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# Systems of Environmental Security of Urbanized Territories Within the Framework of the Program of Ecological Development of Urbanized Territories

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**Abstract.** The threat of environmental degradation and depletion of natural resources is directly related to the state of the economy and society's willingness to understand the globality and importance of these problems. This threat is especially great for Russia as a whole and its various regions, because of the priority development of the fuel and energy industries, the lack of development of the legislative basis of environmental protection, lack or limited use of "green" technologies. Environmental security of regions is imperative for sustainable development of the region, is the basis of preservation of natural systems, and maintain environmental quality. The basic meaning of environmental security associated with the necessity of compliance with environmental regulations. The violation of such regulations affects the public health seriously and leads to the destruction of the stability of ecological systems. To maintain the state of all living systems in urban areas is necessary to ensure the environmental security of these systems. The article offered conclusions of developed theory of environmental security of natural resources in urbanized areas, considered threats (vulnerability issues of ecological systems) to each natural sites. This article defines the purpose and objectives of the system of environmental security and illustrates the relationship of all systems of environmental security between itself and the Program of ecological development. Based on the obtained data there was a need for conclusions about the inclusion of theoretically developed systems in the ecological development program of any urbanized area.

## 1. Introduction

At the last conference All-Russian research-to-practice conference "Ecology and safety in the technosphere" (2017) our model team presented the Model Development and Urbanized Areas [1]. Despite the fact that the developed model is universal for any urbanized territory, it turned out that we did not take into account one of the most important factors in contemporary time. This is a factor in ensuring environmental security in all subprograms of the Model. The model should be adequate to the management task, that is, reflect the environmental problems of the urbanized area with the accuracy of the management task solution. It was one of the shortcomings of the Model because of the problem of environmental security are typical for all regions of Russia, and they are traced in all environmental spheres. The actual environmental problems of Russian regions are waste management and waste consumption (52 regions); problems in the water sector (51 regions); problems related to forestry activities (31 regions); problems of air pollution (24 regions). Therefore, it is necessary to ensure environmental security in all areas of economic and natural resource activities in cities. The need to solve the problem in the Saratov region is explained by the presence of chemically hazardous objects of all hazard classes, a large number of hydraulic structures, critical infrastructure (nuclear power plants, hydroelectric power plants, chemical weapons destruction facilities, etc.), deterioration of the



basic production assets of chemically hazardous objects.

The aim of this work is to develop an environmental safety system of urbanized areas to improve the model of the program of environmental development of urbanized areas.

Work objectives: to identify the threats of each level of the environmental development program; theoretically develop the content of each type of environmental safety corresponding to each level of the environmental development model (2017).

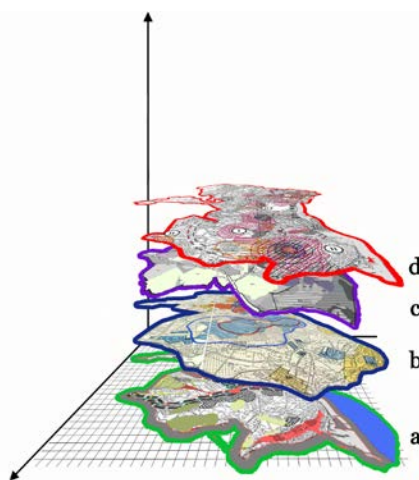
## 2. Results and discussion

Environmental security is a set of conditions, processes and actions that ensure the ecological balance in the environment and does not lead to vital damage (or threats of such damage) caused to the natural environment and people.

At first, within the framework of the development of an environmental development program considered only impacts on the environment (for example, air and water). However, such a narrow approach is not suitable for solving environmental problems in the system. The environment should include the social sphere (human health, welfare [2]) natural environment, ecosystems, and agriculture; climate and atmosphere; natural resources (renewable and mineral); waste disposal; historical and cultural monuments, landscape, social consequences, transboundary impacts. In addition, to determine the sustainability of the environmental safety system, it is necessary to take into account the degree of vulnerability of ecological systems (identification of potentially dangerous changes in the functional capabilities of ecosystems [3]). To do this, we used the term "threats to environmental security."

The basic meaning of environmental safety is associated with the need to comply with environmental standards. If they are violated it will greatly affect the public health and lead to the destruction of the sustainability of ecological systems. On the territory of each region, many natural resources are in a state of destruction. This condition is associated with violation of environmental and environmental standards in the implementation of economic activity. Moreover, in order to maintain the state of all living systems in cities, it is necessary to ensure the environmental safety of these systems. The object based on which the model will be created is Saratov city. Saratov is the administrative center of the Saratov region. Location – the right coast of the Volgograd reservoir.

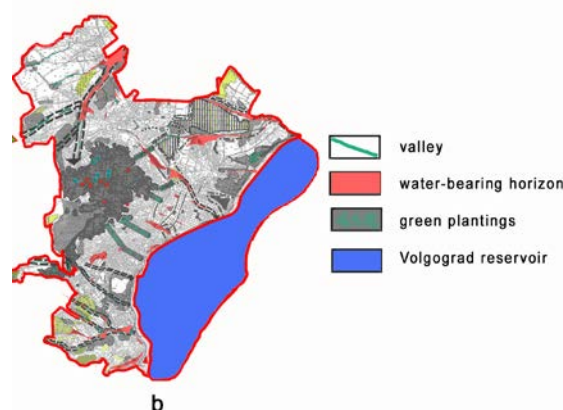
We have developed a model of ecological development of the urbanized area, which is a visualized scheme of subprograms aimed at the development of individual areas (nature, social development, environmental development, anthropogenic factor).



**Figure 1.** Model of environmental development of Saratov city (Saratov region, Volga Federal district): a – 1 layer (natural); b – 2 layer (social); c – 3 layer (Economics); d – 4 layer (the natural environment).

In the same way as in the model of the environmental development program, we assume the following: working with environmental issues, financing environmental programs, monitoring of compliance needs must be carried out at one place for every single area of a region (selected point on the map) correspond to their threats and their decisions.

The basis for the “overlay” of the security system on the program will serve as a natural layer - the natural characteristic of the city (Figure 1, layer “a” of the ecological development model, Figure 2).



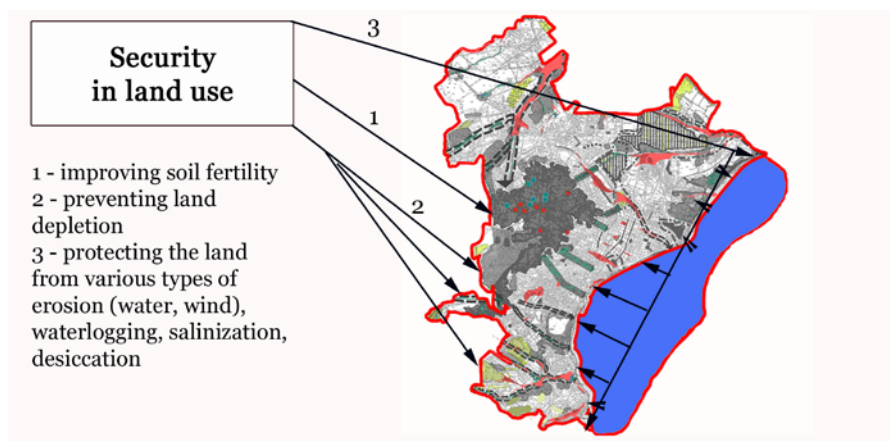
**Figure 2.** The natural characteristics of the city with the indication of natural objects.

The analysis of environmental problems and environmental programs of the regions indicates the following types of threats (environmental hazards) that are universal for most regions of Russia. Accordingly, each of the types of danger must be installed its own security system.

### 2.1. Security in the field of land use.

Threats: degradation of land and soil, polluted land by industrial facilities, banks of water bodies. Counter threat - changes in soil quality and characteristics affect other ecosystem processes [4]. The goal of security in land use is the prevention of these environmental threats. Objectives: improving soil fertility, preventing land depletion, protecting the land from various types of erosion (water, wind), waterlogging, salinization, desiccation, compaction, pollution by radioactive and chemical substances, production and consumption waste.

Places to ensure the security in one location of the most dangerous areas: areas of industrial facilities, areas of land under greenery, areas of the riverbank.

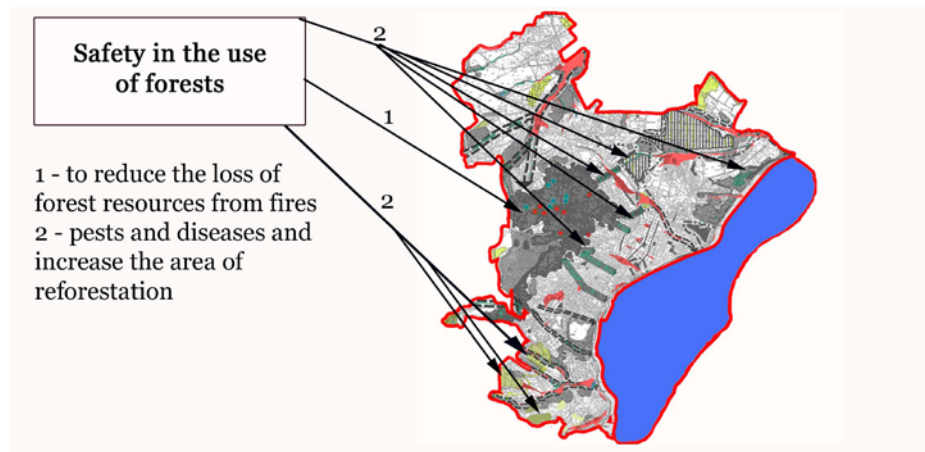


**Figure 3.** Security in land use (facilities under threat).

## 2.2. Safety in the use of forests.

Threats: reduction of losses of forest resources from fires, pests and diseases. Counter threat - decreases of forest area affects air quality [5], soil condition (ravines grow, leaching of the fertile layer), reduction of water flow in rivers, as well as increased greenhouse effect. The goal of safety in the use of forests is to increase the area and quality of forest plantations. Objectives: to reduce the loss of forest resources from fires, pests and diseases and increase the area of reforestation.

Places to ensure the security in one location of the most dangerous areas: areas of industrial facilities, green areas along the banks of water bodies, decreasing urban forests (green areas).

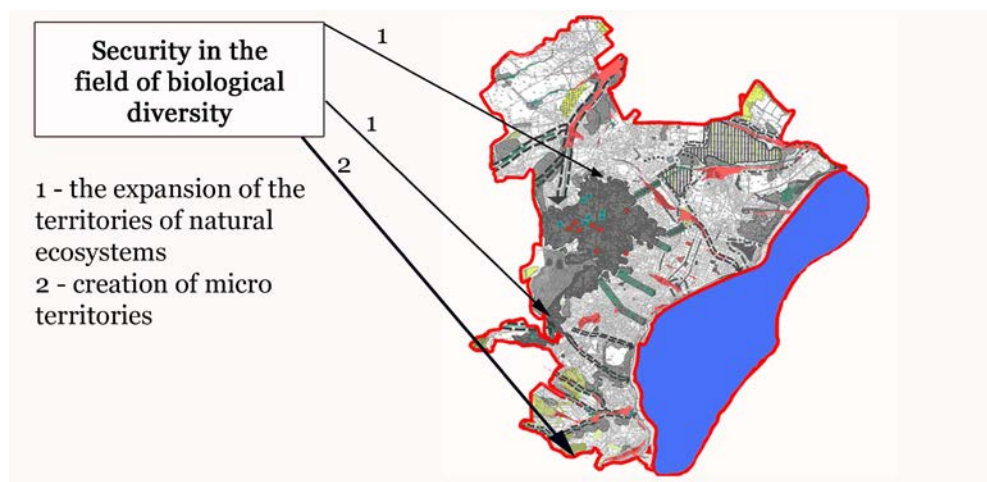


**Figure 4.** Security in the use of forests (facilities under threat).

## 2.3. Security in the field of biological diversity.

Threats: changes in biodiversity (including due to population growth and the seizure of natural areas) [6]. The purpose of security in the field of biological diversity is the preservation of biological diversity. Objectives: the expansion of the territories of natural ecosystems; creation of micro territories where economic activity is not performed (micro reserve, natural monuments, micro parks).

Places to ensure the security in one location of the most dangerous areas: urban forests (green areas), border areas - areas of the seizure of natural territory by industrial facilities.

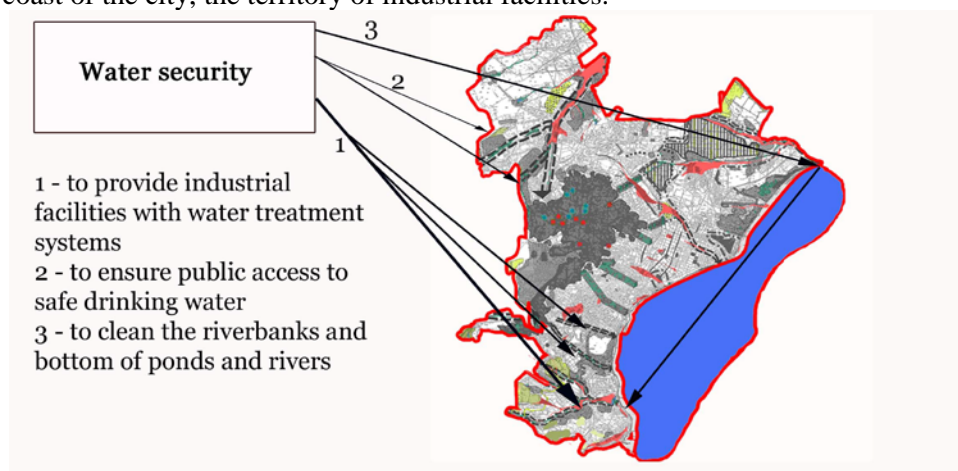


**Figure 5.** Security in the field of biological diversity (objects under threat).

## 2.4. Water security.

Threats: polluted drinking water, transboundary pollution, extreme events (floods) [7]. The Volga River as the longest river and one of the most polluted in Europe is a good example of a cumulative effect: excessive water use, poor wastewater treatment and industrial facilities on the bank. The pollution of the Volga subsequently leads to pollution of the Caspian Sea, which receives more than 85% of the fresh water of the Volga [8]. The purpose of water security is to prevent water pollution, improve water quality in water bodies, and restore aquatic ecosystems. Tasks: to provide water supply and sewage systems; to provide industrial facilities with water treatment systems; to ensure public access to safe drinking water; to clean the riverbanks and bottom of ponds and rivers from past clogging.

Places to ensure the security in one location of the most dangerous areas: the Volga coastline along the entire coast of the city, the territory of industrial facilities.



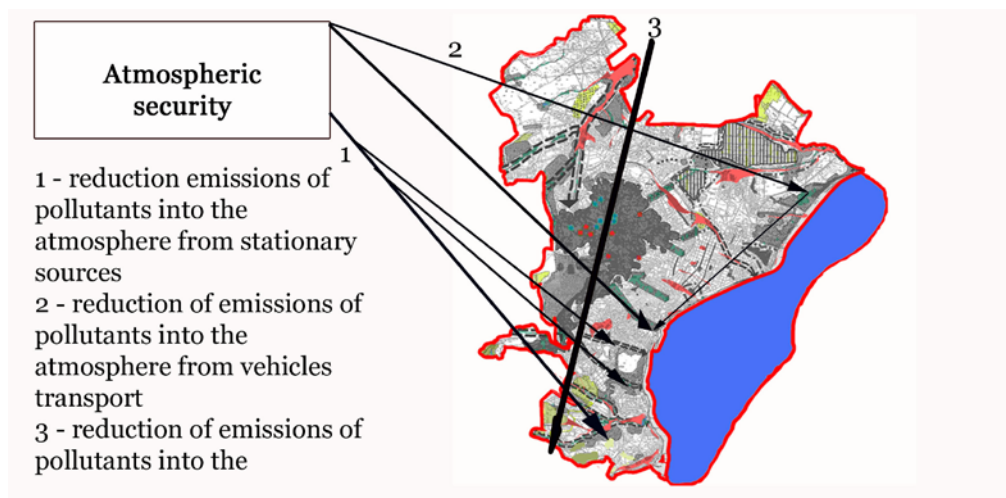
**Figure 6.** Water security (facilities under threat).

## 2.5. Atmospheric security.

Threats: air pollution. Causes: overcrowding, excess transport (according to ecologists, more than 90% of air pollution is accounted for by road transport [8]), emissions of pollutants from industrial facilities. The goal of atmospheric safety is to prevent further pollution and reduce the level of air pollution. Objectives: reduction emissions of pollutants into the atmosphere from stationary sources; reduction of emissions of pollutants into the atmosphere from vehicles and railway transport.

Places to ensure the security in one location of the most dangerous areas: industrial facilities, roads, railways.



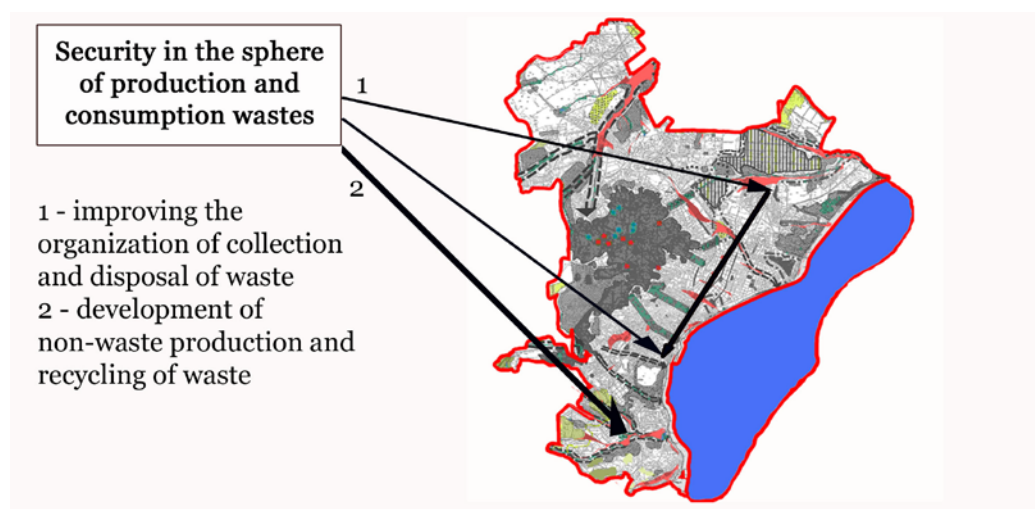


**Figure 7.** Atmospheric security (facilities under threat).

## 2.6. Security in the sphere of production and consumption wastes.

Threats: the formation of a significant amount of waste with a low level of recycling, a large number of legal and illegal landfills [9]). Counter threat: air pollution due to landfill gas emissions [10]); soil and groundwater pollution. The goal of safety in the field of production and consumption wastes is to increase the level of waste disposal and to eliminate accumulated waste. Objectives: improving the organization of collection and disposal of waste; improving the organization of recycling and recycling of household and industrial waste; development of non-waste production and recycling of waste.

Places to ensure the point security of the most dangerous areas: populated areas of the city, landfills, and industrial facilities.



**Figure 8.** Security in the field of waste production and consumption (facilities under threat).

In addition to these types of security that can be provide systematically in one location and depending on the levels of the threat, can be called several types of security. They should not be provided in some areas of the city but in the region as a whole: radiation security, chemical security. However, in order to determine the most dangerous places in the city that require an early response and building such security system that requires data on radioactive and chemical pollution, which is

very difficult to obtain. In this regard, these types of security require independent research and development.

### 3. Conclusions

Thus, by comparing the safety system schemes on the map of the city's ecological development model, we can easily integrate safety issues into the environmental development program. Our assumption about the local solution of problems is confirmed in the question of the location of security systems. Environmental security should not be "horizontal" - in a continuous way over the entire territory of the city, but "vertical" - in the most dangerous places, depending on the threats. For example, in the southern part of the city are concentrated all the main threats - soil pollution with heavy metals, water pollution from sewage, air pollution from industrial enterprises, and reduction of forests. Consequently, this particular area should be safe with the involvement of the largest part of finances and people.

Thus, the Program for the environmental development of virtually any urbanized territory in Russia must include the Environmental Security Program. It consists of the following systems: Security in the use of forests, Security in the field of land use, Atmospheric security, Security in biodiversity, Water security, Security in the sphere of industrial and industrial waste, Radiation security, Chemical security.

In addition to the formal inclusion of security issues in urban development programs, it is necessary to solve problems in the following areas:

- improvement of the regulatory legal framework;
- solving issues of financial environmental security;
- improvement of the administrative and legal basis for ensuring safety (revealing facts of evasion of state and local authorities from fulfilling their obligations to ensure environmental security);
- development of a system of measures aimed at the prevention of offenses in the field of environmental security.

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