

Special Aspects of Natural Resources Management in the South of the Kurgan Region: Problems and Solutions

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Abstract— This paper describes specific aspects of natural resources management of the border areas of the Kurgan region which have similar climatic, geological and morphological, landscape, hydrological and ethnic and economic characteristics. It includes the analysis of natural resources management system in the conditions of degradation of agro-industrial complex, decreased socio-economic potential of the region and, as a consequence, the deterioration of investment environment. Changes in natural resources management in the studied territory were considered, in connection with the development and mining of uranium by the method of in-situ leaching in difficult hydrological and geological conditions and environmental risks arising from this. An innovative solution to the problem of reducing the risk of radiation and toxic pollution of natural environment, surface and underground water resources and water supply sources is proposed, as well as a system for organizing specialized integrated natural resources management based on agriculture cluster and a food supply procurement system in the Kurgan region.

Keywords—*natural resources management, population carrying capacity, recreational carrying capacity, socio-economic potential of the region, investment environment, agriculture cluster, in-situ leaching.*

I. INTRODUCTION

Natural resources management is a complex multifactorial process for using the population carrying capacity of territory and human environment. Population carrying capacity (PCC) provides the biological existence of man and society and is a factor required for the production that defines its possible implementation and the effectiveness level. Obviously, the specific character of natural and man-made environment is fundamental in the formation of the socio-technological potential of the region (STPr), its functional sufficiency and role in the national economy [1]. President of the Russian Federation V.V. Putin has stated a strategy for the country's long-term and sustainable development through the creation of restoring systems using nature-like technologies. The idea of the president has a profound evolutionary meaning, as it predetermines the harmonization of natural environment (NE) and human social life. It contradicts the postulate that human is "the king of nature". On the whole, human receives a natural role in biogeocenosis and in the evolutionary process in all its aspects. It seems appropriate to carry out the study of natural resources management problems at the regional level

on the basis of defining and studying the problems of NE interaction with socio-economic processes and phenomena in the existing institutional environment [2]. Theoretical and methodological basis for harmonizing the processes of natural resources management and understanding the main problems arising from it is the noosphere concept of V.I. Vernadsky. The essence of this concept is that natural resources management is a global process of transition of the biotic and abiotic components of NE into the noosphere under the influence of substantive and practical human activity, the latter due to the corresponding socio-economic organization of society and the role of institutions which regulate social life [3]. Moreover, V.I. Vernadsky assigned a special role to human as an active element whose psychophysiological activity gives rise to "biogeochemical energy" [4].

II. RESEARCH METHODOLOGY

Theoretical and methodological basis of the study and the findings is systematic approach. Considering the organization of natural resources management and economic activity in the border areas of the Kurgan region in the terms of systematic approach, we can suggest the following:

1. Taking into account the territorial organization of natural resources management with the participation of two subjects of international law the Russian Federation and Kazakhstan, it is necessary to establish the priorities for natural resources management based on ecological approach and with consideration to the system of restrictions caused by specific NE parameters and the peculiarities of economic activity, as well as functional zoning of territories.

2. Forecasting changes in NE is possible taking into account nonlinear dynamics of changes in territory assimilation capacity in accordance with the modern concept of the stability of natural processes and their anisotropy [3,5].

3. Analysis of the problem and source information was made using the methods of economic geography, ecological landscape agriculture and natural resources management. Economical and geographical approach to the study of the border areas of the Kurgan region allows understanding the influence of socio-economic factors on traditional natural resources management and environmental behavior of people, as well as defining trends and risks of the excessive usage of PCC [6]. Cartographic and statistical methods, analysis of

reports by PJSC Atomredmedzoloto on the environmental safety of uranium mining using in-situ leaching method, as well as technological regulations for mining of minerals using hydrometallurgical methods are the important part of the study of this problem [7,8]. It is obvious that hydrology, geology, and landscape zoning methods are important for studying the subject under consideration. These methods made it possible to establish that hydrosphere boundaries in the adjacent territories of Russia and Kazakhstan can conditionally be considered the limits of dynamic water circuit – main zones of interaction of surface and groundwater at the depth of first hundreds meters [9]. The most significant effects of water bodies in NE in the border areas are: effect on thermal regime of water bodies, effect on physical weathering processes due to seasonal cryogenic phase change, dissolution of organic and inorganic substances, transport of substances in earth's crust and their accumulation, participation in the generation of organic compounds (photosynthesis) and in metabolic mechanisms in living organisms, as well as in the interconnection of living organisms with NE. The territory of two neighboring states of Russia and Kazakhstan is unique due to the fact that the Tobol River flows here. The water resources of Tobol River basin are the most important source of water supply in the region. Among the regions of the Ural Federal District, the Kurgan region takes the last place in water supply what happens due to natural and environmental reasons: significant amount of underground saline water with exceeding maximum permissible concentration standards for a number of elements (iron, manganese, boron, etc.). Underground water quality in border areas does not meet the standards. Water quality in surface water supplies is also not satisfactory. The main reasons are the discharge of domestic and industrial wastewater, as well as storm water falling into surface water bodies. Increasing economic use of rivers and catchment basins, taking of the significant part of flow, discharge of polluted water into rivers – all this leads to the pollution of river beds what makes safe pass of flood water difficult. The problems of floods and flooding of settlements and infrastructure are urgent for the Kurgan region since large floods repeat every 10-15 years what creates additional difficulties for the rational organization of the territory and natural resources management system.

4. The fundamental basis for studying the problem and developing solutions are the theory of N.N. Moiseev “On the co-evolution of human and NE” [10].

The dynamics of co-evolution process on a global scale, scientific and technological progress contributing to changes in technological patterns, transition to the post-industrial era lead to changes in all components of natural and man-made environment [2]. Obviously, it has a significant impact on the type of natural resources management, the extent of its rationality, environmental acceptability and socio-economic efficiency. This article describes main natural resources management problems in several territories of the southern Trans-Urals located in the Kurgan region which arose in connection with the changes in socio-economic, geopolitical and institutional situation. The possibilities of stabilizing depressive and destructive processes in the economy, STPr increasing and the assimilation capacity of the region are also analyzed, taking into account its border position which determines the system of restrictions established by the Law of the Russian Federation “Concerning the State Border of the Russian Federation” [11,12]. This study and solution to these problems contribute to:

- increased protection of NE and ensuring the safety of human life in the context of negative natural phenomena and human impact;
- sustainable and sufficient provision of the economy of the Kurgan region with natural resources;
- ensuring the development of NE protection system and improving the organization and management of PCC usage processes in the Kurgan region;

Relevance of this article is due to the fact that there have been significant changes in the framework of “nature-economy-population” system during the period of liberal democratic reforms in Russia. Changes in the socio-economic basis of society and the primacy of the market regulatory mechanism by the economy have led to imbalances in the economic and social development of different areas of the region, increased gap between areas successfully developing under new conditions and areas incapable to use the natural and socio-economic potential to the full extent. The signs of these phenomena are: decreased production volumes, aggravated employment problem, and destroyed social infrastructure. In terms of living standards and average per capita GDP, the Kurgan region takes the last place in the Ural region. The following sources were used as a scientific methodological and information basis for this article: normative acts of federal and regional authorities and administrations, state standards, international standards, technological and administrative regulations, as well as scientific papers, monographs and publications by scientists and specialists in specialized periodicals [13,14].

The objects of this study are the areas of the southern part of the Kurgan region bordering Kazakhstan: Tselinny, Kurtamyshsky, Zverinogolovsky, Polovinsky, Makushinsky, Petukhovsky. Understandably, the status of border area actually increases the functional diversity of its use. In addition to traditional forms of management, i.e. production and processing of agricultural products, mainly livestock, using the recreational potential of the region, as well as various types of commercial natural resources management, the southern areas of the Kurgan region and the border areas with Kazakhstan are used as an outpost to ensure state security, the integrity of its territory and sovereignty [15]. Areas under consideration have favorable conditions for the development of fish farming and other aquacultures, hunting, beekeeping, etc. Since the beginning of the 90s, due to the degradation of agriculture and decreased human-determined impact on NE, especially on water bodies, as well as the activation of succession processes, the restoration processes of flora and fauna were intensified what led to the increase in the number of wild animal species: Siberian roe deer, wild boar, beaver, raccoon, badger, etc. This predetermines the development of sports and trophy hunting and tourist activities [12,16].

Maximum effect of rational natural resources management, production and processing of agricultural products in the region was achieved in the late 19th and early 20th centuries. This was the time of implementation of intensive production methods based on the achievement of scientific and technical progress and progressive forms of production organization (guilds, “Union of Siberian Butter Masters”). This was facilitated by the improvement of logistic situation in the southern Trans-Urals (due to Trans-Siberian Railway). Since the beginning of the 20th century, a new form

of natural resources management has appeared in the Kurgan region – balneological recreation (Medvezhye Lake). In the post-revolution period, as a result of institutional changes and appearance of collective forms of agriculture based on the principles of planned economy, natural resources management was carried out in a regular, systematic and comprehensive way. Development of agricultural science, development of regional farming systems and ecological landscape farming reduced the load on regional ecosystem; this predetermined the increase in number and diversity of recreational sources and territories. There appeared health resorts of both local and national importance (Sosnovaya Roshcha and Medvezhye health resorts), while there were imbalances in the processing sector of agro-industrial complex which was concentrated mainly in urban settlements. At the same time, in regional centers which are now border areas, there were butter and cheese factories, bakery plants, as well as feed production enterprises [15]. From the beginning of the 90s to the present day, in the economy of areas in general and in the agro-industrial sector in particular, there is a process of worsening socio-economic situation, decreased level of production effectiveness, destroyed infrastructure, decreased STPr and marginalization of the population [17]. Modern market institutional environment contributes to the mismatch in target designations of national economic importance and the private goals of agricultural producers which are mainly motivated to maximize profits [18]. This objectively increases the load on NE and leads to irrational natural resources management. During the years of liberal democratic reforms, the number of cattle decreased by 5 times, of pigs by 4.6 times, sheep and horse breeding almost completely disappeared, especially since grazing was traditionally the main type in the areas under consideration, as the climatic conditions of the border areas of the Kurgan region are characterized with dry climate and insufficient rainfall. Specified areas do not differ much in their landscape. They are mainly steppe and forest-steppe, with limited forests in the floodplains of the Tobol and Ubagan rivers which are of great environmental and recreational importance (ribbon forests). An important form of natural resources management is hunting and fishing [8]. On the territory of Zverinogolovsky area there is a faunal reserve in the Tobol River region which is located in border zone. In the field of agriculture, the structure of crop production has changed, the number of fodder and industrial crops has decreased, 80% of arable land is used for wheat what shows the transition to single-crop farming and leads to disruption of crop rotation, and – in the absence of sufficient fertilizers – to reducing fertility of arable land. The most important factor hindering the development of meat and dairy production is the lack of processing companies. Negative social consequence of this becomes reduced livestock production what results in seasonal employment of the population, increased unemployment, poverty, degradation and complete disappearance of rural settlements. According to the Federal State Statistics Service, the population of the Kurgan region is steadily decreasing by about 40 thousand people annually from the year 2000 to the present day. This indicates the insolvency of regional authorities and administration, their inability to create a self-developing system of agro-industrial complex (AIC) on the basis of traditional natural resources management and taking into account historically developed agricultural system. Natural resources are the most essential element of NE which ensures the suitability of the territories of neighboring states for people living and conducting economic activities [5].

III. RESULTS

1. Minerals are extracted in the places of their deposits. The need for energy in all spheres of state activity is increasing, including the generation of thermal energy from the fission of uranium and transuranium elements. Obviously, ensuring a balanced combination of traditional natural resources management using subsoils and NE in the fields is an important scientific and practical task.

2. Stable and long-term co-evolution process in the field of natural resources management is possible if all the norms, rules, regulations and technical conditions for the compatibility of technologies used in various types of socio-economic activities are met. The experience of OAO Dalur in Dalmatovskoye field complies with ISO 14001:2004 [1].

3. Specific geological and hydrological features when developing Dobrovolnoye field should be taken into account, since the situation here is much more complicated: pressure ore-bearing horizon is located in hydrodynamic discharge zone in the watershed of Tobol floodplain, so the extraction is supposed to be periodically (once in 8-10 years) flooded during high water. On the territory of Zverinogolovsky area, flowing relief wells arranged during geological exploration were not removed and create a threat of pressure flow of activated radioactive solution to the surface and into water-bearing beds.

4. The need to maintain the recreational potential of Zverinogolovsky area is obvious. On its territory, there are valuable natural recreational sites, faunal reserve and Sosnovaya Roshcha health resort which are at risk of destruction. Uranium mining at Dobrovolnoye field actually causes alarmist feelings in people and will contribute to increased migration of the population from the Kurgan region and a further decrease in STPr. This actually leads to the deterioration of investment environment of the region and of marketing situation in the agro-industrial sector of economy [15].

5. When uranium is extracted by in-situ leaching, negative environmental impact is inevitable; therefore, accurate forecasting of this negative impact is of particular importance. To solve this problem, Dalur company has developed the regulation "On Industrial Environmental Control" which is now in force. Technology of in-situ leaching is currently sufficiently developed and is a controlled, relatively safe and environmentally acceptable production method that can be applied even with the most stringent NE protection standards. In addition to the number of technological advantages compared to traditional production methods, in-situ leaching is characterized by the best economic parameters [1,19,20].

6. A range of organizational and technological measures should be carried out for creating an anti-filter screen around the ore-bearing horizon and casings, injection and recovery wells.

7. It is reasonable to develop joint ventures in AIC on the territories adjacent to the border due to their natural and climatic, historical and ethnic, landscape and geomorphological common character. Currently, inter-regional projects are developed aimed at improving and harmonizing the processes of natural resources management of the border territories of two states.

IV. DISCUSSION

Using of rational natural resources management in territories subject to radiation and chemical pollution allows the creation of appropriate economic, financial, organizational and technological conditions for the implementation of the range of compensatory and expensive technologies in AIC enterprises, as well as in housing and utilities sector, and the development of engineering and social infrastructure. The interdependence of economic entities within the agricultural cluster allows achieving a synergy effect due to the covariant nature of its subsystems and ensuring the sustainable existence and development of the economy of the south of the Kurgan region. Balanced functioning of restoration systems using various forms, technologies and types of natural resources management contributes not only to the reducing the load on NE, but also to the implementation of infrastructural projects in the region. There are territories in the Kurgan region that experience excessive industry-related negative effect from operating chemical weapons destruction facility; on its territory there is a landfill for the disposal of bitumen-salt mass formed as a result of the conversion of chemical weapons. This landfill is the source of negative impact on NE which results in oncogenic, mutagenic and teratogenic effects. Obviously, the experience of the considered specialized natural resources management can be used in other regions of the Russian Federation. Proposed range of measures predetermines involving the unique characteristics of the Kurgan region for business development in the field of international eco-tourism, organizing trophy hunting tours, ethnic and cultural tourism. In accordance with the requirements of the international standard on social responsibility of business, it seems reasonable to consolidate the efforts of legislative and executive authorities, business entities and the population of the Kurgan region for creating a natural resources management system on the criterion basis of minimizing the usage of PCC.

V. CONCLUSIONS

1. The process of intra-regional natural resources management should be manageable and should be carried out in accordance with certain technological regulations on the basis of project management;

2. The system of intra-regional management of the functional zoning of natural resources management should be based on the principles of minimal usage of PCC, principle of creating balanced and proportional sectoral structure of regional economy which ensures its balance and stability: the implementation of logistic models in projects for the organization of territories using the principle of integrated arrangement of interconnected industries what allows infrastructure sharing and the principle of maintaining ecological balance and sustainability of NE;

3. Given the dominance of economic methods of production management, specialized agricultural clusters should be developed in the territories under consideration on the basis of joint natural resources management by agricultural, mining and industrial enterprises. This form of joint natural resources management will provide a synergy effect and can become the basis for a special type of socio-economic development of the Kurgan region taking into

account difficult environmental situation and the risks of technological accidents and incidents; this type of development will include special NE monitoring system, food procurement system taking into consideration the guidelines for protective nutrition, the system of measures for the prevention of harmful effects from the object of increased industry-related danger on NE;

4. Creation of a functional safety system for enterprises in mining and metallurgical industries based on innovative technical solutions;

5. Creation of an interstate system for the restoration and rehabilitation of water bodies, for the construction of engineering protection facilities and the improvement of operational reliability of hydraulic structures, for the elimination of water shortages in water-deficient areas, for the rational use of water resources;

6. Increasing the area of faunal and landscape reserves, reducing the risks of forest fire danger and their protection from pests, rational use of forest vegetation by organizing complexes for processing plant materials into fuel pellets;

7. Rationalization of the use of hunting resources, ensuring the maintaining and restoration of hunting resources, increasing flora and fauna species diversity;

8. Implementation of adequate measures to reduce mental and psychological load on the population of the Kurgan region in the studied territories which is associated with the functioning mining enterprise which is the source of increased radiation and toxic hazard [21].

9. Organization of survey and research work to study the effect of uranium and accompanying elements deposit, as well as of geopathic zones on the balneological and recreational properties of Gorkoye, Medvezhye, Mironovskoye, Sukhanovskoye and other lakes, in order to develop an adequate strategy for the development of the recreational potential of Kurgan region.

10. Maintaining of the traditional natural and economic and ethnic and cultural way of life of the multinational and multi-confessional population of the south of the Kurgan region seems to be a significant social result of natural resources management of this territory [21,22].

The authors of this article took an active part in solving problems in the field of natural resources management of the Kurgan region. As a result of R&D and experimental design work, a project was proposed to create an anti-filter screen restricting the filtration and diffusion transportation of radioactive and toxic substances from the ore-bearing horizon and technological wells to water-bearing beds and groundwater and surface water sources. The main functional element of this screen is a cryogenic generator with electromagnetic activation (patent No. 2669644) [9]. Obviously, the natural resources management system in the border areas of the Kurgan region requires corresponding changes taking into account the joint usage of PCC by economic entities of two states. This primarily requires an institutional basis in the form of international agreements on water use, subsurface use, land and forest use.

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