8.5*	*3.2*	*4.4*	*6.5*	*3.7*	*2.0*
Forage harvesters	*7.5*	*36.7*	*5.3*	*25.0*	-	*6.8*	*3.9*	*1.7*	*12.3*	*14.0*
Potato harvesters	*17.1*	*10.8*	*17.8*	*6.6*	-	*9.1*	-	*6.3*	*14.3*	-
Milking machines	*9.7*	*19.1*	*8.9*	*21.5*	*2.9*	*2.0*	*4.2*	*13.0*	*9.3*	*2.0*

The main factors hindering the use of innovative technologies are: the difficult financial situation of agricultural organizations, the lack of the necessary own funds, and the unavailability of bank loans. At present, even taking into account subsidies, almost half of the agricultural organizations of the republic are unprofitable. They are the ones who need the most investment. In 2020, the level of profitability of assets of agricultural organizations amounted to 7.3%, of sold products - 6%. Moreover, the profitability of organizations for 2010-2020. tended to decrease.

In crop production, the agrochemical and water-physical properties of the soil are deteriorating, the areas of swampy and bushy lands are increasing due to the destruction of drainage systems and the cessation of reclamation work from 2007 to 2020. The application of mineral and organic fertilizers has sharply decreased. For 1990–2020 the application of mineral fertilizers in terms of 100% nutrients per 1 ha of crops fell from 135 to 12 kg, organic - from 18 to 3.8 tons. In 2020, 23% were fertilized with mineral fertilizers, and 11% of crops were fertilized with organic fertilizers , in 1990 these figures were 81 and 26%, respectively. The areas of meadows and pastures fertilized with mineral fertilizers have especially sharply decreased. If the area under agricultural crops fertilized with mineral fertilizers decreased by 9.3 times, then the fertilized areas of natural fodder lands - 130 times. As a result, the removal of nutrients from the soil with the crop exceeds their application.

During the period of market transformation, the number of people employed in agriculture decreased by 6.8 times. The outflow of workers from agriculture has led to a shortage of qualified personnel in the industry.

An analysis of the qualitative composition of managers, specialists, and cadres of mass professions in the agricultural sector showed their insufficient readiness to introduce innovations into production. According to the 2020 agricultural census, the share of employees in agricultural organizations with higher education accounted for 9.5%, with secondary vocational education - 20.7%, and initial vocational education - 27.6%. The level of professional education of heads of small business forms remains extremely low. The proportion of heads of peasant farms with higher agricultural education is only 7% against 41% for heads of agricultural organizations.

During the period of market reforms, social problems in the countryside became more acute. For 1990 - 2020 due to outflow and natural decline, the rural population decreased by 116.4 thousand people, or by 38%. Mortality in the countryside exceeds the birth rate by 13%. The mortality rate of the rural population is 1.5 times higher than that of the urban population. This indicator has grown from 9.5% in 1990 to 16.7% in 2020. There is a process of depopulation of rural areas. Rural residents move from small to large settlements, regional centers and cities with a more developed engineering and social infrastructure. The persistence of the negative demographic situation in the countryside will lead to a reduction in the number of labor potential and in the future will become a factor limiting the development of the rural economy.

Market reforms have deepened income differentiation between workers in agriculture and other industries. In the industry, wages are almost two times lower than the average national level (56%), 3.2 times lower than in mining industries. In many rural areas it is well below the subsistence level. It should be noted that in 1984 the level of the average monthly salary of agricultural workers in relation to the average for the national economy was 84%. The rural engineering, social, market and information and consulting infrastructure is extremely underdeveloped. In rural areas, most of the roads are unpaved. On-farm paved roads account for 37%. 84% of the rural population lives in non-gasified settlements. Only 9% of agricultural organizations are connected to gas supply networks; 10% of agricultural enterprises receive electricity from autonomous diesel power plants.

During the years of market reforms, many schools and preschool institutions, shops, catering establishments, clubs, and complex reception centers were closed. The share of dilapidated and dilapidated housing stock in rural areas is 15.6% against 1.4% in the city. The proportion of dilapidated and dilapidated premises is especially high in such remote areas as Troitsko-Pechorsky (41% of the total housing stock), Koygorodsky (35%), Ust-Kulomsky (34%).

The formation of agrarian consulting system has not been completed in the republic. At present, the information and consulting department functions as part of the Ministry of Agriculture and the Consumer Market. There is no agricultural consulting at the municipal level. This hinders the access of small forms of agricultural structures and rural residents, especially in remote areas, to information and consulting services. The creation of inter-municipal counseling centers will increase the coverage of small forms of agricultural producers and the rural population with information and consulting services, and the dissemination of innovations for them.

Key risks stemming from both external and internal conditions include:

- the impact of unfavorable external conditions (Russia's accession to the WTO, sanctions, rising inflation);
- maintaining disparity in prices for agricultural products and industrial products;
- reduced financial support, access to credit resources;
- risks of high concentration of large agricultural enterprises in urban and suburban areas, which is associated with the inability to produce organic products, the emergence of negative effects on the environment and the health of food consumers;
- the trend of the outflow of qualified personnel from the agricultural sector;
- the risk of a decrease in the labor potential associated with a reduction in the number and with the aging of the rural population. The continuation of this trend in the future will become a factor limiting the development of the agricultural sector;
- uneven development of rural municipal districts, which led to a significant gap in the indicators of production, labor productivity, and the level of income of the population. In order to prevent sharp fluctuations from intensifying, it will be necessary to differentiate the instruments and mechanisms of development.

The development of the Strategy involves the identification of strengths and weaknesses, opportunities and threats to the development of agriculture. SWOT analysis of the development of the agricultural sector in the regions of the Russian Arctic is shown in Table 4.

As favorable conditions and competitive opportunities for agriculture in the northern region, we note the following. The agro-natural potential of the southern and central regions ensures the efficient production of potatoes, local vegetables, and fodder. Agro-climatic resources make it possible to obtain, using modern technologies, potato yields of 200 - 300 centners / ha, vegetables - 300 - 400 centners / ha, cereals (in the southern regions) - 20 - 30 centners / ha, perennial grass hay - 40 - 50 centners / ha ha.

In the regions of the Russian Arctic, there are favorable conditions for the development of greenhouse vegetable growing on an industrial basis using heat waste from gas compressor stations. The heat of such stations can also be used for artificial drying and briquetting of herbs.

The composition of agricultural land is dominated by natural hayfields and pastures. There are 3 hectares of fodder land per hectare of arable land in the rural periphery, which makes it possible to successfully develop cattle breeding. Of particular economic value are large tracts of floodplain meadows, the potential for collecting fodder from which exceeds 150 thousand tons of fodder units. To improve the food supply of the population, there are significant fish resources and potential opportunities for increasing the collection and processing of wild plants.

Promising opportunities exist for the production of organic (ecological) products. In addition to organic agricultural products, wild plants (mushrooms, berries, birch sap, wild honey, medicinal herbs) can be collected on vast ecological territories. The production of ecological products is a strategic goal for the development of agriculture.

Table 4

SWOT-analysis of the development of the agricultural sector of the Russian Arctic regions

Strengths	*Weak sides*
1	*2*
Competitiveness of traditional northern industries in the national and international markets High demand and guaranteed consumption of local products Significant natural and labor resources Long daylight hours during the growing season, good supply of plants with moisture High genetic potential of cattle Favorable conditions for the production and export of organic products Existence of significant potential of agricultural science	Unfavorable natural conditions for agriculture Low availability of agricultural resources High dependence of livestock production on the supply and market conditions of concentrated feed Outdated technologies and equipment Shortage, low professionally qualified personnel Low level of innovative activity of agro-food organizations Insufficient level of management Inefficient mechanisms for the territorial distribution of financial support Lack of a clearly defined development strategy Limited access of agricultural producers to the markets of material, technical, financial and information resources, markets for finished products. Low quality of the rural living environment (underdevelopment of infrastructure, improvement, services) The low standard of living of the peasants Unsustainable sales of agricultural products, displacement of local producers from food markets Low labor productivity, crop yields, livestock productivity Insufficient competitiveness of agricultural and food products
Increasing the production of local products Transition to international standards of product quality and safety Creation of integrated structures in the system of production, processing and sales of products Availability of budgetary funds to accelerate the modernization and integrated development of rural areas Participation of industrial enterprises in the financing of agricultural and rural development Active state and municipal policy of stimulating the agri-food sector	Physical and moral obsolescence of the material and technical base Deterioration of agricultural land Dependence of food production on imported technologies Reduction of biological resources The outflow of qualified personnel The decrease in the number of the rural population, its aging will in the future become a barrier to the development of the agrarian economy Impact of unfavorable external conditions (sanctions, economic crisis, price disparity) Reduced financial support, access to credit resources Deterioration of the socio-economic situation in the countryside due to the curtailment of agricultural production

The products of traditional industries (reindeer breeding, fishing, hunting, picking wild mushrooms and berries) are competitive not only in the regional, but also in the national and international markets. In addition to deer meat and products of its processing, antlers, endocrine-enzyme raw materials and deer blood are in great demand abroad, primarily in Asian countries.

The industrial nature of the economy is a prerequisite for the technical, technological and socio-economic development of the agrarian sector, which makes it possible to direct significant financial resources for the modernization of the industry and the integrated development of rural areas. In the regions of the Russian Arctic, there is a fairly developed potential of agricultural science.

Weak sides and threats to the development of agriculture are:

- unsatisfactory state of the material and technical base;
- reduction of biological resources;
- shortage and low level of qualification of personnel;
- low quality of life of peasants;
- unfavorable external environment;
- preservation of disparity in prices for agricultural products and industrial products;
- inefficient state support mechanisms, unavailability of concessional loans;
- infrastructure underdevelopment.

The main strategic goals of the socio-economic development of agriculture in the regions of the Russian Arctic are:

- ensuring high and sustainable growth rates of agricultural production;

- full self-sufficiency of the population with potatoes and vegetables of the open ground of the local assortment (except for early production), a significant increase in self-sufficiency in meat and dairy products and eggs;
- bringing the level and quality of life of the peasants closer to the urban population.

When scientifically substantiating the prospects for the development of the agricultural sector and food self-sufficiency of the population of the northern region, one should proceed from the limited possibilities for the production of agricultural products on the spot due to adverse extreme conditions, low availability of biological resources, and underdevelopment of rural infrastructure.

Due to the difficult natural and economic conditions for the development of agriculture for the regions of the Russian Arctic, as well as other subjects of the North of Russia, the principle of self-sufficiency in food is unacceptable. However, the production of basic foodstuffs under favorable conditions is an objective necessity in the North in the foreseeable future. Priority areas for the development of agriculture and trade: production of socially significant food products - potatoes, local vegetables, whole milk, fresh meat, dietary eggs; preservation and development of traditional industries, as well as the collection of wild mushrooms and berries and their processing.

Three scenarios were chosen as a long-term forecast for the development of the agricultural sector: pessimistic, basic, optimistic. The expected results of the implementation of scenarios for the period up to 2035 in comparison with the current state are described in Table 5.

The pessimistic scenario reflects the development of agriculture in the context of persisting unfavorable external factors, disparity in prices for agricultural and industrial products, investment insufficiency, limited budget support, reduced access to soft loans, a worsening demographic situation in the countryside, and an increased outflow of qualified personnel from the industry. This option assumes an increase in crop production and a decrease in the production of milk, poultry, pork and eggs. Self-sufficiency in food will remain at the same level. The pessimistic scenario is unacceptable, since it does not ensure the growth of self-sufficiency in food, a significant increase in the incomes of peasants, and may lead to further depopulation of rural areas.

The basic option assumes some growth in production through the implementation of measures to modernize the agrarian economy and rural infrastructure, strengthening state support for the industry. The level of self-sufficiency in food products will increase slightly.

The most acceptable is the optimistic scenario for the development of agriculture. This option is based on the use of innovations, an active protectionist policy of the state, the formation of effective tools and mechanisms for strategic development, the attraction of qualified personnel to the industry, the improvement of placement, specialization, cooperation and integration in the agri-food sector, the development of all types of rural infrastructure, a significant improvement in social and living conditions , quality and standard of living of peasants.

Table 5. Forecast of target indicators for 2035 under different scenarios for the development of agriculture in the regions of the Russian Arctic

Index	*2020*	*Expected results in 2035*		
		Pessimistic	*Base*	*Optimistic*
1	*2*	*3*	*4*	*5*
Share of investments in fixed capital of agriculture, %	*0.6*	*0.5*	*0.7*	*four*
The share of agriculture in the gross output of the region, %	*1.5*	*1.4*	*1.6*	*2.4*
Share of agricultural organizations using innovations, %	*ten*	*21*	*36*	*fifty*
Production, thousand tons Potatoes	*35.5*	*98.6*	*116.3*	*190.4*
Vegetables	*16.8*	*22.2*	*26.8*	*51.6*
Meat (dec. weight)	*23.8*	*21.9*	*23.0*	*31.1*
Including Beef and veal	*2.1*	*2.1*	*2.4*	*9.5*
poultry meat	*14.6*	*14.2*	*14.9*	*15.3*
Pork	*6.2*	*5.4*	*5.8*	*6.8*
Venison	*0.7*	*0.7*	*0.9*	*1.1*

Milk	*54.7*	*53.8*	*62.3*	*102.3*
Egg, million pieces	*137.1*	*118.1*	*121.2*	*168.7*
Cultivation area, thousand ha Potatoes	*4.1*	*4.0*	*4.7*	*8.3*
Vegetables	*0.6*	*0.5*	*0.8*	*1.3*
Livestock and poultry, thousand heads Cattle	*32.9*	*30.1*	*42.4*	*53.5*
including cows.	*14.4*	*13.6*	*16.7*	*24.5*
Pigs	*40.0*	*38.1*	*43.5*	*50.2*
deer	*93.7*	*90.4*	*106*	*122*
Bird	*1689.1*	*1616*	*1950*	*2105*
Share of agricultural structures in production, % *Agricultural organizations*	*72*	*72*	*75*	*78*
Households of the population	*23*	*22*	*17*	*12*
Peasant farms	*5*	*6*	*eight*	*ten*
Average monthly salary in agriculture, thousand rubles	*29.2*	*35*	*56*	*70*
Level of food self-sufficiency, % *Potato*	*51*	*78*	*90*	*Complete self-support*
Vegetables	*21*	*24*	*27*	*45*
Meat and meat products	*35*	*35*	*37*	*46*
Milk and dairy products	*24*	*24*	*25*	*41*
Eggs and egg products	*55*	*55*	*57*	*72*

For the optimistic scenario by 2035, the following targets are planned:

- the growth of the average annual growth rate of agricultural production should be at least 3%;
- the share of agricultural organizations using innovations should be increased to 50%;
- to increase wages in agriculture by 2.4 times and bring them up to 70,000 rubles;
- fully provide the population with potatoes and other open-ground vegetables of the local assortment (except for early products), expand the production of greenhouse vegetables, increase the self-supply of meat and meat products up to 46%, milk and milk products - up to 41%, eggs - up to 72%. To achieve the targets, it is necessary to determine the strategic priorities for the socio-economic development of the agricultural sector. The key strategic priority of development is the use of selection - genetic, technical - technological, organizational - economic and socio-economic innovations that form the fifth and sixth technological modes in the agri-food sector. Innovation should be carried out not only in collective and peasant farms, but also in rural households, whose role in the conditions of cyclical economic crises is great. Small enterprises may be more receptive (compared to large enterprises) to the use of innovations. The use of these types of innovations will ensure the growth of innovative activity of economic entities in the agrarian sector.

Innovative activation is associated with the transformation of the agricultural sector of the economy into its innovation system, the key elements of which are state authorities, the research sector, agricultural education, agricultural organizations, peasant farms, the rural population and innovative infrastructure. The formation and development of the main elements of the innovation system of the agricultural sector should take place with the active participation in the financial support of state authorities and local governments.

It will also require the development of regional agricultural science, primarily the most important applied developments focused on quick returns, training and retraining of personnel, attracting specialists to work on new technologies, stimulating their consolidation in enterprises and peasant farms, forming a network of information and consulting services as a transfer innovations in agricultural production.

One of the priorities is the formation of a multi-structural agricultural production. During the forecast period, all forms of management will participate in the production of agricultural products. But the main producers of the most capital-intensive livestock products will remain medium and large agricultural

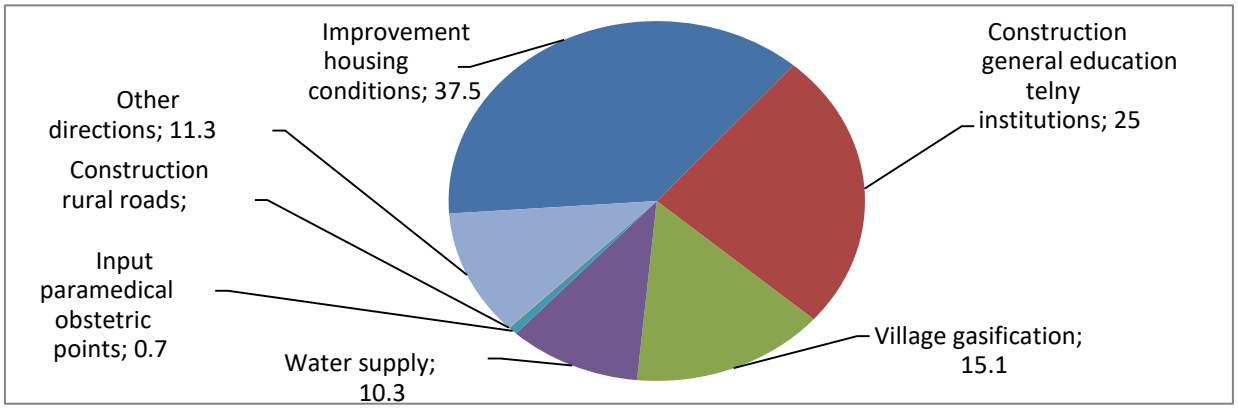
enterprises integrated with the processing industry. Large agricultural organizations will be concentrated in suburban areas and rural areas with good transport accessibility to provide the population with whole milk and dairy products, meat, eggs and fresh greenhouse vegetables, medium ones - in remote rural areas.

The small-scale commodity sector should not be considered as an alternative to large-scale and medium-sized agricultural production, but as a complementary one, allowing to more fully reveal the potential of agriculture. In the forecast period, in our opinion, the farming way of life will not receive significant development. The formation of a peasant (farm) economy requires large investments to create a material base and infrastructure, a lot of time and competent work in market conditions. By 2035, its share in the gross output will be 6-10%.

The role of private households of citizens in the formation of food resources due to the reduction of rural households, the deterioration of the demographic situation in the countryside, the aging of the rural population and the decrease in the proportion of able-bodied persons in it, the low efficiency of production based on manual, low-skilled physical labor, will be reduced. Over the past 20 years, in the households of the population of the regions of the Russian Arctic, acreage, livestock and production have been declining. Since 2005, there has been a steady downward trend in their share in gross output.

The most important direction in achieving the intended results is the social development of rural areas. Social processes in the countryside are currently regulated by the strategy for the sustainable development of rural areas until 2035 and the federal target program with the same name until 2025. However, these documents on the problems of sustainable development of rural areas are not solved in a comprehensive manner, they do not develop mechanisms for ensuring employment and increasing the incomes of the rural population, little attention is paid to the participation of rural residents in the implementation of activities. The volume of financial resources does not correspond to the stated goal of ensuring a stable improvement in the quality and standard of living of the rural population. Of the total budget funds (1954 million rubles) allocated in the period 2003-2020. for the development of rural infrastructure in the regions of the Russian Arctic, only 0,

Sustainable development of rural areas involves improving the living conditions of the population, searching for optimal options for the regions of the Russian Arctic to combine large, medium and small businesses, increasing the role of the state and differentiation of tools and mechanisms in rural development, diversifying the rural economy and developing non-agricultural activities. In the regions of the Russian Arctic, the development of non-agricultural activities can occur in the following areas: organization of local industry; integration of agriculture and forestry; procurement and processing of wild mushrooms and berries, medicinal plants and other natural raw materials; development of trades and crafts; rural tourism; commercial, domestic, social and cultural services for the rural population; landscape maintenance; environmental protection.



Picture 3. Structure of budget expenditures for the development of rural infrastructure in the Russian Arctic regions for 2003–2020, %

An important strategic direction is the rational intra-regional distribution of agro-industrial production. In the Far North, due to unfavorable agro-climatic conditions, poor agricultural development, reindeer breeding and dairy cattle breeding will be further developed. Reindeer breeding and cattle breeding are to be developed in the northern agricultural zone, and the cultivation of potatoes and vegetables in the households of the population. In the central and southern agrarian zones, with the most favorable agricultural conditions, it is planned to deepen the specialization and concentration of the

production of milk, poultry meat, cattle, eggs, potatoes and vegetables. Part of the manufactured products will be directed to improving the provision of the population of the Arctic and near the Arctic territories of the republic,

It is very important to link the improvement of the location and specialization of agricultural production with the development of the processing of agricultural raw materials.

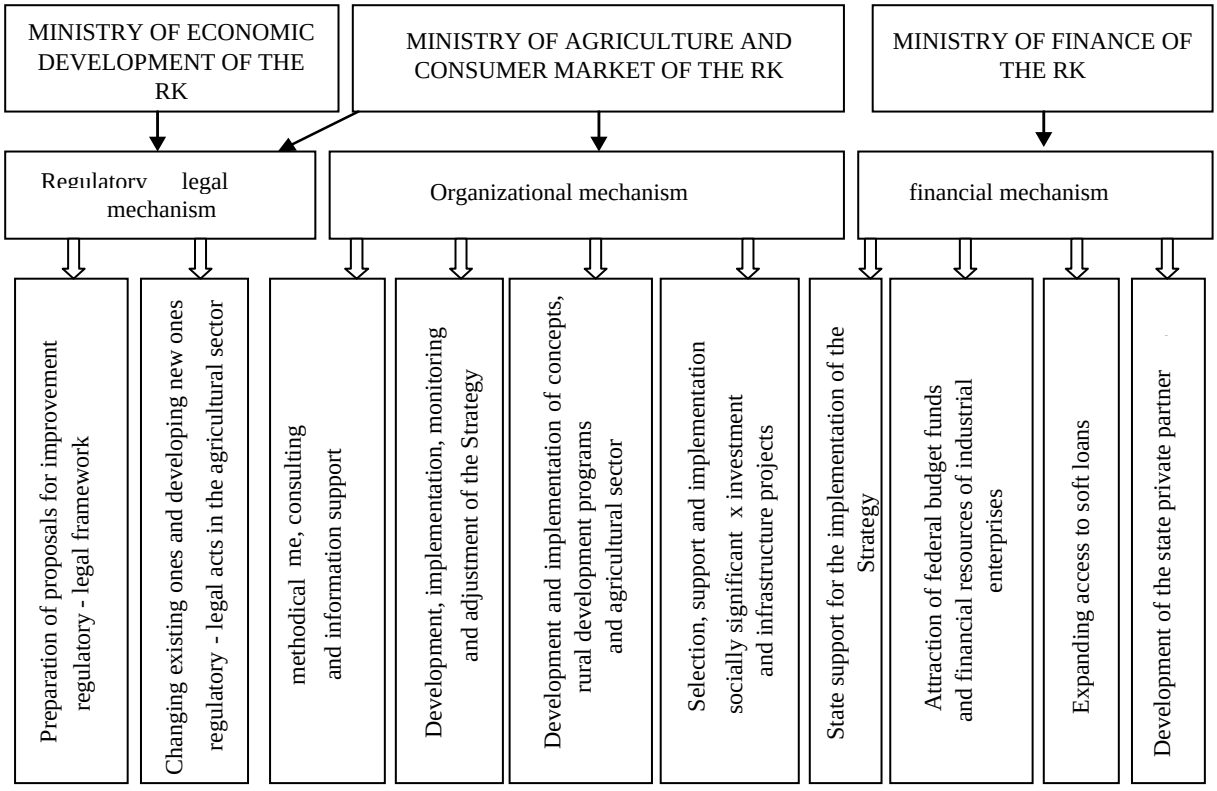
It will be necessary to create a closed cycle of agricultural production, its processing and food sales through its own trading network.

The priority should be the development of all types of cooperation (agricultural, consumer) for medium and small forms of management and the rural population.

The successful implementation of the Strategy is connected with the improvement of economic relations in the agricultural sector. These should include:

- increase in the volume of financial resources for the agricultural sector of the rural periphery at the expense of budgetary funds and the redistribution of subsidies from agricultural organizations that are self-supporting and self-financing;
- supporting investment activities by increasing direct public investment and expanding access to concessional lending;
- elimination of disparity in prices for agricultural products and means of industrial production;
- reduction of the tax burden on agricultural business entities;
- stimulation of domestic demand for agricultural products by improving the contract system, which provides priority in the purchase of products to regional and municipal funds of local products used to provide the population with biologically valuable food, free meals for children and schoolchildren and the sale of food stamps to the poor, as well as the elimination of the monopoly of procurement, intermediary and processing structures by transferring the cycle of production, processing and sale of products to a cooperative basis.

Achieving the goals of the Strategy involves the creation of an effective mechanism for the strategic management of sustainable socio-economic development of the agricultural sector. Regulatory, organizational and financial mechanisms of the Strategy for the development of the agricultural sector are presented in Picture 4.



Picture 4. The mechanism of strategic management of sustainable development of the agricultural sector of the Russian Arctic regions

The legal mechanism provides for the preparation by the Ministry of Economic Development and the Ministry of Agriculture and the Consumer Market of the Russian Arctic regions of proposals for improving, amending and developing new regulatory documents in the agricultural sector. As a result, an effective legal mechanism for the implementation of the Strategy will be created.

The organizational mechanism provides methodological, consulting and information support, implementation and monitoring of the Strategy, communication of concepts, state programs for the socio-economic development of rural areas and the agricultural sector as part of the strategic management of the industry. An important direction of the organizational mechanism is the selection, state support and implementation of socially significant investment and infrastructure projects. Taking into account changes in external and internal conditions, the Strategy must be periodically adjusted.

Achieving the target strategic indicators will be possible with financial support for the implementation of the Strategy. The main financial instruments for the implementation of the Strategy for sustainable socio-economic development of the agricultural sector are: financial resources of the republican budget; strengthening and participation of municipal budgets in state support for the implementation of the Strategy; targeted co-financing of state programs for rural development, priority investment projects at the expense of the federal budget; financial resources of industrial enterprises of the region; own funds of agri-food business entities; available concessional bank loans. Active participation in the implementation of socially significant investment projects is assigned to public-private partnerships.

The Ministry of Agriculture and Consumer Market annually submits to the heads of the Russian Arctic regions a report on the implementation of the results of the implementation of the Strategy. In case of non-fulfillment of the planned indicators, the reasons and factors hindering the achievement of the planned results are indicated. Depending on the achievement of target indicators, proposals are submitted for consideration by the regions of the Russian Arctic on adjusting the Strategy.

Conclusion

The study of methodological and practical provisions on the strategic management of sustainable development of the agricultural sector of the northern region allows us to draw the following conclusions and recommendations:

1. The need for strategic management of agriculture is due to overcoming the crisis situation in the industry. Currently, both at the country level and in the regions of the Russian Arctic, there is no strategic management of the sustainable development of rural areas and the agricultural sector. Strategic management should eliminate the prevailing approach to solving current tactical problems and be directed to the performance of the countryside and agriculture of diverse national economic functions.

2. The stages of strategic management of the agricultural sector are proposed, including trends, problems and risks of development, SWOT analysis, formulation of a strategic goal, scenario forecast of results, substantiation of priority areas of development, creation of an effective mechanism for the implementation of the Strategy.

3. An analysis of the development of agriculture shows a steady growth trend in agricultural production over the 30-year period preceding the market reforms. The market transformation of the agrarian economy was accompanied by a reduction in the production of milk, beef, pork and eggs. There was an increase in the production of poultry meat as a result of the modernization of the poultry meat industry. The highest rates of reduction in livestock production were among agricultural producers in the rural periphery, which have significant production potential.

4. The key problems of the development of agriculture in the regions of the Russian Arctic are: the destruction of the material and technical base of the industry due to lack of investment; increase in depreciation of fixed assets; a sharp reduction in cultivated agricultural land, livestock and poultry, and the number of employees; deterioration of agricultural land; the narrowness of the sphere of application of labor due to the reduction of agricultural production and the underdevelopment of non-agricultural activities; shortage and low quality composition of managers, specialists and cadres of mass professions; low wages; underdevelopment of engineering, social, innovation and market infrastructure.

5. The study of the external and internal environment made it possible to assess the strengths and weaknesses, competitive opportunities and threats to the development of the agricultural sector. A long-term forecast of target indicators is made for possible scenarios for the development of agriculture in the regions of the Russian Arctic (pessimistic, baseline and optimistic scenarios). It has been established that the implementation of the pessimistic scenario will lead to further degradation of the northern village and the agricultural sector. The most acceptable option is the optimistic one, which ensures the innovative development of agricultural production, the average annual growth rate of at least 3%, and a significant increase in the level and quality of life of peasants.

6. The strategic goals for the development of agriculture are outlined: ensuring high and sustainable growth rates of agricultural production; complete self-sufficiency of the population with potatoes and vegetables of the open ground of the local assortment, increasing self-sufficiency in livestock products;

bringing the level and quality of life of the peasants closer to the urban population.

7. To achieve the goals set, priority areas for the strategic development of agriculture associated with innovative modernization, the formation

multistructural agrarian economy, improvement of location, specialization, cooperation and integration, creation of favorable economic conditions for all forms of agrarian structures, integrated development of rural areas on the basis of national, regional and municipal programs.

8. A mechanism for strategic management of sustainable socio-economic development of the agrarian sector of the northern region has been developed, including legal, regulatory, organizational and financial aspects.

The success of the implementation of the Strategy will depend on increasing the responsibility and ability of the Ministry of Agriculture, economic and social departments, municipal authorities of the Russian Arctic regions to increase investments, solve employment problems, train and retain specialists in the agricultural sector, modernize all types of rural infrastructure, significantly improve the level and quality life of rural workers.

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Issue **Article**

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STAGES OF REAL ESTATE VALUATION WHEN OBTAINING BANK LOANS IN UZBEKISTAN

Abstract: *Among the elements of a market economy, a special place is occupied by real estate, which acts as a means of production (land, administrative, industrial, warehouse, commercial and other buildings and premises, as well as other structures) and an object or object of consumption (land plots, residential buildings, cottages, apartments, garages). Real estate is the basis of personal existence for citizens and serves as the basis for economic activity and development of enterprises and organizations of all forms of ownership. There is an active formation and development of the real estate market in Uzbekistan and an increasing number of citizens, enterprises and organizations are involved in real estate transactions.*

Key words: *real estate valuation, determination of the market value of real estate, a comparative approach to real estate valuation, bank loans.*

Language: *English*

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Scopus ASCC: *2000.*

Introduction

Everyone knows that real estate prices on the Russian market are very high, whether it is secondary housing or square meters in a new building. For most people who have a stable average income, it is almost impossible to acquire ownership of an apartment. It will take a long number of years to save for such an acquisition, and no one can postpone the solution of the housing issue for decades, as well as the high cost of rent for housing pushes people to mortgage loans to buy real estate. Real estate valuation is currently relevant. Therefore, residential real estate is taken as an example of a phased assessment.

Main part

The first stage in the evaluation process: set a task and conclude a contract for the evaluation of the object, develop an evaluation plan. The assessment can begin with a study of the properties of the property. Next, we will determine the scope of the assessed property rights, because the customer may have a certain share in the partnership or only the right to lease, the property may be encumbered with collateral, mortgage, lease, mortgage and other restrictions (encumbrances) [1].

Determine the valuation date, since the market and market conditions may change over time, so the whole process of analyzing the analysis of information must be tied to a specific date. It is necessary to determine the purpose of the assessment for the customer (insurance of the object, its sale or obtaining a mortgage against its collateral), to disclose the restrictive conditions. Restrictive conditions may relate to the amount of information provided by the customer, the possibility of a thorough visual inspection of the object [2].

The second stage: analysis and collection of adequate market information, making conclusions about the conditional variant of the best use of property, studying the factors of supply and demand. This information should include general factors affecting the value of the object, real estate at the regional level, special information about factors affecting the local level, and specific information about the features of the assessed site and the improvements on it that affect the value of the object [3]. The real estate market currently includes office buildings, residential apartments and rooms, premises, industrial and commercial buildings, cottages, cottages and rural houses with land plots. It is necessary to take into account the regional characteristics of the real estate market [4].

For example, it is impossible to determine the motivation of buyers' behavior, their plans for the use of the property, their preferences, and often potential buyers themselves. The experience of examination of reports on the evaluation of residential real estate objects carried out within the framework of audit procedures shows that these features of regional markets are either simply ignored by most appraisers, or are solved purely formally. The latter is partly due to an attempt to give the assessment report the appearance of validity, in the spirit of its understanding by the interpreters of federal assessment standards.

The danger of this state of affairs lies both in the potentially significant distortion of the evaluation results, and in the fact that the cost estimate performed in this way does not help the real user in any way to understand and evaluate the logic of real market pricing, and at worst asserts the existence of artificially invented illusory dependencies [5].

The cost of real estate is determined based on a number of factors: physical, economic, social, political, administrative, legal. Only after analyzing all of them, it is possible to evaluate real estate objects. There are many price-forming factors that reduce or increase the cost per square meter, both to a small and significant extent. They are divided into two large groups: price-forming factors for urban settlements and price-forming factors for rural settlements [6]. Further, the price-forming factors are divided according to the following characteristics: location, socio-economic development, environment, infrastructure, etc.

As a rule, the administrative center of the region of the Republic of Uzbekistan has a higher economic potential than the municipalities within it. In turn, not all municipalities are at the same level of economic development [7]. Belonging of a locality to more economically developed municipal districts, as a rule, increases the value of real estate objects that are located on its territory. The real estate market in the administrative center, like all other markets, is not homogeneous. The central districts of the city are more developed due to the concentration of cultural and historical attractions, more places of leisure, catering and, accordingly, are characterized by a higher population density compared to the outskirts of the city.

Real estate in the center, as a rule, is more expensive. as for the region, real estate objects located closer to the center of a particular locality or to the administrative center have a more developed infrastructure and, consequently, a higher cost. In addition to the proximity to the center, the surrounding area influences the value of real estate: proximity to recreational facilities, transport interchanges, roads or to other objects that have both positive and negative price-forming influence [8]. Thus, for the end consumer of the real estate market, location and environment are very important criteria when choosing a real estate object, depending on the type of real estate and the purposes of further use [9].

We can say that these characteristics. objects are the main factors that determine the specifics of the real estate market. The availability of communications and the possibility of summing them up are also important criteria in the pricing of a real estate object. When choosing a property for a buyer, significant factors are both the characteristics of the location of the object (proximity to the administrative center of the district, favorable environment or the absence of unfavorable centers in the environment) and the availability of infrastructure [10].

Infrastructure development requires a lot of money, and therefore the presence of a developed infrastructure increases the value of the property. The analysis of the real estate market conducted in the regions of Uzbekistan confirmed the tendency to change the prices of real estate objects depending on location, environment, physical characteristics, socio-economic development and infrastructure.

The third stage: performing calculations based on selected approaches and evaluation methods. The comparative approach in real estate valuation occupies, most likely, a central place [11]. The market approach is not related to the assessment of past costs and their adaptation to changes in conditions to the current price level, nor is it related to the need to make long-term forecasts or refer to them, as, for example, when using the revenue approach [12]. The comparative approach, based on the principle of "here and now", seems to be the most realistic, because it clearly shows the current market situation. The market of average market values is analyzed. The main element of the approach is the selection of analog objects and their comparison (by regression analysis, quantitative adjustments and other methods) with the object being evaluated. Within the framework of the comparative approach, the method of direct comparative analysis of sales is distinguished, which consists in the sequential execution of subsequent actions.

As a result, the market value of each of the suitable characteristics (comparable) is determined objects, as if at the time of sale, it had the same basic characteristics as the property being evaluated [13]. The adjusted value of the object allows the appraiser to draw logical conclusions about the probable value of the object being evaluated on the market. Applying this approach, the appraiser performs the following steps:

1. Identifies recent sales of comparable properties.

2. Checks information about identified transactions.

3. Identifies the key characteristics of comparable analog objects and the evaluated object.

4. Makes adjustments taking into account the differences between the evaluated object and each of the comparable objects. In the part in which the assessed real estate (property) differs from comparable, the price of the latter is amended (adjustments) in order to determine how much it could be alienated on the market if it had the same basic characteristics as the property being valued [14].

5. Determines the value of the assessed object by weighing the adjusted prices of comparable objects obtained, taking into account the scale and reliability of the latest corrective corrections made to the prices.

As part of the comparative approach, the appraiser uses the sales comparison method. The sales comparison approach is applied if there is a sufficient amount of reliable market information about the purchase and sale transactions of objects similar to the object being evaluated [15]. In practice, as a rule, it is impossible to find even two absolutely similar objects of property.

Physical characteristics, location, condition, time of sales and encumbrances and financing conditions, as well as other characteristics for which objects have differences, cause the need to make corrective changes in the prices of market transactions. The final conclusion about the value of the result determined by the sales comparison method is made based on the analysis of adjusted sales prices of comparison objects that have the maximum similarity with the object of evaluation. the fourth stage: coordination of results. In the process of completing the assessment task, three main approaches to determining the value of a real estate object were analyzed; costly, comparative and profitable [16].

The cost approach can be useful, in particular, for evaluating objects for which there is no sales market, and the disadvantage of the cost approach is its static nature and the inability to take into account the political and economic situation in the country [17]. This approach is based on the principle of substitution, which states that the buyer does not pay for real estate more than the amount that will need to be spent on the purchase of a land plot and the construction of an object on it, similar in its consumer characteristics to the object of evaluation, for example, an apartment in an apartment building. The construction of a separate apartment is impossible [18]. The appraiser does not have a cost estimate for the purchase of a plot and the construction of a building on it, of which the object of assessment is a part. In turn, the calculation of "standard" estimates, etc. taking into account all the real additional costs, determining the total depreciation of the building as a whole and allocating the cost of a unit of apartment area will lead to a large error in calculations [19].

The appraiser is not aware of cases of a similar purchase of housing, when a private buyer purchased an apartment in an apartment building through its construction.

Therefore, it is taken into account that:

– the report on the evaluation of the object should not allow ambiguous interpretation or mislead;

– the information on the evaluation provided in the report, used or obtained as a result of calculations during the evaluation, significant from the point of view of the value of the object of evaluation, must be confirmed (the principle of validity);

– the content of the evaluation report it should not mislead users of the evaluation report, as well as allow ambiguous interpretation (the principle of unambiguity).

The appraiser decides not to calculate the object of evaluation by a costly approach within the framework of the submitted report. The income approach reflects the marginal cost, more than which a potential investor, counting on the use of the object and on the accepted rates of return, will not pay. Investors for the presented type of objects rely mainly on the desire to get the greatest income from ownership [20].

The appraiser has several arguments against the use of a profitable approach, as it is not suitable in this situation. Basically, this is the information received from the customer that this object of evaluation (apartment) it will be used only for residential purposes, that is, the future owner does not intend to rent it out in order to generate income [21]. Despite the existing developed housing rental market, it continues to remain mostly "black". In a large number of cases, lease agreements are not registered anywhere, and payment is made in cash, since it is not taxed in this form. This circumstance does not allow the appraiser to collect reliable information in sufficient quantity about the number of rental rates and rents for similar objects. The appraiser does not have the right to apply this information, which does not have a documentary justification and confirmation. In this regard, taking into account the above, as well as the absence of a generally accepted practice in the Russian Federation of calculating the cost of such housing, depending on the income it

brings, the appraiser decided not to apply a revenue approach for the object of assessment.

The fifth stage: determination of the liquidation value of the valuation object. The calculation of the liquidation value is necessary for the transfer of the assessed object as collateral in case of obtaining a loan; when closing a company or financing a debtor's enterprise, etc., the Bank will approve mortgage lending for you, if only you submit a document on the current market value. When making a mortgage, the purchased housing becomes collateral, and the document on the evaluation of the apartment for obtaining a loan determines the market value of the collateral. In case of the borrower's insolvency or other circumstances, the bank, having your real estate as collateral, is thus insured against possible losses of borrowed funds. The main feature of an independent assessment for mortgage lending (evaluation of an apartment for collateral purposes) It is a condition for the participation of three parties in the process – an independent appraiser, a bank and a borrower. At the same time, the interests of all 3 parties are taken into account. The liquidation value of the appraised object is the estimated amount reflecting the most probable price at which this appraised object can be sold for the period of exposure of the appraised object, the smallest of the usual exposure period for market conditions, in conditions when the seller is obliged to make a transaction for the alienation of property.

The market value of the valuation object is always greater than its liquidation value due to the impact of 2 factors: the factor of forced sale is a psychological nuance, and the factor of limiting the time of sale, affecting the initiative of buyers.

To calculate the liquidation value of the valuation object, the report uses the method Galasyukov, who takes into account two basic factors: the factor of the value of money in time and the factor of elasticity of demand for price.

The sixth stage: the final stage of the evaluation of the object is the preparation (compilation) written conclusion (report) on evaluation with the requirements of the legislation of the Republic of Uzbekistan in the field of evaluation activities. The report is personally signed by the appraiser and stamped. The seventh stage: providing an evaluation report to the evaluation customer. Conclusions of the study and prospects of real estate valuation. Based on the conducted research, the algorithm of the stages of real estate valuation was studied. Three approaches used for evaluation were also considered. Referring to the above, it should be noted that the valuation of real estate and the determination of market value currently plays a very significant role and requires an objective and qualified approach to solving the task

Conclusion

Residential real estate appraisals are allocated to a separate group due to its specifics, as well as in the process of classifying real estate objects. First of all, this is due to the fact that housing is an economic good, the main purpose of which is to satisfy the need for housing, the other purposes of use are secondary. The existing grounds for the emergence and termination of rights to residential real estate objects determine the direction of the entire assessment process. This fully applies to all types of such real estate, which eventually form residential real estate as a single object of evaluation. Each object under study is unique, due to its location, number of floors, etc.; the market value of such a real estate object will differ from the value of a similar object. The stages of real estate valuation help to make the clearest conclusion about the value of the market value of the assessed object after a thorough comparative analysis of the results for each of the approaches used, taking into account the priority and specifics of the approach that is most logical and acceptable in each case.

The fixed theoretical knowledge and acquired practical skills in the field of real estate valuation based on independent study of special economic literature and generalization of legislative and other regulatory legal acts made it possible to analyze the algorithm of step-by-step evaluation. In general, all of the above confirms the usefulness of the descriptions of the evaluation stages. These stages make it possible to obtain the most effective assessment of residential real estate.

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Issue Article

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THE MAIN DIRECTIONS OF DEVELOPMENT OF ECOTOURISM IN THE REPUBLIC OF KARAKALPAKSTAN

Abstract: *Currently, tourism in Uzbekistan has great prospects for development, but there are many limiting factors that hinder this process in the regions. Since the main tourist centers of the country are well developed and tourists visit them constantly, there are many problems in the regions that prevent these territories from becoming tourist areas. The article will consider the main problems faced by regions remote from the main tourist centers and give some examples. Some options for solving problems are also considered.*

Key words: *tourism, ecotourism, tourism in Karakalpakstan, tourism problems.*

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Introduction

Tourism in the modern world is seen as a socio-economic phenomenon that has a direct and indirect impact on the development of all related infrastructure. Modern tourism is based on a high level of development of transport, the social sphere and the service sector, which ultimately turns it into a highly profitable sector of the economy.

According to the World Tourism Organization (WTO), today tourism is one of the most profitable and most dynamic world economies. In terms of profitability, it is second only to production and a shortage of capital. Tourism accounts for about 6% of international transport costs and 5% of all tax shipments. In this regard, in many countries, the tourism industry is actively developing with state support[1].

As part of the development strategy of the "New Uzbekistan for 2022-2026", about 300 laws were adopted aimed at reforming all spheres of life of the state and society; some of them are also directly or indirectly connected with Karakalpakstan and/or Khorezm, as well as with the tourism sector[2].

The introduction of the mahalla model is intended to provide the necessary resources and opportunities to address development issues in each territory by encouraging entrepreneurship and employment while taking measures to reduce poverty. This includes the creation of infrastructure such as sports, cultural and environmental facilities, as well as business facilities and training centers through public-private partnerships. Within this framework, a thorough study of the problems and opportunities of each region creates the basis for programs aimed at improving the integrated socio-economic development for the period 2022-2026, also referred to as the "Road Map"[2].

An important aspect of the development strategy is the improvement of road infrastructure to improve transport connectivity as well as road safety, both of which are relevant to the tourism sector[2].

The most notable aspect of the road development plan, as one of many other aspects of the five-year development program adopted by the Cabinet of Ministers, focuses on the following:

Construction of 240 km of roads under Corridor 2 of the Central Asia Regional Economic Cooperation Program financed by a US$274 million loan from the Asian Development Bank. The project will modernize a section of the Guzar-Bukhara-Nukus-Beineu (A380) highway in the Republic of Karakalpakstan, which will expand the capacity of one of the key trade routes in the region. This project will improve transport links in Western Uzbekistan and neighboring Kazakhstan[2].

Another goal is to increase the export of tourism, transport, information and other services by 1.7 times, which corresponds to an export volume of 4.3 billion US dollars. As for the development of tourism and an increase in the number of local tourists, within the framework of the Travel Uzbekistan program, it is planned to increase this number to 12 million, and the number of foreign tourists to 9 million. Part of these efforts is the creation of barrier-free tourism infrastructure in the main tourist areas, as well as doubling the number of people employed in the tourism sector to 520,000 people by 2026[2].

A prerequisite for this growth is the further development of tourism infrastructure and cultural heritage sites through the adoption of a state program for the efficient use of more than 8,000 cultural heritage sites.

In particular, with regard to the Republic of Karakalpakstan and the Aral Sea region, the new airport in Muynak is conceived as an engine for development, while the tourism sector in the Khorezm region should simultaneously become the main engine for creating new jobs. The Aral Sea region is also prepared for further strengthening of social support for the population living in this area.

For the transport system, the unification of all modes of transport is envisaged, which makes it possible to create conditions for facilitating the possibility of daily trips along regular transport routes between major cities of the country.

In recent years, Uzbekistan has changed the policy framework for tourism development by taking measures such as visa liberalization, creating incentives for the establishment of tourism businesses, and restructuring what was formerly the State Committee for Tourism Development and is now the Ministry of Tourism and Cultural Heritage. Some of these measures had an almost immediate effect, and Uzbekistan experienced a steady increase in tourist traffic, which also benefited Karakalpakstan until the coronavirus pandemic brought tourism to a temporary halt. As the pandemic slowly fades away, a return to the previous growth model is crystallizing, and the opportunities associated with this require a constant increase in the level of professionalism. As tourism by its very nature is a multi-stakeholder activity involving both a range of public sector institutions and many private sector companies, a tourism strategy is increasingly becoming a necessity, creating a comprehensive framework of reference for each member of the Karakalpakstan tourism industry.

The development of this tourism strategy can be seen as a continuation of many previous efforts related to tourism development in product development, marketing, destination management, stakeholder engagement and capacity building. However, for the first time, all these areas of activity are combined into a single integral complex, which will allow Karakalpakstan to reach the next stage in its development as a unique tourist destination in Uzbekistan. This will not only facilitate the implementation of activities, but also strengthen a common understanding of the challenges in general that need to be addressed, a sense of commitment to jointly address these problems.

As the local government increases the level of planning and preparation, new opportunities usually appear - opportunities for funding, strategic partnerships, joint activities and previously unimagined synergies. The investment climate is becoming more attractive, marketing is becoming more targeted, and more tourists are starting to arrive as measures are implemented. An important advantage of such a process is that the locals, namely the Karakalpaks themselves, learn to cherish and appreciate the diverse sights of their region like never before. The World Tourism Organization of the WTO at the UN has stated that a tourist destination cannot be truly ready to receive foreign tourists if its own local population does not appreciate the sights and culture of their homeland. By ensuring broad participation and awareness of the tourism strategy, Karakalpakstan is thus preparing to attract local, domestic and foreign tourists.

The Tourism Strategy of Karakalpakstan is a highly differentiated expression of the common mission and vision of all stakeholders associated with the tourism industry, reflecting the desire to take tourism to a higher level. The mission and vision capture the essence of what a tourist destination like Karakalpakstan is. While the mission describes the main business directions of Karakalpakstan, its goals and ways to achieve these goals, the vision is more predictable and describes the desired perspective for the future.

In other words, mission focuses on today and vision focuses on tomorrow.

A well-defined mission and vision can provide a sense of clarity, unity and purpose that will help strengthen the bond between all tourism players in Karakalpakstan and therefore can lead to better decision-making with broader support, ensuring that Karakalpakstan takes the lead tasks related to the development of its tourism, in an efficient manner.

After the great contribution of the tourism business players in Karakalpakstan, the Mission and Vision can be formulated as follows:

Karakalpakstan offers travelers an incomparable experience, allowing guests to discover the true soul of a unique and preferred tourist destination within Uzbekistan.

The main objective of the strategy is to promote the development of tourism in Karakalpakstan, based on five key principles:

- Provide travelers with unique and unforgettable experiences that they will have for a lifetime.
- Promote sustainable tourism development through careful planning, co-management and participation of key stakeholders in each area.
- Ensure that tourism always benefits local communities in Karakalpakstan in terms of economic, environmental and socio-cultural impact.
- Continuously promote research, innovation, capacity building and knowledge management for better tourism management and marketing.
- Build influence through strategic alliances with partners inside and outside Karakalpakstan, including national authorities, neighboring Khorezm and international trading partners.

The stakeholders of the tourism sector of Karakalpakstan, committed to the development of tourism in Karakalpakstan, share the following core values:

Value Creation: Tourism is not an end in itself, but an activity that creates real value, both for the tourist and for the communities visited and service providers. Quality, honesty and high standards of service inspire any tourism activity.

Preservation: tourism is a tool for preserving and enhancing the natural and cultural heritage of Karakalpakstan. Tourism allows for a genuine expression of the identity and traditions of Karakalpakstan, while avoiding the simplification of Karakalpak culture or the adaptation of typical designs.

Regional Development: Tourism is seen as one aspect of regional development and investment in tourism is focused on developing rural areas, improving infrastructure that benefits the general population and enhancing leisure opportunities for the local population.

Competitiveness: Because tourism is an economic activity, it is through result-oriented and professional destination management and marketing that Karakalpakstan successfully competes with other tourism destinations.

According to the findings, Karakalpakstan, with its combination of the Aral Sea, the Ustyurt plateau, the desert and the Amudarya river delta, offers a unique landscape for both national and foreign tourists, with great potential for ecotourism. In particular, over the past 40 years, the retreat of the coastline has led to a dramatic change in the Aral Sea region. Thus, this area can become an attractive destination not only for nature and adventure tourism, but also for educational tourism, providing tourists with a deeper understanding of the causes and consequences of this man-made disaster and the measures being taken to overcome the many problems associated with this disaster.

However, according to this study, it will be a long time before ecotourism products can be implemented in Karakalpakstan, as there are practically no initiatives for:

a) Obtaining direct financial benefits for conservation purposes.

b) Establishing effective participation of the population in tourism at the village level.

c) Training guides, tour operators and ecotourism consultants.

e) Provision of environmentally friendly housing and transportation.

According to the study, the main reasons for the reluctance of Uzbekistan Tour Operators to actively promote ecotourism in the Aral Sea area include the following:

- Lack of experience (in the design and development of ecotourism products and services).
- Lack of competencies (in promoting ecotourism products and services).
- Lack of international networks to promote and market ecotourism products and services.
- The main demand for ecotourism coming from domestic tourists, who were far from wealthy, resulted in shorter ecotourism tours and limited profitability.

Thus, although Karakalpakstan is considered an attractive place for nature tourism, closely related to cultural tourism, it cannot yet be considered a destination for ecotourism.

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Issue Article

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Director, docent

FOURTH NATIONAL OPERA (About K. Zaretdinov's opera «For the people»)

Abstract: *In this article, we have touched upon some issues related to the creation of the fourth opera "For the People", which was staged at the Karakalpak State Academic Musical Theater named after Berdakh and presented to our people. In this regard, the main source of information on the essence of the content of opera and its stages of development in the Republic of Karakalpakstan was noted.*

Key words: *theatrical art, opera, orchestra, stage, conductor.*
Language: *Russian*
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ЧЕТВЁРТАЯ НАЦИОНАЛЬНАЯ ОПЕРА (Об опере К.Заретдинова «Для народа»)

Аннотация: *В данной статье мы затронули некоторые вопросы, связанные с созданием четвертой оперы «Для народа», которая была поставлена в Каракалпакском государственном академическом музыкальном театре имени Бердаха и подарена нашему народу. В связи с этим отмечен основной источник информации о сущности содержания оперы и этапах ее развития в Республике Каракалпакстан.*

Ключевые слова: *театральное искусство, опера, оркестр, сцена, дирижёр.*

Введение

Опера – особый жанр и наивысшая вершина музыкального искусства. Развитие оперы в искусстве каждого народа, следует признать наглядным свидетельством развития музыкального искусства данного народа. Опера - синтетический жанр, включающий в себя несколько видов искусства. В частности, в одном сценическом процессе непрерывно соединяются образцы драматургии, музыки, изобразительного искусства, хореографии. Среди которых музыка занимает ведущее место.

Основная часть

Литературная основа оперы – события в либретто представленные музыкой, а в ней выделены вокальные данные актёра (исполнителя). В том числе эмоции героев изображаются в спектакле через исполнительское мастерство, мимику и действия актёров. В различных вокальных ансамблях (дуэт, трио и др.) взаимоотношения персонажей раскрываются через драматические события. Хор в свою очередь выполняет роль объяснения происходящего. С его помощью рассказываются события жизни людей [2].

В опере оркестр играет значимую роль. Он служит для раскрытия содержания происходящих на сцене событий и выражения душевного состояния каждой сцены. Несомненно, успешное исполнение каждого оперного произведения напрямую связано с заложенной в нём идеей, целью, связью событий в сюжете, реализацией программ музыкально – творческой школы, творчеством композитора с неповторимым стилем создателей.

Повысить влияние оперного и балетного искусства в создании нового Узбекистана, популяризировать национальное оперное и балетное искусство в мировом масштабе, донести

до нашего народа лучшие национальные и классические произведения оперного и балетного искусства. Сохранять и пропагандировать его уникальные шедевры, всестороннее развитие педагогических традиций и творческих школ, развитие системы подготовки кадров для оперного и балетного искусства, обеспечение сотрудничества между театрами и учебными заведениями, в том числе приветствуется поддержка театральных организаций в этом направлении и укрепление их материально технической базы [1].

За последние годы нашего столетия можно заметить, огромное развитие каракалпакского театрального искусства. За последнее время широкой публике Каракалпакского государственного академического музыкального театра имени Бердаха были поставлены и представлены народные произведения. После опер «Ажинияз», «Тумарис» и «Сорок девушек» театральный коллектив предоставил ценителям искусства свою четвёртую оперу – «Для народа», что стало ещё одним достижением театрального коллектива.

Либретто оперы «Для народа» принадлежит перу известного народного поэта Каракалпакстана Кенгесбая Каримова. Опера состоит из 2-х актов и 7-ми сцен. Безусловно, успешное исполнение оперы напрямую зависит от мастерства исполнителя. Основоположником данной оперы является известный деятель искусства Республики Узбекистан и Каракалпакстан, композитор Курбанбай Заретдинов. Молодой талантливый режиссёр, заслуженный артист Республики Каракалпакстан Маркабай Усенов перенёс на сцену события либретто этого произведения в разных музыкальных стилях композиторского мастерства. Непосредственно незаменима роль и режиссёра в художественной интерпретации событий спектакля.

В «Для народа» отражены события, связанные с жизнью и творчеством каракалпакского народного поэта – классика XIX века Бердаха Каргабай-улы. В произведении главным образом отражены последние годы жизни поэта Бердаха, период после вхождения каракалпаков расположенных на правом берегу Амударьи, где жил Бердах в состав России в 1873 году.

Бердах является классическим поэтом каракалпаков, начитанным, просвещённым и искусным поэтом своего времени [10; 66-69]. Поэт оставил нам уникальные образцы творчества: стихи, дастаны.

Безусловно, всю творческую деятельность Бердаха и его заслуги перед родиной невозможно раскрыть одной всего лишь оперой. В связи с этим в произведение включены несколько эпизодов из жизни поэта – защитник женщин и народа с прогрессивным мировоззрением.

Особо следует отметить роль в опере заслуженного деятеля искусства Узбекистана и Каракалпакстана, Лауреата Государственной премии Бердаха, композитора Курбанбая Заретдинова, главного дирижёра Государственного академического музыкального театра имени Бердаха. К. Заретдинов – деятель с широкими возможностями в сфере культуры и искусства. Каждое созданное им произведение имеет национальный характер. В каждом его произведении описывается национальный менталитет: отвага, непокорность, настойчивость, стойкость и тонкость творческого духа каракалпаков. Совершенно верно, что до ныне мэтры каракалпакской музыки создавали произведения, выражающие неповторимые национальные традиции и разновидную самобытность отличающаяся от других народностей. Несомненно, такие произведения создают в сердцах людей национальный дух. Создание национального характера – одна из главных задач каждого исполнителя. По этой причине композитор старается осветить национальный характер своего края и описать его в прекрасных музыкальных волнах, создавая музыку. Это тонкое музыкальное чувство занимает особое место в творчестве Курбанбая Заретдинова. Национальный характер каракалпакского народа отчётливо просматривается в каждом созданном им произведении, в том числе и в данной опере «Для народа».

Безусловно, опера – это музыкальный жанр. Мы не можем представить каждую сцену в опере без музыки. Публика полностью понимает и чувствует содержание произведения по тонкой музыкальной волне симфонического оркестра Академического театра под руководством дирижёра К. Заретдинова. Связь творчества композитора с оркестром и артистами легла в основу создания целостного творческого продукта. Однако некоторые сцены спектакля показывают, что потребность в оперных артистках для Каракалпакского театра всё же есть. Следует отметить, что выступление хора также было очень успешным. Заслуживает признания творческая работа искусных концертмейстеров театра А.Толеповой, А.Махамметшариповой, К.Кинжебаевой.

Актёры театра в спектакле: Бердах – С.Шерманов, поэт Кулмурат – А.Аширов, дочь поэта Хурлиман – Заслуженная артистка Узбекистана и Каракалпакстана Э.Айтниязова, супруга поэта – образ Бибитхан - Заслуженная артистка Узбекистана и Каракалпакстана Р.Кутекеева, Кулман – болыс – Ф.Узакбергенов, Г.Рейипназарова успешно исполнила роль

Перийзат ученицы Хурлиман бахсы. В массовых представлениях принимали участие актёры театра, артисты хора и балета.

В успешном исполнении любого произведения немаловажную роль играет и сценическое оформление. Немалый вклад в оформлении оперы «Для народа», ярко выражающей дух того времени, внёс и театральный художник Тимур Шардаметов. Художник тщательно изучил каждую сцену произведения и создал образец работы, подходящий для каждой сцены. Следует отметить, что появление героев спектакля в национальных костюмах каракалпаков соответствующих тому периоду, повышает доверие зрителей к событиям спектакля. В правильном выборе национальной одежды, мы можем заметить, что художник по костюмам С. Давкараева очень талантливо и со вкусом смогла сделать правильный выбор. А именно, в пьесе каракалпакские национальные уборы (шогирме, дегелей, бори) уместно использовались для женской так и мужской одежды.

Как мы уже упоминали выше, опера сочетает в себе множество видов искусства. В опере «Для народа» искусство хореографии, то есть исполнение балета юношей и девушек на свадебной сцене спектакля, (несмотря на то, что таких танцев в то время не существовало), обогащает и объединяет историческое и современно - творческое наследие нации. В нём мы видим, что балетмейстер, народный артист Узбекистана Абибулла Шарипов соединил национальное танцевальное искусство с балетным жанром. Это, в свою очередь, вызывает у зрителей интерес к произведению, что в дальнейшем послужит к его творческому успеху.

В заключении спектакля припев песни «Для народа» пробуждает в зрителях чувства любви к своей стране и Родине, призывает каждого из нас жить с болью народа и способствовать его благополучной жизни.

Заключение

В целом, внимание и возможности, уделяемые театральному искусству в нашей стране за последние 3-4 года, приносят свои плоды. За один год в Каракалпакском государственном академическом музыкальном театре имени Бердаха зрителям были представлены две национальные оперы – это уже большое достижение. Подводя итоги данной статьи, мы пришли к выводу, что четвёртая по счёту национальная опера «Для народа» была созидательным произведением, созданным для народа и отвечающим требованиям сегодняшнего дня.

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Issue Article

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THE IMPORTANCE OF TEXTBOOK IN ACQUISITION OF RUSSIAN LANGUAGE

Abstract: *In acquiring Russian language, paper-based materials are considered to be essential due to being familiar with terminology and contexts depicted in the textbooks on subject matter which focuses on mainly specialty of adult learners for their future training and employment opportunities. Consequently, learners with specific desire are able to acquire linguistic skills through contexts. Besides, textbooks are full of content-based texts and illustrate the features and terms learners need to obtain, and interpret. This paper highlights the scholars' statement according to textbooks and its functions.*

Key words: *terminology, content-based texts, textbook, Russian language.*
Language: *English*
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Introduction

In recent years, learning a language has given more opportunities and knowledge to learners. Consequently, Russian language learners acquire a language through textbooks on different subjects. For instance, Russian for petroleum engineering is required by companies and organizations and is in need of. As a consequence, vocabulary is considered as a main component to know the language. According to the statement of some linguists (Koizumi & In'nami, 2013; Stæhr, 2008; Nation, 2006; Alsaif & Milton, 2012; Chujo, 2004; Koosha & Akbari, 2010; Marmol, 2011; Sakata, Tagashira, & Mochizuki, 2014) vocabulary knowledge has been perceived as a key factor of learning FL and focusing on high-frequency words has been occurred in every context the learners face. Furthermore, while learning terminology in Russian learners often feel that all vocabulary words used in textbooks which seem to be less learnable words in spoken context.

Besides, adult learners may have chances to acquire generally frequent words that do not occur frequently in textbooks with word books or authentic materials corresponding to their specialty and are need of. Moreover, we carried out a survey with 20 group students who were invited to be interviewed with during the class in order to find out their target needs in texts which are full of technical vocabulary in the field of oil and gas, Faculty of oil and gas, Karshi Engineering-Economic institute was chosen as a place to make a door to door experiment.

Essential characteristics of textbooks in acquisition of technical vocabulary

Alsaif and Milton (2012) claimed that language learners often depend on textbooks for exposure to the target language, especially when they learn the language far from where it is spoken. Russian learners were indicated an increasing number of words in a textbook, which they are not able to follow in media, on TV, films and other electronic resources. Additionally, some scholars (Alsaif & Milton, 2012; Chujo, 2004; Koosha & Akbari, 2010; Marmol, 2011; Sakata et al., 2014) reveled that lexical frequency in textbooks is not congruent with general frequency; namely, many generally infrequent words were overly used, whereas some generally frequent words are missing. Linguist Kh. Abdinazarov stated about the importance of authentic material which is considered as a text; authentic material gives language teachers,

learners new data which may reflect students in learning the subject matter, consequently, improve student's professionally-oriented knowledge in language; furthermore, it may support them with a lot of experience, instruction, description of works what they will be accustomed to. in addition to that, authentic material not only provides updated data on profession but also it prepares students for job-oriented purposes and develops their linguistic and professional skills in language.

Learning vocabulary of specialty

Additionally, Maja Bratanic (2015) revealed other essential features in teaching foreign language for specific purposes such as FL for Aviation course. He stated that the language and terminology used to depict:

- An airport or airfield, relevant equipment and the associated personnel as an airport or airfield
- Aircraft types, parts and characteristics
- Aircraft operations and communication/control facilities
- The division of Airspace and the agencies responsible for Airspace
- Navigation and navigation aids
- The Language of Air and Sound emergencies
- An introduction to meteorology/climatology
- A revision/update of ICAO standard Aviation words and phrases

Therefore, teaching vocabulary courses or materials should be focused on specialty which learners are keen on studying and acquiring it. Materials may be paper based, or audio, video. At present, even if audio and video supplements are famous in classes of languages but textbooks are also effective in learning any profession in Russian language. Furthermore, some textbooks are also on sale in amazon internet market where learners may purchase for high prizes. It means that textbooks are very essential to reach the aim learners to put forward.

If we take a text from the book on oil and gas, we may see that comprehending terminology occurring in those texts are very complicated to guess. For instance;

1) В процессе бурения скважины в неустойчивых горных породах возможны интенсивное кавернообразование, осыпи, обвалы и т.д. В ряде случаев дальнейшая углубка ствола скважины становится невозможной без предварительного крепления ее стенок. Для исключения таких явлений кольцевой канал (кольцевое пространство) между стенкой скважины и спущенной в нее обсадной колонной заполняется тампонирующим (изолирующим) материалом. Это составы, включающие вяжущее вещество, инертные и активные наполнители, химические реагенты. Их готовят в виде растворов (чаще водных) и закачивают в скважину насосами. Из вяжущих веществ наиболее широко применяют тампонажные портландцементы. Поэтому процесс разобщения пластов называют цементированием.

2) В скважину спускают обсадные колонны определенного назначения: направление, кондуктор, промежуточные колонны, эксплуатационная колонна. Направление спускается в скважину для предупреждения размыва и обрушения горных пород вокруг устья при бурении под кондуктор, а также для соединения скважины с системой очистки бурового раствора. Кольцевое пространство за направлением заполняют по всей длине тампонажным раствором или бетоном. Направление спускают на глубину от нескольких метров в устойчивых породах, до десятков метров в болотах и илистых грунтах. Кондуктором обычно перекрывают верхнюю часть геологического разреза, где имеются неустойчивые породы, пласты, поглощающие буровой раствор или проявляющие, подающие на поверхность пластовые флюиды, т.е. все те интервалы, которые будут осложнять процесс дальнейшего бурения и вызывать загрязнение окружающей природной среды. Кондуктором обязательно должны быть перекрыты все пласты, насыщенные пресной водой.

Table 1

Profession-based terminology in Russian
бурения скважины
горных породах
каверн образование
стенкой скважины
обсадной колонной
кольцевой канал
тампонирующим (изолирующим) материалом
инертные и активные наполнители
химические реагенты

тампонажные портландцементы
цементированием
пласт
колонны
промежуточные колонны
эксплуатационная колонна
Кондуктор
бурового раствора
геологического разреза
неустойчивые породы
пластовые флюиды
интервалы
загрязнение
природной среды
насыщенные пресной водой

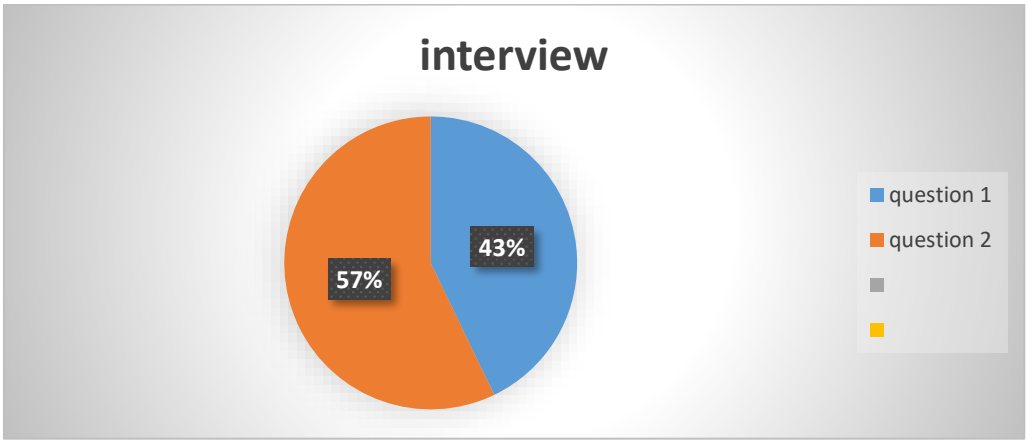
Research methods

In order to find out target needs of learners in acquiring Russian language, we conducted a research. A research was based on survey which reflected specific needs of learners during the interview. Interview took place at the faculty of oil and gas, Karshi Engineering-Economic institute, with a group which consisted of 20 students who actively participated in the interview and expressed their thoughts according to learning Russian language through texts and its essential features for their studies.

A survey comprised of two questions;

1) Why is text essential in acquiring Russian language?

2) What you think is technical text effective in learning both Russian and subject matter?



Picture 1.

According to the data we have collected and made an analysis showed that technical text is efficient in obtaining Russian and specialty through. Besides, learners stated that texts which are full of technical terminology alleviate our reading and listening, and spoken comprehension as well.

Conclusion

In learning Russian language, a teacher is to know what kind of tasks and processing would be associated with particular texts. Besides, skimming and scanning technical texts is very difficult because of not having enough vocabulary knowledge in that field of. Furthermore, translation is of high importance for better assimilation of the specialized terminology, as it helps professionally oriented students to interpret scientific and technical texts of the oil and gas sector while reading. Furthermore, terminology of this field is being more required by officials in recent years due to the developments of oil and gas industry in our country. Additionally, learners feel a failure in translating specific vocabulary (technical terminology), which complicates the comprehension of context in the process of reading since they could hardly find L1 translation, and those translated from English into Uzbek, that indicates the lexical deficiency in the field of oil and gas in L1 (Kh. Abdinazarov. 2021:74).

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Issue Article

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TEACHING RUSSIAN LITERATURE TO YOUNG LEARNERS

Abstract: *In teaching Russian language to young learners, teacher's aim is to improve their linguistic competence by involving them being interested in literature especially, Russian one because it enriches young learners' imagination world, increase their vocabulary range and let them remember every hero mentioned in stories or novels told my practitioners. Furthermore, literature helps developing young learner's psychological sense, directing what to follow and what is right or wrong. Besides, literature is the main source of education which help us to build our better future.*

Key words: *Russian language, Russian literature, psychological sense, stories, novels.*
Language: *English*
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Introduction

In teaching and learning Russian through literature is very effective for both teachers and learners because Russian literature is very rich in literature, especially, stories, fairy tales, and novels, fictions which gives human kind endless knowledge as well as extend the horizons of knowledge towards the world. Furthermore, life does not exist without literature because we definitely know that it will enable us to create our imaginative ideas where we live in our childhood. Additionally, the stories focusing on truth and kindness gives young learners much lightening and bright future to pursue his/her prospects in order to find own ideology of how to behave and communicate with people in the society.

Comprehending the stories and novels, fiction and others, learners should be aware of lexical and grammatical knowledge which help interpretation those ones. According to the statement of linguists (Olga A. Drozdova, Elena V. Zamyatina, Darya N. Volodina, Elena O. Zakharova, Alexandra V. Ruchina, Alexander F. Nepryakhin: 2015:118) the successful mastering of any lexical and grammatical topic and understanding the subject of communication in a foreign language is best of all achieved through speech interaction. Active and interactive methods of teaching underlie the modern educational process and help to immerse international students in active communication in the language studied (in our case Russian). Among the activities which develop and enhance students' communicative skills are turn-taking, open discussions, collective decision-making, etc. Moreover, while reading literature and learning poems or stories to tell, we study how to communicate and how to express our own thoughts, insights to people around us.

The importance of literature in learning Russian

According to the statement of G. Neuner (2006) "learning FL inevitably brings us into contact with a new world in which, although their world 'in principle' is similar to our own world (in its elementary dimensions of living) and they do rather the same things as we do, people have arranged their environment differently and arrange their social behavior according to different conventions". The need for a more robust pedagogy that provides linguistic support for student discussion of literary texts is clear as well from recent studies into the nature of the language use

that learners engage in when taking advanced literature classes in the target language. Besides, some scholars (Donato and Brooks 2004; Polio and Zyzik

2009; and Darhower 2014) indicated that the frequent disparities between the level of discourse that the profession has assumed learners will engage in (usually, ACTFL Advanced/Superior levels) and the kind of discourse they actually produce (often, Intermediate level) in such classes.

William J. Comer (2016) claimed that in some ways then, the situation for Russian, where literary texts figure to some degree in the curriculum of advanced-level language classes, seems to manage the integration of literature and language focus that seems so elusive in programs for the more commonly taught languages. And yet the presence of literary texts by themselves does not tell us how they are being used to develop language skills and whether they are at the same time being used to develop skills in critical reading and literary analysis. Olga Karasik, Nadezhda Pomortseva (2015) stated that it is mainly it is a part of the obligatory course of World Literature within the schedule of different majors: World Literature, Russian Literature, Regional Literature, Foreign Languages, Teaching Methods in Language and Literature, Translation. Linguist Kh. Abdinazarov revealed that teaching language through a literature improves youngsters' not only linguistic skills but also increase their views according to society where they live in. Besides, To deal with the complexity of syntax students encounter in authentic literary texts, she advocates activities that have students decode difficult structures from the text as rereading work. According to the statement of Rosengrant (2000) dealing with the many unfamiliar vocabulary items, she emphasizes judicious glossing of key words that are likely to be unfamiliar. Her advice, particularly for productive tasks and discussion, is useful although how exactly to support learners dealing with complex syntax and vocabulary as they perform output-based tasks needs further exploration.

Methods of teaching Russian literature to young learners

At present there are an increasing number of methods of teaching literature but we may use grammar translation method which is traditional and that have been in use for some years. However, CLIL is very effective in learning Russian literature because it enables us how to communicate in this language and how to use words appropriately. For example, if we take a story such as " *красноя шапочка", "винни пух"* which gives more joy and pleasant time to young Russian learners.

The group is divided into two sub-groups A and B. Group A reads a story and asks members of group B about the story. The main characters of *"красноя шапочка*" are young girl, wolf, and grandmother. Their performance in this story is impressive and essence of that is to focus on more kindness against to cruelty. Briefly extract taken from the story: *Красная Шапочка была послушной девочкой, она сейчас же собралась и отправилась к бабушке, которая жила в другой деревне. Идёт она по лесной тропинке и тут навстречу ей волк. Волк хотел было её съесть, да побоялся, потому что поблизости был слышен стук дровосеков*.

Meanwhile, the story *"винни пух"* demonstrates friendship, kindness and peace for people in the world. Population of the planet should live friendly and with joy. Moreover, the stories, novels young learners read and learn is able to lead them to accomplish well-done performances in the future life path. At the beginning their ages they acquire needful instructions and rules of how to construct private life and what to pursue, and whom to follow. That's why teaching literature to young generation increase their cognitive senses. Briefly extract taken from the story: *Как-то утром, когда завтрак уже давно кончился, а обед еще и не думал начинаться, Винни-Пух не спеша прогуливался со своим другом Пятачком и сочинял новую песенку.*

Research methods

We intend to carry out a research focusing on learning Russian through literature, and 20 young learners were invited to be interviewed with specific questionnaire at primary school № 34, Karshi. As a consequence, a survey was prepared and made some improvements in questionnaire by Russian linguists at the Department of Uzbek and Uzbek literature, Karshi Engineering-Economic institute. A survey consisted of four specific questions for respondents to answer during the interview.

1) Are the stories easy way to gain Russian language?

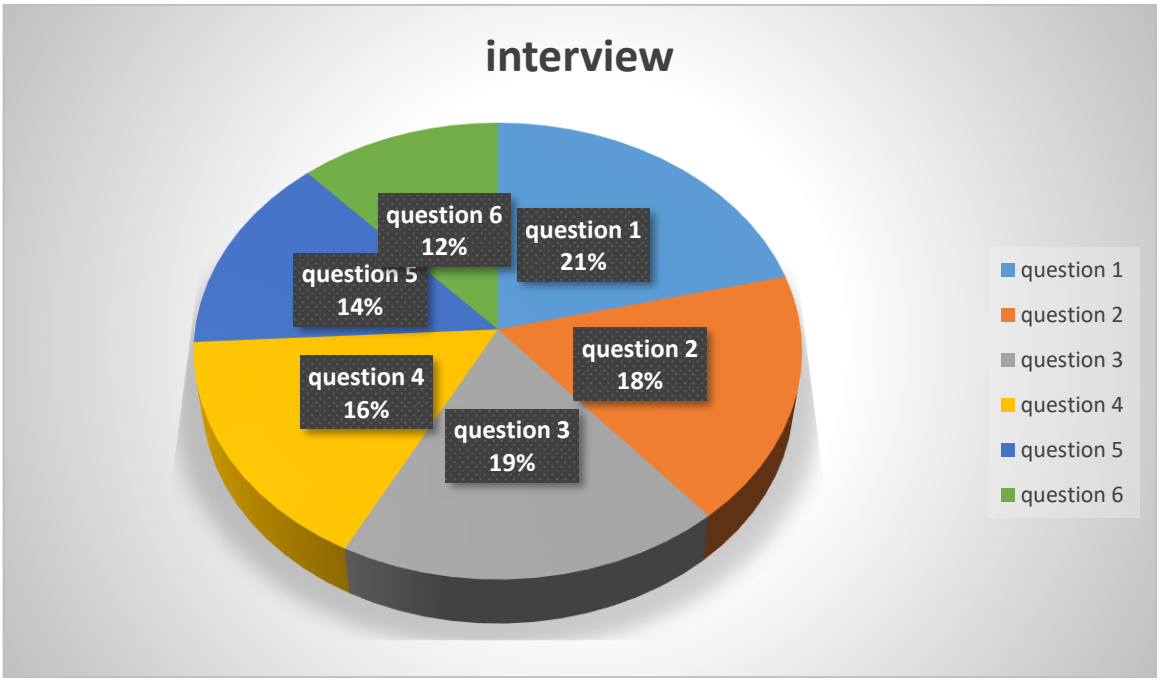
2) Are those novels constructed comprehensively?

3) Do they help you to express your thoughts in Russian?

4) Do you comprehend vocabulary of the stories?

5) Can you understand them without knowing grammar rules?

6) Can you realize the content of the story without knowing phonetic rules?



Picture 1.

The collected analysis showed in the above-mentioned diagram, the answer of respondents was different according to their target needs. The result indicated that 1st ,2nd and 3rd questions was important one for them to answer and they could acquire Russian language by reading and comprehending, explaining, expressing their ideas about the stories and novels which are considered main components of Russian literature. Additionally, Kulibina (2001) gives extensive methodological advice for teaching literary texts in the context of Russian language. For her, the goal of working with a text is to help nonnative readers understand the explicit meaning of the text so that they can create their own interpretation of it

Conclusion

Teaching Russian language to young learners is very needful due to motivating them learning Russian though stories, novels and fiction which are able to improve their background knowledge and let them to express ideas according to thoughts depicted in the contexts of the stories and novels and fiction. Those could enrich their ideology according to the philosophy of literature. Furthermore, teaching Russian literature to learners is very efficient. In some ways then, the situation for Russian, where literary texts figure to some degree in the curriculum of advanced-level language classes, seems to manage the integration of literature and language focus that seems so elusive in programs for the more commonly taught languages. And yet the presence of literary texts by themselves does not tell us how they are being used to develop language skills and whether they are at the same time being used to develop skills in critical reading and literary analysis (William J. Comer, 2016).

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Issue Article

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ANALYSIS OF THE EFFECTIVENESS OF COMBATING CORRUPTION IN THE EDUCATION SYSTEM OF THE REPUBLIC OF UZBEKISTAN AND WAYS TO IMPROVE IT

Abstract: *This article is devoted to the topical issue of improving the effectiveness of combating corruption in the education system of Uzbekistan. The article's aim is to analyze the effectiveness of combating corruption in the education system of the Republic of Uzbekistan and ways to improve it. The research methods were the following: analysis of scientific literature and legal acts, comparative legal analysis, induction, deduction and forecasting. The article's author comes to the conclusion that much has been done in the Republic of Uzbekistan in recent years to improve the effectiveness of combating corruption in general and in the education system in particular. At the same time, there are still many unresolved problems, which are also noted by experts from OECD countries. Nowadays, manifestations of corruption in education are of particular concern, since they are widespread. The article presents specific proposals for improving the current anti-corruption legislation of Uzbekistan and a list of priority measures that will improve the effectiveness of combating corruption in the education system of the Republic of Uzbekistan.*

Key words: *combating corruption, improving effectiveness, legislation modernization, education system, Uzbekistan.*

Language: *English*

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Introduction

In 2018-2022 many effective anti-corruption reforms have been carried out in the Republic of Uzbekistan, since 2017 anti-corruption legislation has been continuously modernized[1], however, the country still lacks legal norms regulating the declaration of assets and income of civil servants, key issues of the organization and functioning of the judiciary, as well as the support of courts and judges should not be regulated by acts of the President or the Cabinet of Ministers, but by a law in which only technical or procedural issues are classified as regulations. It is important to reconsider the role and scope of powers of the Supreme Court in the organization of the judiciary, in particular, in matters of financing courts and remuneration of judges. At present, only partially implemented are the recommendations of the OECD[2], which were provided by the organization to Uzbekistan in 2019 based on the results of anti-corruption monitoring. At the same time, there is a concentration of anti-corruption efforts mainly on reducing the level of corruption manifestations in public authorities. It seems that at the same time it is important to strengthen the fight against corruption in

[1] Закон Республики Узбекистан «О противодействии коррупции» №ЗРУ-419 от 03.01.2017 // Lex.uz. – URL: https://lex.uz/docs/3088013 (дата обращения: 27.07.2022).

[2] Anti-corruption reforms in Uzbekistan 4th round of monitoring of the Istanbul Anti-Corruption Action Plan // OECD. – 2019. – URL: https://www.oecd.org/corruption/acn/OECD-ACN-Uzbekistan-4th-Round_Monitoring-Report-2019-ENG.pdf 8-12 pp. (reference date: June 27, 2022).

various areas of public life, including the field of education. Education today is not sufficiently protected from corruption; this is clearly demonstrated by the high statistics of bringing workers in this area to justice.

At the beginning of 2020, the Prosecutor General of Uzbekistan N. Yuldashev announced that over the past two years, 326 employees of the system of higher and secondary specialized education were prosecuted for crimes related to the educational process, including 220 in colleges and lyceums, 106 in higher educational institutions.[3] Corruption affects not only the quality of education, but also negatively affects the positions of the country's universities in international rankings. In particular, the largest educational institution, the National University of Uzbekistan, occupies 3971th place in the global Webometrics ranking, which includes about 30 thousand universities in the world.[4]

Corruption manifestations in the field of education in the Republic of Uzbekistan currently have the following types in the areas of activity: due to the implementation of educational functions; caused by the provision of goods and services, which is accompanied by inappropriate professional behavior; based on violations in the field of taxation and disposal of property.[5] In the scientific literature, one can also find the division of corruption into large-scale (at the level of organizations) and small-scale (at the level of individual officials' bribing).[6]

The conducted research showed that it is possible to free the education system of Uzbekistan from corruption manifestations by ensuring the transparency of the regulatory system, strengthening the managerial resource and increasing the responsibility of personnel and introducing stricter controlled accountability. Anti-corruption activities in education require clear rules and regulations, transparent procedures and a clear policy for the distribution of responsibility between a wide range of parties interested in the use of educational resources. Improved management, accounting, monitoring and auditing skills are required. It is important to focus on improving the quality of training for all administrative staff, as well as providing the general public with access to information in order to stimulate citizen involvement in the control system. Citizens of Uzbekistan should have full information about the ways and methods of protecting their rights, so that all manifestations of corruption are promptly identified, promptly eliminated and prevented. Corruption in education not only causes economic damage to the country, but also leads to a loss of confidence in teachers and public authorities.[7]

We also studied the phenomenon of giving gifts as one of the types of corruption in the education of the Republic of Uzbekistan, in legal terms this issue is not regulated, because unlike in many countries of the world, gifts in Uzbekistan are not limited to any amount of money or types of acceptable gifts for teachers. It is important to understand that a gift is a managerial category, as it is associated with building relationships in an organization and corporate culture.[8] In this regard, we propose to resolve this issue in the Civil Code of the Republic of Uzbekistan[9] and the Law of the Republic of Uzbekistan "On the State Civil Service"[10] in relation to civil servants and public sector employees.

Each educational institution in Uzbekistan should adopt codes of ethics for teachers, which, among other things, reflect the position of the educational organization regarding the acceptance of gifts by teachers. The practice of ethical codes in educational institutions is widespread abroad and has already proven its effectiveness, so it is useful for Uzbekistan to adopt it. The document should provide for a whole range of relationships between the teacher and students, their parents, the administration of the educational institution, colleagues, etc. In this regard, the provisions of the code must be clearly structured, written in a language understandable to any employee, practically feasible, and it is important to control their compliance, since otherwise it is difficult to ensure liability for violations.

Young students must be educated in the spirit of rejection of any manifestations of corruption and the desire for respectable behavior. In this matter, the most coordinated and comprehensive joint work of the

[3] «Коррупция существует на всех ступенях высшего образования» – Танзила Нарбаева // Газета.UZ. – 07.08.2020. – URL: https://www.gazeta.uz/ru/2020/08/07/corruption-edu/ (дата обращения: 27.07.2022).

[4] Ibidem.

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[10] Закон Республики Узбекистан «О государственной службе безопасности президента Республики Узбекистан». Принят Законодательной палатой 7 мая 2021 года. Одобрен Сенатом 29 мая 2021 года // Lex.UZ. – URL: https://lex.uz/ru/docs/5491509 (дата обращения: 27.07.2022).

state, all educational institutions, the youth themselves, civil society and the media is required.[11]

The main directions of anti-corruption development of the education system in the Republic of Uzbekistan are associated with the adoption of the following measures:

- Ensuring stability, order and clarity in the system of secondary education - approximation and identification of national standards with the best European and world practices;

- Improving the quality of education, including universal access to the education system, achieving a high degree of involvement of the population in educational activities; applicability of training, comparability of achievements in the context of a comprehensive educational process;

- Increasing the financing of education at the expense of budgetary funds and attracting private investment, increasing the salaries of teachers and other officials in the field of education;

- Effective management focused on strategic planning, organization, coordination and control of integrated educational activities, decentralization and autonomy of self-government bodies.[12]

The Council of Europe has launched the Pan-European Platform on Ethics, Transparency and Integrity in Education (ETINED)[13], which is a new platform for combating corruption in the education system, the principle of which it is useful to analyze the principle of Uzbekistan in the process of improving legislation aimed at combating corruption and introducing ethical standards and rules of conduct.

The Council of Europe plans to actively develop cooperation in this direction with other international organizations and agencies working in this field, with the aim of exchanging information and best practices in the field of ensuring transparency and integrity in education, developing solutions to combat corruption and involving all participants in observing fundamental positive ethical principles.

Platform-related events are held annually: an international workshop on plagiarism, research on academic integrity and openness in higher education, regional roundtables on the impact of national codes of conduct on the teaching profession, development of common guidelines and pilot projects for member countries.[14]

We systematized our proposals for amending the current regulatory legal acts of the Republic of Uzbekistan aimed at combating corruption in the education system:

1. The Article 3. The Law of the Republic of Uzbekistan “On Combating Corruption” “Basic Concepts” shall be stated as follows: “Corruption is the abuse of the advantages of public status for personal gain”.

2. Amend the Law of the Republic of Uzbekistan “On the State Civil Service” in accordance with the draft law “On the State Service”, developed jointly by the Ministry of Justice, the Ministry of Employment and Labor Relations and the Academy of Public Administration under the President of the Republic of Uzbekistan in 2019. Supplement this law with the provisions on the Code of Ethics for Civil Servants and the mechanisms for monitoring its observance in order to prevent corruption. The Article 23 of this law “Ethics of a civil servant” shall be stated as follows: “In order to resolve issues related to compliance with the Ethical Rules, security units, inspections, professional ethics commissions, and anti-corruption compliance services are formed in state bodies and organizations. The activities of the above bodies are regulated by the Regulation approved by the authorized body for public service affairs”.

3. In the Special Part of the Criminal Code of the Republic of Uzbekistan, disparate norms governing corruption manifestations are combined into one chapter called “Corruption crimes related to the position of an official”.

4. The Article 23. The Law of the Republic of Uzbekistan “On Education” “Powers of the Cabinet of Ministers of the Republic of Uzbekistan in the field of education” shall be supplemented with the following provision: “determines the procedure for introducing ethical codes of pedagogical workers into all types and forms of education”.

5. The Ministry of Education of the Republic of Uzbekistan should develop and put into effect model codes of ethics for teachers for different levels of the education system with a view to their subsequent introduction into the systems of local acts of all educational institutions of the country.

6. The Anti-Corruption Agency, together with the Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan, the Ministry of Public Education of the Republic of Uzbekistan, the Ministry of Preschool Education of the Republic of Uzbekistan, should develop and implement programs to educate the younger generation about anti-

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corruption activities, actively involve young people in measures to combat corruption in the field education and the formation of an intolerant attitude towards corruption among citizens from early childhood.

7. The Ministry of Higher and Secondary Specialized Education of the Republic of Uzbekistan and the Ministry of Public Education of the Republic of Uzbekistan should establish a system of counseling centers that provide information to the younger generation about the possibilities of training and subsequent employment, as well as combining work with education; provide state funding for all types of educational institutions by providing social grants with a strict system of control over the expenditure of budgetary funds.

Thus, much has been done in the Republic of Uzbekistan in recent years to improve the effectiveness of combating corruption in general and in the education system in particular. At the same time, there are still many unresolved problems, which are also noted by experts from OECD countries. Nowadays, manifestations of corruption in education are of particular concern, since they are widespread. We have presented in this article priority measures that will improve the effectiveness of combating corruption in the education system of the Republic of Uzbekistan.

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Issue Article

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TWO-DIMENSIONAL NONLINEAR MATHEMATICAL MODEL OF THE PROCESS OF DISTRIBUTION OF HARMFUL SUBSTANCES IN THE BOUNDARY LAYER OF THE ATMOSPHERE

Abstract: *The article discusses in fact, to develop a mathematical model of an object using natural laws, we build an information model that includes complete information about the process or object under study. The choice of the most significant information when creating an information model and its degree of complexity is determined by the purpose of mathematical modeling. It should be noted that the construction of an information model is the main point in the development of a mathematical model of the object of study. All input parameters of the object selected during the analysis are ranked, and based on the selection methods, the model is simplified in accordance with the purpose of modeling. At the same time, factors that are not informative in the mathematical modeling of the object of study are discarded.*

Key words: *rate of deposition of particles, the process of transfer and diffusion of aerosol particles in the atmosphere, numerical algorithm.*

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Introduction

In addition to industrial and economic facilities, natural phenomena are also a significant source of harmful emissions, mainly, the removal of particles from the soil surface as a result of the turbulent movement of air masses in the surface layer of the atmosphere. This example is very relevant for the Aral Sea region, due to the drying of the Aral Sea and the exposure of about 60 thousand km $^{2\ of}$ its bottom, composed mainly of solonchaks and saline soils containing a large amount of pesticides and other

harmful chemicals brought into the sea by wastewater for many years [1].

The presence of a large amount of impurities in the atmosphere entails many negative effects on the living environment. In many respects, this affects the decrease in yield and quality of agricultural products as a result of damage to crops from “acid rain” [1].

The decrease in the quality of atmospheric air in places of residence causes significant harm to the health of the population. According to the International Committee on Health, the number of cases of cancer, asthma, allergies, etc. has increased dramatically in recent years. diseases due to the deterioration of the ecological state of the environment around the world [2].

Thus, in the tasks of environmental protection, the issues of monitoring and forecasting pollution of the atmosphere and the underlying surface of the earth by passive and active aerosol emissions, the location of new industrial facilities in compliance with sanitary standards and the determination of the amount of suspended particles in the air basins of the regions under consideration become extremely relevant [3].

Since the ecology of the atmosphere is one of the most important indicators of the state of the environment, it becomes necessary to carry out forecasts of the concentration of impurities in the surface layer of the atmosphere for various time frames. Of practical interest here are short-term forecasts related to the control of the maximum permissible concentration of harmful impurities in the design of structures of new enterprises[4, 5].

Pollution of the surface layer of the atmosphere and the underlying surface, including the transfer and diffusion of harmful substances, as well as their deposition and concentration, is a very complex process influenced by various factors that need to be taken into account in a detailed analysis of its state and in the performance of prognostic estimates, including geographical and weather and climatic conditions characteristic of a particular region under consideration, etc. Moreover, it is important to take into account the fact that meteorological conditions change during the day and seasons [6, 7].

Therefore, to date, one of the main approaches to the study of the process of distribution of harmful emissions in the atmosphere, the most acceptable in terms of economic and environmental criteria, is mathematical modeling, which can provide sufficient accuracy in describing and predicting changes [6].

The available means of mathematical modeling are able to provide comprehensive research, the purpose of which is to develop adequate models, efficient computational algorithms and software tools for automating the solution of problems of predicting the ecological state of industrial regions and making decisions on protecting the environment from harmful effects with a sufficiently high degree of certainty [6].

It should be noted that the current level of development of information technologies, computer hardware and software makes it possible to conduct computational experiments on problems of almost any complexity and dimension based on complex computer models that take into account a large number of various factors that affect the processes under study.

In response to the actualization of the problems of the ecological state of the atmosphere, the issues of mathematical modeling of the processes of transfer and diffusion of harmful substances in the boundary layer of the atmosphere are currently being actively studied by many scientists around the world. With the use of computer simulation tools for the process of transfer and diffusion of harmful substances in the boundary layer of the atmosphere, many studies of both applied and fundamental nature have already been carried out and are being carried out [1, 6].

As noted in the introduction, scientific research aimed at developing and improving mathematical models, computational algorithms and software systems for solving problems of monitoring and predicting the process of atmospheric pollution is carried out in many leading scientific centers and universities in the world.

Among the most significant scientific works on various aspects of the methodology of mathematical modeling in this area are the works of such prominent foreign and domestic scientists as E. Naslund, WJ Layton, WC Reynolds, G.I. Marchuk, M.E. Berlyand, V.V. Penenko, F.B. Abutaliev, K.S. Karimberdieva, M.L. Arushanov, N. Ravshanov and others.

The results obtained by the noted researchers in the field of mathematical modeling of the process of transfer and diffusion of aerosol particles and carbon dioxide in the atmosphere, in water and soils are of great theoretical and practical importance. Their efforts have created entire scientific schools that are effectively working today around the world.

Summarizing the experience of the published works of many authors, it can be argued that the key to successful comprehensive studies of the process of spreading emissions of harmful substances into the atmosphere, taking into account various internal and external disturbances acting on the process, is the development of an effective tool expressed by the triad - a mathematical model, a computational algorithm and a software tool for conducting computational experiments on a computer[6, 3].

Many works on the study of atmospheric dispersion models emphasize the need for a more thorough description of the features of aerosol particle deposition when calculating concentration fields in different layers of the atmosphere and directly on the underlying surface.

In particular, in the study [8] the authors, using the analytical solution of the advection-diffusion equation of the form

$$u_n \frac{\partial c_n}{\partial x} = K_n \frac{\partial^2 c_n}{\partial z^2} + w_s \frac{\partial c_n}{\partial z} \quad z_n \le z \le z_{n+1}, \quad n = 1:N,$$

showed that the sedimentation rate changes the concentration of particles along the entire length of the atmospheric boundary layer. Modeling has shown that gravitational settling can strongly influence the final distribution of the concentration of harmful particles in the air and the maximum concentration near the ground. The authors considered particles with a diameter of 10 to 100 μm at different heights of emission sources and under conditions of stable and unstable atmosphere. The particle settling rate was calculated according to the Stokes law, and the height of the atmospheric boundary layer was taken equal to 1000 m. The authors also showed the influence of particle diameters on the concentration distribution at ground level depending on the conditions of atmospheric stability. The results obtained by the authors show that under conditions of an unstable atmosphere for particles with a diameter of less than 10 μm, the gravitational component of the settling rate can be neglected. It should be noted that the authors applied a stepwise approximation to the problem posed by discretizing the height *h* into sublayers. The solution of the problem was obtained using the Laplace transform, but, due to the complexity of the integrand, the integration was performed numerically using the Talbbot algorithm .

The authors of [9] developed a mathematical model for the transfer of aerosols emitted from a point ground source, taking into account the rate of deposition of particles. Two-dimensional stationary mass transfer equation

$$u(z)\frac{\partial c}{\partial x} - w_s \frac{\partial c}{\partial z} = \frac{\partial}{\partial z}\left(k_z \frac{\partial c}{\partial z}\right)$$

with the corresponding boundary conditions was solved by the authors by applying the method of the generalized integral Laplace transform. The solution area was limited to the surface layer of the atmosphere, and changes in wind speed and vertical eddy diffusion were taken into account. The results obtained by the authors demonstrate the influence of the gravitational regime and dry deposition of particles on the distribution of their concentration at ground level, and are generally consistent with the results of other researchers.

In [10] the authors carried out a capacious review of recent achievements in the field of mathematical modeling of the processes of transfer and diffusion of pollutants in the atmosphere. The paper discusses the advantages and disadvantages of the most popular approaches and modeling strategies, namely Gaussian, Lagrangian , Euler , and computational fluid dynamics (CFD) models. Particular attention is paid to the parametrization of turbulent mixing in the atmospheric boundary layer and particle settling, and the influence of these processes on the distribution of pollution concentrations is analyzed. The authors also highlight the main methods for numerically solving problems based on finite-difference approximation of derivatives, including the method of splitting the original problem into physical processes. Due to the fact that the class of problems under consideration has a large computational capacity, the authors also pay attention to the trends in the use of parallel computing technologies using graphic modules or adaptive mesh refinement.

Menshov M.V. [11] proposes a modification of the model for the movement and settling of a polydisperse aerosol cloud resulting from the spraying of liquid fertilizers by agricultural aircraft. To describe the migration of an aerosol cloud, M.V. Menshov uses the equation of the semi-empirical theory of transport and turbulent diffusion with a set of corresponding initial-boundary conditions. The author carries out vertical averaging of the main equation under the assumption that the vertical distribution of concentration is close to the normal distribution. The method for solving the problem is based on the discretization of the original systems in the grid domain. Spatial approximation of differential operators is based on monotone schemes and schemes with increasing total variation, algebraic systems of finite-difference equations are solved iteratively using incomplete factorization methods, and implicit splitting methods are used for time integration. Comparison of calculation results with field data shows that the proposed model of aerosol formation migration and settling has a modeling error not exceeding 12-18%, which can be considered quite acceptable for field experiments due to the natural possibility of anomalous wind profiles.

In the article by Menshov M.V. [12] the results of mathematical modeling of the transfer of aerosol formation in conditions of rugged terrain using the model described in [11]. The above results show that the presence of even low gentle hills introduces significant changes in the nature of the distribution and deposition of aerosols [12].

A number of studies by Raputa V.F., Shlychkov V.A., Lezhenina A.A., Romanov A.N. and Yaroslavtseva T.V. is devoted to the problem of the transfer of heavy inhomogeneous impurities in the atmosphere [13, 14]. The authors proposed a model for reconstructing the fields of impurity particle fallout from a high-altitude source. The authors note that, in contrast to the situation with low-lying emission sources, when modeling the transport of aerosols in the atmosphere from high-altitude sources, there are significant difficulties associated with uncertainties in the height and power of the source, the initial distribution of aerosol particles in the cloud, and meteorological conditions. This explains the need to create reconstruction models. To describe the impurity propagation process, the authors use the semi- kinematic approximation, i.e. it is assumed that turbulent scattering occurs only in horizontal

directions, while particles move vertically at a constant Stokes velocity. The authors considered the influence of the effects of wind turns in the boundary layer of the atmosphere on the formation of the field of long-term fallout of aerosol impurities. The developed model was tested in the numerical analysis of snow cover pollution with benzapyrene in the vicinity of one of the thermal power plants in Barnaul. An analysis of the simulation results showed quite satisfactory agreement between the measured and calculated values of pollutant concentrations at control measurement points.

2. Statement of the problem

An analysis of previous studies, including by other authors, showed that one of the significant variables affecting the process of transfer and diffusion of fine particles in the atmosphere is the rate of particle deposition on the underlying surface of the earth. This factor directly affects changes in the concentration of harmful substances over time [15].

Therefore, to study the process of transfer and diffusion of aerosol particles in the atmosphere, taking into account this essential parameter, a mathematical model was developed, which is described on the basis of the law of hydromechanics using a two-dimensional differential equation in partial derivatives [15]:

$$\frac{\partial\theta}{\partial t}+u\frac{\partial\theta}{\partial x}+\left(w-w_g\right)\frac{\partial\theta}{\partial z}+\sigma\theta=\mu\frac{\partial^2\theta}{\partial x^2}+\frac{\partial}{\partial z}\left(\kappa\frac{\partial\theta}{\partial z}\right)+\delta Q; \quad (1)$$

$$\frac{dw_g}{dt}=\frac{mg-6\pi\gamma rw_g-0,5c\rho sw_g^2}{m} \quad (2)$$

with the corresponding initial and boundary conditions:

$$\theta\big|_{t=0}=\theta^0;\quad w_g\big|_{t=0}=w_g^0; \quad (3)$$

$$-\mu\frac{\partial\theta}{\partial x}\bigg|_{x=0}=\xi\left(\theta_E-\theta\right);\qquad \mu\frac{\partial\theta}{\partial x}\bigg|_{x=Lx}=\xi\left(\theta_E-\theta\right); \quad (4)$$

$$-\kappa\frac{\partial\theta}{\partial z}\bigg|_{z=0}=\beta\theta-f_0;\quad \kappa\frac{\partial\theta}{\partial z}\bigg|_{z=H_z}=\xi\left(\theta_E-\theta\right). \quad (5)$$

Here θ, is the concentration of harmful substances in the atmosphere; t is time; θ_0 – primary concentration of harmful substances in the atmosphere; θ_E - concentration entering through the boundaries of the area under consideration; x, z - coordinate system; u, w – wind speed in two directions; w_g is the particle settling rate; σ - coefficient of absorption of harmful substances in the atmosphere; μ, κ are the diffusion and turbulence coefficients; Q is the power of the source; δ is the Dirac function; ξ is the mass transfer coefficient across the calculation boundaries; β is the coefficient of particle interaction with the underlying surface; f_0 - a source of emission of harmful substances into the atmosphere from the underlying surface of the earth; c is a dimensionless quantity equal to 0.5; is the ρ particle density ; r is the particle radius; s is the cross-sectional area of particles; g is the acceleration of gravity, m is the mass of the particles, $\gamma$is the specific gravity of the particles.

It should be noted that in this formulation, equations (1), (2) and the corresponding initial and boundary conditions (3)–(5) describe three physical processes: convective transport of aerosol particles in the atmosphere due to the action of the atmospheric air flow; diffusion propagation of aerosol particles in the atmosphere due to molecular and turbulent diffusion; absorption of aerosol particles in the atmosphere due to the moisture content of the air mass in the atmosphere.

Unlike the works of other authors [16, 17, 18, 19, 20, 21, 22, 23], here the particle settling rate w_g is variable and depends on the physical and mechanical properties of fine particles (density, radius, cross-sectional area of particles, gravity acceleration, mass) ejected from industrial sites and production facilities, and is described by equation (2) and the corresponding initial condition (3).

According to [23, 24, 25, 26, 27], to determine the initial particle settling velocity, it is necessary to take into account three main forces that act on particles when moving in the atmosphere: gravity M_t , buoyancy N_v force resistance force R_s , which are determined using the equalities

$$M_t=mg;\quad \mathrm{N}_v=\mathrm{m}_\mathrm{p}g;\quad \mathrm{R}_s=\mathrm{k}_c S\frac{\rho w_g^2}{2},$$

where m_p is the mass of air in the volume; k_c - coefficient of air resistance.

Since, in general, aerosol particles emitted from production facilities are spherical with a diameter

equal to d , these three forces are calculated using the following formulas:

$$M_t = \frac{\pi d^3}{6}\rho g;\ \ \mathrm{N}_v = \frac{\pi d^3}{6}\rho g;\ \ \mathrm{R}_s = k_c\frac{\pi d^2}{4}\rho\frac{w_g^2}{2}.$$

Using the equilibrium equation, one can find the initial particle settling velocity:

$$w_g(0) = \sqrt{\frac{4dg(\rho_ч - \rho\ )}{3k_c\rho}},$$

where $\rho_ч$ is the particle density.

It should be noted that depending on the Reidnols number [24, 28, 26] you can calculate the air resistance coefficient using the following formulas:

$$\text{a)}\ k_c = \frac{24}{\mathrm{Re}};\ \ \text{b)}\ k_c = \frac{18,5}{\mathrm{Re}}\ \ \text{c)}\ k_c = 0.44.$$

We also emphasize that, unlike the works performed on the problem of mathematical modeling of the process of distribution of harmful substances in the atmosphere [22, 4, 5], here we consider a two-dimensional formulation of the problem of transfer and diffusion of harmful aerosol particles in the atmosphere, taking into account the inflow and outflow of substance through the boundaries of the considered solution area with stable, indifferent and unstable stratification of the atmospheric air mass.

We consider industrial production facilities as sources of emissions of harmful substances into the atmosphere, as well as, with unstable wind stratification, the surface of the earth, which is an additional generator of emissions of harmful substances due to wind erosion of the soil [10].

Summarizing, we note that as a result, a mathematical model (1) - (5) was developed to study, monitor and predict the concentration of harmful substances emitted from production facilities into the atmosphere, taking into account changes in the rate of deposition of aerosol particles on the underlying surface of the region under consideration, changes in the rates atmospheric air mass, as well as changes in the turbulence coefficient along the height of the atmospheric layer and other external disturbances acting on the object of study.

3. Problem solving methods.

It should be noted here that for the numerical solution of Eq. (2), it is necessary to set the initial condition and the initial iterative value for $w_g(0)$, w_g^S . According to [24, 27], the initial values and the initial iteration for these variables are given by the following relations:

a) with stable stratification

$$w_g(0) = \frac{d^2 g(\rho - \rho_z)}{18k};\ \ w_g^s = \frac{d^2 g(\rho - \rho_z)}{18k};$$

b) with indifferent stratification

$$w_g(0) = c_1\frac{d^{1.14}(\rho - \rho_z)^{0.714}}{\rho_z^{0.286}k^{0.43}};\ \ w_g^s = c_1\frac{d^{1.14}(\rho - \rho_z)^{0.714}}{\rho_z^{0.286}k^{0.43}};$$

c) with unstable stratification

$$w_g(0) = 5.46\sqrt{\frac{d(\rho - \rho_z)}{\rho_z}};\ \ w_g^s = 5.46\sqrt{\frac{d(\rho - \rho_z)}{\rho_z}}.$$

Here ρ_z is the particle density; $c_1 = 0.78$.

So, to solve the problem (1)-(5), a numerical algorithm has been developed, using which it is possible to carry out numerical experiments on a computer for monitoring, forecasting and making managerial decisions in order to protect the ecological state of industrial regions [15].

The numerical calculations carried out on the processes of transfer and diffusion of harmful substances in the atmosphere showed that one of the main factors influencing the change in the concentration of harmful aerosol particles is the absorption coefficient. It depends on external factors (humidity and temperature of the air mass of the atmosphere, density of the atmosphere, saturation of the mass, etc.).

To determine the absorption coefficient, consider the simplest equation for the transfer of a substance in the atmosphere:

$$\frac{\partial\theta}{\partial t} + div\vec{U}\theta + \sigma\theta = 0,$$

where σ is the absorption coefficient or the reciprocal of the time interval during which the concentration of harmful substances θ_0 decreases several times compared to the initial concentration.

The uptake of the substance in the environment will vary depending on weather conditions. Thus, in dry weather, substances are absorbed less and spread more in the atmosphere, while at high humidity or the presence of precipitation, the aerosol is absorbed more or, without spreading in the atmosphere, settles on the earth's surface. Consider how the coefficient behaves σdepending on the decrease θ on a simple transport equation when there is no pollution source *f(x,y,z,t)* and *U=V=W=0* . In this case, the transport equation can be written in the form

$$\frac{\partial\theta}{\partial t} + \sigma\theta = 0\ .$$

We have found the following solution to this equation:

$$\theta = \theta_0 e^{-\sigma t}.$$

Suppose that at the initial moment of time a certain amount of harmful aerosol was released into the atmosphere. We also assume that 10, 20, 30, 40, 50, 60, 70, 80, and 90% of the aerosol substance is absorbed within an hour, depending on weather conditions. Let us calculate what the absorption coefficient should be σunder these conditions:

$$\theta = \theta_0 e^{-\sigma t},$$
$$\ln\theta = -\sigma t + \ln\theta_0,$$
$$-\sigma t = \ln\theta - \ln\theta_0.$$

Let after an aerosol ejection for an hour ($t = 3600$ s) when interacting with the atmosphere

1. 10% of the substance was absorbed, then we have:

$$-\sigma t = \ln 9 - \ln 10 = 2,1972 - 2,3026 = -0,1054,$$

$$-\sigma = \frac{-0,1054}{3600} = -0,000029\frac{1}{c},$$

$$\sigma = 0,000029\frac{1}{c};$$

2. absorbed 20% of the substance:

$$-\sigma t = \ln 8 - \ln 10 = 2,0794 - 2,3026 = -0,2232, \qquad \sigma = 0,000062\frac{1}{c};$$

3. absorbed 30% of the substance:

$$-\sigma t = \ln 7 - \ln 10 = 1,9459 - 2,3026 = -0,3567, \qquad \sigma = 0,000099\frac{1}{c};$$

4. 40% of the substance was absorbed:

$$-\sigma t = \ln 6 - \ln 10 = 1,7918 - 2,3026 = -0,5108, \qquad \sigma = 0,00014\frac{1}{c};$$

5. Absorbed 50% of the substance:

$$-\sigma t = \ln 5 - \ln 10 = 1,6094 - 2,3026 = -0,6932, \qquad \sigma = 0,00019\frac{1}{c};$$

6. Absorbed 60% of the substance:

$$-\sigma t = \ln 4 - \ln 10 = 1,3863 - 2,3026 = -0,9163, \qquad \sigma = 0,000254\frac{1}{c};$$

7. 70% of the substance was absorbed:

$$-\sigma t = \ln 3 - \ln 10 = 1,0986 - 2,3026 = -1,204, \qquad \sigma = 0,000334\frac{1}{c};$$

8. 80% of the substance was absorbed:

$$-\sigma t = \ln 2 - \ln 10 = 0,6931 - 2,3026 = -1,6095, \qquad \sigma = 0,00044\frac{1}{c};$$

9. Absorbed 90% of the substance:

$$-\sigma t = \ln 1 - \ln 10 = 0 - 2,3026 = -2,3026, \qquad \sigma = 0,000639\frac{1}{c}.$$

In this example, we see that the relationship between $\sigma$and θ inversely proportional. It also shows that under different weather conditions, the absorption coefficients will be different. So, for example, in a dry climate, when up to 10% of the substance is absorbed, σ= 0.000029 1/ s, and in heavy rain or snow, up to 90% of the substance is absorbed and σ= 0.000639 1/s.

According to [18], based on the analysis and statistical processing of long-term meteorological data, a sinusoidal dependence was obtained for calculating the absorption coefficient:

$$\sigma(t) = \sigma_0 + \Delta\sigma Sin\omega t,$$

where σ_0 is the average daily change in the absorption coefficient of aerosol particles in the atmosphere; $\Delta\sigma$ - the amplitude of the change in the absorption coefficient per day; ω - cyclic frequency of daily change.

It follows from the studies carried out in the above works that the absorption coefficient depends significantly on the daily change in the state of the air mass of the atmosphere and the season. In the spring and winter periods of the year, the amplitude of the absorption coefficient has the greatest value, as a result of which the maximum absorption of harmful substances in the atmosphere occurs at night. In summer, the values of the extinction coefficient between nighttime and daytime variations differ very little [60, 92].

Most authors believe that β is a constant value. This distorts the prediction of particle distribution on the underlying surface. To avoid such a problem, when developing a mathematical model of the process, it is necessary to take into account $\beta = \beta(x, y, z, r)$.

To take into account the absorption of aerosol particles in the vegetation cover, the coefficient of interaction with the underlying surface β must be calculated using the formula:

$$\beta(x, y, z) = \begin{cases} 0, & z > z_h, \\ 0,264u(z)^{1,65} w_g^{0,66} s(z), & z < z_h. \end{cases}$$

Here z_h, is the height of the vegetation layer, and $s(z)$ is the specific surface area of vegetation.

Thus, in this section, a functional dependence is obtained for calculating the absorption coefficient of harmful aerosol particles in the atmosphere. This coefficient plays a significant role in changing the concentration of aerosol particles in the atmosphere. A dependence was also obtained for calculating the coefficient of interaction with the underlying surface, which depends on the specific vegetation cover of the earth's surface.

4. Methods for solving the problem

Since problem (1)-(5) is described by a multidimensional nonlinear differential equation in partial derivatives with the corresponding initial and boundary conditions, it is difficult to obtain its solution in an analytical form.

For simplicity of solving problem (1)-(5), we consider the area $D=\{0\le x\le L_x,\ 0\le z\le H_z,\}$ as a rectangular one, and the source is assumed to be located in the surface layer.

As the experience accumulated in the world scientific community shows, for the numerical integration of problems similar to the stated problem (1)-(5), economical and universal finite-difference methods are used. This led to their comprehensive study in terms of analyzing and predicting the state of the considered process of propagation of harmful aerosol particles in the atmosphere over time and their impact through a combination of weather , climate, orographic and other external factors.

Based on the foregoing, for the numerical solution of problem (1) - (5), the area of change of the desired variables (concentration of harmful substances), taking into account the boundary conditions, will be covered with a square grid area with a step $\Delta x;\ \Delta z$:

$$\Omega_{xzt}=\left\{\left(x_i=i\Delta x, z_k=k\Delta z, \tau_n=n\ \Delta t\right); i=\overline{1,N_x}; k=\overline{1,L_z}, n=\overline{0,N_t},\ \Delta t=\frac{1}{N_t}\right\}.$$

To solve the problem and ensure the stability of the finite difference algorithm, as well as a high order of approximation in time and space variables, we use an implicit difference scheme and obtain [15] with $\left(w-w_g\right)<0$:

$$\frac{1}{2}\frac{\theta_{i,j}^{n+\frac{1}{2}}-\theta_{i,j}^{n}}{\Delta t/2}+\frac{1}{2}\frac{\theta_{i+1,j}^{n+\frac{1}{2}}-\theta_{i+1,j}^{n}}{\Delta t/2}+\frac{1}{2}u\frac{\theta_{i,j}^{n+\frac{1}{2}}-\theta_{i-1,j}^{n+\frac{1}{2}}}{\Delta x}+\frac{1}{2}u\frac{\theta_{i,j}^{n}-\theta_{i-1,j}^{n}}{\Delta x}+$$
$$+\left(w-w_g\right)\frac{\theta_{i,j+1}^{n}-\theta_{i,j}^{n}}{\Delta z}+\sigma\theta_{i,j}^{n+\frac{1}{2}}=\frac{\mu}{\Delta x^2}\left(\theta_{i+1,j}^{n+\frac{1}{2}}-2\theta_{i,j}^{n+\frac{1}{2}}+\theta_{i-1,j}^{n+\frac{1}{2}}\right)+$$
$$+\frac{1}{\Delta z^2}\left(k_{i,j+0,5}\theta_{i,j+1}^{n}-\left(k_{i,j+0,5}+k_{i,j-0,5}\right)\theta_{i,j}^{n}+k_{i,j-0,5}\theta_{i,j-1}^{n}\right)+\frac{1}{2}Q_{i,j}^{n+\frac{1}{2}}$$

or

$$\frac{1}{\Delta t}\theta_{i,j}^{n+\frac{1}{2}}-\frac{1}{\Delta t}\theta_{i,j}^{n}+\frac{1}{\Delta t}\theta_{i+1,j}^{n+\frac{1}{2}}-\frac{1}{\Delta t}\theta_{i+1,j}^{n}+\frac{u}{2\Delta x}\theta_{i,j}^{n+\frac{1}{2}}-\frac{u}{2\Delta x}\theta_{i-1,j}^{n+\frac{1}{2}}+$$
$$+\frac{u}{2\Delta x}\theta_{i,j}^{n}-\frac{u}{2\Delta x}\theta_{i-1,j}^{n}+\frac{w-w_g}{\Delta z}\theta_{i,j+1}^{n}-\frac{w-w_g}{\Delta z}\theta_{i,j}^{n}+\sigma\theta_{i,j}^{n+\frac{1}{2}}=$$
$$=\frac{\mu}{\Delta x^2}\theta_{i+1,j}^{n+\frac{1}{2}}-\frac{2\mu}{\Delta x^2}\theta_{i,j}^{n+\frac{1}{2}}+\frac{\mu}{\Delta x^2}\theta_{i-1,j}^{n+\frac{1}{2}}+\frac{k_{i,j+0,5}}{\Delta z^2}\theta_{i,j+1}^{n}-$$
$$-\frac{k_{i,j+0,5}+k_{i,j-0,5}}{\Delta z^2}\theta_{i,j}^{n}+\frac{k_{i,j-0,5}}{\Delta z^2}\theta_{i,j-1}^{n}+\frac{1}{2}Q_{i,j}^{n+\frac{1}{2}}. \qquad (6)$$

Grouping the terms of equation (6), we obtain

$$-\left(\frac{u}{2\Delta x}+\frac{\mu}{\Delta x^2}\right)\theta_{i-1,j}^{n+\frac{1}{2}}+\left(\frac{1}{\Delta t}+\frac{u}{2\Delta x}+\sigma+\frac{2\mu}{\Delta x^2}\right)\theta_{i,j}^{n+\frac{1}{2}}-\left(\frac{\mu}{\Delta x^2}-\frac{1}{\Delta t}\right)\theta_{i+1,j}^{n+\frac{1}{2}}=$$

$$=\frac{u}{2\Delta x}\theta_{i-1,j}^{n}+\left(\frac{1}{\Delta t}-\frac{u}{2\Delta x}+\frac{w-w_g}{\Delta z}-\frac{k_{i,j-0,5}+k_{i,j+0,5}}{\Delta z^2}\right)\theta_{i,j}^{n}- \quad (7)$$

$$-\frac{1}{\Delta t}\theta_{i+1,j}^{n}+\frac{k_{i,j-0,5}}{\Delta z^2}\theta_{i,j-1}^{n}+\left(\frac{k_{i,j+0,5}}{\Delta z^2}-\frac{w-w_g}{\Delta z}\right)\theta_{i,j+1}^{n}+\frac{1}{2}Q_{i,j}^{n+\frac{1}{2}}.$$

Further, grouping like terms of Eq. (7), we finally have

$$a_{i,j}\theta_{i-1,j}^{n+\frac{1}{2}}-b_{i,j}\theta_{i,j}^{n+\frac{1}{2}}+c_{i,j}\theta_{i+1,j}^{n+\frac{1}{2}}=-d_{i,j}\,.$$

Here

$$a_{i,j}=\frac{u}{2\Delta x}+\frac{\mu}{\Delta x^2};\;\; b_{i,j}=\frac{1}{\Delta t}+\frac{u}{2\Delta x}+\sigma+\frac{2\mu}{\Delta x^2};\; c_{i,j}=\frac{\mu}{\Delta x^2}-\frac{1}{\Delta t};$$

$$d_{i,j}=\frac{u}{2\Delta x}\theta_{i-1,j}^{n}+\left(\frac{1}{\Delta t}-\frac{u}{2\cdot\Delta x}+\frac{w-w_g}{\Delta z}-\frac{k_{i,j-0,5}+k_{i,j+0,5}}{\Delta z^2}\right)\theta_{i,j}^{n}-$$

$$-\frac{1}{\Delta t}\theta_{i+1,j}^{n}+\frac{k_{i,j-0,5}}{\Delta z^2}\theta_{i,j-1}^{n}+\left(\frac{k_{i,j+0,5}}{\Delta z^2}-\frac{w-w_g}{\Delta z}\right)\theta_{i,j+1}^{n}+\frac{1}{2}Q_{i,j}^{n+\frac{1}{2}}.$$

Similarly , when $\left(w-w_g\right)>0$ we approximate differential operators by finite-difference operators and obtain

$$\frac{1}{2}\frac{\theta_{i,j}^{n+\frac{1}{2}}-\theta_{i,j}^{n}}{\Delta t/2}+\frac{1}{2}\frac{\theta_{i+1,j}^{n+\frac{1}{2}}-\theta_{i+1,j}^{n}}{\Delta t/2}+\frac{1}{2}u\frac{\theta_{i,j}^{n+\frac{1}{2}}-\theta_{i-1,j}^{n+\frac{1}{2}}}{\Delta x}+\frac{1}{2}u\frac{\theta_{i,j}^{n}-\theta_{i-1,j}^{n}}{\Delta x}+$$

$$+\left(w-w_g\right)\frac{\theta_{i,j}^{n}-\theta_{i,j-1}^{n}}{\Delta z}+\sigma\theta_{i,j}^{n+\frac{1}{2}}=\frac{\mu}{\Delta x^2}\left(\theta_{i+1,j}^{n+\frac{1}{2}}-2\theta_{i,j}^{n+\frac{1}{2}}+\theta_{i-1,j}^{n+\frac{1}{2}}\right)+$$

$$+\frac{1}{\Delta z^2}\left(k_{i,j+0,5}\theta_{i,j+1}^{n}-\left(k_{i,j+0,5}+k_{i,j-0,5}\right)\theta_{i,j}^{n}+k_{i,j-0,5}\theta_{i,j-1}^{n}\right)+\frac{1}{2}Q_{i,j}^{n+\frac{1}{2}}.$$

To calculate the value of the desired function (concentration of suspended particles in the atmosphere) for an integer time step, similarly, for $\left(w-w_g\right)<0$ we get

$$\frac{1}{2}\frac{\theta_{i,j}^{n+1}-\theta_{i,j}^{n+\frac{1}{2}}}{\Delta t/2}+\frac{1}{2}\frac{\theta_{i,j+1}^{n+1}-\theta_{i,j+1}^{n+\frac{1}{2}}}{\Delta t/2}+u\frac{\theta_{i,j}^{n+\frac{1}{2}}-\theta_{i-1,j}^{n+\frac{1}{2}}}{\Delta x}+\frac{w-w_g}{2}\frac{\theta_{i,j+1}^{n+1}-\theta_{i,j}^{n+1}}{\Delta z}+$$

$$+\frac{w-w_g}{2}\frac{\theta_{i,j+1}^{n+\frac{1}{2}}-\theta_{i,j}^{n+\frac{1}{2}}}{\Delta z}+\sigma\theta_{i,j}^{n+1}=\frac{\mu}{\Delta x^2}\left(\theta_{i+1,j}^{n+\frac{1}{2}}-2\cdot\theta_{i,j}^{n+\frac{1}{2}}+\theta_{i-1,j}^{n+\frac{1}{2}}\right)+ \quad (8)$$

$$+\frac{1}{\Delta z^2}\left(k_{i,j+0,5}\theta_{i,j+1}^{n+1}-\left(k_{i,j+0,5}+k_{i,j-0,5}\right)\theta_{i,j}^{n+1}+k_{i,j-0,5}\theta_{i,j-1}^{n+1}\right)+\frac{1}{2}Q_{i,j}^{n+1}$$

and, grouping like terms of equation (8), we finally have

$$\bar{a}_{i,j}\theta_{i,j-1}^{n+1}-\bar{b}_{i,j}\theta_{i,j}^{n+1}+\bar{c}_{i,j}\theta_{i,j+1}^{n+1}=-\bar{d}_{i,j}, \quad (9)$$

where

$$\bar{a}_{i,j}=\frac{k_{i,j-0,5}}{\Delta z^2};\quad \bar{b}_{i,j}=\frac{1}{\Delta t}-\frac{w-w_g}{2\Delta z}+\sigma+\frac{k_{i,j-0,5}+k_{i,j+0,5}}{\Delta z^2};\;\; \bar{c}_{i,j}=\frac{k_{i,j+0,5}}{\Delta z^2}-\frac{1}{\Delta t}-\frac{w-w_g}{2\Delta z};$$

$$\bar{d}_{i,j}=\left(\frac{u}{\Delta x}+\frac{\mu}{\Delta x^2}\right)\theta_{i-1,j}^{n+\frac{1}{2}}+\left(\frac{1}{\Delta t}-\frac{u}{\Delta x}+\frac{w-w_g}{2\Delta z}-\frac{2\mu}{\Delta x^2}\right)\theta_{i,j}^{n+\frac{1}{2}}+$$

$$+\frac{1}{\Delta t}\theta_{i+1,j}^{n+\frac{1}{2}}+\left(\frac{1}{\Delta t}-\frac{w-w_g}{2\Delta z}\right)\theta_{i,j+1}^{n+\frac{1}{2}}+\frac{1}{2}Q_{i,j}^{n+1}.$$

equation (9) with $\left(w-w_g\right)>0$ the coefficients of the transition matrix are determined using

$$\bar{a}_{i,j}=\frac{w-w_g}{2\Delta z}-\frac{k_{i,j-0,5}}{\Delta z^2};\ \bar{b}_{i,j}=\frac{1}{\Delta t}+\frac{w-w_g}{2\Delta z}+\sigma+\frac{k_{i,j-0,5}+k_{i,j+0,5}}{\Delta z^2};\qquad \bar{c}_{i,j}=\frac{k_{i,j+0,5}}{\Delta z^2}-\frac{1}{\Delta t};$$

$$\bar{d}_{i,j}=\left(\frac{u}{\Delta x}+\frac{\mu}{\Delta x^2}\right)\theta_{i-1,j}^{n+\frac{1}{2}}+\left(\frac{1}{\Delta t}-\frac{u}{\Delta x}-\frac{w-w_g}{2\Delta z}-\frac{2\mu}{\Delta x^2}\right)\theta_{i,j}^{n+\frac{1}{2}}+$$

$$+\frac{\mu}{\Delta x^2}\theta_{i+1,j}^{n+\frac{1}{2}}+\frac{1}{\Delta t}\theta_{i,j+1}^{n+\frac{1}{2}}+\frac{w-w_g}{2\Delta z}\theta_{i,j-1}^{n+\frac{1}{2}}+\frac{1}{2}Q_{i,j}^{n+1}.$$

To solve the problem numerically, we replace the boundary condition (4) with a finite-difference condition with the second order of accuracy and obtain

$$-\mu\frac{-3\theta_{0,j}^{n+1/2}+4\theta_{1,j}^{n+1/2}-\theta_{2,j}^{n+1/2}}{2\Delta x}=\xi\theta_E-\xi\theta_{0,j}^{n+1/2}.$$

Grouping like terms in the equation, we end up with

$$\theta_{0,j}^{n+1/2}=\alpha_{0,j}\theta_{1,j}^{n+1/2}+\beta_{0,j},$$

where the sweep coefficients are calculated as follows:

$$\alpha_{0,j}=\frac{4c_{1,j}\mu-b_{1,j}\mu}{3c_{1,j}\mu-a_{1,j}\mu+2\Delta x\xi};\ \beta_{0,j}=\frac{d_{1,j}\mu+2\Delta x\xi c_{1,j}\theta_E}{3c_{1,j}\mu-a_{1,j}\mu+2\Delta x\xi}.$$

Also, replacing the boundary condition (3) with a difference condition, we obtain

$$\theta_{1,N-2,j,k}^{n+\frac{1}{3}}$$

which allows you to calculate $\theta_{N,j}^{n+1/2}$ as follows:

$$\theta_{N,j}^{n+1/2}=\frac{2\Delta x\xi\theta_E-\left(\beta_{N-2,j}+\alpha_{N-2,j}\beta_{N-1,j}-4\beta_{N-1,j}\right)\mu}{2\Delta x\xi+\left(\alpha_{N-2,j}\alpha_{N-1,j}-4\alpha_{N-1,j}+3\right)\mu}.$$

We apply the above procedure for the boundary conditions (5) and finally obtain

$$\bar{\alpha}_{i,0}=\frac{4\kappa_1\bar{c}_{i,1}-\bar{b}_{i,1}\kappa_1}{3\kappa_1\bar{c}_{i,1}-\bar{a}_{i,1}\kappa_1-2\Delta z\beta\bar{c}_{i,1}};\ \bar{\beta}_{i,0}=\frac{\bar{d}_{i,1}\kappa_1+2\Delta z\bar{c}_{i,1}f}{3\kappa_1\bar{c}_{i,1}-\bar{a}_{i,1}\kappa_1-2\Delta z\beta\bar{c}_{i,1}};$$

$$\theta_{i,L}^{n+1}=\frac{2\Delta z\xi\theta_E-\left(\bar{\beta}_{i,L-2}+\bar{\alpha}_{i,L-2}\bar{\beta}_{i,L-1}-4\bar{\beta}_{i,L-1}\right)\kappa_L}{2\Delta z\xi+\left(\bar{\alpha}_{i,L-2}\bar{\alpha}_{i,L-1}-4\bar{\alpha}_{i,L-1}+3\right)\kappa_L}.$$

To solve the stated problem (1)-(5), linearizing equation (2) and replacing it with finite-difference schemes, we obtain an equation for calculating the intermediate result according to $w_g^{n+\frac{1}{2}}$ [15]:

$$\frac{w_g^{n+\frac{1}{2}}-w_g^n}{\Delta t/2}=\frac{mg-6\pi\gamma r w_g^{n+\frac{1}{2}}-0,5c\rho s\left(2\tilde{w}_g w_g^{n+\frac{1}{2}}-\tilde{w}_g^2\right)}{m};$$

$$w_g^{n+\frac{1}{2}}=\frac{2m}{2m+6\pi\gamma r\Delta t+c\rho s\Delta t\tilde{w}_g}w_g^n+\frac{mg\Delta t+0,5c\rho s\Delta t\tilde{w}_g^2}{2m+6\pi\gamma r\Delta t+c\rho s\Delta t\tilde{w}_g}.$$

To calculate, w_g^{n+1} we obtain the following relation:

$$\frac{w_g^{n+1} - w_g^{n+\frac{1}{2}}}{\Delta t / 2} = \frac{mg - 6\pi\gamma r w_g^{n+1} - 0,5c\rho s\left(2\tilde{w}_g w_g^{n+1} - \tilde{w}_g^2\right)}{m};$$

$$w_g^{n+1} = \frac{2m}{2m + 6\pi\gamma r\Delta t + c\rho s\Delta t\tilde{w}_g} w_g^{n+\frac{1}{2}} + \frac{mg\Delta t + 0,5c\rho s\Delta t\tilde{w}_g^2}{2m + 6\pi\gamma r\Delta t + c\rho s\Delta t\tilde{w}_g}.$$

The resulting nonlinear equations for w_g are solved by simple iteration. The convergence of the iteration process is checked using the condition $\left|w_g^{S+1} - w_g^S\right| < \varepsilon$, where ε is the accuracy of the iteration process, S is the number of iterations [15].

5. Computational experiment

To carry out the SE on a computer, a software tool in the C++ language was created. The following input parameters were taken into account in the calculations: the size of the area for solving the problem is 21x21 km, while the emission source is located in the center of the area; height of the mouth of the discharge pipe - 100 m above the ground; source power - 100 mg / m ^{3} per second; the initial value of the particle settling velocity is 0.00015 m/s; absorption coefficient - 0.00048 1/s; wind speed - 5 m/s; wind direction - 130°.

The effectiveness of the developed algorithm for solving the problem based on the physical splitting method was evaluated by comparing the calculation results with field measurement data and calculations based on other numerical methods for solving the above problem. On fig. 1-4, the concentration distribution of fine particles in each case is given for time $t = 5$ h at a height of 200 m above the earth's surface. Colors indicate concentration values in kg/m ^{3} per second.

The sizes and shapes of the loops in fig. 1-4 visually have minimal differences. Nevertheless, the analysis of the numerical results shows a quite tangible advantage of the developed computational algorithm based on the method of splitting by physical processes.

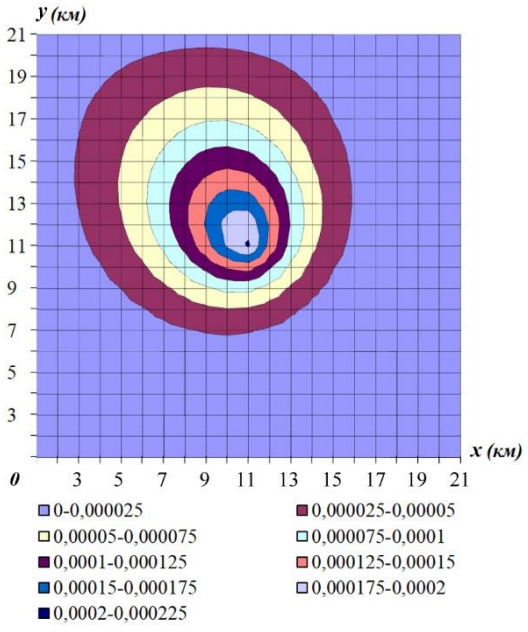


Fig. 1. Field measurement data

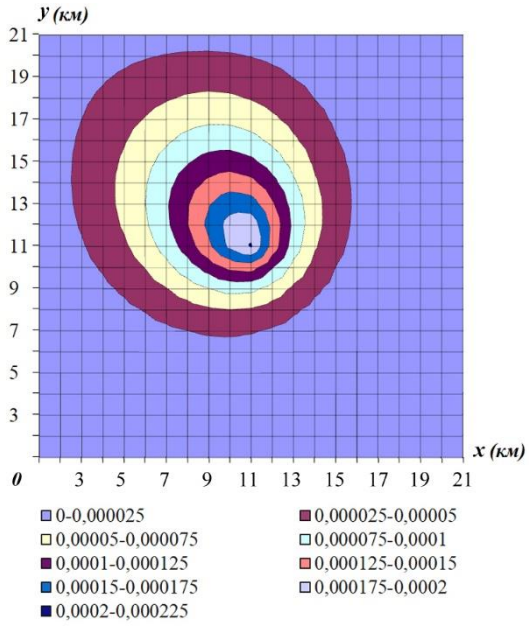


Fig. 2. Method of physical splitting

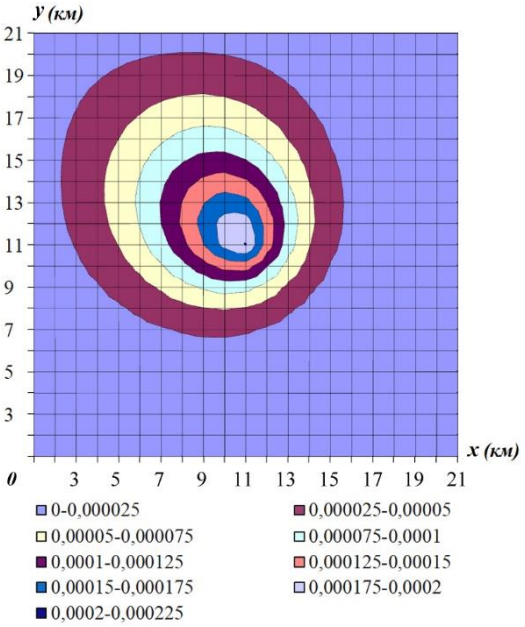


Fig. 3. Finite-difference scheme of the 2nd order of approximation

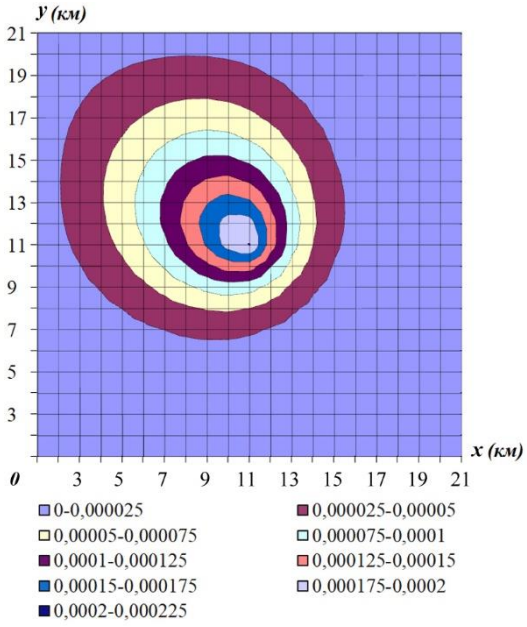


Fig. 4. Solution based on the change of variables method

On fig. Figure 5 shows a graph of the values of the concentration of harmful particles along the middle line of the problem solution area for x, obtained by various methods, and the table shows the performance indicators of the algorithms developed on the basis of the considered numerical methods.

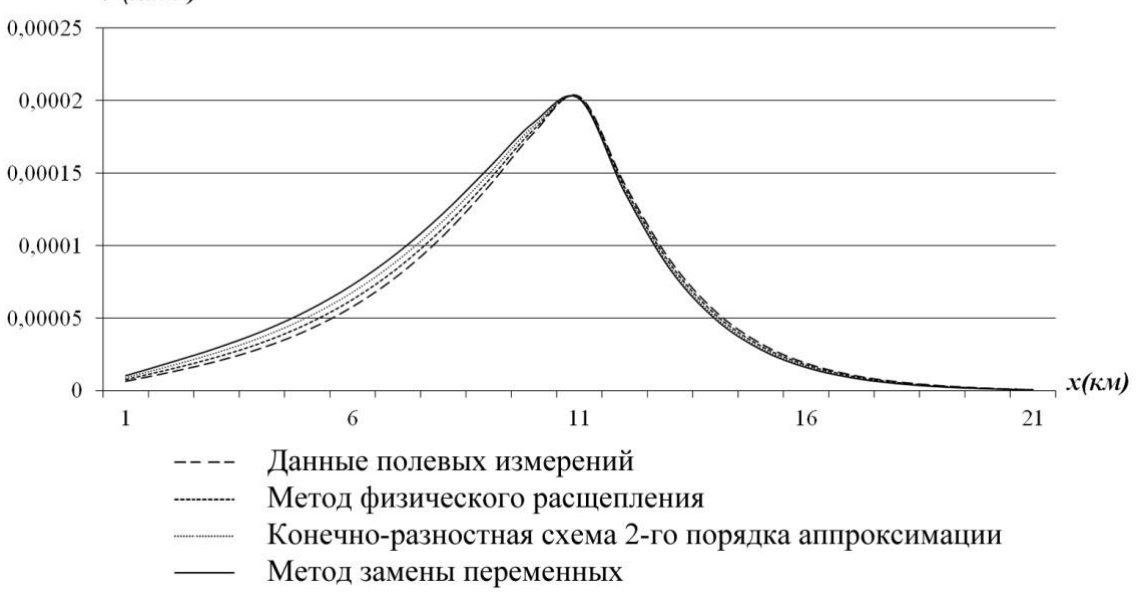


Fig. 5. Consistency of various numerical methods for solving the problem with real measurement data

According to the graphs shown in the figures, the results of the numerical solution of the problem of the distribution of harmful emissions in the atmosphere by the physical splitting method have a minimum discrepancy with the measurement data. The accuracy is higher by 5-10%, while the calculation time is the smallest.

Table 1. Performance indicators of computational algorithms

Indicators	Physical splitting method	Finite-difference scheme of the 2nd order of approximation	Variable substitution method
Accuracy (%)	95.07	90.25	85.53
Time (ms)	1.2	1.5	1.9

The SE found that with a decrease in the time integration step, the solution of individual problems tends to solve the main problem. Although the method of splitting into physical processes gives good results, inaccuracies in the solution of split problems can arise due to changes in parameters u, v, w, w_g, μ, $\kappa(z)$ both in time and in space variables.

Comparison of the results of the conducted SE with the data of field measurements, as well as the regularities identified in the works of other authors, showed their fairly satisfactory agreement.

Based on the foregoing, we conclude that the developed model adequately describes the process of atmospheric dispersion of pollutants and their precipitation. The computational algorithm for solving the problem based on the method of splitting by physical processes is quite efficient and gives good results. The purpose of creating the considered model and algorithm, which was to provide the possibility of analyzing, monitoring and predicting the process of distribution of harmful industrial emissions in the surface layer of the atmosphere, was achieved to a sufficient extent.

As an example, consider **Farkhad village, Samarkand region.** For the experiment, an assessment was made of the spread of aerosol emissions from one of the industrial enterprises near the village of Farhad, Samarkand region. The area under consideration is a flat area at the foot of the Zerafshan Range. The soil cover here is represented mainly by sands and meadow-serozem soils. The climate is inland with hot dry summers and cold winters. The average annual temperature is $+16.5^{0}$, the average annual rainfall is 310-330 mm. In the area under consideration, weak winds up to 4-5 m/s prevail, blowing mainly from the north-west direction.

The following input parameters were taken in the calculations: the initial value of the particle settling velocity - 45.762×10^{-5} m/s; the size of the area for solving the problem is 21x21 km, while the emission source is located in the center of the area; height of the mouth of the discharge pipe - 100 m above the ground; absorption coefficient - 30%, i.e. 0.00048 1/s; source power - 10 mg / m^3 in s.

Numerical calculations have established that the change in the concentration of aerosols in the atmosphere depends significantly on the absorption coefficient of particles in the atmosphere. This parameter varies depending on the degree of humidity of the air mass of the atmosphere, time of year and day. At the same time, the maximum absorption of harmful aerosol particles in the atmosphere is typical for the morning and evening hours of the day. In general, the region under consideration is characterized by absorption from 10 to 18% of aerosol particles.

Of the numerical experiments performed, the most significant parameters affecting the distribution and accumulation of harmful aerosol particles in the atmosphere of the region under consideration are the horizontal and vertical components of the wind speed and their direction, as well as the particle settling rate. As might be expected, under moderate wind (when the wind speed components approach zero), the concentration of harmful substances accumulates around the emission sources and the change in the concentration of aerosol particles in the atmosphere mainly occurs due to an increase in the particle settling rate w_g (Fig. 6).

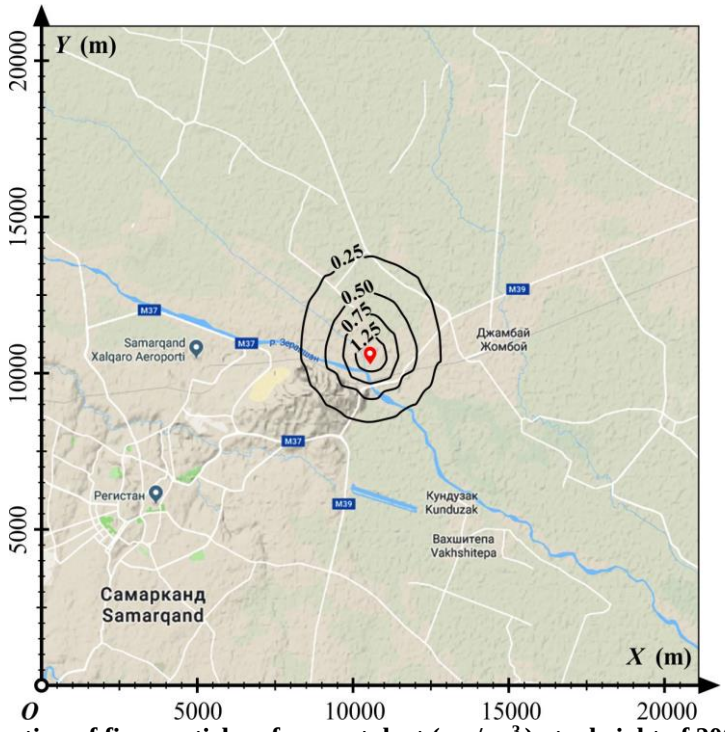


Fig. 6 . The concentration of fine particles of cement dust (mg/m ^{3}) at a height of 200 m with a southerly wind of 1 m/s and calculation time t = 4 h

The SE were carried out under the condition that aerosol particles with different diameters are emitted into the atmosphere, which also plays a significant role in the process of transfer and the rate of particle deposition. Thus, it follows from the calculations that the transportation of aerosol particles along the vertical largely depends on both the vertical component of the wind speed and the physicomechanical properties of the particles (radius, mass and cross-sectional area, density), as well as the acceleration of gravity.

With an increase in wind speed due to the horizontal transfer of aerosol particles, the concentration of harmful substances around the source decreases proportionally, and the area of their transportation expands over time. The maximum accumulation of aerosol particles in the atmosphere is observed at a level of 200-350 m. The concentration of pollution decreases exponentially with distance from the source. The maximum concentration of harmful particles is observed in the axial part of the atmospheric transport plume at a distance of up to 10 km from the source (Fig. 7, 8).

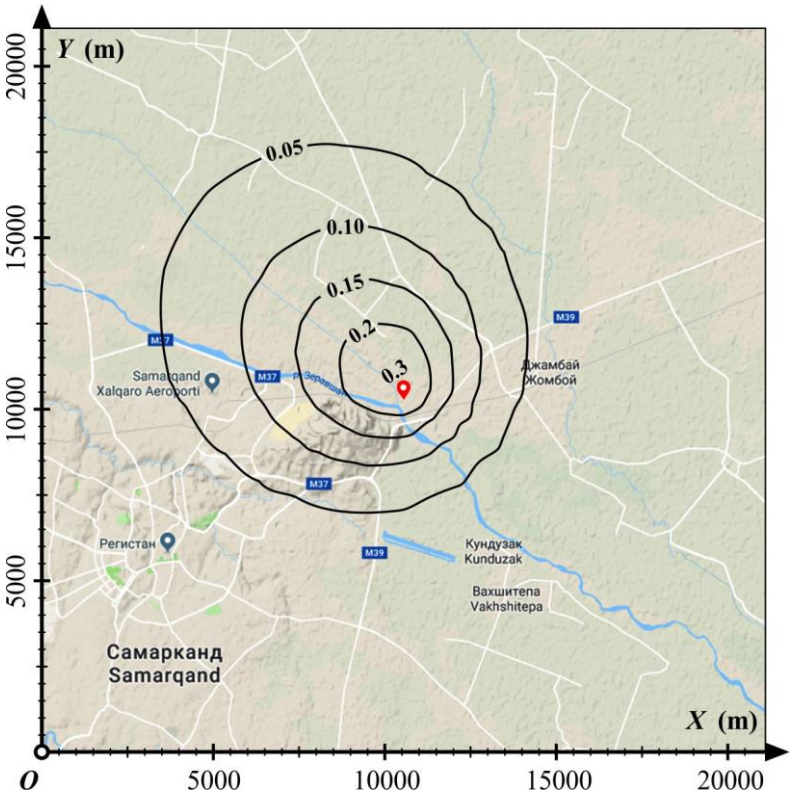


Fig. 7 . The concentration of fine particles of cement dust (mg/m ^{3}) at a height of 200 m with a southeast wind of 3 m/s and calculation time *t* = 4 h

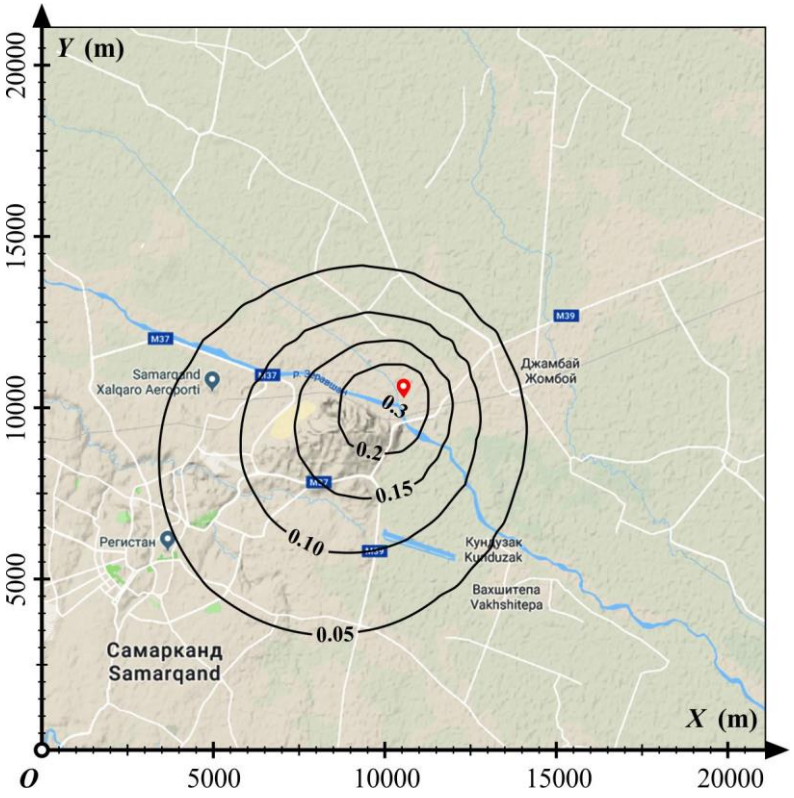


Fig. 8 . The concentration of fine particles of cement dust (mg / m ^{3}) at a height of 200 m with a northeast wind - 4 m / s and calculation time *t* = 4 h

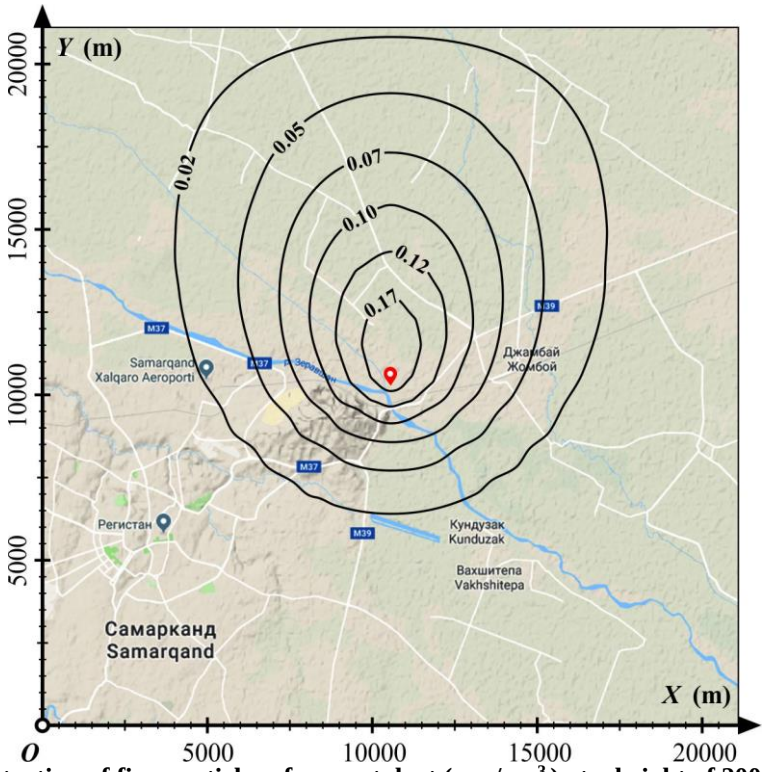


Fig. 9 . The concentration of fine particles of cement dust (mg / m ^{3}) at a height of 200 m with a southerly wind of 6 m / s and calculation time *t* = 4 h

When emitted from a high source (>100 m), the maximum concentrations of pollution are recorded at dangerous wind speeds (in the range from 3 to 6 m/s, depending on the speed of the outflow of gases from the mouth of the exhaust pipes). Dangerous wind speed combined with unstable stratification leads to the maximum increase in the concentration of harmful substances in the surface layer of the atmosphere. In such cases, the main role in the dispersion of pollutants is played by horizontal flows (Fig. 9).

On the example of Nurabad district of Samarkand region. In this case, it was assumed that it was required to locate a new cement plant in the Nurabad district of the Samarkand region of Uzbekistan. The coordinates of the object are 39°7′37″ north latitude, 66°3′8″ east longitude south of the settlements of Charvadar, Kurusai, Maylidzhar.

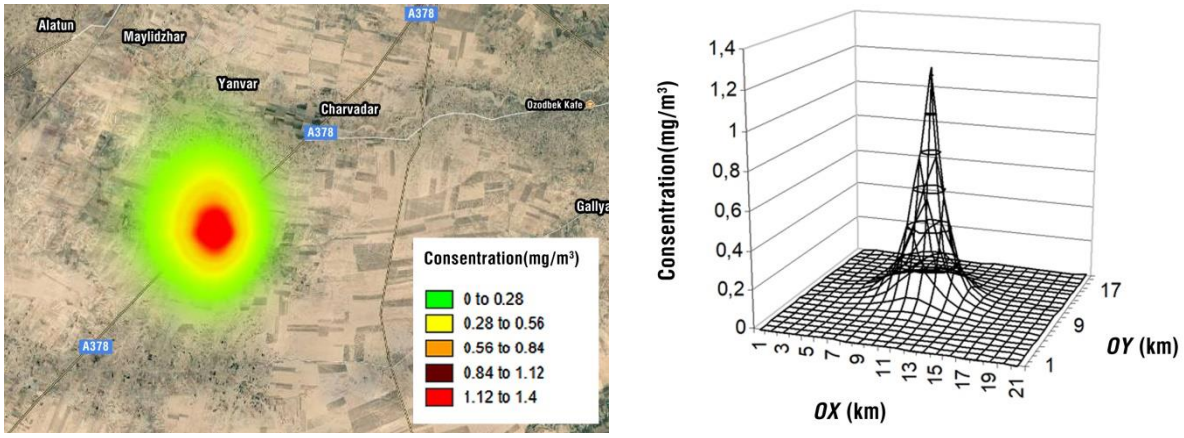
The area under consideration, as in the previous case, is a flat area at the foot of the Zerafshan Range with similar geographical and weather-climatic characteristics.

In the calculations, the following input parameters were taken: source power 50 mg/m ^{3} per second, height of the mouth of the exhaust pipe - 100 m above the earth's surface.

The results of calculations of the concentration fields of cement dust particles in Figs. 10, fig. 11, 12 are given at a height of 200 m above the earth's surface with a calculation time of 2 hours for various wind speeds and directions. Note that the MPC value for cement dust is 0.3 mg/m ^{3} - the maximum single concentration and 0.1 mg/m ^{3} - the average daily concentration.

From the numerical calculations carried out on a computer, it follows that with moderate wind and calm, the concentration of harmful substances accumulates around the source of emission of fine particles in the atmosphere at a level of z = 200 m (Fig. 10).

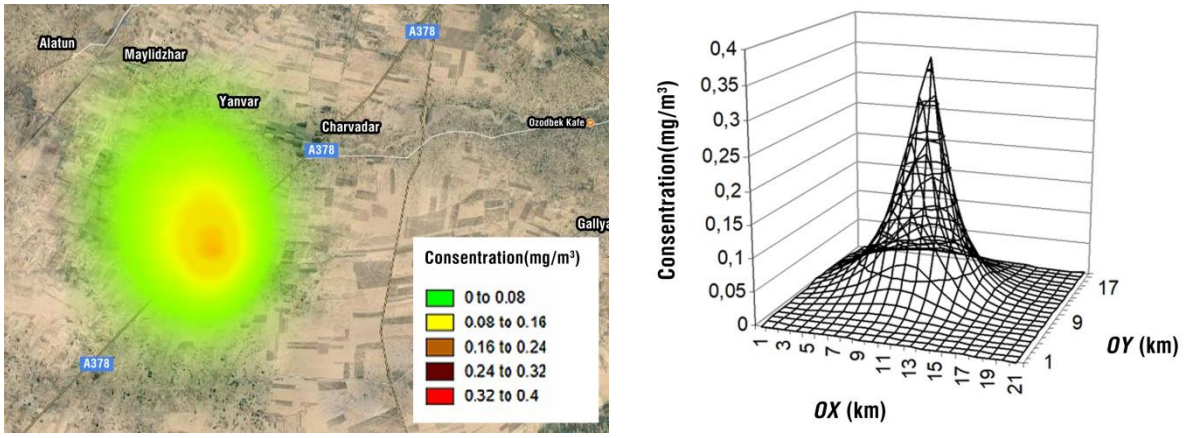
According to fig. 11, 12, with an increase in the horizontal wind speed component, the process of horizontal transfer of cement dust occurs. The concentration of harmful substances around the source decreases proportionally, and the area of their transportation expands over time.



a) *b*)

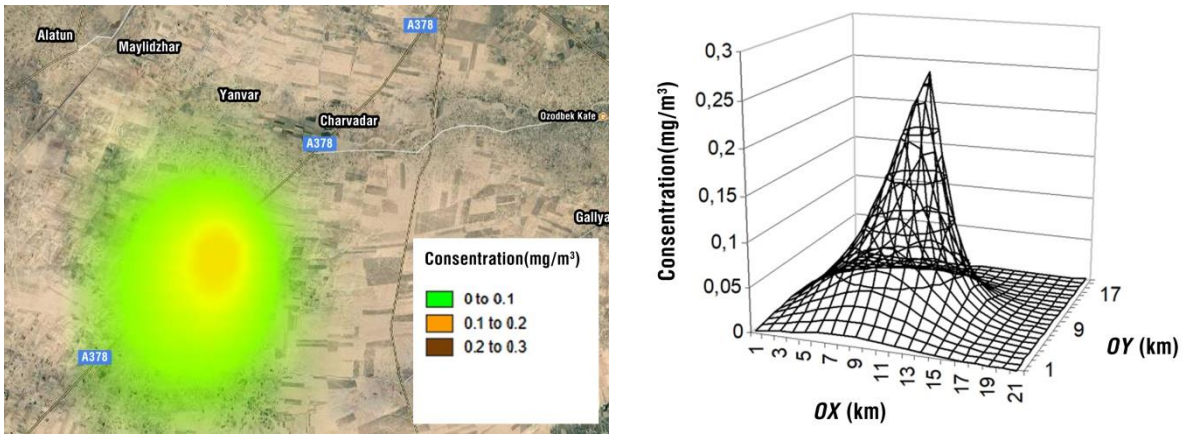
a - visualization in GIS *b* - concentration field

Fig. 10 . Accumulation of concentration of harmful substances at U=1 m/s, $\alpha = 45^0$ **,** $\sigma = 0.0014$ / c **and calculation time** ***t=2*** **h**



a) visualization in GIS *b*) concentration field

Fig. 11 . At $U = 3$ **m/s,** $\alpha = 45^0$ **,** $\sigma = 0.0014$ / c **and calculation time** $t = 2$ **h**



a) visualization in GIS *b*) concentration field

Fig. 12 . At $U = 4$ **m/s,** $\alpha = 135^0$ **,** $\sigma = 0.0014$ / c **and calculation time** $t = 2$ **h**

An analysis of the numerical calculations performed showed that the maximum values of the concentration of aerosol particles in the atmosphere are observed near the earth's surface when z changes in the range from 200 to 350 m. The concentration of cement dust particles exponentially decreases with distance from the emission source (Fig. 11, 12) . Numerical calculations have shown that the particle

concentration maximum is located in the axial part of the atmospheric transport plume. At the same time, the maximum concentration corresponds to a level of 400-425 m in calm and moderate wind.

The SE found that the process of transfer of fine particles is significantly affected by the components of the horizontal wind speed and their direction on the surface in the surface layer of the atmosphere. With the growth of this indicator, the area of distribution of harmful particles in the direction of the wind increases proportionally.

According to the results of numerical calculations on a computer, with an increase in the horizontal velocity of the air mass of the atmosphere, the concentration of harmful substances in the surface layer increases. This is especially noticeable at wind speed $u \geq 2.5$ m/s and is clearly observed at h = 200-300 m. It was also found that with an increase in the intensity of aerosol generators, the area where the concentration exceeds the permissible sanitary standards increases. With unstable stratification, the concentration distribution has a peak -like character, i.e. maximizes in a short period of time. In such cases, the main role in the dispersion of harmful substances in the atmosphere is played by horizontal flows.

In the vertical transport of aerosol particles, the role of the turbulence coefficient is extremely important. It has been established that the value of the turbulence coefficient increases significantly in the surface layer of the atmosphere in the range of height from 10 to 250 m. In addition, this coefficient directly affects the rate of deposition of aerosol particles.

An analysis of the experimental results shows that an increase in the absorption coefficient reduces the value of the concentration of pollutants in the atmosphere, and the parameter itself depends on the humidity of the air mass. The maximum concentration values correspond to the summer season, when the absorption coefficient tends to zero.

The SE found that the atmospheric basin of the industrial regions of Uzbekistan, on average, is characterized by absorption from 10 to 18% of aerosol particles. Absorption occurs at air humidity from 70 to 80%.

The obtained results of SE were compared with the results and revealed regularities given in the works of other authors, as well as with the real data of instrumental measurements, and their fairly satisfactory agreement was established.

It should also be noted that in the implementation of the developed software and tool complex, GIS technologies and web-based architecture were actively used with the use of online services that ensure the supply of geographic and meteorological operational data. Using the API of existing online information services, coupled with their constant development, active support and comprehensive documentation, has greatly simplified the development of software tools.

5. Conclusion

In the era of rapidly developing information technologies, the solution of transport and diffusion problems cannot be imagined without the development of an effective mathematical apparatus implemented on a computer in the form of mathematical models, analytical, approximate and approximate-analytical algorithms and their software. With the help of the developed software, it is possible to study the process under various natural and artificial conditions.

Among the universal methods for solving complex multidimensional problems of fluid and gas mechanics and solid mechanics, heat and mass transfer is the finite-difference method based on replacing the continuous domain of solving problems with a grid one.

Recently, the automation of solving boundary value problems has been widely developed on the basis of universal numerical methods created by the scientific schools of A.A. Dorodnitsin , A.N. Tikhonov , A.A. Samarsky , N.N. F.B.Abutalieva , C.Atkinson , S.Banerjee , GIBarenblatt , TWPatzek , DBSilin , F.Boyer , C.Lapuerta , S.Minjeaud , F.Golfier , R.Pongraz , MKPanga . These methods are sufficiently substantiated and are well suited for numerical simulation of mass transfer processes in the atmospheric boundary layer.

It should be noted that the universal difference schemes used for the numerical integration of problems must satisfy the requirements of convergence and stability of the method on any sequence of grids and for any input data and their small perturbations from the norm. When developing numerical algorithms, all available methods should be involved: exact approximate, approximate-analytical and numerical methods based on the replacement of differential operators by difference ones, as well as asymptotic estimates of the solution, dimensional analysis and experimental data.

When solving problems described using partial differential equations with lumped parameters and corresponding initial and boundary conditions, it is necessary to pay special attention to the conservatism of finite-difference analogs based on the laws of conservation of mass, energy, momentum, and process kinetics.

When solving the tasks set numerically, it is necessary to:

a) choose the steps of integrating the problem set over the spatial and temporal layers, which ensure the conservatism of the finite difference model;

b) replace the area of continuous change of prognostic variables with a discrete one;

c) replace the differential operators of the mathematical model of the object with finite-difference operators, and also write out a difference analogue for the boundary conditions and initial input data.

To study, predict and monitor the state of the atmosphere in industrial regions, two- and three-dimensional nonlinear mathematical models have been developed for the process of the spread of harmful substances in the boundary layer of the atmosphere, taking into account their absorption and the variable rate of particle settling.

To carry out computational experiments on a computer and solve the problem of transport and diffusion of aerosol particles in the atmosphere, a numerical algorithm based on an implicit finite-difference approximation scheme with the second order of accuracy has been developed.

A functional dependence is obtained for calculating the absorption coefficient of aerosol particles in the atmosphere.

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Issue Article

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INDUSTRIALIZATION OF KYRGYZSTAN: RETROSPECTIVES AND MODERNITY

Abstract: *The article attempts to comprehend the experience of industrialization in Kyrgyzstan during the Soviet period and the possibility of its use in modern processes of market restructuring of the economy. The features of socialist industrialization in the Kirghiz SSR are briefly analyzed, possible ways of carrying out the reindustrialization of the Kyrgyz Republic at the present stage are outlined. The relevance of this problem is caused by the need to determine the modern model of economic development of Kyrgyzstan.*

Key words: *Kyrgyz Republic, socialist industrialization, industrialization, economic development.*

Language: *English*

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Introduction

An appeal to the past experience of the historical and economic development of Kyrgyzstan in order to determine the optimal model of economic development corresponding to its current state in the context of globalization is urgently needed. The purpose of the article is to consider the experience of carrying out socialist industrialization in Kyrgyzstan and to note its positive and negative aspects and the possibilities of using the experience of the past in the modern life of the country.

In the history of the socio-economic development of Kyrgyzstan in the Russian-Soviet period, industry played a significant role, being the locomotive of the progressive development of the national economy, changes in the social structure of society, and the formation of an advanced image of the people and the country.

Materials and methods

The dialectical approach to the study of the patterns of formation and development of the industrialization process of the Soviet period and the potential of modern Kyrgyzstan served to analyze the experience of industrialization in Kyrgyzstan, general scientific empirical and theoretical methods of system analysis, analogy, historical and logical research methods, as well as induction and deduction, data visualization techniques were used.

Results and discussion

The history of Kyrgyzstan from the time of acceptance of Russian citizenship to the collapse of the USSR proceeded in the general context of Russian-Soviet history. Therefore, all their advantages, achievements, shortcomings and contradictions had a common methodological and theoretical basis.

Since the middle of the XIX century, being a colony of the Russian Empire, Kyrgyzstan has been objectively involved in the world commodity circulation as a raw material appendage. The industry of Kyrgyzstan before the Great October Socialist Revolution consisted of small semi-industrial enterprises for the extraction of coal, salt and primary processing of livestock raw materials. After the end of the civil war, these rudiments of industrial production were undermined.

The modernization processes that began in Kyrgyzstan with its entry into Russia in the middle of the XIX century, significantly intensified in the early XX century, due to the large-scale transformations that the Great October Socialist Revolution brought with it.

The end of the 20s - 30s of the XX century dramatically changed the socio-economic portrait of Kyrgyzstan. During this period, large-scale changes took place in all spheres of life of the Kyrgyz society, associated with a radical restructuring of political, socio-economic relations that affected the socio-economic system, education, health care and other areas of society.

The Kyrgyz people acquired statehood, Kyrgyzstan became a union republic, which became equal with other republics of the USSR.

In Kyrgyzstan, as in the whole Soviet country, in accordance with the instructions of V.I. Lenin, the Communist Party and the government put forward the task of forced industrialization, capable of putting the Soviet state among the economically developed countries of the world. The main emphasis was placed on large-scale industry not only in the central industrial areas, but also in the national republics. In the uniform distribution of productive forces throughout the territory of the Soviet country, the leadership saw the most important means of eliminating the economic backwardness of the peoples who were transitioning to socialism from the pre-capitalist system.

The industrialization of Kyrgyzstan was designed to solve such important tasks as the elimination of the technical and economic backwardness of the republic, its transformation from agrarian to industrial-agrarian, strengthening and expanding socialist industrial relations, and the creation of a material and technical base, the formation of qualified national workers and engineering and technical intelligentsia.

In general, the tasks of socialist industrialization in Kyrgyzstan were the same as in the country as a whole, but the conditions and pace of their implementation had their own distinctive features. In Kyrgyzstan, the task was much simpler and at the same time a hundred times more difficult. Kyrgyzstan has started to industrialize, being a backward agrarian region.

Industry and modern agriculture were not to be reconstructed, but to create, often from scratch, almost to create anew a cadre of skilled workers and engineering and technical intelligentsia.

"In this regard, the most important feature of the industrialization of Kyrgyzstan was the increase in the pace of economic development, the advance of its industrial development in comparison with the central regions of the USSR" [1].

“Industrialization required huge investments. For Kyrgyzstan, the main source of industrialization was the fraternal assistance of the peoples of the USSR in the form of appropriations from the budgets of the USSR and the RSFSR. Therefore, the growth rate of capital investments in the national economy of the republic was higher than in the country as a whole. Thus, in the first five years, the share of the federal budget in the budget allocations of Kyrgyzstan was 96.3%, and the share of the local budget was 3.7%” [2, p.548].

"State lending was also an important source of industrialization of Kyrgyzstan. The amount of long-term loans for the needs of industrial construction in the republic was 3.4 million rubles in 1926, 8.4 million rubles in 1928" [3, p. 44]. Industrialization was also facilitated by the savings of workers placed in savings banks, a strict regime of saving money and material resources, and the struggle to reduce overhead costs.

"The total volume of industrial output in 1940 exceeded the level of pre-revolutionary Kyrgyzstan by 10 times" [1, p.7]. “The years of industrialization had a great impact on the growth of the well-being of the population of the republic. For 13 years, from 1926 to 1939, the state budget of the Kirghiz SSR increased more than 70 times” [4].

It should be noted that the predominance of agricultural production in the republic necessitated the priority development of the processing, food and textile industries, as well as the mining industry, which contributes to the development of natural resources.

The main principle of the industrialization of Kyrgyzstan was the approximation of production to sources of raw materials, fuel and areas of consumption, taking into account national factors in the distribution of productive forces and the division of labor. This approach contributed to the correct combination of the interests of the Kirghiz SSR with the interests of the country as a whole.

During the Great Patriotic War, the industry of the republic grew sharply, the output of gross

industrial output in 1945 was higher than the pre-war 1940 by 22%.

However, the structure of industrial production in the Kirghiz SSR was drastically changed towards the development of heavy industry due to the evacuation of more than 30 plants and factories of defense significance here without taking into account the economic conditions of the republic for political reasons dictated by defense necessity.

The post-war period is characterized by the implementation of a new grandiose industrial construction, but without taking into account economic feasibility. As a result, the production base of the heavy industries of the Kyrgyz SSR has significantly strengthened, the machine-tool, tool-making, instrument-making, and electrical industries have developed, which were cut off from the sources of raw materials and components. The economy of Kyrgyzstan developed as an organic component of the national economic complex of the USSR, within the framework of the all-Union division of labor, which allowed it to function only within its framework, depending to a large extent on the supply of raw materials and components from other republics. Any industrial production in the republic could function successfully only in close relationship with the whole country. As a result, the share of Kyrgyzstan's industry grew from 3% in 1913 to 50% in the 80s. The republic's industry, created during the years of Soviet power, produced 211 times more products than in 1913. Kyrgyzstan has become an industrially developed country. The successes achieved in such a short period of time could be called a "Kyrgyz miracle".

However, ignoring the economic laws of development, the huge centralization of the national economy of the country, the functioning of the economy, primarily on the basis of ideological and political laws, led the Soviet economy to a crisis and collapse.

With the collapse of the USSR and economic relations, the massive outflow of the European population, the industry of Kyrgyzstan, almost completely dependent on the Union budget, was dismantled, since it did not have a solid base of existence and raw materials for heavy industry. The transition to market relations had a negative impact on the industry of Kyrgyzstan.

Due to the loss of financial support from the central budget of the Soviet Union, Kyrgyzstan was in an economic crisis. In order to maintain the previous achievements, Kyrgyzstan needed significant financial and technical assistance from the international community.

In just the first 10 years after independence, the country rolled back in its economic development and turned from an industrial-agrarian into an agrarian-industrial country, the most important sector of the economy of which was agriculture.

Today, the industry of the Kyrgyz Republic is in a very difficult situation. The Kyrgyz Republic is a classic example of deindustrialization, it fully corresponds to the definition of Caincross [*Cairncross* A. What is deindustrialization? - London: Pergamon, 1982.] (Cairncross, 1982), according to which the country has:

– a consistent decline in the volume of industrial production or employment of the population in the manufacturing sector;

– the process of migration from the production of goods to the production of services, in which the share of industrial production in the final product decreases and the share of services increases;

– reduction of industrial production in the export structure of a country or region;

– the long-term persistence of the trade deficit leads to the inability to pay for imports and, consequently, leads to a new round of decline in industrial production.

In the economic science of Kyrgyzstan, in contrast to the official state economic policy, various points of view have been put forward on the formation of ways to develop the country's economy.

Thus, in the Kyrgyz historical science, possible alternative ways of socialist industrialization of the Kyrgyz Republic were put forward. Back in 1962, a book by the economist N.E. Esipov, who questioned the correctness of the choice of industrialization in Kyrgyzstan through the creation of heavy industry. The economist noted the correct industrial policy pursued in Kyrgyzstan during the first five-year plans, when “the starting point for industrialization was light industry enterprises, without which it was difficult to erect a building of heavy industry from scratch, when the production of consumer goods had to be drawn into the whirlpool of industrial production in the shortest possible time. life of the local population, prepare the ground for heavy industry, strengthen the development of trade” [5, p.105]. Due to a number of historical reasons in connection with the Great Patriotic War, which caused the need to strengthen the country's defense capability, heavy industry began to develop in Kyrgyzstan in favor of specific military consumption. This direction of priority development of heavy industry remained in the future, in the post-war years. N.E. Esipov called the subsequent stage of industrial development of the republic a period of continued industrialization. He put forward the concept of a more complete use of raw materials and labor resources of each national republic and the general principle of efficiency, strengthening the local production base to bring it in line with the raw materials of the republic, combining industrialization with the correct geographical location of enterprises. To do this, he proposed to create the necessary model for the development of Kyrgyzstan as an economic region, taking into account the proximity of production to consumption areas, the economic

efficiency of natural resources and the availability of appropriate labor resources, in each republic should develop, first of all, those industries for which there are the most favorable natural and economic conditions.

Subsequently, his point of view was supported and developed by M. Malabaev, who also believed that for the Central Asian industrially backward regions of the USSR, first of all, it was necessary to develop the light and food industries, that is, the industries of group "B" - the production of consumer goods. If this concept had been implemented at the time, then perhaps Kyrgyzstan after the collapse of the USSR would not have faced, or to a lesser extent, the severe economic problems of the current decline in the level of economic development.

Kyrgyzstan is in the process of searching for ways to update the economic system, choosing a model and strategy for economic development. Most economists tend to think that the reindustrialization of the country should be at the heart of the economic recovery [7]. The various authors are essentially united in understanding the strategic development goals and the need for reindustrialization in the country. However, there are certain discrepancies in the definition of priorities and the nature of actions. At the same time, the drivers of the rise of industry are called the most diverse branches of industrial production, however, all economists are united in one thing, understanding by reindustrialization not only the process of effective innovative renewal of traditional sectors of the economy, but also the creation of new high-tech industries in accordance with the new technological order.

The unity of views is also manifested in the opinion of the majority on the issue of the development of heavy industry in Kyrgyzstan in the form in which it developed during the Soviet period. Mechanical engineering is given a certain importance, but only within the framework necessary in connection with the emerging new sectoral structure of the economy: mechanical engineering for the agricultural and food industries, mining and servicing hydropower [8]. At the same time, it is proposed to bet on new types of industries: the development of the radio-electronic and electrical industries using semiconductor materials obtained on the basis of our own mineral resources, etc. Such an approach to industrial policy takes into account, in our opinion, the historical experience of the development of our republic [9].

In our opinion, the launch of reindustrialization processes for Kyrgyzstan is due not only to the need to ensure the restoration of traditional basic industries on a modern technological basis (modernization policy), but to the need for sectoral and structural restructuring of industries, taking into account the raw material, labor and other opportunities of the country.

What else does the experience of our history teach us?

As it is known, in the Soviet Union, the entire economy was rigidly state-controlled, the state exercised full control over economic activity. In Kyrgyzstan, in an effort to quickly introduce the principles of a market economy into the economy, they chose a liberal-market economic model, a policy of reducing state regulation of business, which ultimately led to a violation of the balance of interests of the state, business and the community and was one of the reasons for the decline in industrial production. Meanwhile, in the modern economic development of many countries of the world, the role of the state in managing economic processes is increasingly increasing. The USA, France, Germany, Japan and other highly developed countries are actively taking measures to support or develop specific sectors of the economy with the help of the main instrument – industrial policy. In a country where transformational processes are taking place, the role of the state is even more increasing. According to the Russian economist professor Yu . Knyazev, "the state plays a big role in the market economy. In different countries and at different stages of their development, state intervention in economic life varies in scale and means, but it is inevitably carried out, turning the state in the person of its authorities into the most important economic entity" [6, p. 28].

Therefore, taking into account our historical experience in Kyrgyzstan, it is necessary to determine the necessary balance in the implementation of the role of the state in the economy, since only the state is able to implement a set of legal, economic, organizational and other measures in the formation of a new type of industry structure [10].

During the Soviet period of our history, the economy of Kyrgyzstan and, in particular, its industry was closely integrated into the unified national economic complex of the USSR, which made it possible to create an industrial-agrarian economy in an underdeveloped area in a short time. At the same time, there is a high dependence of the republic's industry on inter-republican supplies of raw materials and materials.

By now, when the Kyrgyz Republic is part of the global world economy, the international division of labor has already secured for all countries their place in the system of international production of goods and services, we can say that the West has already integrated our economy into the world community as a primitive, resource-based, underdeveloped countries with an inefficient, uncompetitive market.

Conclusion

Foreign economic integration in a globalized world is necessary, but on different terms that respect our national interests. We are convinced that this can be achieved only as part of an integration grouping, in

regional integration, in particular, within the framework of the EAEU. The restoration and development of economic ties with neighbors in the region, but on a new basis, will enable the republic's industry to develop. At the same time, it is necessary to calculate which positions should be used to enter the regional, which – to the continental, which – to the world market.

Concluding our reflections on the lessons of history, I must say that today, in a difficult transition period for our country, we need to use our experience of economic development, take into account positive and negative aspects, and be able to apply them taking into account modern realities.

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Issue Article

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KYRGYZSTAN'S POLICY ON COMBATING INTERNATIONAL TERRORISM AND DRUG TRAFFICKING

Abstract: *The relevance of the study on international terrorism and drug trafficking arises from this subject becoming a global concern over recent decades. The purpose of this study is a detailed investigation of theoretical and practical aspects that will help to consider the general mechanism of international terrorism and drug trafficking, and to identify the main methods of combating this global issue based on the foreign policy of Kyrgyzstan and foreign practice. A number of methodological approaches were used in the scientific research, which reveal, as stated above, theoretical and practical aspects. Among such methods, it is necessary to distinguish the theoretical and methodological approach, the method of logical analysis, the formal and legal method, the dialectical methodological approach, the functional methodological approach, the method of comparative analysis, the method of synthesis, and the method of analysis of scientific literature. As a result of the study, the goals and objectives set by the author were fulfiled, namely, the concepts of "terrorism", "international terrorism", and "drug trafficking" were considered in detail, their main characteristic features of the implementation of these infringements were highlighted, which, consequently, allows considering the general mechanism of this issue. The norms consolidated in international legislation, and methods of combating terrorism and drug trafficking were also analysed. In particular, the political efforts of Kyrgyzstan in the fight against the global issue under study, and a comparative analysis of the policies of foreign states at present, were studied in detail. The findings of this study will increase the effectiveness of the fight against international terrorism and drug trafficking in Kyrgyzstan, which will have a significant impact on the country's current internal and external political situation in the international arena.*

Key words: *globalisation, types of terrorism, drug mafia, drug trafficking, international practice.*

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Introduction

The 21st century is an era of challenges and global issues. Due to the high level of development of scientific and technological progress, the processes of globalisation and digitalisation, the world community must face daily challenges that can reach the scale of more than one state. Therefore, scientists single out international terrorism and drug trafficking among

such global dangers and issues. At present, considerable attention is paid to international crimes, which affect not only the socio-political aspect but also the legal aspects.

It is important to note that international terrorism and terrorism, in general, are an act of ideological interconnection, psychological warfare against the morality of the public and the apparatus of power. It cannot be ignored that international terrorism is a global problem that requires a joint solution. For instance, the Secretary-General of the United Nations notes that in the last few decades the number of international terrorist acts, the number of victims and casualties due to terrorist acts and their scope have increased significantly, making terrorism an unprecedented threat to the world, its development and the security of the world community. It is particularly dangerous as an act of indirect aggression that is disguised as an independent action by individual actors or groups of actors [1].

At this stage, it is worth mentioning that there are quite a number of approaches to defining "terrorism" and "international terrorism". Since there is no single agreed definition of these concepts at the international level, this becomes a significant obstacle to the effective application of international normative legal acts [2].

Given the specific nature of the current era, terrorism arising in modern conditions should be characterised as international. However, the very concept of "terrorism" is defined as an international or interstate, but of an international character, organisational or other activity that is aimed at creating organisations or groups for the purpose of attempted murder or murder, inflicting serious bodily injuries, forcibly depriving a person of freedom by means of torture, blackmail and abuse of the subject, the capture of people for ransom as hostages or the transfer of people for ransom [3]. The main feature of terrorist acts is its orientation against key universal values, which are protected by normative acts of both national and international character.

There are several types of terrorism. A nationalistic terrorist act is described as being based on territorial conflicts, setting itself the goal of separating the community at the national level from larger entities in the state and gaining independence in the political aspect, fighting against the dictatorship of monopolies or non-national states [4]. Further, it is necessary to mention such a form as internal, that is, which sets itself tasks in the form of pursuing the fundamental goals or maintaining the current state of both political and economic aspects in the state. This type of terrorist manifestation appears in two key directions – the right and the left, which are quite antagonistic in their ideas, but they are brought together by a negative attitude to the already existing system. And, the last type of terrorist acts is religious, the direction of which is determined in the struggle of supporters of one religion with supporters of another religion, setting themselves the goal of overthrowing secular power, undermining its authority and at the same time establishing the religious authority. In practical application, these directions rarely appear separately, most often intertwining and borrowing ideas and slogans from one another [5].

Thus, it is of great importance to conduct a detailed study of the phenomenon of international terrorism as one of the global problems of the world community, along with such a problematic phenomenon as the spread of drug trafficking. It is possible to achieve this goal by studying the theoretical mechanism of these global challenges, their impact on various spheres of public life, and the effective foreign policy of various states to combat such phenomena.

Materials and Methods

The study on the topic of Kyrgyzstan's foreign policy on international terrorism and drug trafficking was carried out using a variety of methodological approaches. First of all, it is necessary to disclose the theoretical aspect of the study to obtain greater accuracy of the studied problem, which is possible due to the introduction of a theoretical-methodological approach, which allows revealing the concepts of "international terrorism" and "drug trafficking", and identifying characteristic features of these infringement actions and methods of their implementation. The method of logical analysis, in turn, will help to accurately analyse and reveal the theoretical component of this investigation. Further, the importance of using the formal legal method is highlighted, which helps to analyse the norms enshrined in the international legal instruments and to identify the level of importance in combating international terrorism and drug trafficking. A dialectical methodological approach is also important since it allows general patterns in the implementation of these infringement actions to be considered. Such a methodological approach, such as a functional methodological, cannot be overlooked, as it makes it possible to highlight the key objectives and goals set by Kyrgyzstan's foreign policy to combat international terrorism and drug trafficking. The method of comparative analysis will help to identify positive and negative qualities in the foreign policy of Kyrgyzstan in the topic under study and to consider the international practices in this area. It is possible to consider in more detail how this process should be carried out, based on the theoretical and practical information gained, by introducing the synthesis method into the study. It is also worth mentioning the use of the method of scientific literature analysis, which will help in the research on the topic, based on studies by various authors.

Thus, the author sets the following tasks in the investigation:

– to reveal the theoretical aspect of research in the study the concepts of "international terrorism" and "drug trafficking", while highlighting the characteristic features of these infringing activities;

– to consider a practical application based on the study of international legal norms and methods of combating international terrorism and drug trafficking;

– to analyse foreign policy on international terrorism and drug trafficking in Kyrgyzstan, and the policies of foreign states in this regard.

The study will be conducted in several key stages:

1. The first stage is based on the study of the theoretical aspect of the investigation, which consists in exploring the concepts of "terrorism", "international terrorism" and "drug trafficking", identifying characteristic principles and characteristics through which these offences can be classified.

2. The second stage is based on the study of legal norms enshrined in international instruments, and the consideration of methods of combating the problem under study in general.

3. The final, third stage, directly examines the foreign policy of Kyrgyzstan in combating international terrorism and drug trafficking, and analyses the policy of foreign states in combating international terrorism and drug trafficking to identify new methods and their application in the policy of Kyrgyzstan towards increasing the effectiveness of ongoing state policy.

Results and Discussion

As society develops, there is an increase in the various types of criminal activity that emerge and operate for the primary purpose of generating cash turnover. Notably, all criminal activities are latent, which creates an opportunity for security in the long-term functioning of the income-generating stage of criminal activity. Since one of the global problems of the modern world is the active development of the drug business, its example can be used to consider the trend of generating the stage of criminal income by producing, transporting, storing, and selling narcotic drugs to generate criminal income. When considering this type of criminal income, it is important to mention that this phase of economic activity represents a plurality of stages, and is also one of the most common, as the organisation of this sector is well investigated.

The process of organising income-generating activities through the distribution of the drug business should be further studied. One of the characteristic features of drug trafficking is obtaining more monetary income by narcotic passing through such stages as the production of narcotic drugs, their processing, transportation, storage of narcotic drugs, and their direct sale.

First, considering the concept of the production of narcotic drugs and psychotropic substances, it should be mentioned that this process is characterised by the implementation of the technological stage of their production since further stages of this process require the involvement of more resources to complete the production of narcotic drugs and psychotropic substances and their transportation. Each subsequent stage is characterised by an increase in the expenses of the production process, as a result of which there is an increase in the growth of prices for covering these expenses. Among the most common methods of production of narcotic drugs and psychotropic substances is the establishment of specialised clandestine laboratories by persons who are involved in the circulation of such drugs to implement the production process of narcotic drugs and psychotropic substances.

Another stage in the drug business is the processing of narcotic drugs and psychotropic substances, which involves purifying the mixture, increasing the intensity and potency of the drug in the mixture that is prepared, and adding special medicaments, chemical substances to such mixtures to exert greater influence on the human body. The processing part of the drug business is characterised by an increase in the price of narcotic drugs and psychotropic substances, as this stage includes the use of additives and the increasing concentration and saturation of the narcotic or psychotropic substance, which indicates an increase in the level of its purity in comparison with the original substance.

In the following steps that characterise the organisation of the drug business, it is important to note the transportation of narcotic drugs and psychotropic substances, which means the transportation of these substances from one key point to another by using a vehicle or other means of transportation. Another stage that deserves mention is the storage of narcotic drugs and psychotropic substances. It is characterised by any actions of a person that are associated with the possession of narcotics and psychotropic drugs, storing them in any place without highlighting the key task in the form of further sale of these substances. The last stage in the drug business is the sale of narcotic substances. This stage is defined as a form of transfer of ownership or possession of these substances to another subject [6].

According to the latest data from the United Nations and the International Monetary Fund for 2020, the annual amount of profit from the business of trafficking in narcotic drugs and psychotropic substances is around USD 500 billion [7]. These statistical indicators provide information that the drug business makes up a significant part of the global income spectrum, which is the basis for satisfying the subjects of the criminal economy by increasing the importance of the criminal economic cycle. In other words, based on these figures, it can be stated that

trafficking of narcotic drugs and psychotropic preparations allows subjects of the criminal economy to make between 300 and 2000% profit, as a result of which the stages of the criminal cycle are successfully developed and operate further [8].

Given the above information, it should be concluded that the distribution of narcotic drugs and psychotropic substances is a global issue. In this case, it is important to consider in more detail not only the negative qualities and consequences of drug trafficking but also the impact of this sector on the economic and legal segments.

The legalisation of criminal income is beginning to prevail in the world, which means conducting financial plan operations, which means conducting financial transactions that are intended to make the proceeds of criminal activities appear legal. There are three key ways to conduct money laundering operations around the world: placement, integration, and layering. The first method involves introducing the proceeds into the financial system, thereby removing them from their place of origin; this method is considered rather unreliable, as law enforcement authorities can easily trace these funds. Considering such a method as the integration of funds, it should be characterised as the legalisation of money obtained during criminal operations and their introduction into the legal economic system. That is, based on the definition of this method and its direct implementation in practical application, criminal proceeds acquire the character of funds that are obtained through legal operations. The last highlighted method, which is called layering, should be defined as the removal of such funds through a series of complex financial transactions, the need for which lies in the attempt to conceal their criminal origin and to legitimise them. That is, on this basis, a series of complex financial transactions take place, which are "layered" upon one another to hide a previous financial transaction, thereby providing grounds for determining an increase in the level of their conduct [9].

The importance of studying the issue of legalisation of criminal proceeds from the turnover of narcotic drugs and psychotropic substances is also driven by statistical indicators in the global community. Financial measures to combat money-laundering, particularly in the distribution of narcotic drugs and psychotropic substances, have been established, revealing that in the United States of America and Western European countries about USD 85 billion are being laundered each year. In the Russian Federation, the figure ranges from USD 2 to USD 7 billion annually. The rise in the annual global money laundering numbers is influenced by factors such as constant improvements in the way these transactions are conducted and their concealment, which exacerbates and complicates the enforcement agencies' control of these transactions. Importantly, money laundering amounts to USD 1.5 trillion annually in legal funds, or approximately 5% of the world's gross product [10].

In further disclosing the danger of a global problem of international terrorism, it is important to mention that not only public security is the object of the issue under study since the object of terrorist acts is also relations that are regulated by the subject of coercion, which prevails mainly in the powers of authority and administrative nature of state authorities, both local and autonomous, which are protected by the rights conferred upon them. That is, it points to direct interference in the power and administrative powers of the state and local authorities, which directly violates the security of the state as a whole and infringes on the constitutional foundations of the system. It is also worth mentioning that an act of terrorism can be directed at an individual and their group or a legal entity, which consequently violates the security of the state, society, and individuals.

Moreover, the concepts of "terrorism" and "international terrorism" are enshrined in the world's legal instruments. In examining this issue, an important problem is further defined by the lack of clarity in the definition of the institution. That is, the terms "terrorism" and "international terrorism" are used in parallel since they are connected semantically. But it is worth pointing out that most international legal instruments focus on combating terrorism in general, and not on its international implementation. The concept of "international terrorism" was mentioned only a few times in certain United Nations normative legal acts, namely: the 1979 Hostages Convention, the preamble to the 1979 Convention on the Physical Protection of Nuclear Material, the preamble to the 1988 Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation [11]. However, international legal doctrine has not proposed distinguishing characteristics to differentiate between 'terrorism' and 'international terrorism', which would help to build a clearer definition in this legal concept and distinguish it from other legal phenomena. But, for example, when looking at the practice of the Russian Federation on this issue, one cannot but mention the inclusion in the Criminal Code of the Russian Federation of a new corpus delicti of "acts of international terrorism" as "a crime against the peace and security of mankind" [12]. This demonstrates the increasing relevance of the issue of other national criminal law instruments to international counter-terrorism legal standards.

Yet, if the question of 'international terrorism' is explored in more detail through an analysis of the United Nations legal instruments, two key criteria stand out, namely the territoriality of the terrorist act and the legal affiliation of the perpetrator with a particular state [13]. In this case, the goals, motive, nature of the damage caused and the state-legal affiliation of the victims are not considered as

constructive elements of this concept. But these neglected criteria do have a significant value as a reflection of the concept of international terrorism. In practical terms, this provides objective factors to complicate the search and prevention of terrorist crimes, which consequently creates additional barriers to international communication in the legal sphere [14]. Having studied in detail the theoretical aspect of such global issues as international terrorism and drug trafficking, it would be necessary to move on to the practical component, namely, the analysis of political activities to combat these phenomena in Kyrgyzstan.

When investigating Kyrgyzstan's counter-terrorism policy, the main legislative acts to be noted are the Law of the Kyrgyz Republic No. 87 “On Counteracting the Financing of Terrorist Activities and Legalization (Laundering) of Crime Proceeds” (2018), the Law of the Kyrgyz Republic No. 178 “On Countering Terrorism” (2006), the Law on National Security Bodies of the Kyrgyz Republic [15], the Law on Internal Affairs Bodies, the Code of Administrative Responsibility, the Law of the Kyrgyz Republic No. 150 “On Counteracting Extremist Activities” (2005).

The practice of combating terrorism by the bodies of the State Committee for National Security shows that terrorist organisations are constantly improving their methods of subversive activity, and adjusting their plans and intentions. Nevertheless, the government policy of the Kyrgyz Republic is primarily oriented at maintaining its position in the fight against 'international terrorism' and continues to cooperate closely with the Shanghai Cooperation Organisation and the Collective Security Treaty Organisation along with other allies and partners in combating the issue under study. In recent years, this policy has been carried out quite successfully, as evidenced by the detention of more than dozens of militants who were transferred to the territory of Kyrgyzstan to carry out terrorist tasks. It is also worth mentioning the joint efforts of the Kyrgyz Republic and the Russian Federation, which have prevented several terrorist attacks in recent years, notably in Moscow, St. Petersburg and Yekaterinburg. Kyrgyzstan's active foreign policy efforts against international terrorism are reflected in the participation of thousands of Kyrgyz citizens in terrorist organisations in states such as Syria and Iraq [16].

Kyrgyzstan's counter-terrorism policy is also aimed at raising the general level of education to explain the difference between various religious movements in the extremist direction to prevent the population from being drawn into joining terrorist organisations. This is evidenced by the creation of specialised forums by the Security Council of the Kyrgyz Republic, the Eurasian New Wave Foundation, the Association of Veterans of the Anti-Terror Unit "Alpha" and the Pikir Expert Club. The activities of 21 destructive, extremist and terrorist organisations in the Kyrgyz Republic have been banned by court decisions of various instances. For example, "Islamic State", "Islamic Movement of Uzbekistan", "Al-Qaeda", "Taliban", "Islamic Jihad Union", "Jabhat Al-Nusra" and others. The State National Security Committee of the Kyrgyz Republic has an active policy to detain and prosecute individuals who are involved in the activities of the above-mentioned and other terrorist organisations [17].

An important focus in the fight against terrorism is the adoption of Program of the Government of the Kyrgyz Republic No. 394 "On Countering Extremism and Terrorism for 2017-2022” (2017). Among the counter-terrorism methods already mentioned above in the foreign policy of the Kyrgyz Republic is the work of the Computer Incident Response Centre established under the State National Security Committee, whose key task is to monitor access to various unauthorised resources on the Internet platform to remove, prevent the spread of or block access to such content. This approach in foreign policy is quite important and effective since in today's context the media is influential in reducing extremist and terrorist trends, and practice also shows that communication strategies are a powerful and fast means of preventing real threats from these directions. This is done through such components as the development of social marketing to shape communication with the population to meet their needs, the development of peacekeeping civic communications, the inclusion of "peace journalism" in the media to build communication with target audiences, focusing on its current demand and needs. To increase public confidence and engage the population against the phenomenon of international terrorism, work should be done to improve current communication strategies.

The next important stage in the foreign policy of the Kyrgyz Republic is the fight against the spread of drug trafficking. As part of the fight against the spread of narcotic drugs and psychotropic substances, the capabilities to control this phenomenon were developed in the powers of the Drug Control Service of the Ministry of Internal Affairs of the Kyrgyz Republic and the Department of Drug Provision and Medical Equipment of the Ministry of Health of the Kyrgyz Republic. Measures have focused on the objective of supporting existing legislation in drug control, strengthening potential law enforcement control over the licit movement of controlled narcotic drugs and psychotropic substances based on the United Nations Conventions (Single Convention..., 1961), supporting the operational capacity of the competent authorities in narcotic drug law enforcement at the national level [18].

The Law of the Kyrgyz Republic No. 66 “On narcotic drugs, psychotropic substances and precursors” (1998) was drafted and adopted as part of

an initiative by Japan to allocate funds for the control of drug trafficking. According to the introduction of this project, many law enforcement officers have been trained in resisting the illegal distribution and trafficking of narcotic drugs and their prevention methods. It is also worth mentioning the collection "Control Over the Turnover of Narcotic Drugs, Psychotropic Substances and Their Precursors in the Kyrgyz Republic in 2009-2017" (2018). According to this initiative, the United Nations Office on Drugs and Crime signed a protocol on cooperation between the Drug Control Service of the Ministry of Internal Affairs of the Kyrgyz Republic and the Drug Control Agency under the President of the Republic of Tajikistan. An important area of Kyrgyz foreign policy is also cooperation with the Central Asian Regional Information and Coordination Centre, through which a special catalogue is created that contains information on the methods of illegal movement of drugs, identifying the various concealment methods used by various criminal organisations for drug trafficking, such as vehicles, consumer products, use of postal envelopes and parcels, on the body and personal clothing [18].

To increase the effectiveness of the foreign policy of the Kyrgyz Republic in combating such global problems as international terrorism and drug business, it would be necessary to mention successful policies in other states. For example, the United States of America is characterised by its flexible nature in its foreign policy efforts against international terrorism, the focus of which is to maintain previously achieved positions and ensure the security of the State of Afghanistan through the consensus of all forces of a military-political nature, including the "moderate Taliban". It is also the policy of the United States to assist Syria by providing arms and qualified military training. A more detailed examination of the United States' experience with international terrorism policy is important since it is pragmatic and flexible in nature [19].

It is also worth considering Germany's policy on combating international terrorism. The policy is implemented in several ways, including information technology security for the transmission of any information on international terrorist organisations, the development of the Federal Border Guard, which focuses on border security to prevent crime on the eastern borders, and international cooperation to combat the phenomenon of terrorism more effectively [20].

The most striking example in the fight against drug-related crime is the policy of the Kingdom of Spain. It should be noted that law enforcement agencies have created specialised observation posts, using information and communication technologies to identify methods of production of narcotic drugs, to prevent criminals from using improved methods of transportation and distribution of narcotic drugs, and to conduct monitoring on digital platforms. Equally important in Spanish policy is prevention among the population, which aims to reduce the demand for narcotic drugs and psychotropic substances, and the development of rehabilitation centres to help people who are drug addicts [21].

Thus, based on the above, there is a high risk of the spread of the phenomena of global terrorism and drug trafficking, which, in turn, directly affect public spheres and the safety of citizens. The analysis of the policy of the Kyrgyz Republic shows that it conducts an active and effective fight against these global problems to maintain the current level of stability on the territory of the state and provides assistance to foreign states to combat these phenomena. An important aspect of the investigation is also the study of the policy practices of developed states, among which are the United States of America, Germany and the Kingdom of Spain. The experience of these states in combating international terrorism and drug trafficking will help identify new ways and methods to eliminate the studied global challenges.

Conclusions

By investigating international terrorism and drug trafficking, both the theoretical and practical aspects of these global world problems have been highlighted. Considering the term "international terrorism", it has been pointed out that international legal doctrine has not proposed a distinguishing feature to differentiate between the concepts of "terrorism" and "international terrorism", which would help to build a clearer definition in this legal concept and distinguish it from other legal phenomena. However, in the practice of the Russian Federation in this matter, the new composition of the "Act of international terrorism" as a "crime against the peace and security of mankind" is enshrined in the Criminal Code of the Russian Federation.

The drug trade, on the other hand, has been analysed in terms of how this global phenomenon is implemented. Among the key stages, the study covered drug production, drug processing, drug transportation, drug possession, and the direct sale of drugs. An equally important factor in the study of this issue is the consideration of the impact of drug trafficking on the economy in the form of criminal income. From a practical aspect, the successful foreign policy efforts to combat the segments under study should be highlighted. Among such methods are the development of social marketing to shape communication with the population to meet their needs, the development of peace-making civic communications, the inclusion of "peace journalism" in the media to build communication with target audiences in line with their current demand and needs. The fight against the trafficking of narcotic drugs and psychotropic substances takes place in the form of support for the current legislation on the control of

narcotic drugs, strengthening the potential control of law enforcement agencies under the legal turnover of controlled narcotic drugs and psychotropic substances, and the provision of specific training to law enforcement officers to increase their effectiveness in the control of these activities.

An important part of the study is the analysis of foreign policies to combat international terrorism and drug trafficking. Thus, the policies of the United States and Germany were examined to highlight new ways of controlling and combating the phenomenon of terrorism, and the effective policies of the Kingdom of Spain in the field of drug trafficking were considered.

The highlighted methods and approaches would help to increase the level of activity against the phenomena under study in the Kyrgyz Republic and to make this foreign policy more flexible, pragmatic, and relevant.

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Issue **Article**

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THE ROLE OF TEXTBOOK IN ACQUISITION OF TERMINOLOGY

Abstract: *In the process of studying English, it is difficult to acquire technical terms because of their miscomprehension and misinterpretation. Consequently, ESP classes are mainly designed on introducing technical terms which we do not use in our everyday life. Besides, ESP is content based and consists of texts relating to learners' specialty and it requires them much knowledge and experience in order to understand the context they read and learn. Furthermore, ESP teacher should use variety of techniques for comprehending the whole context while reading. Vocabulary is fundamental in ESP classes in the process of realization of technical terms of petroleum engineering. This paper highlights some peculiarities about effectiveness of texts using in ESP classes claimed by linguists.*

Key words: *ESP classes, techniques, petroleum engineering, contexts.*

Language: *English*

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Introduction

ESP is mainly constructed on texts which are full of technical terminology of that field learners are engaged in learning and acquiring, understanding. However, it is complicated to comprehend the contexts if learners have insufficient vocabulary words in that field of. Furthermore, ESP courses are life-learning process because they are focused on unknown words and terms which adult learners have no idea. As a consequence, learners may be able to understand whole context through reading. Besides, there are skimming and scanning techniques which may alleviate learners' reading comprehension. What's more, we should use more strategies in order to reach expected aims which may reflect the target needs of learners. One of the target needs of ESP learners in English language learning is to realize written contexts which complicate their understanding specialty in English. Particularly, reading material such as authentic context is strongly make them confuse while translating FL contexts into L1. This involves self-regulation, metacognition in reading, and the feasibility of improving strategy use through direct training and instruction. Although reading strategy instruction has been found to be successful in first language reading (Kh. Abdinazarov. 2019) such claims of success in L1 environments need to be validated in FL contexts to determine them to generalize ability to FL readers. In addition to that, Linguist Kh. Abdinazarov (2019) conducted a research with group of students, having organized an interview with them, using well-designed questionnaires in order to find out whether reading techniques such as skimming and scanning is effective in reading comprehension, the result was unexpectedly successful.

Importance of strategies in understanding unknown context

Distinguished linguists Tony Dudley-Evans and Maggie Jo St John (1995:75) stated Where English is used as the medium of communication and students are expected to present written work and make oral presentations in accurate English, serious weaknesses in grammar require more specific help. This may mean allocating time to concentrate on the given difficulty, teaching both the form and its use in contexts relevant to learners' needs. Besides, a linguist Kh. Abdinazarov (2019) claimed that the ESP teacher is to know what kind of tasks and processing would be associated with particular texts or information. Additionally, reading technical texts and

understanding them is difficult not only for English learners but also English language teachers who does not have any idea about learner's specialism. Experiences, knowledge gains not in a day, it takes some years, and surely, teachers who have wide knowledge on subject matter must help learners and English language teachers to comprehend the authentic texts and subject matter. Moreover, we should use all conveniences; such as techniques/ methods in reading and comprehending the written context in FL. What's more, Duffelmeyer and Duffelmeyer (1979) point out that the way words are learned is important in that it affects how well they are really understood. It is often the case that the knowledge gained by the learner is only the surface meaning of the word and the essential meaning of the word is missing. Lapkin and Swain (1977: 279-314) claimed that FL reading strategies differ at lower levels of proficiency, but as the proficiency level increases, the strategies approximate each other. Alderson (1985:192-2041) found that L2 reading involves both language proficiency and reading strategies.

Making Text Analysis

In order to carry out a research on ESP contexts, we briefly stated short text from the course book focusing on oil and gas engineering;

1) Seismic waves are sound waves, and they can travel through rock layers. Most oil companies use vibrator trucks to make seismic waves. These heavy trucks make vibrations on the surface, and the vibrations send waves down to the rock below.

2) The crew use hydrophones, not geophones, and they use an underwater gun to make seismic waves.

3) A typical production platform has four main areas above the water. One is the accommodation area, where the workers eat and sleep another. Another is the well head or drilling area. That contains the derrick, well head s, and drilling equipment.

4) Crude oil comes up to the well heads with gas and water in it. So it goes to the process area, which separates the oil from the other things. All the areas need electricity and other utilities. The utilities area provides these: a generator makes electricity, and there is equipment for heating, ventilation, air conditioning, and water distribution.

5) Routine maintenance is important for the generator's safe operation and long life. Routine maintenance is especially important in hot and dusty environments. The schedule at the right shows the procedures and frequency for basic maintenance. The generator's hour meter shows the number of hours that the generator has run.

6) Crude oil goes from the well to a **refinery.** Refineries **separate** crude oil into **light** and **heavy** products, such as petrol (light) and asphalt (heavy).

7) **Roustabouts** are often the youngest people in a drilling crew. They clean, maintain, and move equipment and help the other workers. Roustabouts want better jobs, so they work hard, listen carefully, and learn fast.

8) 8) **Roughnecks** are like roustabouts, but they are more skilled. They work on the drilling floor. They connect the heavy drill pipes and put them into the hole, or they disconnect the pipes as they come up out of the hole.

9) The **derrickman** works high up on the monkey board about 25 meters above the floor. He guides the top part of the drill pipe. At other times, he helps the mud engineer (or 'mud man'): he checks the mud and maintains the pump. The mud must not be too thick or too thin, and the pump must keep working.

10)The **driller** supervises and trains the drilling crew, and he controls the drilling equipment. For example, he operates the motor that lifts the drill pipes. He controls the speed of the drill, which must not be too fast or too slow. On very modern rigs, the driller sits in a special driller's chair. The chair has joystick controls and display screens - like a computer game.

11)The **rig manager or tool pusher** is the most senior person in the drilling crew. He is usually the oldest and most experienced person too. He makes sure the crew has all the right equipment. He is responsible for their safety and for paperwork (Lewis Lansford and D'Arcy Vallance: 2011:29).

In the given text there are an increasing number of technical terms which learners need to understand and translate in L1 but if they have no ideas on those terms mentioned in the context, they are not able to comprehend anymore.

Unknown terms the students often face in this field of study are seismic waves, rock layers, vibrator trucks, heavy trucks, vibrations, hydrophones, geophones, underwater gun which are used for exploration oil and gas deposits in the sea and in the fields. It is known that students without background knowledge and experience or any thoughts on that field of study are not able to realize whole context any longer.

Table 1.

№	Terminology of oil and gas
1	*Seismic waves*
2	*rock layers*
3	*vibrator trucks*
4	the vibrations
5	Hydrophones
6	Geophones
7	Accommodation area
8	the well head
9	drilling area
10	the derrick
11	drilling equipment

12	Crude oil
13	Tool pusher
14	Derrickman
15	Roustabouts
16	Rig manager
17	Rigs
18	Joystick control
19	Display screens
20	Drilling floor
21	Drilling mud
22	Drill pipes
23	Monkey board
24	Pump
25	Drilling tower

Conclusion

In learning English for engineering purposes, students often face using different techniques which are able to involve them better recognition the passage of authentic context. Such techniques: skimming, scanning, and translating and defining the meaning of the words. Where English is used as an instrument of communication and adult students aim to present written work and make oral presentations in accurate FL, deficiency in grammar and phonetics require more specific help. The English language teacher has to know particular tasks and instruments to better leading to understanding the terms depicted in contexts. Furthermore, technical texts reading comprehension is complicated not only for adult students but also language teachers who are not experts in that field of expertise and sometimes ESP teachers feel needs for assistance from the staff at the Technical Department. Learners feel a failure in translating specific vocabulary (technical terminology), which complicates the comprehension of context in the process of reading since they could hardly find L1 translation, and those translated from English into Uzbek, that indicates the lexical deficiency in the field of oil and gas in L1(Kh. Abdinazarov. 2021:75).

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