The current environmental and economic situation in the Far Eastern North and possible directions for its transformation

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Abstract. Far Eastern Arctic territories, poorly developed in comparison with the northern territories of the European part of Russia, 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. The obtained results allow the reasonable determination of the main priority areas of activity. They include: balanced ecological and economic development of the Arctic territories of the Russian Far East, considering the development of traditional employment sectors of the indigenous peoples of the North, their own food security for the region is guaranteeing (diversification of the economy of the traditional industry through the development of food processing, handicrafts, souvenirs production, and tourism). It 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.

1. Introduction
In this research, the Arctic territories of the Russian Far East (RFE) include Chukotka Autonomous Okrug and 5 ulus (districts) of Sakha (Yakutia): Allaikhovsky 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 [1-7 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 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.

2. 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.

3. 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. 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, [8]. Since table 1 is very voluminous, a fragment is shown in the work.

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 [9,10]). 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. 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.
Table 1. Transformation of the ecological and economic characteristics of the Arctic regions of the Russian Far East (fragment) [8]

| Characteristic/Parameter | 2020 | 2015 |
|--------------------------|------|------|
| Transformation of the ecological and economic characteristics of the Arctic regions of the Russian Far East | | |
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| Characteristic | Description |
|---------------|-------------|
| Decline in whale population | Reduced whale population due to various factors. |
| Impact | Implementation of projects for the protection and development of the Arctic, especially sea life. |
| Effects | Increase in the number of marine mammals. |
| | 2000 - 2008: 5% decline, 2009 - 2010: 5% decline |

| Environment | Description |
|-------------|-------------|
| Coal and hydrocarbon production | Increased production of coal and hydrocarbons. |
| Thermo electrotechnological complex | Production and distribution of electricity and heat. |
| | Production of electricity and heat. |
| | Especially the workers. |
| | Employment of sea mammals. |
| | With a long career in marine ecology. |

| Procedure | Description |
|-----------|-------------|
| Reduce whale population | Reduce whale population to control the impact on the environment. |
| Administration and organization | Coordinated and scheduled program for the reduction of whale population. |
| | Reduction of whale population through a comprehensive plan. |
| Gold mining and hydroelectric | Gold mining, hydroelectric power, and gold exploration. |
| | Gold mining; hydroelectric power; gold exploration. |
| Gold mining and power | Gold mining; hydroelectric power; gold exploration. |
| | Gold mining; hydroelectric power; gold exploration. |
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). 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 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 [11-12, etc.].

Economic activity forms the structural directions of environmental management [13], 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 2).

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" [14].

Table 2. 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                         | ++                       | ++                                | ++                       | +++                 |

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 [8]).

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 [15]. 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.

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 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 2) and the environmental status of these territories after the projects would have been implemented (some of them had already been launched) [16] (Fig. 2).

![Figure 2. Possible environmental changes in the Arctic territories of the RFE](image)

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 [17-19, 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 [19].

4. 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 activity. They include: balanced ecological and economic development of the Arctic territories of the Russian Far East, and for this it is necessary 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).
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