Environmental studies and support economic activities in regions the Western-Siberian north

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Abstract. Economic activity in any territory involves compliance with certain environmental parameters. The specialization of economic activity of the West Siberian North is not environmentally safe, as it is mainly associated with oil production. The ecological justification of the impact of activities on the surrounding area is an urgent scientific and practical objective of time. Climatic conditions form ecological stability of natural ecosystems to anthropogenic loads. The numerical values of the elements of heat and moisture turnover are necessary to assess the natural potential of territory. They are parameters required for the analysis and assessment in the environmental regulation of economic activity. The maximum permissible technogenic load, which reflects the degree of impact of activity on natural landscapes, is important. On the basis of the calculated characteristics of heat and moisture supply, the energy equivalents of the maximum permissible technogenic load of the surface layer of air, surface waters and phytocenoses of the studied region are determined. On the basis of the calculations and analysis their latitudinal distribution from South to North in the studied territory is revealed. The results can serve as a basis for environmental regulation of economic activity in order to evaluate the modern and long-term environmental sustainability.

1. Introduction

The actual problem of geographical science and practice is the negative impact of economic activity on the processes taking place in the landscape sphere. The magnitude of the possible anthropogenic impact can be estimated through their comparison with the natural potential of ecosystems, taking into account their commensurability [1]. In this regard, the regional characteristics of heat and moisture and economic indicators that reflect the socio-economic development of the region play the key role when determining the stability of natural ecosystems to technogenic loads and formation of ecological and geographical conditions of their existence.

In the regions of the West Siberian North – Yamal-Nenets (YNAO) and Khanty-Mansi Autonomous districts (KHMAO), the Northern regions of the Tyumen region - economic activity is largely regulated by the location of districts in high latitudes and, as a result, by natural and climatic features typical for these territories. Natural environmental conditions that have developed over a long period of time, have an impact on the characteristics of the livelihoods of the population of districts, the development and location of social and economic facilities, as well as production indicators of economic complexes of the considered territory.

The nature of the location of the infrastructure and settlements of the administrative units under consideration were formed and linked to large oil and gas fields developed since the mid-twentieth
century. Thanks to these resources they are still operating nowadays. The existing and emerging oil and gas transportation systems represent a fairly developed complex of production, transportation and partial processing of this hydrocarbon raw material. Taking into account the reserves of natural resources of the territory and the peculiarities of socio-economic development of the country, the economic specialization of the region will continue in the future. In this regard, to ensure sustainable and safe development of landscape ecosystems and long-term development of production and economic potential of the region, it is necessary to have scientifically based geocological parameters that reflect the impact of the main environmental users of the region on the environment, i.e. oil and gas production enterprises, procurement industries, oil and gas chemistry enterprises and the corresponding transport and energy infrastructure [2].

Oil production, transportation and processing of hydrocarbon products are the main type of production and economic activity for these territories. To a certain extent, this was facilitated by the geographical location of the Northern part of the Tyumen region – Uvat, Vagai and Tobolsk, where natural and climatic features do not allow wide spread of agricultural types of development of territories. This can be justified by the fact that current share of fuel and energy resources in the total cost estimate of the volume of mining in the YNAO and KHMAO is more than 99%.

The production profile of the districts, formed mainly by enterprises for the extraction of mineral fuel and the production of products of their distillation and bitumen, cannot be attributed to the number of environmentally safe ones [3]. Despite this, in the future, the production capacity of the fuel and energy complex will increase. The implementation of innovative investment projects for the development of Yamal and adjacent territories, the development of transport and energy infrastructure, the construction of facilities for the production and processing of hydrocarbon raw materials in the West Siberian North will continue. In the context of industrial development of these territories and creation of the basis for the growth of the "green" economy, it is extremely important to take into account the quality of life of the population. These indicators are determined by the parameters of equilibrium and balanced development of natural ecosystems in existing and potential national and international projects [4]. Therefore, the assessment of ecological and geographical conditions of nature management, so necessary for the further successful development of the territories of the West Siberian North, is relevant and timely.

2. Models and methods

It is obvious that the ecological stability of the ecosystems of this vast region is formed on the basis of the peculiarities of natural and climatic factors. The formation of natural landscapes of the region is associated with the conditions of heat supply and moisture of the earth surface and, as a consequence, the soil characteristics of the active layer. The diversity of the ratio of moisture and heat resources of the regions forms significant differences in the structure of their water balance, soil cover and species composition of vegetation. The Northern part of the territory under consideration has insufficient heat supply, so the process of total evaporation consumes a small amount of heat resources. High heat supply in the southern regions of the region forms the predominance of the total evaporation indicator in the water balance structure [5].

In turn, these parameters and indicators are decisive in determining the values of both the ecological state of the environmental components of the region (surface layers of air, water resources, phytomass), and the ecological and geographical conditions of nature management, in particular, the size of the maximum permissible technogenic load (PDT) on the territory of natural systems of the West Siberian North. The system method of establishing the maximum permissible technogenic load (PDT) when consistently taken into account, calculated and summed private PDT, is the most optimal in determining this indicator. The factor and condition determining the maximum permissible technogenic load are the parameters and indicators of the energy characteristics of the territory and their annual distribution. Quantitatively, these values are the sum of the specific values of the energy equivalents of the surface air layer (q₁), surface water resources (q₃) and phytocenoses (q₄).
The essence of this methodological approach is that the energy values of both natural (natural) characteristics and technogenic have a single calculation and analytical basis. In other words, the maximum permissible technogenic load (q), based on the natural resources of the territory, determines the technogenic energy value and characterizes the energy exchange in ecosystems, thus being one of the main factors of their stability and ability to self-recovery [6].

Calculations of the maximum permissible technogenic load were carried out on the basis of the developed regional dependencies reflecting the thermal power and water balance features of the territory under consideration and the results of the assessment of the total specific maximum permissible technogenic load and its components.

3. Results and discussion
Taking into account the results of the study of the laws of formation of the radiation regime, the processes of moisture and heat, as well as the productivity of vegetation, a quantitative assessment of the components of the maximum permissible technogenic load in the West Siberian North was carried out.

The distribution of the values of the specific maximum permissible man-made loads calculated for the points (weather stations) of the studied region is reflected in the table 1.

Table 1. Values of specific maximum permissible technogenic loads of the territories of the West Siberian North, per year

| Meteostation     | $q_1$ TFE | $q_2$ TFE | $q_3$ TFE | $q$ TFE |
|------------------|-----------|-----------|-----------|---------|
| Yalutorovsk      | 2946      | 192       | 423       | 3561    |
| Tyumen           | 3000      | 229       | 426       | 3655    |
| Uvat             | 2863      | 264       | 430       | 3557    |
| Tobolsk          | 2855      | 391       | 429       | 3675    |
| Demyanskoye      | 2718      | 438       | 428       | 3584    |
| Sytomo           | 2512      | 620       | 415       | 3547    |
| Khanty-Mansiysk  | 2666      | 499       | 425       | 3590    |
| Ugut             | 2550      | 1014      | 359       | 3923    |
| Surgut           | 2504      | 1018      | 358       | 3880    |
| Lar'yak          | 2514      | 721       | 403       | 3638    |
| Pitlar           | 2159      | 826       | 384       | 3369    |
| Nadym            | 2131      | 795       | 389       | 3315    |
| Hale-Savoy       | 2275      | 1095      | 336       | 3706    |
| Tarko-Sale       | 2187      | 907       | 371       | 3465    |
| Urengoy          | 2096      | 762       | 394       | 3252    |
| Taz              | 1953      | 1190      | 336       | 3479    |
| Sidorovsk        | 2082      | 772       | 392       | 3246    |
| Novy Port        | 1827      | 1190      | 295       | 3312    |
| Tazovskoye       | 1953      | 1190      | 336       | 3479    |

*TFE – measure, tons of fuel equivalent, /km$^2$, per year

The calculation results show that within the investigated area, the dynamics and distribution of the total maximum permissible anthropogenic load (q) has a pronounced zoning and varies depending on the latitude - from 3200 tons of fuel equivalent/(km$^2$-year) in the North to 3900 tons of fuel equivalent/(km$^2$-year) in the South of the region. The same distribution in the considered area is subject to the values of the components of the total maximum permissible technogenic load (PDT), that is, the initial values - $q_1$, $q_2$ and $q_3$. It should be noted that in accordance with the mechanism of the process of exchange of matter and energy, the maximum permissible technogenic load on surface
water resources depends on the characteristics of the conditions of flow formation. In principle, it
depends on the moisture content of the territory, which in turn allows assessing the natural potential of
surface runoff and determine its possible use [7, 8].

The value of annual production of vegetation cover and the territorial distribution of this indicator
is largely determined by the joint interaction of water, heat and soil resources. The distribution of
maximum permissible technogenic load of phytocoenoses on the territory \((q_3)\) also has a latitudinal
character, subject to the general geographical zoning [9].

It is obvious that the reduction (regeneration) of a single natural complex has a more favorable
situation in those conditions when the values of specific maximum permissible technogenic loads take
the greatest values, both for surface water resources and phytocoenoses. Such territories, other things
being equal to the parameters of economic impact, have more diverse conditions for self-restoration of
natural ecosystems. According to the results of calculations of specific maximum permissible
technogenic loads for the West Siberian North (table) such areas include Taz, New Port, Tazovskoye,
Surgut, Ugut, Hale-Savoy, etc., where the total indicators of their values \((q_2 + q_3)\) are by 20...35% higher
than the average for the region as a whole. At the same time, there are areas in the region
(Yalutorovsk, Tyumen, Tobolsk, Uvat, Demyanskoje), where the total values are low. These areas
and the like of them can be attributed to less resistant to various types of anthropogenic influence.
Therefore, to ensure sustainable and safe development of landscape ecosystems in the economic
development of such areas the scientific justification of geoeconomic parameters of the region,
characterizing the features of the perception of anthropogenic impact on the environment is the
necessary condition [10].

4. Conclusion
Thus, the maximum permissible technogenic load is an indicator, which contributes to the solution of
the problem of ecological justification of the commensurability of natural and economic potentials of
natural systems. The comparison of anthropogenic impact on the ecological environment with the
maximum permissible values reflecting the self-healing capabilities of ecosystems in the region is
based on the energy characteristics accompanying economic activity, and at the same time allowing
taking into account the natural and climatic features of specific regions of the country.

For the West Siberian North, the obtained values of ecological and geographical parameters are of
scientific and practical importance and can be used in the development and adjustment of territorial
schemes of rational nature management, in regional and state planning and forecasting, as the
indicators characterizing the stability of ecosystems to regional and local anthropogenic impacts.

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