

Eco-economic Characteristic of the Arctic Regions of Russian Far East and Possible Trends of Their Change

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Abstract--- *The Arctic territories are drawing increasing attention from the world community. Their uniqueness and identity, rich and diverse natural resource potential, great prospects for reclamation and development on the one hand, and harsh climate with extreme conditions, permafrost, fragile natural environment sensitive to human impact on the other hand create the problem of balancing reclamation and preservation of the features of this unique ecosystem. The prospects of these territories depend on the choice of the most reasonable, economically and environmentally sound development blueprint. The existing ecological and economic situation in these territories needs to be studied to determine possible changes in the relations of production and nature, which is the purpose of this study. The methods of comparative statistical, historical and cartographic analysis describe the studied regions, the dynamics of environmental management and the environmental situation as a result of reclamation in the context of ulus and districts. The need and priority of activities divided by types of structural directions of environmental management are also determined.*

Keywords--- *Russian Far East, Arctic Territories, Natural Resource Potential, Crude Hydrocarbons, Ecological State, Structural Directions of Environmental Management.*

I. INTRODUCTION

The Arctic territories of the Russian Far East (RFE) include Chukotka Autonomous Okrug and 5 ulus (districts) of Sakha (Yakutia): Allaikovsky District, Anabarsky District, Bulunsky District, Nizhnekolymsky District and Ust-Yansky District. All of them are typical of sharp continental climate, widespread permafrost, low population density, high resource intensity, focal character of industrial and economic development and dependence of life on Northern Supply Haul, and low stability of ecosystems. Since the Arctic territories have a variety of rich natural resources that have not yet been sufficiently explored and developed, they are of interest to both Russian and foreign investors. Since these territories are complex and, at the same time, quite attractive for reclamation, the analysis of their eco-economic situation in the Arctic territories of the RFE, its dynamics, the consequences of economic activity, the existing structural directions of environmental management, as well as the most reasonable, economically and environmentally-reasonable development in the nearest future is relevant and timely. All this determines the purpose of this study.

A lot of Russian and foreign works [4, 8, 11, 14, 18, 19, 21, etc.] study certain aspects of the Arctic territories, like the issues of their sustainable development, natural resources, the impact of both natural and anthropogenic changes on the environment of these territories. This study is relevant and new since it considers eco-economic

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situation in the Far East Arctic territories as a result of different types of management, their consequences, the existing production and natural relations and environmental conditions.

II. MATERIALS AND METHODS

Consideration and analysis of current eco-economic situation, as well as determining its trends, the types of economic activities, required consideration of the consequences and the environmental situation in different time periods (they differ due to the lack of comparable information) in the context of ulus and districts. The research was conducted on the basis of official statistics of Federal State Statistics Service (FSSS) using cartography, analytical methods and statistical analysis.

III. RESULTS AND DISCUSSION

Currently, the indicators of socio-economic development of the Arctic and Northern regions of the RFE are lagging behind the national average. The main problems in the current situation are:

- Underdeveloped transport and energy infrastructure;
- Highly deteriorated social infrastructure;
- Low level of welfare of the population,
- Reduction of the working-age population (migration outflow).

These problems are due to the limited ability to build and maintain a modern system of life support and life activity at the expense of local resources only. In addition, there is a high level of accumulated environmental damage, erosion of the traditional way of life and reduction of the territories of traditional nature management of the indigenous peoples of the North. Natural changes and emergencies also have a significant impact. Due to global warming, the permafrost is in critical condition. There are irreversible processes of melting underground ice. Every year the permafrost landscapes lose their stability and functional properties, which cause continuous adaptation of the population, economy and social sphere to the new conditions of management and life.

The key sectors of economic specialization of the Arctic territories of the Russian Far East are mining and traditional forms of nature management (reindeer husbandry, hunting and fishing) (table.1).

The Arctic territories of the world are attractive because of their diverse and rich natural resource potential [1, 20, 25, etc.]. The Arctic zone of the Russian Far East also has a unique mineral resource potential. There are more than 1100 deposits and sites of solid minerals. As the basis of species diversity of resources on land, the researchers divide 10 types of raw materials (Fig.1). The share of deposits of precious metals and tin prevails in the species structure. Due to the lower degree of geological development, the density of deposits is 1.18 per 1000 km², which is less than the average in the Far East (1.65) and in Russia (2.2). For example, only about 5% of the territory is explored in Chukotka, 10 to 15% is estimated remotely. The economic importance of mineral resources extraction can be traced from the indicators of the dynamics of production and the share of extractive industries in the industrial production of the region. As can be seen from Table 2, in recent years, the mining industry accounts for almost 90% of the industrial production of Chukotka. At the same time, the cost of the extracted products increased

more than twice from 2010 to 2016. Even against the background of double fall of ruble against US dollar in 2014-2016, the level of mineral resources production remained at the level of 1.7–1.3 billion US dollars.

In short and medium terms, the basis for the economic development of the Far Eastern Arctic will be the extraction of such traditional mineral resources as gold, silver, coal, and diamonds. The dynamics of their production over the past 25 years is shown in Table 3.

Table 1: Eco-economic Characteristic of the Arctic Regions of the Russian Far East [27]

Region, ulus, districts	Period of time	Types of economic activity		Man-made consequences	Ecological situation*
		existing	planned (according to the regional development strategy)		
Republic Of Sakha (Yakutia)					
Allaikhovsky	30's	fishery			+++
	2000's - present.	reindeer husbandry, fur trade (reindeer, Arctic fox, sable, stoat, wolf) and fishery, fish processing; dairy industry	gold mining, mammoth tusk extraction, reintroduction of musk ox, reindeer husbandry, fishing and hunting, food, leather and fur production	trampling of vegetation and soil, reduction of reindeer lichen reserves	++
Anabarsky	30's	reindeer husbandry, hunting and fishing			+++
	80's – 90's	extraction and beneficiation of diamonds, reindeer husbandry, hunting and fishing		land-cover disturbance, erosion, trampling of soil	++
	2000's - present.	extraction and beneficiation of diamonds, hunting and fishing, domestic reindeer husbandry; processing of reindeer husbandry, hunting and fishery products, souvenir manufacturing; air transportation (passenger and freight); extraction of mammoth tusks.	diamonds, coal, bitumen mining, reintroduction of musk ox, reindeer husbandry, fishing and hunting, food, leather and fur production, souvenir manufacturing.	man-made disturbance of land, erosion, trampling of soil, reduction of reindeer lichen reserves, clogging with scrap metal, empty fuel barrels and tanks, broken equipment	+
Bulunsky	30's	fishing and hunting			+++
	40's – 50's	fishing and fish processing, coal mining		violation of land, erosion, trampling of soil, reduction of reindeer lichen reserves.	++
	2000 – present.	reindeer husbandry, fishing and fur trade, domestic reindeer husbandry; port facilities (commercial sea port Tiksi), airport	diamonds, coal mining, mammoth tusk extraction; reconstruction and modernization of Tiksi port; reintroduction of musk oxen, reindeer husbandry, fishing and hunting, food, leather and fur production		++
Ust-Yansky	30's	reindeer husbandry, fishing, hunting			+++

	2000's - present.	tinnery, gold mining, fish processing, reindeer husbandry and fur farming, air transportation	mining and processing of gold, tin, coal, and mammoth tusk, reindeer husbandry, fishing and hunting, food, leather and fur production	man-made disturbance of land, erosion, trampling of soil, reduction of reindeer lichen reserves, clogging with scrap metal, empty fuel barrels and tanks, broken equipment	+
Nizhnekolymsky	30's - 90's.	reindeer husbandry, fishing, hunting			+++
	2000's - present.	reindeer husbandry, fur farming, fur trade and fishery, fish processing, road construction, port facilities ("Zelenomyssky river port"), airport, on 14.04.2006 on the part of the Nizhnekolymsky district the border zone has been constructed	construction of roads and thermal power plant, coal mining, reconstruction of the port "Zeleny Mys", reindeer husbandry, fishing and hunting, food, leather and fur production	man-made disturbance of land, erosion, trampling of soil, reduction of reindeer lichen reserves, clogging with scrap metal, empty fuel barrels and tanks, broken equipment	++
Chukotka Autonomous Okrug					
Anadyrsky	20's - 40's.	seal-fisheries (walruses, bowhead whales) and fur trade, reindeer husbandry			+++
	1941-1945	tinnery and coal mining		disturbance of land, clogging with scrap metal, empty fuel barrels and tanks, broken equipment	+
	50's - 60's.	sea fishery, reindeer husbandry; gold mining, road construction, development of civil aviation, reindeer husbandry, fishing, hunting, dairy farming, pig farming, greenhouse farming, caged-animal farming; food processing industries, construction industry (building materials)		disturbance of tundra cover, erosion, trampling of soil, extinction of reindeer lichen reserves, clogging with scrap metal, empty fuel barrels and tanks, broken equipment	+
	80's - 2000's.	decline in reindeer husbandry, hunting and marine hunting, revival of the traditional fishing of bowhead whales, curtailment of industrial production		sharp reduction in the livestock of domestic reindeer, fur-bearing animals; violation of the tundra cover, soil erosion, extinction of reindeer lichen, clogging with scrap metal, empty fuel barrels and tanks, broken equipment	+
	2000's-present.	revival of industry (mining), port facilities (Beringovsky port), airport, reindeer husbandry	mining (gold, silver, copper, tin, tungsten, coal, hydrocarbons), road construction, reconstruction of CHP; reindeer husbandry, greenhouses, tourism	disturbance of tundra cover, soil erosion, contamination with metal scrap, empty fuel barrels and tanks broken equipment	+
Bilibinsky	30's-early	fishing, fur trade			+++

	40's.				
	50's - 60's.	electric power industry (Bilibino NPP), gold mining		disturbance of tundra cover, soil erosion	++
	2000-present.	gold mining, electric power industry, food industry, reindeer husbandry, plant cultivation	gold, silver, copper tin, tungsten mining and beneficiation (MPP), road construction, construction of energy parks	disturbance of tundra cover, erosion, trampling of soil, extinction of reindeer lichen, clogging with scrap metal, empty fuel barrels and tanks, radiation pollution	+
Iultinsky	40's	road construction		disturbance of land	+++
	50's - 60's.	electric power industry (Ekvekinot SDPP), minor seal fisheries		the decline of populations of walrus, ringed seal, bearded seal, and a slight decline in the population of beluga whales.	++
	70's- 80's.	activation of hunting due to the increase in the number of marine animals (especially walrus)			++
	2000's - present.	energy power industry (turbine power plant in the district center and diesel power plants in villages), reindeer husbandry, sea seal fisheries and fishing	gold, silver, copper, tin, tungsten, coal, and hydrocarbons mining, road construction, traditional industries and processing of their products	disturbance of tundra cover, contamination with metal scrap, empty fuel barrels and tanks broken equipment	++
Providensky	50's - 60's.	formation of the border crossing checkpoint with a large center in urban locality Provideniya; port activities (Providensky seaport), small-scale seal fisheries.		decline in walrus population, ringed seal, bearded seal, a slight decline in the population of beluga whales.	++
	70's- 80's.	the intensification of seal fisheries (especially the walrus)		disturbance of tundra cover, contamination with metal scrap, empty fuel barrels and tanks broken equipment	++
	2000's - present.	production and distribution of electric and thermal energy, water, processing industry	coal and hydrocarbon production, balneological tourism		++
Chaunsky	40's - 50's.	encountering, extraction and enrichment of uranium (MPP)		radioactive contamination, land disturbance	+
	50's- 60's, 90's.	power industry (Chaunskaya CHPP, Ekvekinotskaya SDPP, floating nuclear power station in the city of Pevek), road construction, civil aviation development, intensification of port activities (Pevek sea port), reindeer husbandry, fishing, hunting		radioactive contamination, disturbance of lands, contamination with metal scrap, empty fuel barrels and tanks	+
	2000's - present.	development of transport infrastructure (airport, sea	gold, silver, copper, tin, and tungsten mining,		+

		port, capable of receiving large displacement vessels)	power industry (energy center and floating nuclear power station), road construction, traditional seal fisheries and reindeer husbandry, processing of reindeer husbandry products: clothing, footwear, gift, pharmaceutical industry		
Chukotsky	40's - 60's - early 80's	seal fisheries		decline in walrus population, ringed seal, bearded seal, beluga whales.	++
	Late 80's - 2000's - present	activation of seal fisheries due to the increase in the number of marine animals (especially walrus), reindeer husbandry, hunting, the beginning of the development of leather, perfume and soap production, technical and medical fortified fats (based on the fat of marine animals), bone-cutting production (walrus tusks and teeth);	implementation of projects for the preservation and development of traditional industries (reindeer husbandry, sel fisheries, fishing and fur trade), the development of production on the basis of traditional farming products, balneological tourism		+++

*Ecological situation: favorable +++, relatively favorable ++, unfavorable +

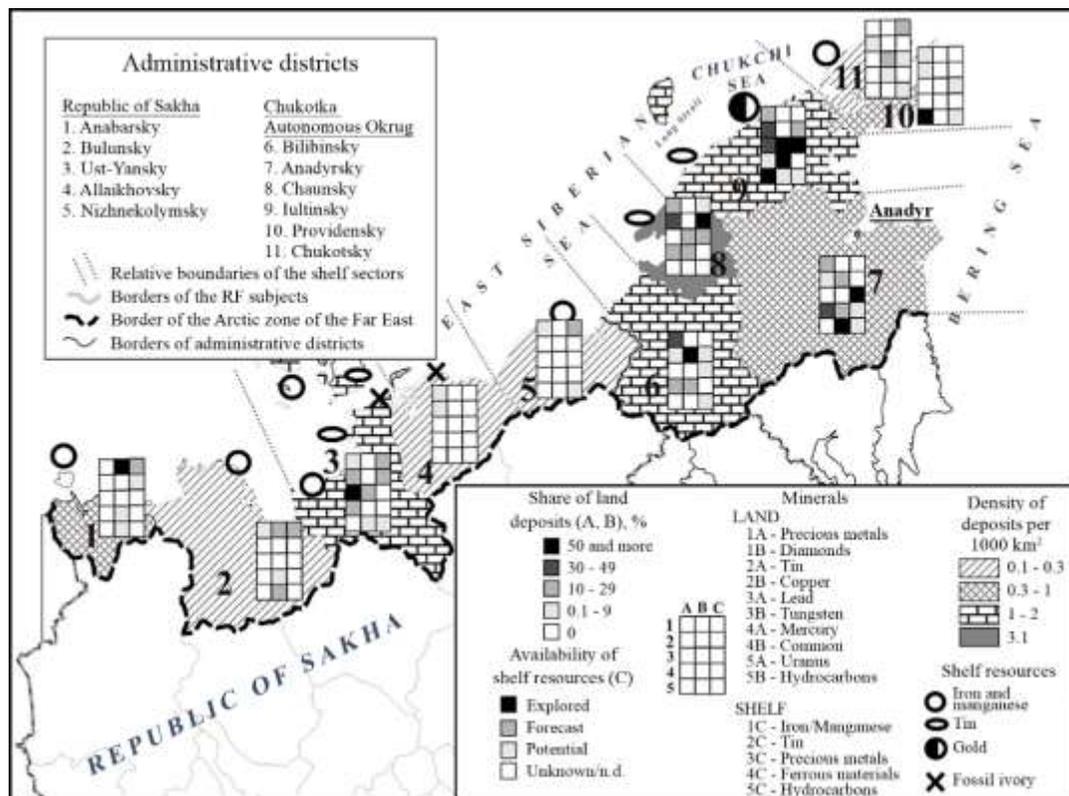


Fig.1: Territorial Differentiation of Solid Mineral Deposits in the Arctic Zone of the Russian Far East [12, 28]

Table 2: Economic Performance of the Mining Industry of Chukotka in 2005–2017. [24]

	2005	2010	2011	2012	2013	2014	2015	2016	2017
Mining, million rubles	2648	35494	38547	34116	34853	63813	76671	84733	65316
to the level of 2010, %		100	108.6	96.1	98.2	179.8	216	238	184
Share of industrial production, %	41.2	82.5	85.8	80	75.5	87	88	89	87.8
Mining, million dollars	94	1168	1311	1097	1094	1659	1257	1268	1119

Table 3: Dynamics of Extraction of the Main Types of Mineral Resources in Chukotka

Resources	1990	1995	2000	2005	2010	2015	2016	2017
Coal, thousand tons	1222	874	331	600	388	200	241	445
Gold, tons	17.7	9.8	6	4.7	24.4	32	29.2	25.3
Silver, tons	n.d.	n.d.	6	9.8	221.7	156	163	131

One of the most important promising directions in the extraction of mineral resources is the development of non-ferrous metals (copper, tin) on the basis of previously exploited deposits (the tin deposit Deputatskoe in the Republic of Sakha) and deposits prepared for operation, but not previously exploited (copper deposits of the Baim reservoir in Chukotka) (Table 4). The geological activities revealed that the reserves of copper at one of the deposits account for 1 million 200 thousand tons, the work at the second deposit is still in progress. The main prospects here depend on the development of the largest deposit Peschanka within the Baim reservoir. Expected reserves of copper account for 4.5 million tons, of associated gold – 260 tons. The resource potential of the Baim metallogenic area is estimated at 27 million tons of copper and 1600 tons of gold. Even in the conditions of low development status, the reserves of tin and tungsten in Chukotka are estimated as the largest in

Table 4: The Main Minerals of the Arctic Regions of the Russian Far East [12]

Region, ulus, districts	Deposits	
	Exploited	Promising
<i>Sakha (Yakutia)</i>		
Allaikhovskiy		Odinokoe (tin, tungsten, bismuth), Chokurdakh (tin), deposit Odinokiy stream (tin, tungsten)
Anabarskiy	Deposit Ebelyakh (diamonds)	extraction of hydrocarbons (shelf),
Bulunskiy		Taymyl'skoe (bituminous coal)
Ust-Yanskiy		Deputatskoe (tin, indium), Odinokoe (tin, tungsten, bismuth), deposit Odinokiy stream (tin, tungsten), deposit Tirekhtyakh stream (tin, tungsten), Vera stream (gold), extraction of mammoth tusks
Nizhnekolymskiy		Drevniy stream (gold), Rodinka stream (gold), crude hydrocarbons, raw gemstones, construction materials (clay, sand-gravel mixture)
<i>Chukotka Autonomous Okrug</i>		
Anadyrskiy	Kupol (gold, silver), Zapadnoozernoe (gas), Anadyrskoe (coal), Bukhta ugol'naya (coal), Amaamskoe (coal)	Nutekingenkyveem (gold), Pastbishchnoe (zeolites)
Bilibinskiy	Karalveemskoe (gold)	Baimka (gold), Peschanka (gold, copper, molybdenum), Kekura (gold, silver), Klen (gold, silver),
Iul'tinskiy		Kuvet (gold), Lenotap (gold), Olenya reka (gold), Skryty stream (gold), Pilkhinkuul'skoe (sandstone)
Providenskiy		
Chaunskiy	Dvoynoe (gold, silver), Mayskoe (gold)	Chaanay (gold), Valkumeyskaya deposit (tin), Krutoe (tin, tungsten), Pervonachalny stockwork deposit (tin, tungsten)
Chukotskiy	Lorinskoe (mineral water)	

Russia, the potential for copper – one of the largest deposits in the world, gold in this region takes the fifth place in Russia, and coal reserves accounts for more than 1 billion tons. It is planned to increase diamond production in the Anabarsky region of Yakutia.

Long-term prospects for the development of the Arctic North of the RFE are primarily associated with the production of hydrocarbons. In future, the development of these deposits (especially on the shelf) may open up wide opportunities for these territories. Therefore, there is a serious geopolitical struggle for the territory of the shelf [5, 15, 21, etc.]. The hydrocarbon reserves of the Western North of Russia (including the water area) are much higher than those of the far eastern Arctic, and the degree of exploration of the total oil and gas resources of the far East is not more than 3%. Exploration in the Arctic territories of Western Russia is about 25-60%, the degree of depletion of oil reserves – 17-26%, of gas reserves – 9-36%. Profitable oil reserves of the Arctic zone of the RF are located in the Nenets and Yamal-Nenets Autonomous Okrugs, as well as on the shelf of the Kara Sea. Therefore, in the near future, the oil and gas resources of the shelf of the far eastern Arctic will be transferred in the reserve of environmental management.

Despite the serious and global reasons for the development of new fields, the development of Arctic oil and gas resources require high costs and high risks, the main of which are:

- Severe Arctic climate, which is characterized by year-round severe frosts, long polar night, the threat of damage to offshore drilling rigs with Arctic ice, swampy tundra, which causes seasonality in most regions, as well as limited biological activity;
- Underdeveloped infrastructure; due to this fact, it is necessary to develop new fields "from scratch", which is a very expensive occupation and, at the same time, subject to significant environmental risks. Development of Arctic fields requires special equipment (tank vessels and icebreakers), as well as installing long communications;
- Competition is represented by other deposits of hydrocarbons. Current conditions of supply growth in the global gas market from different sources, both conventional and non-conventional, puts the expediency of developing Arctic fields under question. Gas extracted from shale, coal seams and liquefied natural gas is a great competitor [6].

Economic activity forms the structural directions of environmental management [3], production and natural relations that determine the ecological state of the territory. In the ulus of the Chukotka Autonomous Okrug, along with traditional croppings, the production that involves the extraction of minerals prevails. The various types of traditional croppings prevail in the Districts of the Republic of Sakha (Yakutia), except the Ust-Yansky district, where tinnery and gold mining is performed. The remaining structural areas of environmental management are poorly developed (Table 5).

Table 5: Directions of Natural Resources Management of the Arctic Zone of the RFE

Structural directions of environmental management	Chukotka Autonomous Okrug		Sakha (Yakutia) (Arctic Districts)	
	existing	possible in future	existing	possible in future
Production	+++	+++++	++	+++
Spatially-linking	+	++	++	++
Utility	+	++	++	++
Environmental protection	++	++	++	+++

In the studied territories, the main components of the ecological state are air pollution, water pollution, the formation and contamination of territories with production and consumption waste, radiation pollution.

Due to the low level of treatment of industrial and domestic effluents, and sometimes the completely missing treatment facilities, water resources of the Arctic territories are experiencing intense anthropogenic impact. The Lena river became polluted almost throughout the whole its length and now belongs to "dirty" rivers, the same is for the rivers Aldan, Indigirka, Yana, Amga. The Vilyui river became "very dirty" [23].

One of the adverse effects on the environment of the Arctic RFE is atmospheric pollution: carbon dioxide, carbon monoxide, sulfur dioxide and nitrogen dioxide, as well as some other substances, are the main pollutants. The high level of air pollution leads to a rapid increase in morbidity among the population, especially with infectious, cardiovascular diseases and cancers.

A serious problem for the territories of the Far East is the formation and storage of solid waste of production and consumption, as well as the formation of unauthorized dumps, which leads to clogging of territories, ground and surface waters, disturbance of landscapes, etc. The major amount of waste comes from the mining industry, the bulk of which are overburden grounds, refinement tailings, and ash dumps. The volume and rate of waste accumulation and underdeveloped recycling industry causes the use of landfills as the main method of waste disposal. The sanitary condition of waste disposal sites remains unsatisfactory: often there is no fences, the embankments, territories and access roads are not landscaped, they overflow with waste, there is no remediation work, the balance holder of the landfill is not defined, the register of waste generators is not maintained, the accounting of municipal waste at the level of municipal settlements is not organized, etc.

Traditional types of management prevail in the Arctic territories of Sakha (Yakutia), and, as a result, the environmental situation is generally quite favorable, except for the Anabarsky and Ust-Yansky Districts. In the 2000s, the dynamic extraction of diamonds, gold, and tin has started, which shortly has led to a sharp deterioration of environment in these areas (Table 1).

The districts of the Chukotka Autonomous Okrug have more complex territorial and economic structure: the production of I-V hazard classes are located here and, despite the fact that recently there has been a significant decline in production, the environmental condition has not improved, as evidenced by the environmental rating. For a long time, Chukotka Autonomous Okrug was one of the leaders in the environmental rating of the regions of the Russian Federation. Sakha (Yakutia) occupied the decent place in this ranking. In 2018, these regions somehow lost their positions: Chukotka Autonomous Okrug – 12th place, Sakha (Yakutia) – was at the 74th [10]. The unfavorable environmental situation was observed in Anadyrsky, Bilibinsky districts; Iultinsky and Providensky districts were

relatively stable, and in the Chukotsky district there has been recorded some positive dynamics. The most problematic ecological situation is the Chaunsky district. In this area, energy is actively represented, the situation is aggravated by radioactive pollution. On the shore of the East Siberian Sea, 18 km to the east of Pevek, there is a uranium enrichment plant, which has been closed in the early 1950s, the tailings of which contain and is accumulated. The surface of the sludge tank is open; its area is 20 km². According to radiometric studies, the specific alpha activity of waste and the concentration of radon is more than 100 times higher than the background.

The efficiency of environmental management is formed by environmental activities, which are very low in these regions. Financial support of activities aimed at reduction of the negative impact of production on the environment is insufficient and remains consistently low (current costs, investments in environmental protection (EP) and wise environmental management, their structure). The actual volume of investments in the EP is disproportionately small if compared to the economic optimum: for Sakha (Yakutia) in 2007/2010 they were respectively 36,8%/18,9%, in 2013/2014 - 10.7%/20.4%; for Chukotka – 2007/2010 they were 2.4%/1.16%, in 2013/2014 – 5.2%/of 10.0%. This is also justified by the index of economic sufficiency of environmental activities (ESEA), proposed and calculated from the ratio of the actual amount of financing for environmental protection and environmental management and economic optimum (with the optimal value of ESEA - 1). Both in the Chukotka Autonomous Okrug and in the Arctic territories of Sakha (Yakutia) it is 0.1 [26].

Within the framework of the state environmental programs of the Russian Federation, insufficient attention is drawn to the environmental well-being of the Northern territories. For example, the program "Environmental protection for 2012-2020" expects to increase the volume of waste I-IV classes of danger, and does not provide the increase the acreage of protected areas [13].

In general, the territories of the Arctic North of the RFE are described by high-grading extraction of resources by primitive methods of the level of the beginning of the XX century with pollution of water resources, fresh water, soil and air. The causes of environmental problems are:

- Poor quality of drinking water for the population;
- Discharge of untreated wastewater (mainly from domestic use);
- Existing unauthorized solid waste dumps;
- No solid waste disposal;
- Disturbance of land resources, mainly of man-made character;
- Weak development of environmentally protected areas direction of environmental management;
- Low rate of self-purification and self-recovery of biocenoses;
- Inactive position and insufficient real assistance of the state to restore and preserve the unique nature of the North.
- Lack of innovative projects that provide for the waste-free production, low degree of waste recycling, low technological level of existing types of production.

Since the environmental consequences of economic activity have almost no territorial boundaries, their action is long-term and transformative, and there are practically no activities and financing to preserve and maintain the well-

being of these territories, their degradation, destruction and decline are observed, their uniqueness and identity are being lost. Further environmental prospects for the development of the Arctic territories of the RFE are obvious and can repeat the development of the Arctic territories of Western Russia. For example, in the Murmansk region as a result of the development of oil and gas industry, coal mining, nuclear icebreaker fleet, Kola NPP, storage of radioactive waste and SNF formed scorched desert - the so-called "lunar landscapes". In Norilsk, the pollution of the atmosphere by coal dust many times exceeds the MPC. The waters of the bays of the Kola Peninsula are covered with oil stains, the banks suffer from a layer of waste, etc. [9, 22].

The concept of sustainable development of the Arctic Districts emphasizes that the "long-term reference point for the development of the Arctic Districts and places of compact residence of the indigenous peoples of the North is the transition to an effective model of development, namely, a balanced solution to the problems of industrial development and traditional economic activities of the peoples of the North with the mandatory preservation of natural ecological systems and biodiversity." For these territories, the development of industry (mainly extractive and significant manufacturing industries) will certainly give growth to the gross regional product (GRP), investment in fixed capital, etc., but is unlikely to ensure the preservation of natural ecological systems and biodiversity.

The Republic of Sakha (Yakutia) plans to implement the investment projects of creating environmentally friendly media, but Chukotka is missing such projects. The analysis allowed identifying possible changes in the structural directions of environmental management (Table 5) and the environmental status of these territories after the projects would have been implemented (some of them had already been launched) [16] (Fig. 2).

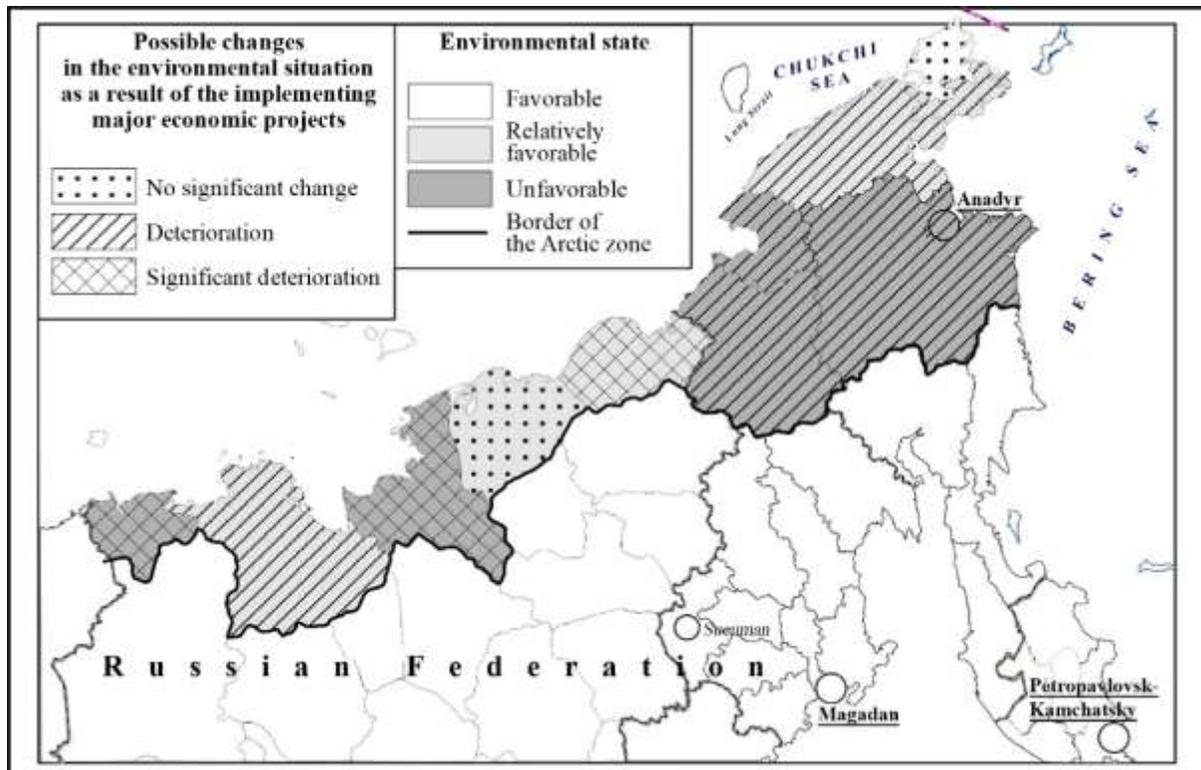


Fig. 2: Possible Environmental Changes in the Arctic Territories of the RFE

Speaking on the ecological and economic balance of the further development of the Far East and its sustainable development, it is necessary to seek the areas of economic activity that do not cause significant damage to the environment. The experience of other countries with Arctic territories shows that such direction is Arctic tourism [2, 17, 30, etc.]. As for the Russian Far East, this is not an easy one, but still one of efficient ways to resolve environmental and economic contradictions in the further development. According to the heads of the Russiatourism, Arctic tourism in the Russian North in the future can bring no less income than mining [29].

The world has accumulated significant experience in the development of Arctic tourism. Each Arctic state strives to create and develop its own unique touristic product. Denmark and Norway actively use snowy landscapes of Greenland and Spitsbergen as tourist destinations, Canada uses the fauna of the Canadian Arctic archipelago with a large number of national reserves. Iceland offers skiing, hiking, kayaking and other wildlife trips in Iceland and Greenland. Finland offers kayaking on the Teno river, mountain biking, traditional salmon fishing in the Utsjoki river and fishing in the Arctic ocean.

The main problem in the development of tourism as a sector of the regional economy in the Russian Arctic is underdeveloped transport and logistics, as well as poor services and insufficient tourist infrastructure.

Nevertheless, Arctic tourism in the North is becoming one of the promising economic directions in the restoration of the polar territories [7]. The Russian Arctic as a tourist destination is harsh and very picturesque nature of the islands and archipelagos of the famous Northern sea route: the shortest water route between the European part of Russia and the Far East along the Arctic ocean. The pearls of the land of glaciers and volcanoes are Chukotka and Cape Dezhnev — the closest point of Eurasia to North America, the Wrangel island, which is in the UNESCO List, with its unique flora and fauna, including the largest walrus rookeries in the Arctic.

However, irregular spatial distribution, wide variety of species and uneven combination of natural recreational resources currently impede the rapid and easy development of tourism in the region. The high vulnerability of the Northern nature and the need to preserve the rich cultural and historical heritage of the territory in combination with unique, original monuments of nature suggests the priority of the development of specific polar types of tourism in Chukotka. The most suitable and promising is ecotourism, which implies minimal anthropogenic impact on the place of residence and contributes to the preservation of natural objects in the Arctic Zone. Potential sites for its formation can be the national Park "Beringia", as well as reserves "Wrangel Island" and "Ust-Lensky". The development should also consider cultural exchanges between neighboring Nations (Chukotka-Alaska), extreme, scientific and educational, sports, fishing, and ethnographic types of tourism. The latter also includes direct participation in projects related to the low-numbered indigenous peoples of the Far North, which in turn is to preserve their rich cultural heritage and improve their socio-economic situation.

IV. CONCLUSION

The conducted analysis of the existing eco-economic situation in the Arctic territories of the Russian Far East, its changes, the consequences of economic activity, and the existing types of structural directions of environmental management allows making the following conclusions:

1. The territory of the Arctic North of the RFE has a significant natural resource potential, including the resources of traditional economic types.
2. The considered territories, despite the more favorable environmental condition if compared with the Arctic territories of the Western part of Russia, have negative consequences of man-made impact.
3. Since the explored hydrocarbon reserves of the Western Arctic territories of Russia are more significant, and they have low degree of their depletion, there is no need to develop hydrocarbon deposits in the Arctic territories of the RFE in the nearest future.
4. Production with a clear focus on the extractive industries prevails in the structural directions of environmental management in Chukotka Autonomous Okrug; the Arctic Districts of Sakha (Yakutia) have more balanced structure. Environmental protection is poorly developed in both regions.
5. Despite the more prosperous environmental situation in comparison with the Western Arctic territories of Russia, the far eastern Arctic is experiencing significant man-made load, the main components of which are pollution (atmospheric, wastewater), landscape disturbance, and clogging of lands.

The obtained results allow the reasonable determination of the main priority areas of a They include: balanced ecological and economic development of the Arctic territories of the Russian Far East, which should be taken into account by the planning and governing bodies when drawing up plans for the socio-economic development of the territories in question. They include:

- Measures to eliminate the existing man-made consequences, restoration of disturbed landscapes;
- Construction of the necessary infrastructure like communication lines treatment facilities, energy supply, with the use of non-conventional energy, housing, arrangement of living conditions of the indigenous peoples of the North. There is enough experience in using alternative methods of electric supply: small settlements that do not deal with the use of fuels and lubricants are already available: wind power plant Chukotka VES-1 in Anadyrsky district at the Cape of Observation.
- Promotion and support of developing the traditional types of economic management, as well as processing of products of these industries (perfume, jewelry, leather, soap, pharmaceutical, etc.). In order to preserve the indigenous peoples of the North, there is a need to preserve their identity through the development of the economic sphere based on the traditional industries of these peoples at their places of residence. Traditional crafts are important not only in cultural context, but also economically, although their role varies from region to region, in ethnic groups and generations. The development of traditional employment sectors of the indigenous peoples of the North also guarantees their own food security for the region. Another strategy is to diversify the economy of the traditional industry through the development of food processing, handicrafts, souvenirs production, and tourism. Such activities can be considered as a modern direction of traditional economy.
- Modernization of existing types of production.
- Stimulation and promotion of investment projects aimed at environmental protection and optimization of industrial and natural relations.

- As one of the ways of eco-economic balancing of further development of the Northern Far East, as well as using the experience of other Arctic countries to develop the tourism industry.
- Active and real support from the state in preserving the uniqueness and further development of the Arctic territories of the RFE (state investment, tax incentives, economic incentives and other preferences).

It is obvious that the development and expansion of only traditional types of management would probably not stimulate the development of these regions. Therefore, the search for a balance between the development of Arctic resources and the preservation of the unique features of this world's only ecosystem is a global challenge for the world community. Development and implementation of the principles of "green economy" (aimed at economical consumption of those resources that are currently subject to depletion, rational use of inexhaustible resources), as well as the "blue economy" (basic principles: any resource can be replaced by another if it is needed for production; there is no waste in nature; any by-product is a source for a new product), a competent state policy aimed at the development and improvement of new technologies, reducing environmental risks. A thorough scientific study of the Arctic would contribute to the sustainable socio-economic development of the Arctic zone of the Russian Far East.

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