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Socio-Economic and Environmental Challenges of Mining Industry in the Komi Republic*

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Abstract. Mineral resources of the Komi Republic and the trends and dynamics of their development determine to a great degree the level of the regions' economic development. The Republic has significant reserves of oil, gas, coal, aluminum, chromium, manganese, titanium, rare metals, gold, barite, fluorite, and quartz raw materials. However, the region's mining industry is still in the process of formation, this fact makes it possible to foresee and handle major social and environmental issues that accompany mining activities. The analysis of global trends in the implementation of mining projects substantiates the necessity to build a positive reputation of mining companies for ensuring stable production and for solving social and economic problems of territories. The paper also determines staffing requirements of prospective mining enterprises and possible social risks. The authors substantiate the necessity to redistribute taxes and payments in favor of the areas where mining companies operate, and they propose ways of attracting investment in

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mining projects on the stage of exploration with the help of a flexible fiscal policy. The main environmental problems of perspective objects of mining complex development can include the concentration of hazardous emissions, discharges and waste and the aggravation of environmental impact. The transformation of living organisms is moving toward the reduction of species diversity, simplification and changing community structure due to the disappearance of sensitive and rare species. The assessment of environmental impact intensity, based on the point estimation of the correlation between existing anthropogenic load and environmental resistance, has shown that the levels are medium and high. Taking into consideration the increased anthropogenic load, it is necessary to determine restrictions of nature management during pre-investment stage, to set out in the license the overall admissible amount of land resources usage for the purposes of industrial infrastructure, conduct environmental impact assessment for the field in general and to restore the disturbed taiga and tundra ecosystems using scientifically grounded restoration methods.

Key words: mining industry, social responsibility, human resources, income distribution, environment resistance, environmental impact assessment, restoration of disturbed ecosystems.

Introduction

Mining industry of the Komi Republic is still at an early stage of its development, so today we can talk about possible social problems and environmental impact of the future mining and processing enterprises, and their prevention.

Currently, mining industry in the Komi Republic is represented exclusively by the production of bauxite and non-metallic construction materials (building stone, gravel, sand). This field of production in the example under consideration can also include the production of crushed stone, brick and cement, because, in accordance with the current classification of types of economic activity, mining industry involves the extraction of non-combustible minerals and manufacture of non-metallic mineral products.

The current volumes of extraction of ore and non-ore mineral raw materials are insignificant. The share of mining industries in the total cost of industrial products shipped to customers is 0.5–1%, in the structure of employment it is less than 3%, in the structure of fixed assets – 0.3%.

At the same time, the Republic has considerable potential for the formation of a powerful modern mining complex – from deposits of strategic and critical minerals to various agrominerals and construction materials.

The list of investment projects includes the creation of mining and chemical complexes on the basis of titanium, bauxite and oil shale deposits, development of quartz deposits, building materials and so on [4].

With the formation of mining complex there will be an inevitable rise and exacerbation of environmental and social problems that are typical for mining industry and that are caused by domestic policy of subsurface use and regional conditions.

Several papers [3, 9, 10] describe common problems that occur in the system "mining industry – environmental services" and propose their solutions at the global and

regional levels. Social and environmental issues occupy a special place among the main problems associated with the development of mining industry in the Komi Republic.

Socio-economic aspects

1. Mining companies currently operate in the conditions of high social and environmental responsibility. Such responsibility is not limited to the implementation of commitments undertaken upon obtainment of a license for subsoil use. Companies must be prepared to put additional funds in their investment programs to satisfy the requests of local communities in fulfilling their socio-economic needs and prompt solutions of potential environmental problems. Such standards should be disseminated down from the largest companies to the smallest ones.

Local administration and population connect the possibility of solving fiscal, infrastructure and employment issues with the development of mineral deposits; on the other hand, they express concern about environmental and social risks connected with this development. The absence of coordinated action, of understanding the concerns and opinions of the local population, indigenous peoples and local governments can cause serious problems with the beginning of the works, up to the revocation of the license. Therefore, the formation of a "positive" public image of the company and awareness of the viewpoints of all interested parties are key objectives of management in mining business.

Leading mining companies have long abandoned the old approach, under which their social interests were limited to the creation of physical (transport, power grid, pipeline, etc.) infrastructure in the area of the deposit. Today, the interests of mining companies go beyond their mining allotment; companies study the interests and needs of local population, especially in the basic elements of the social sphere [7]. This does not mean, of course, that mining companies take over the functions of government administration; they are expanding their area of corporate responsibility. For instance, it is common practice in our country to sign special agreements with regional administrations – the agreements on social partnership, which define the specific forms of the company's participation in the region's socio-economic development. These contracts are attached to license agreements are their integral part.

To date, agreements on social partnership in the fuel sector of the region's economy have been signed between the Government of the Komi Republic and companies such as OAO LUKOIL, OAO Gazprom, OAO NK Rosneft, JSC Yenisey, CJSC Pechoraneftegaz, LLC Dinyelneft, ZAO Severstal-Resources, OAO Novolipetsk Steel.

Such agreements, a kind of social licenses, are of great importance in other countries as well – the weight of this parameter in the ranking of investment climate for the realization of mining projects is 5–15% (in exceptional cases

it is 30% and more) [11] and it is often as important as "infrastructure" parameter. The main thing is that the agreement should be the result of dialogue and wide consultations on all matters with the public and local administrations, rather than the result of non-transparent transactions.

Today, mining industry is one of the most highly organized and high-tech industries. Mining companies are often a driving force of economic recovery of an area, since they usually operate in remote and economically undeveloped areas and often in places where there are no other alternatives for economic development. Environmentally responsible methods of subsoil use are applied at all stages of the life cycle of a deposit, beginning with its prospecting, industrial development and ending with the reclamation of disturbed lands, and even the restoration of landscapes. Proper planning and environmental management can significantly reduce environmental impact and help maintain or restore biodiversity. Modern mining projects at all stages of the works implement "zero waste" programs. However, in the conditions of low awareness of local population, a "bad" environmental image of mining companies still exists. Therefore, mining companies should be open to the dialogue with local population.

Social aspects of mining activities can have negative sides, such as dominance in the labor market or the emergence of excessive number of working population as a result of stagnation, reduction and development of production, and similar factors.

The responsibility of enterprises can be increased through the assessment of social impact of mining projects as well as through the evaluation of environmental impact at the design stage. On the other hand, social burden that enterprises have to bear has its economic limits and, along with compulsory measures, it is necessary to introduce legislative mechanisms for the promotion of socially responsible enterprises.

2. Lack of qualified staff (mainly skilled workers and engineering and technical personnel) is virtually a global problem. It is naive to believe that in Russia or anywhere in the world there is an area with prospects of development of mining industry, which does not have this problem. The main thing is that it is impossible under current conditions to anticipate staffing requirements and be prepared by having unemployed skilled personnel. *Table 1* presents the estimated need for labor resources according to the stated mining projects [4].

Total demand for human resources in the future mining complex with regard to the projects presented in the "Main directions of development of the coal mining industry in the Komi Republic up to 2020", can be about ten thousand people. Given the nature of work in the mining and chemical production and the requirements to professional skills of employees, we can forecast that future mining enterprises will face serious staffing problem.

The solution is seen in precise distribution and managing the various flows

Table 1. Estimated projected number of employees in mining companies

Mining projects	Area of production location	Estimated number of employees, people
Construction of a bauxite-alumina complex in the Komi Republic	Sosnogorsky	1,859
Yarega Mining and Chemical Complex engaged in the mining and processing of ore with the capacity of 650 thousand tons per year	Ukhtinsky	2,500
Titan – an organization on the basis of Yarega field producing titanium coagulant	Ukhtinsky	320
Project of development of Pizhemsky deposit of titanium in the Komi Republic and creation of a vertically integrated chemical and metallurgical complex on its basis	Ust-Tsilemsky, Ukhtinsky	2,331
Reconstruction of the mine to develop the central part of Zhelannoye field	Intinsky	50
A quarry and a plant for the production of crushed stone at Tablikayuskoye freestone deposit	Usinsky	30

of specialists: top managers, workers and specialists who work in shifts, personnel from local residents who have undergone special accelerated training.

The other side of the staffing issue is the opposition of the local population to the influx of migrants, which will increase in the period of construction works. Population growth will increase a burden on local infrastructure and services, and it will change the traditional way of life in the area. This imposes additional obligations on mining companies, because they should consider and monitor these problems.

3. Equitable distribution of mining companies' revenues is also one of the key social issues. Here an important factor is the distribution of taxes and charges paid by mining companies in favor of the territories in which they operate. Under the existing system of formation of budgets, the majority of taxes and payments go to the federal and regional levels. Local budgets receive only tax on land and individual income tax in the amount of 10%. Budget revenue sources of cities and regions do not include even mineral extraction tax. The Budget Code allows for redistribution of regional taxes in favor of municipalities; however, due to rising costs and additional financial commitments, the region prefers to leave most of the tax revenues in the budget of the Republic. In these circumstances, local authorities may not be sufficiently interested in the promotion of mining projects, in the development of mineral resources in their territories, and in the creation of conditions for attracting investment.

4. Attraction of investment in new mining projects is, in fact, the key problem in the development of resource base in the region. Under the current taxation of profits at an average rate of return, mining companies have virtually no funds available for exploration with the purpose of development of mineral resources from their own funds. Therefore, such work is

carried out within vertically integrated companies at the expense of funds of the parent company and outside sources. To encourage exploration in new areas (up to the stage of working exploration) it is expedient to abolish value added tax, to exclude from taxation a portion of the profit reinvested in exploration, to establish a system of reduction factors applied to the existing rates of taxes and fees when funding the early stages of works (exploration and prospecting) by enterprises from their own resources.

5. Problems of small and medium mining business. The development of small and medium-sized mineral deposits, which form the main part of the mineral resource base, is virtually inaccessible for the majority of potential investors in the country. The costs associated with obtaining access to the subsurface, exploration and getting permits are significantly higher than in other countries. Investors lack their own funds to carry out exploration; possibilities to attract bank loans are limited by the need for collateral and by extremely high rates of lending; in addition, the sector of risk capital in the securities market in Russia has not yet been formed. So far, there is no foundation for a possible consolidation of mining companies into industrial clusters for distributing the costs for transport, social, engineering and network infrastructure, and human resources issues.

Environmental aspects

The negative environmental impact of almost every mining project is comprehensive *(tab. 2)*.

The main environmental problems can include the concentration of harmful emissions, discharges and wastes in the territories of Sosnogorsky and Ukhtinsky districts and the aggravation of already existing negative environmental condition. Research carried out in the Pechora basin (Kolva, Usa, Pechora rivers) shows the change in the forage base, deterioration of physiological condition of salmon and whitefish (swelling, bleeding, changes in blood vessel walls) [5]. The reason lies in the deteriorating conditions of natural reproduction, and accumulation of petroleum products and heavy metals in internal organs. It should also be noted that the Zhelannoye deposit is located in the vicinity of the National Park, due to which it is necessary to follow particular rules of organization of transport roads in order to minimize the impact on fishery resources and wildlife.

The graveness of environmental situation in the territories of the specified areas is different. A previous assessment, based on the interconnection between the sustainability of natural environment and the level of anthropogenic load, makes it possible to reveal the degree of environmental impact [8]. The value of the impact under the unit characterizes the reserve of environmental capacity in these areas; the deviation in the opposite direction indicates a poor environmental condition and the reduction of resistance of natural environment to anthropogenic impact *(tab. 3)*. As the table shows, the gravest environmental situation is observed in the territory of Usinsky District.

Table 2. Possible environmental threats due to the development of mining complex

Project /district	Purpose of the project	Environmental impact
A quarry and a plant for the production of crushed stone at Tablikayuskoye freestone deposit/ Usinsky District	Construction of a quarry Construction of a plant for the production of crushed stone of various fractions –50 thousand cubic meters	Destruction of landscape Emission of pollutants from mechanisms and vehicles Discharge of pollutants into water bodies Waste generation Negative impact of noise on the fauna of adjacent territories
Construction of Sosnogorsky bauxite-alumina complex/ Sosnogorsky District	Production of alumina from raw materials of the Middle Timan Bauxite Mine (volume of processed raw materials – 4.8 million tons/year)	Destruction of landscape Emission of pollutants from the production of alumina Water consumption in the amount of 5.3 million cubic meters/year for technological and household needs Discharge of pollutants in the Ayuva River (tributary of the Izhma River) Storm sewers (the wash of dispersed particles from industrial sites) Wastes of red mud (1.7 tons per one ton of alumina/year; the area of slime depository is 370 ha) Generation of hazardous waste of sulfuric acid Pollutant emissions from road transport and railway transport Dust emissions (bauxite, limestone, burnt lime), carbon monoxide, sulfur dioxide, nitrogen oxide Emissions of greenhouse gases in the atmosphere (0.9 tons of CO2 per one ton of alumina) Possible leak of sodium hydroxide, sulfuric acid, fuel and chemicals Negative impact of noise on the fauna of adjacent territories
Construction of Yarega Mining and Chemical Complex/ Ukhtinsky District	Mining and processing of multicomponent titanium ore on the basis of Yarega high-viscosity oil fields	Destruction of landscape Highly toxic pollutant emissions from production Pollutant emissions from vehicles Discharges of hazardous pollutants containing oil and other elements in the small streams of the district (Ukhta River) Negative impact of noise on the fauna of adjacent territories
Development of Pizhemsky deposit of placer titanium/ Ust-Tsilemsky District	Mining of placer titanium	Destruction of landscape Emission of pollutants from mechanisms and vehicles Negative impact of noise on the fauna and fishery resources of adjacent territories and water areas
Production of titanium coagulant on the basis of Yarega field/ Ukhtinsky District	Production of titanium coagulant	Emission of pollutants from vehicles Discharges of pollutants in small streams of the area (Ukhta River)
Reconstruction of the mine to develop raw quartz at Zhelannoye field/ Intinsky District	Quartz mining (25 thousand tons of ore)	Destruction of landscape Emission of pollutants from mechanisms and vehicles Negative impact of noise on the fauna and fishery resources of adjacent territories and water areas (including the areas of the National Park)

Table 3. Estimation of degree of environmental impact in the areas of development

District	Environmental impact		
	Consolidated score of the natural environment sustainability	Consolidated score of the level of anthropogenic load	Environmental impact indicator
*Territories with the **high degree** of environmental impact*			
Usinsky	4.11	18.50	4.5
*Territories with the **median degree** of environmental impact*			
Intinsky	2.33	6.05	2.6
Ukhtinsky	3.59	6.89	1.9
Sosnogorsky	3.39	5.43	1.6
*Territories with the **low degree** of environmental impact*			
Ust-Tsilemsky	5.80	0.30	0.10

The median level of impact is observed in Intinsky, Ukhtinsky, and Sosnogorsky districts. Natural systems of Ust-Tsilemsky District have a more significant margin of resistance to anthropogenic load.

Transformation of living organisms goes towards reducing their biodiversity, simplification of and changes in the structure of their groups due to the disappearance of sensitive and rare species. Natural recovery of land is going on very slowly (about 40 years). Numerous studies in forest and tundra zones of the Komi Republic show that the traditional reclamation by planting shrubs and trees without applying fertilizers is not effective (their survivability after 12 years is no more than 20%) [1]. Given the fact of development, it is necessary to implement methods that have been already developed in order to restore the disturbed taiga and tundra ecosystems. The essence is to speed up the period of self-regeneration with the help of introducing fertilizers, planting *local species of perennial grasses* adapted to severe climatic conditions, and organizing the *care of the plants for 3–4 years*. Thereby an herbaceous community is created, technogenic substrate is fixed by the roots of the grasses, and a sod layer is formed. Then, the herbaceous community gradually transforms and it is replaced by ecosystems, close to the typical zonal ones [2].

Taking into account the inevitability of resource development and the increase of anthropogenic pressure on the natural environment, it is necessary to introduce the following measures in the upcoming decades:

– at the pre-investment stage of territorial planning it is necessary to define limits to nature management that would take into account environmental and social functions of the territory, and not only its economic functions [6];

– when issuing licenses for the use of resources it is required to specify the total admissible volume of land resources to be

used for the purposes of industrial infrastructure, thereby the degree of preservation of territorial resources will be defined;

– it is advisable to resume the principle of mandatory environmental impact assessment for the deposit in general and not only for some of its objects;

– if the surface suffers mechanical disturbance and chemical contamination, it is necessary to implement science-based environmental remediation that will reduce the period of restoration of original geo-systems.

Conclusion

The mining sector in the region is just being formed, so today there is an opportunity to foresee the main social and environmental issues that inevitably accompany industrial development and try to minimize them, or to mitigate their consequences and be ready to address them.

Due to growing environmental constraints and social inequality, an increasing importance is attached to the necessity to go through the procedures of approval with the local authorities and the public in order to get access to the subsurface. It is not enough that mining companies declare their intent to establish a new production, they have to carry out a thorough preparatory work and present all the positive aspects of development of resource potential in the area and assess the related social and environmental impact.

In order to promote the interest of the local population and regional authorities in the implementation of mining projects, and in order to establish partnership relation between participants and interested parties, it is necessary to decentralize the management of natural resources through the transfer of management functions from the central government to the regions, and through a more equitable distribution of payments for subsoil use. When making managerial decisions in the sphere of natural resources usage, it is necessary to take into account the degree of environmental impact and the experience gained from the development of the northern territories.

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