Assessment of the Possibilities of Transition to Sustainable Environmental Management Models in the Arctic Regions

Natalya E. Ryazanova [1], Natalia E. Lobzhanidze [2] , and Elena V. Subbotina [2]

[1]Moscow State Institute of International Relations (MGIMO University), Department of Integrated International Ecological Problems and Wildlife Management, 119454, 76 Vernadskogo prospect, Moscow, Russia
[2] National University of Oil and Gas «Gubkin University» (National Research University) 65-1 Leninsky Prospekt, Moscow, 119991, Russia

Abstract. The sustainable development agenda for regional development can be developed in depth and comprehensively if considered in a cluster manner. It is advisable to distinguish the traditional clusters of sustainable development: economic, environmental and social. This paper considers the Environmental cluster, which has taken in the development of several Targets from the SDGs and conducted a study close to the assessment of the state of the environment. The purpose of the study is the possibility of updating the Arctic Council studies for the regions of the Russian Arctic in connection with their authentic regional ecological pressures. Objectives: to determine the actual environmental loads on each of the nine Arctic regions and to develop approaches to the formation of a model of sustainable environmental management within the framework of the existing scientific developments of the Arctic Council working groups and the formation of a scientific agenda for the future. Research methods: analysis of cartographic material, environmental reports of local and federal authorities, non-financial reports of enterprises operating in the Arctic regions, messengers and activity of civil society institutions, the real state of natural environments (atmospheric air, soil, water resources and forests), perspective development plans of the selected regions. As a result, several of the most urgent areas were highlighted in which it is advisable to focus further efforts to improve the state of the environment in each of the regions. The work was carried out during 2021-2022.

1 Introduction

Work on the research agenda, including the environmental one, in the Arctic began as early as 1991, when the first working programs and working groups were established. In 1996 the Arctic Council was created as an international institute of a high-level intergovernmental forum for the coordination of interactions between the Arctic states. Since 2004, the systematic publication of the results of scientific research and the negotiation process within the framework of the Arctic Council began [1]. It was not until 2016 that an outreach strategy was adopted to disseminate information and knowledge on

climate change and adaptation. The Arctic Council states have created a large base of scientific research that can be used by the Arctic Council member states and other states that want to join the research. These are mainly in the areas of environmental protection and the preservation of the Arctic's natural heritage, as well as protection against disasters. In order to identify the most effective scientific developments for the nine regions of the Russian Arctic, several SDGs of the global agenda were delineated and updated for the national level. An analysis was made of the real anthropogenic pressures and their sources for each region, and the work of each working group that can work well in the current environmental situation to improve the environment was updated. an attempt was made to create a Sustainable Nature Management Model for each region, taking into account the transition from the global to the national level.

2 Methods and materials

2.1 Research Order

The main research steps included: review of the main state and public organizations in the regions; review of climatic and geographical conditions; inventory of natural resources; main environmental polluters in the regions; state of environmental components; formation of scenario approaches to possible regional development; SWOT and PEST analysis for each scenario. At different stages, the analysis is based on geographical maps, reports on the ecological state of the region, state and public reports and reviews of the state of the environment, and analyses of business organizations working in the regions of the Russian Arctic. This paper presents only fragments of the extensive work carried out, presented as an edition of a two-volume monograph [2, 3].

2.2 Research work

The work to identify work for the Russian regions of the Arctic, based on the scientific developments of the Arctic Council working groups, briefly showed the following (using only a few working groups as examples). It is important to understand which state agencies are profile (responsible) for different areas of work and cooperation (Table 1).

Table 1. Agencies coordinating the interaction of the AU Working Groups in the Russian Federation [4].

Arctic Council Working Group	The agency responsible for coordinating of the Working Group's activities in Russia
The Working Group on Sustainable (SDWG)	Ministry for the Development of the Russian Far East Ministry for the Development of the Russian Far East and the Arctic
Working Group on the Conservation of Arctic Flora and Fauna (CAFF)	Ministry of Natural Resources and Environment of the Russian Federation
Working Group to Eliminate Arctic pollution (ACAP)	
Working Group on the Protection of the Marine Arctic environment (PAME)	Ministry of Transport of the Russian Federation
Working Group on Prevention, preparedness and response to emergencies (EPPR)	Ministry of the Russian Federation for Civil Defense Civil Defense, Emergencies situations and liquidation of consequences of

	of natural disasters (EMERCOM) of Russia
Working Group on the Arctic Monitoring and Assessment Program (AMAP)	Federal Service for Hydrometeorology and Federal Service for Hydrometeorology and Environmental Monitoring (Rosgidromet)

2.3 Relationship of the Arctic Council's work to the global SDG agenda

Today in Russia there is no mandatory requirement to correlate any public administration agenda with the SDGs. However, there is a national agenda for sustainable development, which is generally presented in the form of National Projects, today there are more than ten. They do not distinguish the Arctic region separately, it is decided to act on natural environments (atmospheric agenda, unique water bodies and other) or specific issues (waste, hydraulic structures, infrastructure, nature reserves, etc.). For a deeper understanding of how the global goals relate to the scientific developments of the Arctic Council working groups, work was done to identify specific areas of implemented work in Table 2. 2 gives an example of such work on a small fragment.

Table 2. Arctic environmental assessment reports developed by the AU Working Groups [5].

Working group agendas	Relevant SDGs
Conservation of Arctic Flora and Fauna (CAFF) Working Group Assessment of marine biodiversity in the Arctic *Goal 14: 14.4. effectively regulate marine resource extraction.* Assessment of terrestrial biodiversity in the Arctic *Goal 15: 15.5 Measures to Containment of natural habitat degradation.* Assessing the impact of invasive species on the state of biodiversity in the Arctic . *Goal 15: 15.8 Measures to prevent invasive alien invasive species invasive alien species invasion*	Atlas of rare endemic vascular plants of the Arctic (1999) State and Trends of Arctic Flora and Fauna: Recommendations for Conservation (2001) Gathering seabirds in the Arctic (2008) Arctic biodiversity trends: selected indicators of change (2010) Assessment of breeding conditions for birds in the Arctic (2010) Pan-Arctic checklist of lichens and lichen fungi (2010) Arctic Biodiversity Assessment (2013) List of Arctic marine fishes with common names and zoogeographic characteristics (2013) Pacific arctic marine fishes (2016) Status of Arctic marine biodiversity report (2017) Arctic marine fishes. Vol. 1, 2 (2018) Global audit of the status of Arctic and Northern Hemisphere goose populations (2018) The state of Arctic freshwater biodiversity: key findings and recommendations for monitoring (2019). State of the Arctic terrestrial biodiversity assessment (2021) . And other works.
Working Group on Arctic Pollution Abatement (ACAP) Assessment of mercury emissions in the Arctic states, development of recommendations to reduce mercury emissions. Assessment of dioxin and furan emissions in the Russian Arctic, development of measures to eliminate dioxin and furan emissions. *Goal 12: 12.4 Achieve environmentally sound management of chemicals and all*	Assessment of several major sources of dioxins/furans (in the Arkhangelsk and Murmansk oblasts, as well as in the Komi Republic) 2005 Assessment of mercury emissions from the Russian Federation. Reduction of atmospheric emissions of mercury from the Arctic states 2005 Assessment of existing and planned initiatives related to mercury sources in the Arctic states and identification of possible actions to be taken 2006 Report on Phase II of the ACAP project "Reduction

wastes *Assess the environmental impact of oil production in the Arctic and develop and implement technologies for re-injection of associated petroleum gas in the Russian Arctic (indicator 12.4.2)* *Goal 9: 9.4. Upgrade the infrastructure and* *retrofitting of industrial facilities, (indicator 9.4.1)* *Goal 12: 12.c. Rationalize* *subsidize the use of fossil fuels (indicator 12.c.1)* Rapid environmental assessment to identify pesticide contaminated sites and implement abatement measures *Goal 15: 15.3: Combat desertification, Restore degraded land and soil (indicator 15.3.1)* *Elimination of soil and water pollution (in particular, Lake Lovozero in Murmansk Oblast) from unauthorized landfills.* *Goal 6: 6.3. Improve water quality by reducing pollution, eliminating waste dumping (indicator 6.3.2)* *6.b Engage local communities in improving water management and sanitation (Indicator 6.b.1)* *Goal 11: 11.6 Reduce the negative environmental impact of cities (Indicator 11.6.1)* *Develop measures and strategies to reduce the impact of short-lived climate pollutants on the Arctic climate.* *Goal 13: 13.3 Improve education, information dissemination on climate change impacts, adaptation, and early warning (Indicator 13.3.2)*	/ Elimination of Dioxin and Furan Emissions in the Russian Federation with a Specific Focus on the Arctic" 2006 Arctic and Northern regions affecting the Arctic 2008 Assessment of potential air emissions of dioxins/furans, particulate matter, and heavy metals at the Vorkuta Cement Plant using conventional and supplemental fuels fuels (2017) Assessment of potential environmental impacts of APG flaring in the Arctic zone (2019) Demonstration project of rapid environmental assessment in Russia (2021) Reducing the impact of short-term climate pollutants from associated petroleum gas flaring (2021) "Kola Garbage Project": assessment and elimination of garbage pollution in the Murmansk region (2020)

Such work was done for each Working Group. Indicators corresponding to the areas of work of the Working Groups were established.

2.4 Working with the state and public agenda

Work was carried out to identify management bodies and the public agenda in each region of the Russian Arctic according to the following principle: federal, municipal bodies, public associations, and regional public chambers. It was based on open sources and analyzed not only their existence, but the essence of these formal and informal

organizations. This is important for understanding the political and social processes taking place in the regions (Tables 3 and 4). Below is just a fragment of the beginning of such work. The results are presented in a published monograph.

Table 3. Regional bodies of the Murmansk region responsible for environmental issues.

Organization	Link
Ministry of Natural Resources, Environment and Fisheries of the Murmansk region Fishery of the Murmansk region	https://mpr.gov-murman.ru/
Coordinating Council on the interaction between the executive bodies of state power of the Murmansk region and the territorial bodies of the federal executive authorities	https://apparat.gov-murman.ru/activities/komissii/coord_council_interaction_iogv/
Federal State Budgetary Institution Murmansk Department of Hydrometeorology and Environmental Monitoring	http://www.kolgimet.ru/
Baltic-Arctic Interregional Department Rosprirodnadzor	https://rpn.gov.ru/regions/51/news/
Directorate (Administration) of Specially Protected Natural Areas of Regional Importance in the Murmansk Region	https://vk.com/oopt_51

Table 4. Public organizations in the Murmansk region that carry out their activities in the field of environmental protection.

Organization	Link
Public Chamber of the Murmansk Region	https://mvpmk.gov-murman.ru/activities/public_chamber/
Murmansk Regional Branch of the All-Russian Public The Murmansk Regional Branch of the All-Russian Public Organization "All-Russian Society for Nature Conservation".	http://voop-rf.ru/murmanskoeotdelenie/
Kola Center for Wildlife Conservation	https://www.biodiversity.ru/about/partners/kola.html
Barents Sea Department	https://wwf.ru/regions/the-barents-branch/7
World Wildlife Fund (WWF) Russia Public Youth Environmental Movement "Nature and Youth»	http://pim.org.ru/
ANO "Center for Ecological Initiatives "Clean Arctic"	https://vk.com/cleanarctic
4H Murmansk Regional Children's and Youth Movement Union 4H	https://vk.com/4h_apatity
Public movement "Kola Eco-Center" without forming a legal entity juridical person	https://kec.org.ru/organisation/

2.5 Sequence of study of natural factors and ecological state of regions

The next step was to review the environmental activities carried out in each region, which allows you to identify the most pressing environmental problems. The work was also summarized in chart charts and tables for each region. Next, an analysis of the developed mineral resource base (minerals), water, forest, land resources; an analysis of all types of mining and processing, industrial enterprises and types of agriculture conducted in the region was carried out. Current environmental problems have been identified, and the climatic situation has been analyzed. Specially protected natural territories, intra-regional and transboundary were studied. The work is presented in the system of cartographic material.

2.6 Creation of regional development scenarios

The value of any study can consist in the set of proposed scenarios of possible development, which can present the initial (assumed) conditions and options for their transformation under different types of nature management and other environmental factors. Table 5 briefly presents the initial scenario conditions of regional development. These scenarios, with the specified initial parameters, were considered for each region, carried out SWOT and PEST analysis.

Table 5. Scenario Models of Environmental Management to Improve the Ecological Situation in the Region (the example of one region)

Scenario 1. BASIC Preservation of the conditions currently observed. The region will continue to experience a population exodus. The region's infrastructure is already in worse-than-average condition, which can lead to accidents. Gas and oil pipeline strings are particularly dangerous (small regional pipelines, as they have been renewed for a long time because of their lesser importance. The natural loss of population and migration will lead to a surplus of jobs, which will lead to a lack of profitability of enterprises. The infrastructure of existing businesses will continue to deteriorate, resulting in significant emissions of pollutants into the atmosphere, water and soil. Small towns in the interior of the region will be especially heavily polluted. It is possible that the tundra around these settlements will be significantly and irreversibly polluted for tens of kilometers around.	**Scenario 2. POSITIVE** Important for environmental protection. Cessation of emissions and systematic recycling of production waste. This is the most expensive and least plausible scenario. Disposal of industrial waste is very expensive, especially the disposal of heavy metal compounds, removing them from the soil and groundwater. The Arctic Council would not be able to produce such an action for several reasons. 1) Financing such a project should attract investors, but it will pay off in intangible terms as a preserved ecosystem, would not generate direct revenue. 2) The regions in question are also home to military industry enterprises, and the Arctic Council cannot influence the military sector of the states. 3) Such a set of measures involves the use of highly skilled labor. Also, these activities will require infrastructure facilities (equipment), which are not available in the region.
Scenario 3. TECHNOGENIC This scenario assumes even greater volumes of production. It is unlimited industrial growth and exploitation of natural resources. In general, this scenario seems unlikely, the region is experiencing a population exodus and a decrease in the economically active population. This scenario assumes a complete and irreversible transformation of local landscapes, the pollution of rivers will make them almost dead. The region will experience an acute shortage of fresh clean water for consumption.	**Scenario 4. REALISTIC .** A chain of interaction of system components is considered. 1) Water disposal: the problem of water disposal and water losses in the industrial sector should be solved by upgrading surface pipes. This is expensive and will cause temporary problems with water supply to the population. When water losses are reduced from 24 to 7-10 percent, about 350 million m3 of water can be saved, which, when taking into account the cost of water intake and water supply, will reduce costs by billions of rubles. The payback period of this project is about 10 years. 2) Discharge of polluted water - it has little effect on the life of the region from an economic point of view. The Arctic Council can lobby for the introduction of a bill on a progressive pollution tax for businesses. The proceeds could be used for infrastructure projects. Incentives for purchasing and installing wastewater treatment plants could be introduced.

	3) Atmospheric pollution is dangerous for people, for nature, and for all biodiversity.

2.7 Adapting the research agenda to regional conditions

The following work of the Arctic Council has been established, which has been seriously adapted to the regional conditions of specific regions of the Russian Arctic (using as an example only one of the working groups).

Working Group on the Elimination of Pollution in the Arctic (Arctic Contaminants Action Program, ACAP). Successful projects and initiatives:

- Project "Reduction of soot and methane emissions from flaring of associated petroleum gas (APG) in the Arctic zone of the Russian Federation," where research was done on flaring of associated petroleum gas in the Russian Arctic [6].
- The Tundra project, which tested alternative clean and reliable energy solutions in a remote Sámi community in the Murmansk region [7].
- The Circumpolar Local Environmental Observer Network (CLEO) project [8]. Its goal is to raise awareness of vulnerability to the effects of climate change and to connect community members and technical experts.
- Black Carbon Research Platform for the Arctic. ACAP developed this platform to showcase mitigation projects or policies relevant to the Arctic. The partners in this project aggregate case studies on how existing technologies provide successful, sustainable, and affordable black carbon mitigation [9].
- The Black Carbon and Community-Based Public Health Assessment project [10]. Its goals include assessing local sources of black carbon emissions from a representative sample of Arctic villages in Russia and the United States; creating a broad characterization of associated public health risks; exploring short- and long-term mitigation options; assessing local capacity to identify, mitigate and prevent black carbon pollution; developing a framework tool for community-level black carbon emissions and health risks; informing local communities about black carbon emissions and risks.

3 Analysis

The phases of the work allowed the creation of analytics demanded by local governments, regional politicians, the Ministry of Foreign Affairs (at the level of the Senior Official in the Arctic Council), it is also relevant to the youth governments and youth parliaments of Russia [11]. analysis has created information bases on natural resources, natural conditions, social and political processes in the Russian Arctic regions, environmental problems of the regions, the main actors acting in the regions.

4 Summary

In the process, it became clear that the natural and climatic conditions of each region are so different that sometimes it is not possible to apply the same approaches to solve environmental problems. For example, the extreme western Arctic regions and the extreme eastern regions differ as much as possible in terms of average long-term climatic regime, soil composition, specifics of population settlement, types of economic activity and even social activity. It is very difficult to use the existing scientific findings of the Arctic Council in such a situation. Therefore, it is necessary to adapt the findings of each Arctic Council panel to almost every region of the Russian Arctic.

The study was published as a two-volume monograph (35 printed sheets) and had four reviewers: from the Center for Strategic Research and Geopolitics in Energy; the Director of the Arctic Strategic Development Institute of Northern (Arctic) Federal University named after M.V. Lomonosov; the Department of International Cooperation of Murmansk

Arctic State University, a youth envoy of the RF on International Cooperation in the Arctic; a member of one of the Arctic Council working groups, leading research assistant of the Arctic Council.

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