Chapter 5

Comprehensive Assessment of the Sustainability of Coastal Systems of the Arctic Zone of the Russian Federation

Gogoberidze George and Rumiantceva Ekaterina

Additional information is available at the end of the chapter

http://dx.doi.org/10.5772/intechopen.78970

Abstract

This chapter deals with the method of comprehensive assessment of the sustainability of coastal infrastructure systems of the Arctic zone of the Russian Federation, which allows analyzing the socioeconomic development of the Arctic regions of Russia in order to ensure national security, as well as forecasting the environmental and socioeconomic situation in the coastal zone of the Russian Arctic using simulation prediction methods. To account for medium- and long-term climate, environmental, economic, legal, and geopolitical changes in the Arctic in assessing the sustainability of coastal infrastructure systems, it is proposed to use a comprehensive indicator system consisting of five-factor subsystems. As a result of the analysis of the possibilities of accounting for medium- and long-term complex changes, a dynamic model of strategic spatial planning of marine activities is implemented in the regions of the Arctic zone of the Russian Federation on the basis of a comprehensive analysis of the sustainability of coastal infrastructure systems. By this model, values of the indicator were received for each of the factors of stability and the complex integral index of sustainability of coastal infrastructure systems of Russian Arctic for modern, historical, and future periods.

Keywords: coastal infrastructure systems, Arctic zone of the Russian Federation, sustainability, indicator methods, comprehensive assessment

1. Introduction

The importance of Arctic spaces and resources in the people livelihoods and the formation of the global gross product have increased. It is predicted that as a result of global climatic changes in the future, the dominant position in the structure of world trade may emerge

commodity flows passing through the high-latitude transport and communication routes of the Arctic. The full-scale development of mineral and energy resources of the richest Arctic continental shelf begins, which is due to the depletion of mineral resources of the continental part of the Earth and directly affects the structure of the world's energy supply. In the near future, according to the scenario forecasts of the UN World Food Organization, there will be a sharp jump in demand for marine industrial fishery products, in the production of which the Arctic region plays a significant role. The global climate-forming function of the Arctic Ocean and its importance in ecosystem dynamics encourage to intensify fundamental research of its nature. Arctic states are actively developing tourism and recreational business [1–5].

Thus, it becomes important to solve the problem of developing the scientific basis for a comprehensive assessment of the sustainability of coastal systems and coastal infrastructure in order to implement the tasks of territorial planning and the analysis of socioeconomic development of the Arctic zone [6–8].

2. Background of approaches to the assessment of the sustainability of coastal systems and infrastructure

At present, there is no unified approach to the assessment of the sustainability of coastal systems and infrastructure and their impact on the environment caused by various factors. The existing global and regional concepts on the rules for assessing the sustainability of coastal systems and their impact on the environment are a common set of rules, on the basis of which national and/or local regulatory documents are developed, which reflect the regional characteristics of coastal zones and coastal infrastructure [9].

In different countries, there are different approaches to the valuation and assessment of the sustainability of the coastal zone and located infrastructure and of their impact on the environment. In general, all the countries can be divided by Australia and New Zealand, the USA and Canada, and the European Union.

The Australian approach is oriented for maintaining the quality of the coastal zone and the environment and prevents its violation. In the US, the priority is the principle of the lack of wishes to violate the norms. In these countries, the assessment of the sustainability of coastal systems and infrastructure is based on the fact that any changes require a permit for the conduct of coastal works, which set out all the necessary parameters and conditions.

The European Union framework directives give only general provisions on water quality, soil quality, coastal zone in General and environmental impact, while numerical values are set by the EU countries themselves. Thus, within the EU, there are no uniform standards adopted, and most countries are subject to international agreements such as HELCOM, which is more regional, with detailed methods for assessing the sustainability of the coastal zone and its infrastructure, and their impact on the environment.

Common to all countries are the recommendations of national and/or framework laws, regulations, and existing methods for assessing the sustainability of coastal systems and infrastructure.

http://dx.doi.org/10.5772/intechopen.78970

On this basis, they develop their regional/territorial regulatory methodologies to reflect the characteristics of the region in order to reduce the negative impact on the coastal zone and the environment as a whole.

The basic principles of such assessment systems, based on international experience, include [10] the following:

- the principle of preventing the wishes to exceed established standards and benchmarks;
- the principle of accumulated unit points, and so on;
- the principle of "reference" system;
- the principle of particularly valuable biotopes.

Modern trends of harmonization of economy and ecology in order to overcome the global environmental crisis require not only to ensure the ecological and economic security of the territory and society but also effective diagnosis, allowing timely and in the required range to identify the problem areas of regional ecological and economic systems, preventing their bringing to the state of pathology and degradation of the entire system or its individual elements.

In the modern world, one of the most important functions of effective management of the development of the region is to assess the level of comprehensive socioeconomic and environmental development of the territory, based on a system of indicators. In other words, indicative planning is an integral part of regional development. Although the scientific foundations of indicative planning were developed in the 1920s, they have not yet found real practical application in Russia [9]. Nevertheless, it should be noted that recently in Russia, the role of indicative planning in regional management is growing rapidly.

The need to develop indicators to assess the state of the state and the direction of its comprehensive development was formulated in 1992 at the UN Conference on Environment and Development in Rio de Janeiro. This is noted in one of the main documents, Agenda 21, Chapter 40, that in order to create a reliable basis for decision making at all levels and to help alleviate the self-regulating sustainability of integrated environmental systems and systems development, it is necessary to develop indicators of sustainable development [11]. Thus, the global interest in the sustainable development of territories necessitates a comprehensive analysis and assessment of all components and indicators that determine the comprehensive sustainable development.

One of the problems solved by the scientific community today is the development of universal indicators assessing the comprehensive components of sustainable development of territories, including environmental, geographical, socioeconomic, and other parameters of development. However, there is still a lack of consensus on the assessment of the sustainability of the development of the territories. In addition, due to methodological and statistical problems, individual characteristics of different territories, the world-recognized comprehensive index does not exist yet [7, 12, 13].

A prerequisite for the assessment of the integrated sustainability of regional development is a comprehensive analysis of data at all levels of the national economic system: inter-country, national, regional (e.g., subjects of the Russian Federation), and local (local municipalities). This procedure concerns both the development of a system of indicators for assessing the sustainability of territorial development and their monitoring [14].

Nevertheless, it should be noted that currently both Russian and foreign scientists are trying to create a methodology for the indicator assessment of development sustainability, which takes into account the impact of economic, social, and environmental factors, which proves the relevance of the problem of creating a methodology for assessing the sustainability of regional socioeconomic and environmental systems. The main requirements to the system of indicators of sustainable development of regional socioeconomic systems, taking into account the characteristics of the regions, acting as the basis for building a system of indicators for assessing the sustainability of regional systems, are the following [7, 15, 16]:

- a systematic approach is required for choosing indicators, which takes into account the interaction of subsystems;
- the number of indicators should be sufficient but, if possible, limited;
- data collection should not be linked to the need for hard, costly, and time-consuming work;
- all indicators should be transparent; and
- indicators should be complementary.

However, indicators are

- used to justify the decision by quantifying and simplifying;
- help interpret changes;
- allowed to reveal shortcomings in environmental management;
- made it easier to access information for different categories of users;
- facilitated the exchange of scientific and technical information.

The indicator is the most applicable to the process of regional management, the totality of which are index, which are the basis of ecological and economic modeling of the territory development process.

The harmonious combination of indicators assessing the quality of the population, the natural environment, the regional business, and environmental policy will avoid the result of the "system degrades," as the timely detection of intermediate States is an important condition for effective environmental and economic modeling of the territory's development process [17].

In general, on the basis of Russian and international experience in assessing the sustainability of coastal systems and coastal infrastructure, in applying to the tasks of territorial planning, it is necessary to take into account the need to use a multilevel system for assessing the sustainability of coastal systems and infrastructure.

http://dx.doi.org/10.5772/intechopen.78970

3. Methodology and concept for comprehensive assessment of coastal systems and infrastructure sustainability

The main purpose of the methodology for the comprehensive assessment of the sustainability of coastal systems and coastal infrastructure of different spatial levels is to identify the conditions for the stability and formation of the potential of the functioning and development of coastal infrastructure of coastal areas as territorial systems of different spatial levels, as well as their interaction with the environment.

The methodology of comprehensive assessment of coastal systems and coastal infrastructure sustainability and analysis of its components can be used for the following tasks [18]:

- identification and study of factors of territorial organization of nature and society within coastal systems;
- study of the structure and functional dependencies between components (factors, indicators, and indexes) of stability, which explain the nature of intra-system links, forming an assessment of the sustainability of the considered coastal system and coastal infrastructure and its variability, both within the system and between the system and the environment;
- obtaining a comprehensive assessment of the sustainability of coastal systems and coastal infrastructure as an assessment of the sustainability of the operation and economic development under the influence of various factors;
- regionalization, zoning, and typology of coastal systems as territorial systems of different spatial levels;
- development of principles of strategic development of coastal systems and coastal infrastructure for a certain period of time; and
- scientific substantiation of coastal territorial systems and infrastructure management.

The methodology of assessment and analysis of the components of the sustainability factors of coastal systems and coastal infrastructure for different spatial levels can allow

- obtain reliable data on the state of coastal systems and infrastructure at various spatial levels;
- provide persons and organizations making decisions with the information necessary for the prospective assessment of living conditions of the population and placement of components of the economic coastal complex;
- to develop strategic development plans for coastal systems of different spatial levels; and
- to make forecasts of the interaction of society and the nature, including an optimum variant of the placement of productive forces and the forecast of a condition of coastal systems depending on the scenario of development.

At the same time, the indicator approach, which is considered as the basis for the assessment and analysis of the components of the sustainability factors of coastal systems and coastal infrastructure for different spatial levels, involves the use of different systems of indicators for the analysis and assessment of the state of stability and development trends of coastal systems. The main critical points of using the existing indicator systems are as follows [7, 18]:

- most indicator systems operate on the absolute values of indicators, without actually conducting a comprehensive integrated assessment of sustainable development;
- there is no uniform approach to the formation of system of comprehensive assessments of a condition; and
- in principle, the specificity of coastal systems is not taken into account in the existing indicator systems.

Assumptions that can be used in the development of indicator subsystems and methods for indicators calculating can be summarized as follows:

- indicator value must be dimensionless and takes values ranging from −1 to +1;
- requires the rejection of the use of weight functions in the calculation of integral indicators, as this will lead to ambiguity and controversy in assessing the importance of each indicator.

There are four main groups of methods to determine the values of various indicators [7, 18]:

1. Method of the indicator calculation based on the approximate degree of the parameter value to the maximum value. The maximum value can be defined as the maximum value of this characteristic of all coastal zone of the relevant spatial level. Indicator values are always between 0 and 1.
2. Method of the indicator calculation based on the deviation degree of the parameter from the average value. The average value of the considered characteristic of all coastal areas of the relevant spatial level is taken. Indicator values are always more than −1, without loss of the upper limit.
3. Method of the indicator calculation based on the deviation degree of the parameter-specific values from the specific values of similar parameters of a higher spatial level. For example, as a parameter of a higher spatial level, it is possible to have a value with the same characteristic of the Russian Subject coastal zone, if the considered parameter refers to the level of the coastal Regional Municipality of the Russian Federation, and so on. Norm-referenced values can be taken, for example, the population of the corresponding level, area square, and so on. Indicator values are always more than −1, without loss of the upper limit.
4. Method of the indicator calculation based on the deviation degree of the parameter from the extreme values. As the extreme values can be taken, the maximum and minimum values of the characteristic of all coastal areas of relevant spatial level. Indicator values are always in the range from −1 to +1.

http://dx.doi.org/10.5772/intechopen.78970

Certainly, the construction and use of indicator systems can be combined by the methods of calculating the indicator values.

A comprehensive value reflecting situation of the coastal regions and its infrastructure condition can be considered as a set of groups of indexes.

As the main approach to the comprehensive assessment of the sustainability of coastal systems and coastal infrastructure, it is necessary to use the GIS-based research method. GIS in this case is a kind of catalyst, which is necessary for solving problems related to the spatial distribution of climatic, environmental, economic, legal, and geopolitical aspects.

Many GIS are related to inventory-type tasks that focus on data and measurements (e.g., land cadastre tasks); others are related to management and decision-making tasks with a focus on modeling and complex data analysis. The first type of task is most important because it accounts for the maximum number of implemented systems, including the largest number of users and the volume of data collected. However, GIS is also widely used as a reference system. Regardless of whether powerful analytical procedures and complex queries are available for working with data, GIS is very often used as a decision-making tool, and the efficiency achieved here is often very high due to the clarity of cartographic visualization of information and ease of access to information.

For the purposes of complex assessment of sustainability of coastal systems and coastal infrastructure of the Arctic zone of the Russian Federation, the concept of GIS-tool "AZRF Coastal Systems" was made. In general, such GIS is a special information system that collects, processes, stores, displays, and distributes spatial data, as well as non-spatial data on the coastal systems of the Russian Arctic including the maritime components.

Structurally, GIS "AZRF Coastal Systems" consists of the following elements:

- multistructural databases (banks of data and knowledge) with the necessary quality of dynamism, that is, the ability to quickly process and continuously update, reflecting all changes occurring in the coastal systems of the Russian Arctic;
- variety of different models, algorithms, and programs for processing and converting data on the coastal systems of the Russian Arctic in semantic spatial information in accordance with certain requirements of processing and visualization in GIS; and
- interface set access to GIS.

GIS "Coast of the Russian Arctic" was implemented at three spatial levels:

- global (spatial–temporal database for the whole set of coastal systems of the Russian Arctic);
- regional (spatial–temporal database on the coastal subjects of the Russian Arctic); and
- regional (spatial–temporal database for coastal municipalities of the Russian Arctic).

GIS at the third local level is currently under development.

4. Dynamic model of strategic spatial planning of maritime activities of the regions of the Russian Arctic on the basis of a comprehensive analysis of the sustainability of coastal systems and coastal infrastructure

Dynamic model of strategic spatial planning of maritime activities in the regions of the Russian Arctic on the basis of a comprehensive analysis of the sustainability of coastal systems and coastal infrastructure is a dynamic information system for processing spatial information for short-, medium-, and long-term forecasting of economic activities taking into account climatic, environmental, economic, legal, and geopolitical changes.

The dynamic model is based on the indicator approach, the methodology of which is described in part 3.

To take into account medium- and long-term climate, environmental, economic, legal, and geopolitical changes in the Arctic in assessing the sustainability of coastal systems and the relevant coastal infrastructure of the regional level of management, it is proposed to use a comprehensive indicator system consisting of five-factor subsystems:

4.1. Common economic sustainability factors

This group of factors takes into account the level of common economic development of the region, including such factors as the gross regional product (GRP), the amount of attracted investments, the level of foreign economic activity, the economic growth, and industrial production growth values.

Group of indicators of the common economic sustainability factors (index of common economic sustainability) includes:

- indicator of gross regional product;
- indicator of attracted investments;
- indicator of foreign-economic activity;
- indicator of economic growth;
- indicator of industrial production growth.

4.2. Sociodemographic sustainability factors

The importance of the sociodemographic characteristic is determined primarily by the possibility of assessing the prospects for the development of the coastal system and infrastructure in terms of the availability and the use of labor resources and social comfort of living. This group is the determining basis for the development of coastal Arctic systems, and, as a consequence, takes into account factors such as the labor resources, population growth, unemployment level, education and health facilities, the level of wages, and the Gini index.

http://dx.doi.org/10.5772/intechopen.78970

Group of indicators of the sociodemographic sustainability factors (index of sociodemographic sustainability) includes

- indicator of labor resources;
- indicator of population growth;
- indicator of unemployment;
- indicator of educational and health facilities;
- indicator of the amount of wages and the subsistence wages;
- indicator of Gini index.

4.3. Resource sustainability factors

The volume and variability of the development and use of resources is determined by the socioeconomic needs of society. The Russian Arctic is characterized by extreme unevenness of resource use which depends on natural and social factors. Highlighting the enlarged areas of the development of coastal Arctic complexes, this group takes into account factors such as the level of development of the gas-oil and mining industry, the industry of biological resources, the value of cargo turnover of port facilities, the level of development of the manufacturing industry, the level of tourist importance, and the level of development of transport infrastructure.

Group of indicators of resource sustainability factors (index of resource sustainability) includes

- indicator of gas-oil and mining resources;
- indicator of marine bio-resources;
- indicator of cargo turnover of port facilities;
- the indicator of manufacturing industry;
- indicator of transport infrastructure development;
- indicator of tourist significance.

4.4. Environmental sustainability factors

The importance of the environmental group of sustainability factors of coastal systems and the relevant coastal infrastructure is due to the fact that the geographical environment, being a complex unique formation, has a strong impact on the development and preservation of the environment. This group takes into account factors such as the square-protected natural areas of the region, the level of air pollution and waste water emissions, the value of environmental costs, and the level of morbidity of the population.

Group of indicators of environmental sustainability factors (index of environmental sustainability) includes

- protected area indicator;
- indicator of air pollution;
- indicator of sewage pollution;
- indicator of the cost of environmental protection;
- indicator of morbidity.

4.5. Politic-geographical sustainability factors

The essence of this group of factors, which is a part of political regionalism, is the study of spatial (territorial) organization of political life of society and sociopolitical (politic-geographical) systems, their internal structure in the socioeconomic space of the Russian Arctic, taking into account the comfort of human habitation. This group takes into account factors such as the degree of domestic political stability in the region, the level of migration, the level of coastal concentration of population, the level of regional subsidy, and the level of crime in the region.

Group of indicators of politic-geographical sustainability factors (index of politic-geographical sustainability) includes

- indicator of domestic political stability;
- indicator of migration;
- indicator of coastal concentration of population;
- indicator of regional subsidy;
- indicator of crime.

According to the presented methodology (part 3), the comprehensive index value of the sustainability of coastal systems and the relevant coastal infrastructure for Russian Arctic regions are calculated as a medium of five indexes of sustainability.

5. Estimation of the comprehensive value of the sustainability of coastal systems and the relevant coastal infrastructure of the coastal Arctic regions

According to the presented methodology, the dynamic model of strategic spatial planning of the regions of the Russian Arctic was developed based on a comprehensive analysis of the sustainability of coastal systems and coastal infrastructure. For calculation of the indicator values were used official information of Federal Ministries and Agencies, including statistical offices and Governments of the coastal Subjects of the Russian Federation.

In particular, for each Subject of the Russian Arctic, the following were calculated and obtained:

- values of the indicators for each of the reduced factors of stability;

http://dx.doi.org/10.5772/intechopen.78970

- values of sustainability factor indexes and comprehensive index of sustainability of coastal systems and coastal infrastructure for 2016;
- forecast values of sustainability factor indexes and comprehensive index of sustainability of coastal systems and coastal infrastructure for 2025, according to the strategies of socioeconomic development of the Arctic Subjects of the Russian Federation.

At the same time, it should be noted that the boundaries of each Russian Arctic Subject were determined according to the Decree of the President of the Russian Federation. According to these definitions, for the Republic of Karelia, Arkhangelsk Oblast, Krasnoyarsk Krai and Sakha (Yakutia) Republic, the partial (several local municipalities) territorial belonging to these Subjects of the Russian Federation into the Russian Arctic was taken into consideration when calculating indicators and indexes.

Indicators and index values were obtained and visualized by using GIS "AZRF Coastal Systems."

Analysis of the current situation on the index of common economic sustainability showed that the Republic of Karelia is in the worst position of all Arctic regions (the index value is 0.30), which is associated with low economic growth, low investment attraction, and low level of the gross regional product (**Figure 1**). The leader in terms of common economic stability is Yamalo-Nenets Autonomous Okrug (index value 0.74), which is caused by the high level of the gross regional product, industrial production growth, and a large volume of attracted

Figure 1. Index of common economic sustainability, 2016.

investments. Interestingly, only the Republic of Sakha (Yakutia) has all the positive values of indicators.

Forecast for the development of the situation on the common economic sustainability for 2025 was analyzed by the basis of the strategies of socioeconomic development of regions of the Russian Arctic. In comparison with the current situation, not all Arctic regions were able to correctly project the development of economic stability. For example, for the Arkhangelsk Oblast, the index is projected to decline to −0.39, from −0.18 in 2016, and for the Chukotka Autonomous Okrug to 0.17 from 0.72. First of all, this is due to the low forecasts for the size of attracted investments, and economic and industrial growth. Also, a serious projected decline was revealed for the Krasnoyarsk Krai: from 0.19 to −0.32. The leading position on this indicator will be the Republic of Sakha (Yakutia).

Index of sociodemographic sustainability in 2016 shows the most stable position in Yamalo-Nenets Autonomous Okrug and Chukotka Autonomous Okrug, with the index values of 0.39, achieved due to the positive values of all indicators except the Gini index in Yamalo-Nenets Autonomous Okrug (**Figure 2**). The high values of the index in the Murmansk Oblast (0.23) and the Republic of Sakha (Yakutia) (0.21) are due to the stability of the regions in all respects, except for the unemployment rate, the values of which are quite high in these Arctic regions. Other regions of the Russian Arctic have lower indices of the sociodemographic sustainability index. It is interesting that the values of the indicator of educational and health facilities are

Figure 2. Index of sociodemographic sustainability, 2016.

http://dx.doi.org/10.5772/intechopen.78970

positive for all Arctic regions, and the indicator of population growth has negative values only for the Arkhangelsk Oblast and the Republic of Karelia.

By 2025, in all regions of the Russian Arctic, according to their strategies of the socioeconomic development, the current situation in the Western Arctic regions is projected to continue and the current situation in the Eastern Arctic regions will become worse, most likely due to the underestimation of the possibilities of socioeconomic development. The worsening of the situation in the Republic of Sakha (Yakutia), for which the index value is projected to decrease from 0.21 (one of the leaders in 2016) to −0.05 (the worst situation in the Russian Arctic), is especially planned. Thus, the wage indicator values will be positive only in Yamalo-Nenets Autonomous Okrug, in all regions except the Republic of Karelia, a significant decrease in the unemployment indicator values is predicted.

The current situation in the resource economic sector demonstrates a rather difficult situation in all regions of the Russian Arctic, with the lowest values of the corresponding index in the Republic of Sakha (Yakutia) (index value −0.54), and in the Yamalo-Nenets Autonomous Okrug, Krasnoyarsk Krai and Chukotka Autonomous Okrug, the index values do not exceed −0.45 (**Figure 3**). This situation is connected with the sharp one-sided development of the resource potential of the regions, including a small turnover of port facilities, a low level of the manufacturing industry, and the infrastructure. More positive is the resource sustainability in the Western regions of the Russian Arctic, led by the Murmansk Oblast, for which the value of the resource sustainability index is 0.31, with maximum values of indicators of marine

Figure 3. Index of resource sustainability, 2016.

bio-resources and cargo turnover of port facilities of the region. The indicator of infrastructure development is positive only for the Arkhangelsk region.

According to the forecasts of the strategies of the socioeconomic development of the Arctic regions, the situation in the regions in terms of resource sustainability index will remain at the same level. Significant growth of the index is projected only for Chukotka, with growth of values of −0.45 to −0.15 (due to the forecast for the development of the manufacturing industry in the region), and Arkhangelsk Oblast with the growth of index values of 0.15 to 0.34, through the development of port activity, growth of manufacturing industry, and the tourist significance in the region.

Examining the current situation in the regions on the environmental sustainability index draws attention to the generally negative situation throughout the Russian Arctic (**Figure 4**). For example, in the Arkhangelsk Oblast, the index value is −0.40, in the Murmansk Oblast, it is −0.38. Against the background of these results, Krasnoyarsk Krai looks best with a positive index value close to 0.

The following indicators have the greatest impact on the environmental sustainability index:

- air pollution indicator is negative for all Arctic regions except the Republic of Karelia;
- sewage pollution indicator is positive only for Nenets Autonomous Okrug, Yamalo-Nenets Autonomous Okrug, and Chukotka Autonomous Okrug;

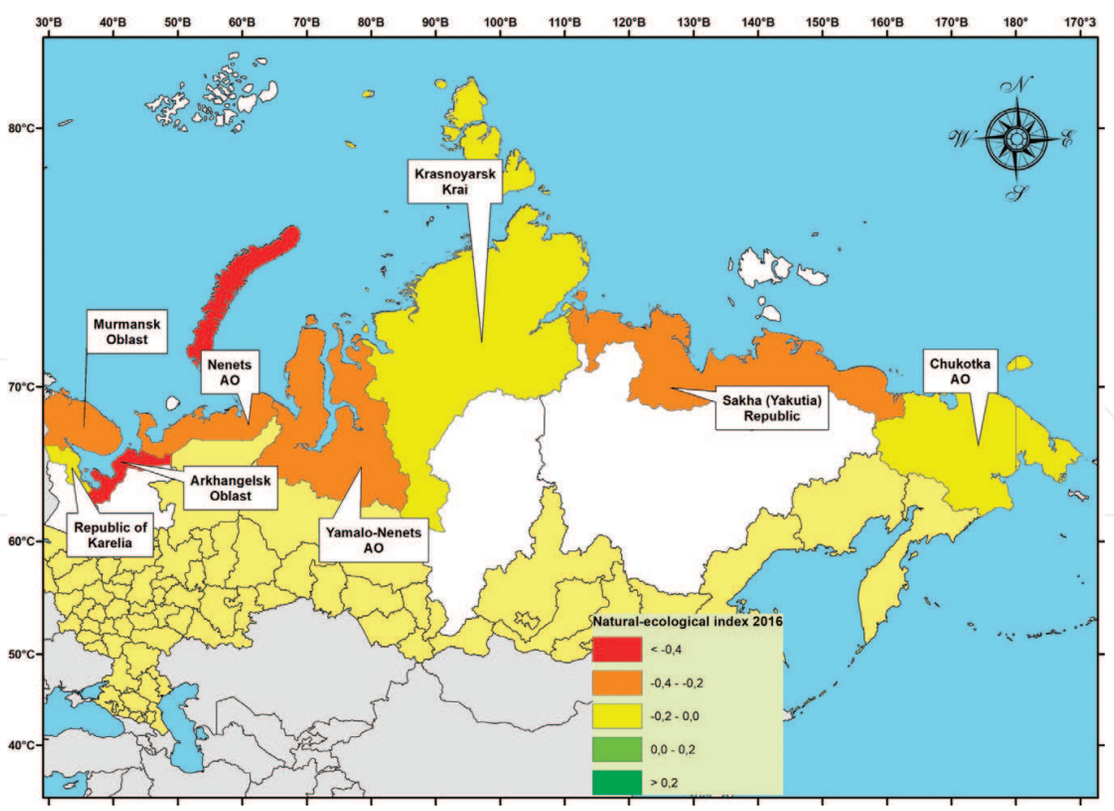

Figure 4. Index of environmental sustainability, 2016.

- the indicator of the protected area is positive only for the Krasnoyarsk Krai and Chukotka Autonomous Okrug.

Interestingly, the Nenets Autonomous district is characterized by a low value of the indicator of the costs of environmental protection.

Predicting using the analysis of strategies of the socioeconomic development of the regions of the Russian Arctic environmental sustainability index values for 2025, it is necessary to state the preservation of the current situation in general, and even its slight deterioration, for example, for the Murmansk Oblast and the Arkhangelsk Oblast, a slight improvement of the environmental sustainability index is projected only for the Yamal-Nenets Autonomous Okrug.

The politic-geographical sustainability index, which reflects the comfort of living of the population of the region depending on the administrative policy of the region, for the current situation showed that the least comfortable living in the Republic of Karelia (the index value is −0.69) is associated with a high level of regional subsidy, the level of crime (crime indicator less −0.5), and unstable political situation (the indicator of domestic political stability is less −0.43). On the contrary, the highest and positive index value was registered for Nenets Autonomous Okrug only—just above zero, 0.05 (**Figure 5**). This region, along with the Yamalo-Nenets Autonomous Okrug, has not regional subsidy from the federal budget, and only this region is characterized by the positive value of the migration indicator. It should be noted that for the Republic of Karelia and the Krasnoyarsk Krai, all the values of indicators of this index are negative.

Figure 5. Index of politic-geographical sustainability, 2016.

The forecast values of the politic-geographical sustainability index for 2025 show a significant improvement in the situation in almost all Arctic regions, except Nenets Autonomous Okrug and Yamalo-Nenets Autonomous Okrug, for which the situation will remain unchanged. Positive values of the index are also predicted for the Murmansk Oblast and Arkhangelsk Oblast, and the most impressive breakthrough is predicted for the Republic of Sakha (Yakutia): from −0.43 to −0.05. These changes are associated with positive dynamics according to the forecasts of indicators of migration and of regional subsidy.

Considering the totality of all the stability indexes obtained, and calculating on their basis the comprehensive index value of the stability of the Arctic regions, it obtains that at the moment among all the regions of the Russian Arctic, the leaders are the Murmansk Oblast, Yamalo-Nenets Autonomous Okrug, and Nenets Autonomous Okrug, with the values of the complex index in the limit of 0.06–0.09, which is associated with sufficiently high and stable situation for most indexes (**Figure 6**). The most unstable situation is registered in the Republic of Karelia, Krasnoyarsk Krai, and the Republic of Sakha (Yakutia), for which the values of the comprehensive index value of the stability range from −0.12 to −0.15.

In the forecast of the situation for 2025, based on the strategies of socioeconomic development of the Arctic regions, the situation is slightly improving in the Western regions (Murmansk Oblast, the Republic of Karelia, and Arkhangelsk Oblast), which more correctly took into account the weaknesses of the regions in strategies and plans to improve the socioeconomic situation in general (**Figure 7**). At the same time, the Murmansk Oblast will remain the only one that is predicted to

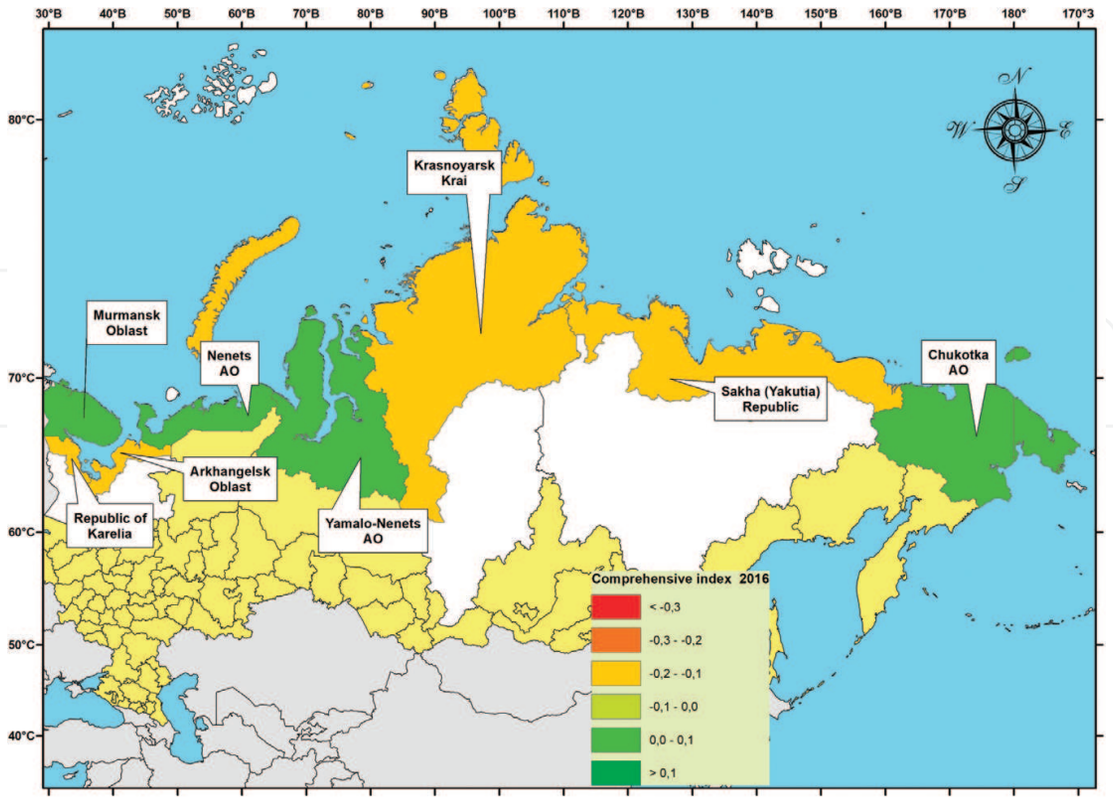

Figure 6. Comprehensive index of stability, 2016.

http://dx.doi.org/10.5772/intechopen.78970

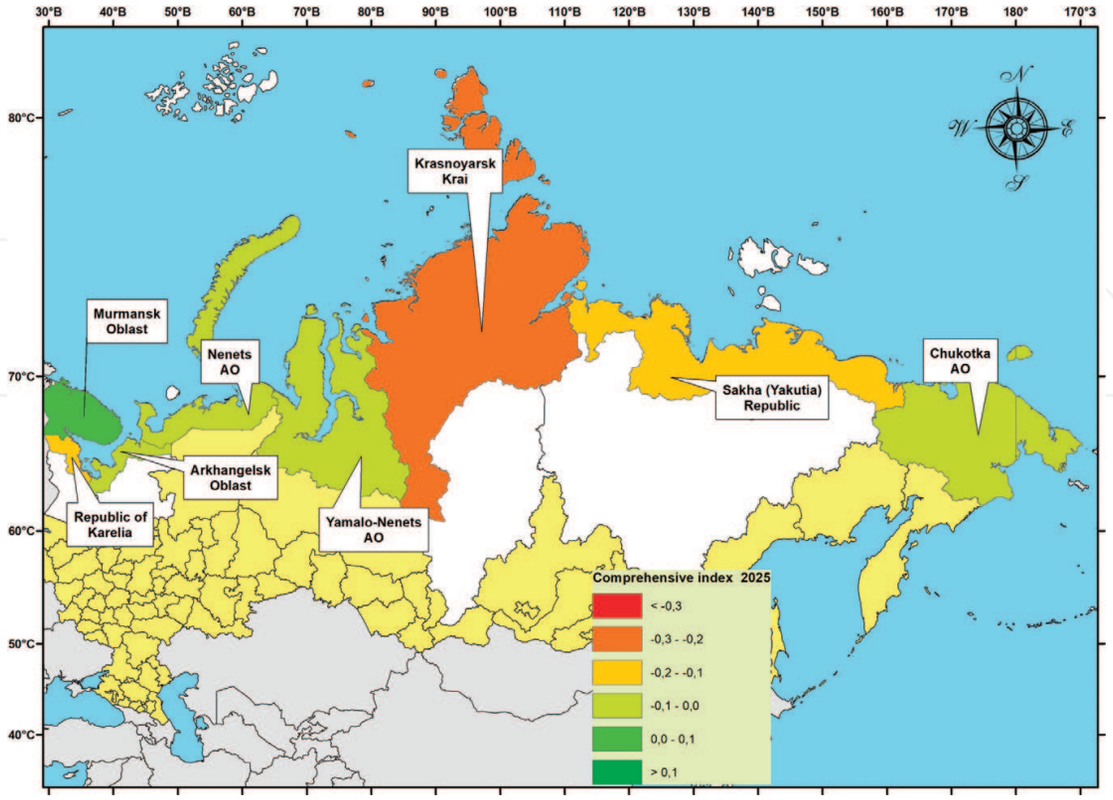

Figure 7. Forecast of comprehensive index of stability, 2025.

have a positive value of the comprehensive index value of the stability (0.11). The forecast situation in Yamalo-Nenets Autonomous Okrug (with a decline of the value of the comprehensive index value of the stability from 0.7 to −0.04) and Krasnoyarsk Krai (with a decline of the value of the comprehensive index value of the stability from −0.12 to −0.20) will deteriorate the most. At the same time, the Krasnoyarsk Krai is projected as an absolute outsider in terms of sustainability of development among all Arctic regions of the Russian Arctic.

This current and prediction situation signals the socioeconomic development priorities that are often incorrectly chosen by the Arctic regions and requires adjustment of the strategies of the socioeconomic development of the Arctic regions and their coordination with the directions of the socioeconomic development of the Russian Federation.

6. Conclusions

As a result of the research, five indicator groups for different factors of sustainability for the assessment of coastal systems and coastal infrastructure are obtained. This includes methods of their calculation on the basis of the analysis of system principles of sustainability of coastal systems and accounting of medium- and long-term climatic, ecological, economic, legal, and geopolitical changes in the Arctic, from the point of spatial planning and development of coastal territorial systems. On the basis of this methodology, a dynamic model of strategic spatial planning of the Russian Arctic regions and the integrated geographic information

system of coastal systems and coastal infrastructure of the Russian Arctic "AZRF Coastal Systems," including the regional component of GIS, were created.

According to the calculation and analysis, at the moment among all the regions of the Russian Arctic, the leaders are the Murmansk Oblast, Yamalo-Nenets Autonomous Okrug, and Nenets Autonomous Okrug, which is associated with sufficiently high and stable situation for most indexes. The most unstable situation is registered in the Republic of Karelia, Krasnoyarsk Krai, and the Republic of Sakha (Yakutia). In the forecast of the situation for 2025, based on the strategies of socioeconomic development of the Arctic regions, the situation is slightly improving in the Western regions (Murmansk Oblast, the Republic of Karelia, and Arkhangelsk Oblast), which more correctly took into account the weaknesses of the regions in strategies and plans to improve the socioeconomic situation in general. At the same time, the Murmansk Oblast will remain the only one that is predicted to have a positive value of the comprehensive index value of the stability. The forecast situation in Yamalo-Nenets Autonomous Okrug and Krasnoyarsk Krai will deteriorate the most, and the Krasnoyarsk Krai is projected as an absolute outsider in terms of sustainability of development among all Arctic regions of the Russian Arctic. These situations signal the socioeconomic development priorities that are often incorrectly chosen by the Arctic regions and require adjustment of the strategies of the socioeconomic development of the Arctic regions and their coordination with the directions of the socioeconomic development of the Russian Federation.

Due to the calculations performed, the applicability of this model is shown not only to assess the current state of the Arctic regions of the Russian Federation but also to predict their development on the basis of scenario forecast.

Acknowledgements

The reported study was funded by the Russian Foundation for Basic Research (RFBR) according to the research project No. 16-05-00724\18.

Author details

Gogoberidze George* and Rumiantceva Ekaterina

*Address all correspondence to: gogoberidze.gg@gmail.com

Murmansk Arctic State University (MASU), Murmansk, Russia

References

[1] Conley HA. Arctic Economics in the 21st Century. Center for Strategic & International Studies. Maryland, United States: Rowman & Littlefield; 2013. 74 p. ISBN: 978-1-4422-2487-2 (pb); 978-1-4422-2488-9 (eBook)

[2] Chance NA, Andreeva EN. Sustainability, equity, and natural resource development in Northwest Siberia and Arctic Alaska. Human Ecology. 1995;**23**(2):217-240. DOI: 10.1007/BF01191650

[3] Gogoberidze G, Zabolotnikov G, Shatrova O, Lednova J, Dobrynina A. Prospects of development of Arctic science and technology in the Russian Federation. In: Conference Proceedings of the 17th International Multidisciplinary Scientific Geo-Conference SGEM 2017. Vol. 17. Issue 52. Ecology, Economics, Education and Legislation. Bulgaria: STEF92 Technology Ltd.; 29 June–5 July, 2017. pp. 727-732. DOI: 10.5593/sgem2017/52/S20.093

[4] Gulas S, Downton M, D'Souza K, Hayden K, Walker TR. Declining Arctic Ocean oil and gas developments: Opportunities to improve governance and environmental pollution control. Marine Policy. 2017;**75**:53-61. DOI: 10.1016/j.marpol.2016.10.014

[5] Serreze M, Holland M, Stroeve J. Perspectives on the Arctic's shrinking sea-ice cover. Science 2007:**315**(5818):1533-1536. DOI: 10.1126/science.1139426

[6] A Reference Guide on the Use of Indicators for Integrated Coastal Management. ICAM Dossier I, IOC Manuals and Guides, 45. Paris, France: UNESCO\IOC; 2003. 127 p

[7] Bowen RE, Riley C. Socio-economic indicators and integrated coastal management. Ocean & Coastal Management. Special Issue: The Role of Indicators in Integrated Coastal Management. 2003;**46**(3–4):299-312. DOI: 10.1016/S0964-5691(03)00008-5

[8] Gogoberidze G. Tools for comprehensive estimate of coastal region marine economy potential and its use for coastal planning. Journal of Coastal Conservation. 2012;**16**(3):251-260. DOI: 10.1007/s11852-011-0155-2

[9] Neveykina N. Indicators of socio-economical region development. Regional Economics: Region Development Strategy. 2013;**23**(302):32-40 (in Russian)

[10] Gogoberidze G, Ryabchuk D, Zhamoida V, Spiridonov M, Arseniev B. Concept of state cadastre of the marine coastal zone of the Russian Federation. In: Proceedings of the 2012 IEEE/OES Baltic International Symposium. United States: IEEE/OES; 2012. ISBN: 978-1-4673-1414-5/12/$31.00. DOI: 10.1109/BALTIC.2012.6249170

[11] United Nations Conference on Environment & Development. Agenda 21. Rio de Janerio, Brazil; United Nations Publisher; June 3–14, 1992. 300 pp. ISBN: 978-92-1-100509-7

[12] Bobyleva SN, Makeenko PF. Sustainable Development Indicators for Russia (Ecological-Economic Aspects). Moscow, Russia: Center of Projects of the Industry Development; 2001. 245 p (in Russian)

[13] Gogoberidze G, Karlin L, Abramov V, Lednova J. Indicator method of estimation of human impact assessment for coastal local municipalities. In: Proceedings of the Baltic International Symposium (BALTIC). United States: IEEE/OES; 2014. ISBN: 978-1-4799-5707-1. DOI: 10.1109/BALTIC.2014.6887840

[14] Shelekhov AM. Main Aspects of the Sustainable Development Strategy for Russia. State Duma, Moscow, Russia: The Federal Assembly of the Russian Federation; 2002. 161 p. (in Russian)

[15] Medvedeva TV, Denisov VN. Indicators of sustainability of the regional socio-economic system. Concept Scientific Journal. 2016;**5**:60-67. Available from: http://e-koncept.ru/2016/56150.htm (in Russian)

[16] Gogoberidze G, Karlin L, Abramov V, Lednova J, Malakhova J. Marine economic potential assessment for environmental management in the Russian Arctic and Subarctic coastal regions. In: Conference Proceedings of the 14th International Multidisciplinary Scientific Geo-Conference SGEM 2014. Geo-Conference on Ecology, Economics, Education and Legislation. Vol. III. June 17–26. Bulgaria: STEF92 Technology Ltd.; 2014. pp. 253-260. ISBN 978-619-7105-19-3/ISSN 1314-2704. DOI: 10.5593/SGEM2014/B53/S21.034

[17] Buletova NE. Improvement of diagnostics of regional social-economic system. Economics, Entrepreneurship and Law. 2013;**1**:3-25. Available from: http://www.creativeconomy.ru/articles/28462/ (in Russian)

[18] Gogoberidze G, Abramov V, Ershova A, Popov N, Lednova J. The concept and methodology of integrated assessment of coastal systems and coastal infrastructure sustainability. In: Conference Proceedings of the 17th International Multidisciplinary Scientific Geo-Conference SGEM. Vol. 17. Issue 52. Ecology, Economics, Education and Legislation. Bulgaria: STEF92 Technology Ltd.; 29 June–5 July, 2017. pp. 951-958. DOI: 10.5593/SGEM2017/52/S20.121