

The study of the environment ecological state from the position of its sustainable development

*Maria G. Ozerova, Olga Yu. Gavrilova, and Anastasia V. Sharopatova**

Krasnoyarsk State Agrarian University, 90, pr. Mira, Krasnoyarsk, 660049, Russia

Abstract. The article deals with the issues of sustainable development, which means the balanced functioning of three components: the ecological component that characterizes the quality of the environment, the social component that determines the quality of life and the economic component that considers economic development. Due to the particular urgency of environmental issues an assessing the ecological state of the environment in the Krasnoyarsk Region is carried out using such indicators as the volume of polluting substance released per 1 km² and per 1 person. It is noted that in 2020 the negative trend of the increasing atmospheric air pollution has intensified and this despite the fact that in this year the costs of environmental protection and rational use of natural resources are almost 92 percent higher. In order to address issues of improving environmental safety it is necessary first of all to improve the management system in the field of environmental protection and continue work on the implementation of the Climate Doctrine of the Russian Federation.

1 Introduction

The concept of "sustainable development" defines the parameters of the dynamic and progressive development of society, its productive forces and industrial relations, provided that the ecological balance of human activity and the outside world is maintained, while providing conditions for the preservation and reproduction of its natural environment [1-3].

The term "sustainable development", adopted by the World Commission on Environment and Development (WCED) under the leadership of Norwegian Prime Minister Gru Harlem Brundtland, is formulated as follows: "Development that meets the needs of the present, but does not threaten the ability of future generations to meet their own needs».

Various authors have repeatedly noted the inaccuracy of the Russian translation of a foreign expression. Indeed, the definition of "sustainable development" simply means steady, constant growth. At the same time in European languages "sustainable development", "nachhaltige Entwicklung", "development durable" have a narrower meaning. This is a "continuing" development (perhaps we can say "self-sufficient"), that is,

* Corresponding author: sharopatova@yandex.ru

one that does not contradict the further existence of humanity and its development in the previous direction [4-6].

Sustainability is a characteristic of any production process and it does not depend on the level of the analyzed indicator or the speed of its change. There are two approaches to the concept of sustainability in the economic literature. Such representatives of the first approach as F.A. Batalin, V.M. Obukhov, A.F. Fortunatov, N.S. Chetverikov and others identified a decrease in fluctuation and an increase in crop stability. Currently, the authors of most of the works that address these issues adhere to the same point of view [6].

Environmental sustainability determines the relationship between the economy of an enterprise, its environmental safety (considering the level of comprehensive solution of economic and environmental issues when making investment decisions, the ratio level of consumption for limited natural capital and renewable in the production process) and minimizing the harmful impact of production and economic activities of the enterprise on the environment [7-9].

The concept of sustainable development formulated by the world community and presented by the Brundtland Commission has defined global, strategic goals of this development. The following areas were identified as priorities – the maximum possible conservation of natural resources and the maintenance of a stable balance between human production activities and the outside world in accordance with the level of technology development and the ability of the biosphere to cope with the consequences of human activity [10].

2 Research methods

In accordance with the basic provisions of the concept “sustainable development” defined by the Commission, the studied problem is proposed to be considered in three main components:

- environmental – determines the nature of human interaction with his environment (the outside world);
- economic – is designed to ensure the continuous, progressive development of the productive forces and industrial relations of society;
- social – ensures the sustainability of society's development and is aimed at meeting its social needs, that is, ensuring a high quality of life and preventing social conflicts [11-13].

Environmental sustainability is determined by 5 major sections:

- characteristics of the environment – air, water, soil and ecosystems;
- level of pollution and environmental impact;
- losses of society from environmental pollution in the form of product losses, diseases, etc.;
- social and institutional opportunities to solve environmental problems;
- ability to solve global environmental problems by consolidating efforts to preserve nature [3].

The need to assess the sustainability and success of socio-economic development for individual regions and countries, as well as the quality of economic growth determines the relevance of developing targets and indicator systems for different levels [14].

Indicators of sustainable development are indicators that characterize changes in the state of the economy, the social sphere and the environment over time. Indicators characterizing the ecological state from the standpoint of its sustainable development include indicators of environmental pollution, indicators of impact on water resources and indicators of land use.

Further, Table 1 shows the indicators of the ecological state for the environment of the Krasnoyarsk Region and the trends of their dynamics with an assessing the environmental sustainability of the territory development.

Table 1. Indicators of the ecological state from the standpoint of sustainable development, characterizing environmental pollution [14].

| Indicator and characteristics of indicators | Tendency characteristics in indicators modification from the point of view of sustainable development |
|---|--|
| The volume of emissions of polluting substance (PS) per year - shows the PS intake from stationary and mobile sources into the environment, which can lead to a deterioration in the quality of atmospheric air and water, the quality of life, with an increase in the concentration of PS | The increase in PS emissions shows a low degree of ecological safety of the technologies used, poor efficiency of gas cleaning equipment, a high level of environmental hazard, an increase in the impact of the economy on human health, etc. Negative dynamics indicates less sustainable development of the territory |
| The volume of PS emissions per 1 km ² /year - shows the amount of PS emissions from stationary and mobile sources per 1 km ² of the territory. It is especially important for territories used for agriculture, lands that have the status of protected | Negative dynamics indicates less sustainable development of the territory |
| The amount of PS emissions per 1 person - shows the amount of PS emissions from stationary and mobile sources per 1 person. It is especially important for the part of the population living in industrial cities. It creates a threat to people's health, worsens the quality of life | Negative dynamics indicates less sustainable development of the territory |

The economic, social and environmental elements of sustainable development should be considered in a balanced way. Sustainable development involves linking economic growth, scientific and technological progress, environmental protection and rational use of natural resources in one system [15-17].

3 Results

The analysis of the ecological aspect of sustainable development in the Krasnoyarsk Region is carried out using indicators on the basis of which it is possible to judge the degree of sustainability for socio-economic development of the region [10, 18].

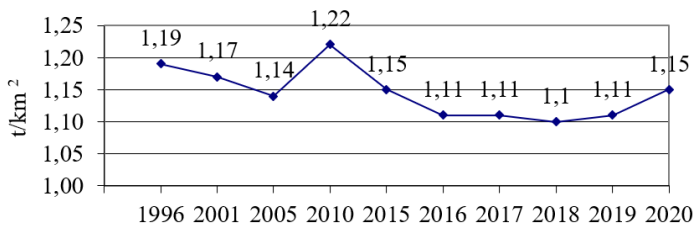


Fig. 1. The number of polluting substance emissions per 1 km² in the Krasnoyarsk Region.

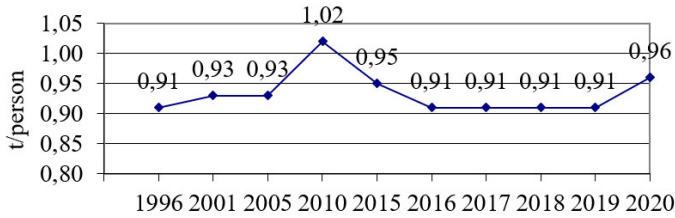


Fig. 2. The number of polluting substance emissions per 1 person in the Krasnoyarsk Region.

Based on the analysis of the data presented in Figure 1, we note that, from 1996 to 2020, the indicator in question tends to decrease. Thus, during these years there was a significant decrease in anthropogenic impact on the environment, which can be considered as a positive factor in the ecological aspect of sustainable development.

If we consider the values of the amount of polluting substance emissions per 1 person in the Krasnoyarsk Region, then from 1996 to 2010, according to indicators of anthropogenic load, there has been a steady increase in indicators, which shows negative dynamics and less sustainable development of the territory. The period from 2016 to 2019 is characterized by stagnation. In general, the dynamics over the analyzed period shows a slight increase in indicators by 5.5 %.

The ecological state is related to the quality of the environment and the quantity and quality of natural resources [19, 20]. Indicators of anthropogenic impact on the environment and its quality are presented in Table 2 [10].

Table 2. Ecological state of the environment*.

| Indicators | Russia 2020 | Krasnoyarsk Region * | | | | | 2020 in % to 2015 |
|--|-------------|----------------------|--------|--------|--------|--------|-------------------|
| | | 2010 | 2015 | 2018 | 2019 | 2020 | |
| <i>General characteristics</i> | | | | | | | |
| Area, thousand km ² | 17098 | 2367 | 2367 | 2367 | 2367 | 2367 | 100.0 |
| Population, thousand people | 146171 | 2829.1 | 2866.5 | 2874 | 2866.3 | 2855.9 | 100.9 |
| <i>Atmospheric air</i> | | | | | | | |
| Gross polluting substance emissions, including motor transport, thousand tons | 22228 | 2886.8 | 2729.1 | 2613.8 | 2622.2 | 2729.5 | 94.6 |
| Polluting substance emissions from stationary sources, thousand tons | 16952 | 2480.2 | 2475.9 | 2318.9 | 2431.6 | 2539.6 | 102.4 |
| Polluting substance emissions from mobile sources (motor transport), thousand tons | 5276 | 406.6 | 253.2 | 295.8 | 190.6 | 189.9 | 46.7 |
| <i>Water resources</i> | | | | | | | |
| Water intake from natural water bodies, million m ³ /year | 61790.9 | 2559 | 2290 | 2093 | 2056 | 1752 | 68.5 |

| | | | | | | | |
|--|---------|-------|-------|-------|-------|-------|-------|
| Use of fresh water, million m ³ /year | 46990.8 | 2296 | 2114 | 1909 | 1849 | 1542 | 72.9 |
| Wastewater discharge into surface water bodies, million m ³ /year | 34232.3 | 2172 | 1833 | 1729 | 1597 | 1303 | 59.9 |
| Volume of polluted (without treatment) wastewater discharged into surface water bodies, million m ³ /year | 11678.2 | 45.4 | 39.7 | 43.6 | 42.2 | 44.0 | 96.9 |
| Waste generated, million tons | 6956 | 302.8 | 368.7 | 514.2 | 508.4 | 404.0 | 133.4 |
| The area of the forest fund, million hectares | 1146.2 | 158.7 | 155.6 | 155.6 | 155.6 | 155.6 | 98.0 |

* based on the materials of the State reports "On the state and environmental protection in the Krasnoyarsk Region for 2009-2020"

* State report "On the state and protection of the environment in the Krasnoyarsk Territory for 2010-2020"

In general, the ecological situation in the region is stable. The population of the region as of 01.01.2021 amounted to 2855.9 thousand people, which is 26.8 thousand people higher than in 2010, but lower than in 2018-2019. The amount of total polluting substance emissions in the Krasnoyarsk Region amounted to 2729.5 thousand tons, which is 107.3 thousand tons higher than the previous year, due to the development of the oil and gas industry in the region. Emissions from industrial enterprises increased by 59.4 thousand tons. In the region, there has been a positive trend in reducing the level of pollution from motor vehicles, in comparison with 2010, their value decreased by 2.1 times.

In 2020, the main indicators of water use in the territory of the region decreased, which is explained by a decrease in production capacities at the main water user enterprises. The volume of waste generated in 2020 increased by 33.4 % compared to 2010, but decreased slightly compared to 2018 and 2019.

The area of the forest fund in the Krasnoyarsk Region is 155.6 million hectares, which is 13.6 % of the area of the Russian Federation. In the region lands structure, the lands of the forest fund account for 65.75 % (155.6 million hectares), agricultural lands - 16.8 % (39.7 million hectares), reserve lands – 12.8 % (30.3 million hectares), lands of specially protected territories and objects – 4.07 % (9.6 million hectares), lands of the water fund – 0.31 % (0.7 million hectares), the lands of settlements – 0.16 % (0.4 million hectares) and industrial and other special purpose lands account for 0.11 % (0.3 million hectares).

The most significant categories of environmental protection costs include current (operational) costs, capital repairs and investments in fixed assets. Current costs are represented by the costs of maintaining and operating environmental and nature-saving facilities, as well as the costs of enterprises for environmental protection [21]. Capital repair costs are investments in the reconstruction and modernization of fixed assets of environmental protection enterprises. Investments in fixed assets are expressed in the costs of capital construction, repair of old equipment and purchase of new one aimed at reducing the negative impact on the environment [2]. The analysis of investments in fixed assets for environmental protection and rational use of natural resources at the national and regional levels is presented in Table 3.

Table 3. Dynamics of investments in fixed assets for environmental protection and rational use of natural resources* [10].

| Subject | Years | | | | | |
|------------------------|--------|---------|---------|--------|--------|---------|
| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| the Russian Federation | 151788 | 139677 | 154042 | 157651 | 175029 | 195962 |
| the Krasnoyarsk Region | 11606 | 14149.3 | 11606.9 | 6925.9 | 6382 | 12201.8 |
| Growth rate, % | | | | | | |
| the Russian Federation | 100 | 92.0 | 110.3 | 102.3 | 111.0 | 112.0 |
| the Krasnoyarsk Region | 100 | 121.9 | 82.0 | 59.7 | 92.1 | 191.2 |

* State report "On the state and protection of the environment in the Krasnoyarsk Territory for 2010-2020"

Financing of environmental management and the environment in the Russian Federation has a positive trend and amounted to 195962 million rubles in 2020. In the Krasnoyarsk Region, the amount of investments in fixed assets aimed at environmental protection and rational use of natural resources in the reporting period was fixed at the level of 12201.8 million rubles, which is 2 times higher than the level of the previous year [22-24]. It should be noted that the volume of investments in fixed assets in the previous analyzed years had a negative trend. From the total investments in the Krasnoyarsk Region, 7,359.6 million rubles were spent on the protection of atmospheric air; 1,759.6 million rubles were spent on the protection and rational use of water resources; 71.5 million rubles were spent on the protection and rational use of land. At the same time, the current (operational) costs for environmental protection amounted to 27,359.8 million rubles.

4 Conclusion

Thus, the transition to sustainable development should be ensured, first of all, by the creation of a law state and the development of regions. The development of complex interregional programs in the subjects of the Russian Federation is of great importance. The reconstruction of the regions industry should take place considering the economic capacity of local ecosystems. Program and forecast documents of the federal level should serve as a guideline for regional programs and together with relevant legal and regulatory acts determine the economic conditions for their development.

As further measures to improve the environmental situation in the Krasnoyarsk Region, contributing to reducing polluting substance emissions, reducing the volume of contaminated wastewater and waste, we believe that it is necessary first of all to improve the management system in the field of environmental protection. It is necessary to continue work on the implementation of the Climate Doctrine of the Russian Federation, based on energy conservation, energy efficiency improvement and the use of renewable energy sources as fundamental directions for solving the problem of anthropogenic influence on the climate [25]. And also use modern, more powerful wastewater treatment systems in the territory of the region and increase the volume of solid waste processing into secondary raw materials and electricity. All this will comprehensively contribute to the prevention and reduction of negative impacts on the environment, public health, environmental safety and its sustainable development.

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