Geoinformation approach to assessing environmental risks of the investment economy in Primorsky Krai

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Abstract. The article presents the analysis of promising directions for the development of a green economy for nature in the Primorsky Krai in the context of supporting a favorable investment climate declared by the Regional Government. We prove that using the method of spatial comparisons of a multilevel nature, tasks to determine the degree of territorial-demographic development and actual territorial settlement are successfully addressed investment zoning is carried out, including at the local level the display of settlements of all types, the most important industrial and residential infrastructure, buffer zones of the anthropogenic impact of settlements, transport networks, communication lines, etc. We recommend to modernize the environmental system of existing and planned Protected Areas as well as substantiate the need for the development and implementation of a specific program to improve economic mechanisms for the preservation of natural ecosystems. The article describes our experience in developing a scientific and information basis for assessing the environmental risks of external and internal investment in the economy of Primorsky Krai. We consider the feasibility of the development of the “Ecoinvest” reference and expert system to provide public and scientific information expertise related to the conservation of biodiversity and areas of high conservation value.

1. Introduction

The current times are characterized by challenging economic and political situations as well as a high degree of unpredictability of the social future in most countries of the world. With a large-scale economic downturn and a severe aggravation of competition, resource efficiency issues become extremely important, with geographic information systems (GIS) [1] get chosen for the role of “navigator”. It is significant that in such difficult conditions, a new round in the development of information technologies (IT) is taking place ensuring the actual transition to the knowledge society characterized by the formation of an economy with a predominance of the investment component [2]. The spatiotemporal paradigm in geography was considered by the geographers from Perm, who claim that “from the conceptual point of view of geographical science, space (geographical spaces) acquires a temporary change only when it turns into a field of interaction of various driving forces and components of nature and society when settlements and communications arise and develop, and, thus, space (environment) of human life is formed” [3].

For many years, Irkutsk has been developing the fundamental foundations of systems analysis in the study and mapping of territorial entities with the use of geoinformation technologies in the Laboratory of Theoretical Geography of Institute of Geography SB RAS. Siberian GIS-developments are based on the principles of conceptual graphic modeling of geosystems proposed by Academician V.B. Sochava.
GIS research is being developed in many works of the Institute staff, which convinces of the relevance of the designation of the environmental approach and the need to highlight a special geoecological ethics of the researches [5]. However, notably, Russian geographers have been using GIS technologies for approximately four decades, with an increasing role, including the aim to create a scientific and informational basis in the use of natural resources and preservation of the environment in the Russian Far East (RFE) [6, 7].

In 2015, Primorsky Krai approved the own law on strategic planning. It contains important developed documents that are aimed at creating a favorable investment climate. In this message, we consider the main applied direction of geoinformation work on the materials of pioneer development of a prototype of the information and reference system, Ecoinvest. We discuss the tasks of the implementation of the project pilot stage and reflect the examples and an algorithm for assessing anthropogenic impact. Its first version was developed to assess the investment activities in Primorsky Krai as a working prototype of a reference and information GIS. In this regard, it was important to resolve three fundamental issues, namely, to develop a basic scientific and theoretical basis for territorial and object-oriented ecological and geographical expertise, to substantiate the conditions for identifying the levels of anthropogenic transformation of geosystems and to establish a visualization format and agree on the principles of zoning of Primorsky Krai according to the degree of preservation of natural geosystems.

Investment attractiveness of the region is a key indicator for attracting resources for its development, but many different geographic factors influence the investment result, which should be considered in terms of applying a systems approach. For this, the geographical point of view is extremely important because to make a decision, the investor needs to conduct a comprehensive assessment of the investment object, which can be defined both at the level of an individual enterprise and in the context of inclusion of the regional level in the economy. Concerning the calculation of the indicators of the investment risk in the region, it should be integral and based on many indicators, which requires appropriate geoinformation support and a developed geographical theory as well as the use of a comprehensive methodology and the calculation of integrative indicators. From the theoretical standpoint, we argue that social geography should become the supporting components of the subdivision (discretization) of continuous space-time and the theory of the geographical field, with the territorial socio-ecological systems as one of the subjects of close research [8].

2. Models and methods
A sustainable and flexible economy that creates more favorable conditions for human life without causing significant damage to the environment is usually called a “green” economy. In this case, space appears as a “local development” of various types of social activities, as well as natural processes, giving them specific spatial forms” [9]. The territorial assessment of the degree of anthropogenic disturbance of the geosystems in Primorsky Krai has become necessary for the creation of a working prototype module of the EcoInvest GIS system. To provide a predictive function about the possible territorial development of Primorsky Krai, we used thematic geoinformation layers, “Schemes of territorial planning of Primorsky Krai”, in the current version of 2015 as well as previous materials and large-scale schemes for the development of municipal districts (Vladivostok agglomeration and Khasansky district) available for public use. Information on investment activities is open and provided by the administration of Primorsky Krai where the main information source is “Investment portal of the Primorsky Krai” (https://invest.primorsky.ru/ru/invest-climate/climate).

Our research includes current global approaches to natural resource management with the principles of Strategic Environmental Assessment (SEA) [10], which, unfortunately, have not yet taken root in the Russian legislation but are still visible in separate additional documents and government projects in pilot regions [11]. This allows us to speak of the need to introduce SEA when creating large infrastructure projects to ensure sustainable development of the region and competent governance of environmental management. The work identified and visualized the proportion of those wildlife areas that have an official conservation status (state nature reserves), including biosphere PAs; National parks; reserves of Federal significance, UNESCO World Natural Heritage sites; Ramsar Sites and Important Bird Areas.
(IBA). To carry out calculations of anthropogenic disturbance, it was also necessary to identify “roadless” and “uninhabited” territories, which made it possible to formalize in a binary (Cybernetic) coding (there is – no or “humanized nature” – “wild nature”) and, most importantly, calculate with a high probability the locations of wildlife sites. The implementation of the territorial assessment of disturbance was based on the use of standard geoinformation procedures for creating buffer zones from linear and polygonal objects from topographic and thematic maps (all types of roads and railways, industrial and production infrastructure, including power lines, oil and gas pipelines, settlements, etc.).

In a comprehensive assessment of the anthropogenic load in the area, the method of constructing raster models (Grid analysis) was used, spatially reflecting the coefficient of development and inaccessibility in any point of Primorsky Krai. Then, the entire territory was zoned according to several threshold values (three categories in total), which reflected the degree of natural areas transformed by human and allowed us to estimate roughly the anthropogenic impact in the entire region with identifying areas of potential threats to natural values from man. The information organized by the World Wildlife Fund (WWF-Russia) enabled us to localize and visualize various information on the distribution of key (“Red Book”) animal species, the location of forest areas with the predominant participation of Korean cedar pine (Korean cedar), and the location of specially protected natural areas of federal and regional significance. Thematic cartographic layers and environmental calculations were carried out based on the geographical database of the Amur branch of WWF-Russia (https://amurinfocenter.org/).

3. Results and discussion
According to the Federal Law “On Strategic Planning in the Russian Federation” of February 13, 2019, the strategy of the spatial development of the Russian Federation (RF) for the period up to 2025 was approved (http://docs.cntd.ru/document/420204138). It determines the priorities of the settlement system in the country, directions of changes in the structure of the economy in the regional aspect, economic specialization of subjects of the Russian Federation in the interregional division of labor, needs for the location and development of the federal engineering, transport and social infrastructure, and directions of the RF integration into a single Eurasian and world economic space. In this regard, academician Peter Baklanov proposes to be guided by the fact that “the most complete geographical object containing real-life relationships and conjugations (spatial contacts and neighborhood) of various natural, natural resource, social and economic components is an integral geosystem that objectively exists within a certain, fairly compact territory” [12].

In the paradigm of domestic nature management, the landscape approach actively developed in our country for more than a century is most often used. Based on many years of the available information to the authors, we attempted to calculate the spatial characteristics of the actual transformation for naturally valuable territories of Primorsky Krai and selected biotic objects.

Now our map is available on-line (https://amurinfocenter.org/geo/values-and-threats/ or https://arcgis.is/0WaCum) as a tool to identify all possible threats for major nature and valuable objects (such as high conservation value forest, protected areas, cedar-broad-leaved and intact forests, wetlands and others) in the Russian Far East. Geoinformation database on the possible large infrastructure projects has a detailed description of each object, including the necessary capital volume for realization and information about the potential harmful impact on the precious natural assets. All the available data is being posted for public access together with the adjustment of the analysis tools to provide the verified information about the most valuable naturals assets in the Russian Far East for the attention of the potential investors and decision-makers (figure 1).

Our database was developed based on different data, including planning schemes of the related territories, invest offers and lots of industry documents on regional development posted on the internet. Objects in the database could be conditionally divided into several categories, such as transport (transport corridor, bridge crossing, rail/auto roads, pipeline, seaport, and terminal logistics center); energy (energy transfer object, power generation, oil and gas); agriculture (livestock or agro-industrial complex); forest industry (timber processing complex); subsoil use (mining operations, metal manufacture, mining and processing integrated plant); integrated. Another block may be associated with
specialists conducting regular studies of objects of the Red Book or flagship species from WWF list. In this module, much more complex, yet more effective hardware and software tools are provided for the work of specialists. For “open” (public) access to useful information that could be used for personal gain, the law of “information protection” should be in effect. Therefore, GIS does not provide precise coordinates; maps have a coarse spatial resolution not allowing to find a nest or growth of a rare species.

Figure 1. Primorsky Krai territory zoning and planned investment activities on new infrastructure constructions.
The indicator of the investment risk in the region should be integral and calculated based on many indicators, which requires appropriate geoinformation support and developed geographical theory, the use of an integrated methodology, and calculation of integrative indicators. Natural capital is one of the least studied and highly generalized indicators considered in the context of sustainable development. In this regard, further development is needed in the area of geoinformation support of the complex regional activities within regional economics. In this area, execution is possible both based on the preparation of cadastral estimates and in the context of determining the volume and amount of damage by type of activity. Preservation of the natural productivity of ecosystems at the geopolitical level refers to the concept of natural capital, although there is still an insufficient degree of coupling between great ideas of sustainable development and real actions of business and other stakeholders in the economic sector. To understand environmental constraints and calculate environmental priorities, it is important to accurately and in detail determine the spatial characteristics of the expected transformation for the naturally valuable territories of Primorsky Krai and selected biotic objects.

4. Conclusion
Global financial, energy and climate crisis has created an urgent need to search for new models of economic growth rather focused on sustainable development than consumption and an increase in wealth. Our work demonstrated that nowadays, geoinformation approach, scientific task setting and close cooperation with public environmental organizations greatly expand the capabilities of traditional mapping. In the context of creating a reference and expert Ecoinvest system, our experience convinces that “custom filling” of its base module should consist of at least two software and information blocks fundamentally different in their purpose and intended use. Preparation of the specialized geoinformation content requires differentiation of the tasks to be solved, and, therefore, the selection and use of different tools, careful selection of scientific methodology and phased development of research schemes.

Historically, the business in the Russian Far East has not been based on corporate social responsibility, which already caused many complex problems of landscape degradation. Today, we should reconsider the existing model of nature management not only for both biodiversity conservation and local population livelihood improvement but also making business in the region competitive, socially responsible and having access to international markets. This is very important for the sustainable development of the local communities of the Russian Far East and entire Russia, as all the natural resources here and its unique biodiversity represent value assets promoting investment attraction.

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