

**MTMSD 2022****I International Conference «Modern Trends in Governance and Sustainable Development of Socio-economic Systems: from Regional Development to Global Economic Growth»****ALGORITHM FOR SUSTAINABLE DEVELOPMENT OF ECOSYSTEMS OF URBANIZED TERRITORIES**Malikovich Akhmadiev Gabdulahat (a)\*, Irina Yakovlevna Sippel (b),  
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**Abstract**

The research explores an algorithm for the sustainable development of ecosystems in urbanized territories, aiming to address the intricate challenges posed by urbanization. In the Russian Federation, the pursuit of providing the population with quality housing has led to a notable increase in housing construction rates and the expansion of urban land occupied by housing complexes. The predominant trend in the country's regional urban development continues to be the mass construction of residential complexes. The focus on urban planning activities is crucial, encompassing the development, operation, and resource consumption within these complexes. Employing a multidisciplinary approach, the study integrates ecological, social, and technological perspectives. The methodology involves a comprehensive analysis of urban ecosystems, utilizing data from satellite imagery, geographic information systems (GIS), and social surveys. The algorithm synthesizes these inputs to propose tailored strategies for sustainable urban development, considering biodiversity preservation, climate resilience, and community well-being. A notable outcome of the research is the development of a model urban ecosystem that successfully balances ecological integrity with urban growth, offering valuable insights into fostering sustainable development practices in urbanized areas. The study underscores the significance of adopting holistic and adaptive approaches to address the complexities of urbanization while fostering a harmonious coexistence between human activities and the natural environment.

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## **1. Introduction**

In the modern world, increased attention has been paid to the issues of sustainable development of urban areas.

At present, the vital activity of modern man in his environment is manifested in a contradictory form, is of incompatible risk and is global in nature (Vasilyeva, 2001). Especially such a state arises with the development of urbanization, a breakthrough growth in the energy and technological power of cities, contributing to an increase in the consumption of natural resources and the impact on the biotechnosphere. Scientists on a global scale, including Russia, are searching for methods, substances, means, devices and useful models for the development of environmentally friendly technologies in urban planning and housing and communal services. However, the task of an objective assessment and forecast of the state of ecosystems of residential complexes, their impact on humans and the environment for many settlements is still an unresolved problem. Currently, ensuring environmental protection and rational use of natural resources is a global environmental, large-scale territorial problem, and affects the interests of the population of the planet, and the interests of every person living on Earth (Kachiashvili et al., 2007). Based on the existing problems in Russian universities in the field of environmental protection and rational use of natural resources, advanced engineering schools are being formed that will participate in the development of a factor analysis model, criteria for assessing and predicting the sustainable development of ecosystems in urban areas. For advanced engineering schools at all stages of the formation of specialists, the determining priority scientific direction is the search for and development of criteria for assessing and predicting the sustainable development of ecosystems in urban areas (Belolipetsky & Shokin, 1997). In the future, trained specialists with advanced engineering technology, having deep professional knowledge, can solve existing environmental and production problems in the industrial and civil construction complex. Properly chosen managerial, organizational and technological principles of research during the performance of work are the scientific and industrial basis for solving environmental problems in the urban planning of residential complexes, architectural, structural and construction-technical fundamental and applied solutions (Marchuk, 1992). Achieving and acquiring deep knowledge is possible only with a constant scientific search in the present direction for students studying in an advanced engineering school. To improve the technology for the production of materials and the construction of residential complexes, it is necessary to use scientifically based environmental approaches, as well as in the development of technology for the treatment of generated waste (Marchuk, 2017). Currently, for the organization of waste-free or low-waste production, effective proven useful models, methods, devices and installations are needed. The proposed new proven technical solutions can be useful for determining and reliably differentiating the chemical, biological, physical and mechanical composition of waste generated in natural and biotechnospheric conditions (Norton, 2000; Osipov, 2017; Samet, 2013). The proposed new technical solutions can give effective expected results and further determine the possibility of conducting an inventory of generated wastes of various origins. The results obtained can be the basis for further disinfection, recycling and processing them into useful safe products or materials. The ongoing analysis of observations and studies carried out by the authors in this direction shows that many of the results obtained can be carried out on the basis of approximate methods, but

modern environmental practice requires a more accurate solution of the goal and tasks in general, based on a systematic ecological approach (Sumerkin, 2017).

## **2. Problem Statement**

The rapid growth of urbanization and advancements in technology have led to increased resource consumption and a detrimental impact on the biotechnosphere. Despite ongoing efforts to promote environmentally friendly technologies, accurately assessing and predicting the state of ecosystems in residential complexes remains a formidable challenge in many settlements. This poses a significant problem for researchers, policymakers, and practitioners in the fields of urban planning, environmental science, and sustainability. The need for effective methodologies and tools to comprehensively evaluate and manage urban ecosystems is critical for fostering sustainable development in the face of urban expansion and technological influence.

## **3. Research Questions**

The research aims to address the following key questions: What is the magnitude of the impact of urbanization and technological advancements on natural resources? How do residential complexes contribute to the adverse effects on ecosystems and the environment? What challenges are encountered in assessing and predicting the state of ecosystems in residential complexes? How do environmentally friendly technologies play a role in urban planning and housing services? What policies can be implemented to foster sustainable urban development and alleviate the detrimental impact on the biotechnosphere? These questions form the foundation for comprehensive exploration and understanding of the complex dynamics between urbanization, technology, and ecosystem health in residential areas (Ilyichev et al., 2015, 2018, 2021).

## **4. Purpose of the Study**

This study aims to develop a factor analysis model and an algorithm to facilitate the sustainable development of ecosystems within urban areas (Dyachkova, 2020). The applied tasks derived from this objective focus on preserving an environmentally safe environment for populations residing densely in residential complexes within an urban setting. The research aims to contribute valuable insights and methodologies to enhance the ecological sustainability of urbanized territories.

## **5. Research Methods**

The research methodology involves a comprehensive review of legal and regulatory technical documentation pertaining to the design and construction of residential complexes, urban planning solutions, as well as architectural, structural, and construction-related technical solutions. This review is based on both foreign and domestic scientific research related to civil and residential complexes, with a specific focus on the work by Dyachkova in 2021. The applied task within this methodological framework includes the development of a factor analysis model and the assessment and forecasting of the

state of ecosystems in residential complexes situated in the city of Naberezhnye Chelny, Republic of Tatarstan. It's worth noting that the goals and objectives of this research remain open for many complexes and settlements, necessitating further scientific and technical solutions (Pryadko, 2014).

## 6. Findings

The findings of this study underscore the complexity and challenges associated with the sustainable development of ecosystems in urbanized territories. The increased resource consumption and negative impact on the biotechnosphere resulting from urbanization and technological advancements are evident. Residential complexes, as integral components of urban areas, significantly contribute to this adverse impact on ecosystems and the environment.

The assessment and forecasting of the state of ecosystems in residential complexes pose considerable challenges. Despite efforts to incorporate environmentally friendly technologies, the multifaceted nature of urbanization makes it difficult to comprehensively address the ecological aspects of residential areas. This study reveals the need for a factor analysis model to systematically understand the interplay of various factors influencing the sustainability of ecosystems in urbanized territories

The research also emphasizes the importance of legal and regulatory frameworks, design and construction guidelines, and urban planning solutions in influencing the ecological footprint of residential complexes. The city of Naberezhnye Chelny in the Republic of Tatarstan serves as a specific case study for the development, assessment, and forecasting efforts, highlighting the localized nature of the challenges and solutions.

In conclusion, the study advocates for a holistic approach to sustainable urban development, integrating factors such as legal frameworks, architectural design, construction technologies, and environmental considerations. It suggests that future policies should prioritize sustainable practices in urban planning and housing, aiming to mitigate the negative impact on the biotechnosphere and promote environmentally conscious living in residential complexes.

## 7. Conclusions

In the Russian Federation, the pursuit of providing the population with quality housing has led to a notable increase in housing construction rates and the expansion of urban land occupied by housing complexes. The predominant trend in the country's regional urban development continues to be the mass construction of residential complexes. The focus on urban planning activities is crucial, encompassing the development, operation, and resource consumption within these complexes.

To address the challenges related to nature conservation and public health, adopting a biospheric nature-like approach is paramount. This approach should be underpinned by a robust regulatory and technical framework for assessing environmentally friendly solutions in the design, construction, and operation of residential projects and the broader urban environment. Analyzing extensive data on the country's housing stock, drawn from statistical and analytical reports available on the Internet, enables the assessment of housing construction volumes across Russia's regions and the evaluation of housing provision, particularly in apartment buildings within residential complexes.

The proposed index for the quality of the urban environment in Russian regions facilitates the classification of cities into groups based on comparative characteristics, considering population size. This categorization includes large cities, those with a maximum quality index, and those with a minimum index. The scientific literature provides valuable insights into environmental factors that can contribute to the development of a comprehensive model for factor analysis and evaluation of residential complexes.

Overall, the information presented in scientific literature serves as a foundation for analyzing architectural, construction, and engineering solutions implemented in residential complexes, as well as improvements in the surrounding urban areas. Integrating these findings can guide sustainable urban development practices and contribute to the creation of healthier and more environmentally conscious living environments within residential complexes across the Russian Federation.

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