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## Advanced economic development of the Russian Arctic: sustainable nature management

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# Advanced economic development of the Russian Arctic: sustainable nature management

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**Abstract.** The principle specific feature of the Arctic is high economic, social and ecological price of incorrect nature management/land use decisions. Mechanisms were proposed for implementation of the Russian Arctic zone economic development programs to provide sustainable nature management. Harsh climatic conditions stipulate specific character of energy and matter fluxes in local ecosystems which resilience to anthropogenic impact is very low. Special attention was drawn to ecological, social-cultural and environmental factors determining elaboration of sustainable nature management decisions. The planned development of industrial, transport, residential nature management inevitably will affect the already existing impact territories, regions of traditional nature use of indigenous population, nature conservation territories. Competing relations in such cases will emerge because of joint exploitation of territorial ecosystem services pools. This will affect primarily regulating ecosystem services controlling ecological assimilation potential as well as provisioning ecosystem services. Growth of nature management/land use areas accompanied by anthropogenic environmental load increase stipulates the necessity of ecological buffer territories development to provide ecosystem functions reproduction at local and regional levels. Atlas information system use was suggested for processing of various data necessary for management practice providing statistical, reference and spatial information. Mapping examples of nature management conflicts violating sustainable development were demonstrated.

## 1. Introduction

The principle specific feature of the Arctic is high economic, social and ecological price of incorrect nature management/land use decisions. These decisions should be supported by integrated analysis of modern ecological, social-economic, social-cultural problems. The State Program “Social-Economic Development of the Arctic Zone of the Russian Federation up to 2020”[8] with additions till 2030, Strategic planning of the Russian Arctic zone development within the frames of the project: “Support of the National Plan of Actions for the Arctic Marine Environment protection” planned till 2020, the State program “Transport infrastructure development”, which includes revival of the Northern Sea Route (further-the Arctic Doctrine) determined advanced economic development of eight basic territories of the Russian Arctic zone (figure 1). Development of industrial (mineral and hydrocarbon resources extraction), transport (intensification of the Northern Sea Route exploitation, new rail- and



automobile roads and airports construction) nature conservation and recreation nature management were foreseen by these programs.

At the same time the Arctic Doctrine declared commitment to sustainable development postulates. Besides economic development issues, special attention is paid to providing favorable ecological situation, enlargement of nature protected territories net as well as local indigenous population traditional nature management support. It is necessary to remember that development will take place in unfavorable for economic activities natural environment. Basic territories mentioned in the Arctic Doctrine are different regarding their modern social-economic characteristics as well as anthropogenic environment disturbances [2]. Neglect of the mentioned above issues as well as disregard of the environmental “background” in territorial planning inevitably launch system conflicts accompanied by economic, ecological and social losses [4]. Elaboration of effective mechanisms for sustainable nature management beneficial for implementation of the key tasks mentioned in the programs is the goal of this study.



Figure 1. Basic territories for advanced development of the Russian Arctic zone [8].

1- Kola, 2 - Arkhangelsk, 3 - Nenets, 4 - Vorkuta, 5 - Yamal-Nenets, 6 -Taimyr-Turukhansk, 7- Northern Yakutia, 8 - Chuckchi.

## 2. Study area

The Russian Arctic zone occupies a large territory which total square is 700 mln.km<sup>2</sup>. It is characterized by specific economic, social and ecological features. It is the main supplying region for raw materials resources, including various mineral and fuel-energy, biological and other resources thus controlling the economic development of Russia to a great extent. The population number is 2.3 million people [3]. It is multi-national: representatives of more than 100 nationalities live there including 0.82 million indigenous peoples of the North. Population distribution is extremely uneven: 64.8% lives in the European part and 32.8%- in the Asiatic part. Population density is low - 0,63 p/km<sup>2</sup>. Nearly 90% of population is urban. Population number is very changeable because of migration processes following economic disturbances. Nowadays population decline is observed. Higher mortality rate is typical compared to Russian average as well as other negative demographic processes demonstrating labour resources losses.

The Russian Arctic zone economic development is primarily connected with industrial and transport nature management: the largest mining industry centres, regions of hydrocarbons extraction, the Northern Sea Route are situated there. Modern geopolitical value of the Russian Arctic is very high.

The study area is situated mainly in the Subarctic and Arctic regions and includes the following zones: polar deserts, tundra and forest-tundra, as well as fragments of northern taiga at the southern periphery of the European part. Harsh climatic conditions stipulate specific character of energy and

matter fluxes in local ecosystems which resilience to anthropogenic impact is very low. Ecosystems disturbances started in the 30th of the 20<sup>th</sup> c. and are connected with the following factors: environment pollution, cutting of pre-tundra forests, mechanical soils and vegetation disturbances accompanying economic development, overgrazing of reindeer pastures, anthropogenically increased thermal erosion rate and so on. Nowadays 9 impact regions occupying 80,000 km<sup>2</sup> exist at the study area. They present the main source of ecological tension [2,10]. The following large impact regions are situated at the study area: the Western Kola, the Arkhangelsk, the Timan-Pechora, the Novaya Zemlya, the Lower Ob, the Western Chukchi zones. Part of these regions overlap territories of the planned advanced development.

### 3. Materials and methods

System analysis of thematic and regional chapters of the Federal programs mentioned above, cartographic materials presenting natural environment, ecological tension [2, 10 etc.], relevant published data presents the basic investigation method supplemented by field experiences of the authors in the Russian Arctic region. Ecological-economic analysis and GIS-modeling were also used. Integrated analysis of cartographic and other materials was performed in ArcGIS media.

### 4. Results and discussion

The investigation showed that in the first third of the 20th c. economic activities in the Russian Arctic were extensive and did not cause noticeable environmental changes. Radical changes in nature management structure took place in the second half of the 20th c.: land use territories enlarged greatly due to hydrocarbons and other mineral resources extraction growth. Industrial nature management replaced traditional of indigenous population and hunting and fishing practice. Anthropogenic impact increased substantially causing negative environmental changes mentioned above.

The planned development of industrial, transport, residential nature management mentioned in the Arctic Doctrine inevitably will affect the already existing impact territories, regions of traditional nature use of indigenous population, nature conservation territories. Competing relations in such cases will emerge because of exploitation of territorial ecosystem services pools. First of all, this will affect regulating ecosystem services controlling ecological assimilation potential as well as provisioning (biological resources) ecosystem services [1,4,6].

Growth of nature management/land use areas accompanied by anthropogenic environmental load increase stipulates the necessity of ecologic buffer territories development to provide ecosystem functions reproduction at local and regional levels. It must be mentioned that large territories with almost undisturbed ecosystems may be regarded as the global level ecological buffers which need preservation. According to UNEP joint contribution of the Russian North ecosystems to global stability support is 12%. Nature conservation areas which are traditionally regarded as ecological buffers occupy only 7% of the territory. Sharp regional differences are typical. But buffer territories structure may be considered much broader and include territories with adaptive nature management types (traditional, recreational) as well as not used lands. Necessary areas of ecological buffers depend on ecological assimilation potential which in general is low for the study area. Greatly variable assessments exist in this respect [5].

Social dimension of sustainable development inevitably depends on preservation/creation of regional population identity. At the background of economic issues efforts in this respect should be directed at revealing and conservation of natural and cultural heritage of the territory. Mapping of ethnic-cultural landscapes of indigenous peoples and old-settlers, soviet period economic development of the Arctic cultural landscapes etc. presents an important relevant task.

Considerable differences of natural environment at the territories of advanced development stipulate the necessity of integrated analysis of hampering or promoting factors. For example, North Yakutia and Chukchi advanced development territories have heightened seismic level and more harsh climatic conditions than that of the European part. Multidirectional natural phenomena are typical: climatic warming is favorable for comfortable settling but at the same time hampers economic

development because of permafrost degradation etc. Nature management models in such cases should be adapted to panarchy systems.

The discussed imperatives of sustainable nature management enabled to suggest the following mechanisms for its future improvement:

- Quantitative ecological-economic studies of territorial ecosystem services pools for future quoting among stakeholders.
- Assessment of social-economic, ecological and environmental factors controlling successful realization of the advanced development plans.
- Ecological buffers net development for negative anthropogenic impact mitigation.
- Population regional identity support based on actualization of modern, historical and ethnic cultural landscapes.
- Monitoring of natural and anthropogenic environmental changes.
- Forecast of potential nature management conflicts.

The authors elaborated original methods of nature management conflicts forecast used for maps series compiling for the Russian Arctic zone (figure 2, 3).

Nature management	Industrial	Transport	Traditional	Nature conservation
Industrial		no conflicts		
Transport	no conflicts			
Traditional				no conflicts
Nature conservation			no conflicts	

Figure 2. Assessment matrix for revealing of competing patterns for ecosystem services exploitation in different nature management types. Indiga region (Nenets advanced economic development territory).

Realization of the mentioned above mechanisms will support data base creation necessary for management tasks. Its important part will include cartographic materials. Atlas information system may be used for these purposes. It is a computer adjusted GIS, connected with a certain territory combined with thematic information. It presents a great variety of instruments for spatial data analysis [9].



Figure 3. Potential nature management conflicts in Indiga region (legend- see figure 2)

## 5. Conclusions

Northern territories development paradigm nowadays is being changed at the state level: economic development is replaced by “habitation” of this region for the sake of sustainable development. This demands elaboration of mechanisms for the planned programs realization but not only in the economic part. System analysis of environmental, social-economic and ecological factors controlling future sustainable development of the Russian Arctic zone enabled to suggest mechanisms contributing sustainable development and corresponding to its postulates. Atlas information system may be helpful to process data for decision making.

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