ENVIRONMENTAL PROTECTION OF PERI-URBAN AREAS UNDER RAPID URBANIZATION CONDITIONS

Shokhbozjon Khaydarov
Senior lecturer at the Department of urban planning Samarkand State Architecture and Construction University named after Mirzo Ulugbek (SamSACU), Lolazor str. 70, 140143 Samarkand, Uzbekistan.
Togaymurodov Zavkiddin,
Samarkand State Architecture and Construction University named after Mirzo Ulugbek (SamSACU), Lolazor str. 70, 140143 Samarkand, Uzbekistan.
Irisov Ruzimurod
Students of the urban construction and design educational direction Samarkand State Architecture and Construction University named after Mirzo Ulugbek (SamSACU), Lolazor str. 70, 140143 Samarkand, Uzbekistan.
E-mail : haydarov.shoxbozjon@samdaqu.edu.uz

Abstract. Rapid urbanization significantly increases anthropogenic pressure on peri-urban environments, resulting in environmental degradation and economic losses. This study analyzes the ecological impacts of urban expansion and industrial concentration in peri-urban areas and proposes scientifically grounded approaches for environmental protection. The research integrates ecological assessment with economic evaluation methods to identify major pollution sources, resource consumption patterns, and environmental consequences. The results demonstrate that multi-level environmental protection measures embedded in urban and regional planning can improve environmental quality and support sustainable territorial development. The proposed framework is particularly relevant for rapidly growing cities in developing countries, including Uzbekistan.

Keywords. peri-urban areas, environmental protection, urbanization, ecological assessment, sustainable development.

Аннотация. Стремительная урбанизация значительно увеличивает антропогенную нагрузку на пригородную среду, что приводит к ухудшению состояния окружающей среды и экономическим потерям. В данном исследовании анализируются экологические последствия расширения городов и концентрации промышленности в пригородных районах и предлагаются научно обоснованные подходы к охране окружающей среды. Исследование объединяет экологическую оценку с методами экономической оценки для выявления основных источников загрязнения, моделей потребления ресурсов и экологических последствий. Результаты показывают, что многоуровневые меры по охране окружающей среды, включенные в городское и региональное планирование, могут улучшить

ISSN 3030-3907

качество окружающей среды и поддержать устойчивое развитие территорий. Предлагаемая концепция особенно актуальна для быстро растущих городов в развивающихся странах, включая Узбекистан.

Ключевые слова. пригородные территории, охрана окружающей среды, урбанизация, экологическая оценка, устойчивое развитие.

Annotatsiya. Tez sur’atlarda kechayotgan urbanizatsiya jarayoni shahar atrofi hududlarida antropogen bosimning keskin ortishiga olib kelib, ekologik degradatsiya va iqtisodiy yo‘qotishlarni yuzaga keltirmoqda. Mazkur tadqiqot shaharlarning kengayishi va sanoat faoliyatining shahar atrofi hududlarida jamlanishi natijasida yuzaga keladigan ekologik ta’sirlarni tahlil qiladi hamda atrof-muhitni muhofaza qilish bo‘yicha ilmiy asoslangan yondashuvlarni taklif etadi. Tadqiqot doirasida ekologik baholash usullari iqtisodiy tahlil metodlari bilan uyg‘unlashtirilib, asosiy ifloslanish manbalari, resurslardan foydalanish xususiyatlari va ekologik oqibatlar aniqlangan. Olingan natijalar shuni ko‘rsatadiki, shahar va hududiy rejalashtirish jarayonlariga integratsiyalashgan ko‘p bosqichli ekologik muhofaza choralari atrof-muhit sifatini yaxshilash hamda hududlarning barqaror rivojlanishini ta’minlashga xizmat qiladi. Taklif etilgan konseptual yondashuv, xususan, O‘zbekiston kabi rivojlanayotgan mamlakatlarning tez o‘sib borayotgan shaharlarida qo‘llash uchun dolzarb hisoblanadi.

Kalit so‘zlar. shahar atrofi hududlari, atrof-muhitni muhofaza qilish, urbanizatsiya, ekologik baholash, barqaror rivojlanish.

1. INTRODUCTION.

Urbanization is one of the most influential global processes reshaping natural landscapes, settlement systems, and socio-economic structures. Peri-urban areas—located at the interface between urban and rural zones—are especially vulnerable to environmental pressure due to intensive land-use change, infrastructure expansion, industrial activities, and population growth.

According to United Nations forecasts, urban areas will continue to accommodate the majority of the global population and generate a dominant share of global economic output. As cities expand spatially, peri-urban territories experience increasing levels of air, water, and soil pollution, depletion of natural resources, and degradation of ecosystems. These challenges require the integration of environmental protection mechanisms into urban and regional planning systems.

This study aims to develop a comprehensive framework for protecting peri-urban environments under rapid urbanization conditions through ecological and economic assessment approaches.

2. MATERIALS AND METHODS.

ISSN 3030-3907

The research adopts a multidisciplinary methodological approach combining urban planning theory, environmental analysis, and economic evaluation. The study focuses on identifying anthropogenic pressures in peri-urban areas and assessing their environmental and economic impacts.

A conceptual framework was developed to analyze the interaction between rapid urbanization, environmental degradation, and protection measures.

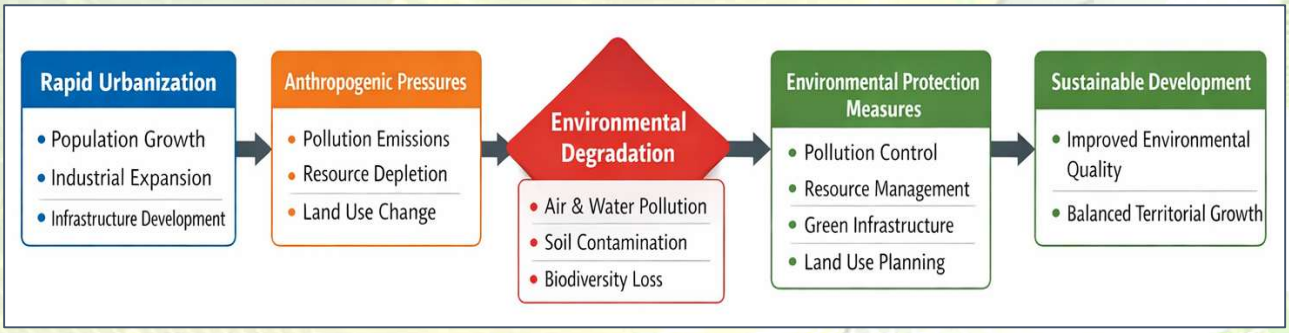


Figure 1. Conceptual framework illustrating the relationship between rapid urbanization, anthropogenic pressures, environmental degradation, and environmental protection measures in peri-urban areas.

The assessment methodology includes:

- analysis of pollution sources associated with industry, transport, and energy systems;
- evalution of resource consumption and waste generation in large urban systems;
- ecological assessment of air, water, soil, and vegetation conditions;
- economic evaluation of environmental damage across key sectors.

3. RESULTS.

3.1 Environmental Impacts of Rapid Urbanization

The results show that large urban systems concentrate industrial enterprises, energy infrastructure, and transportation networks, which collectively generate significant environmental pressure on peri-urban territories. Pollutants produced within cities often disperse beyond administrative boundaries due to atmospheric and hydrological processes.

ISSN 3030-3907

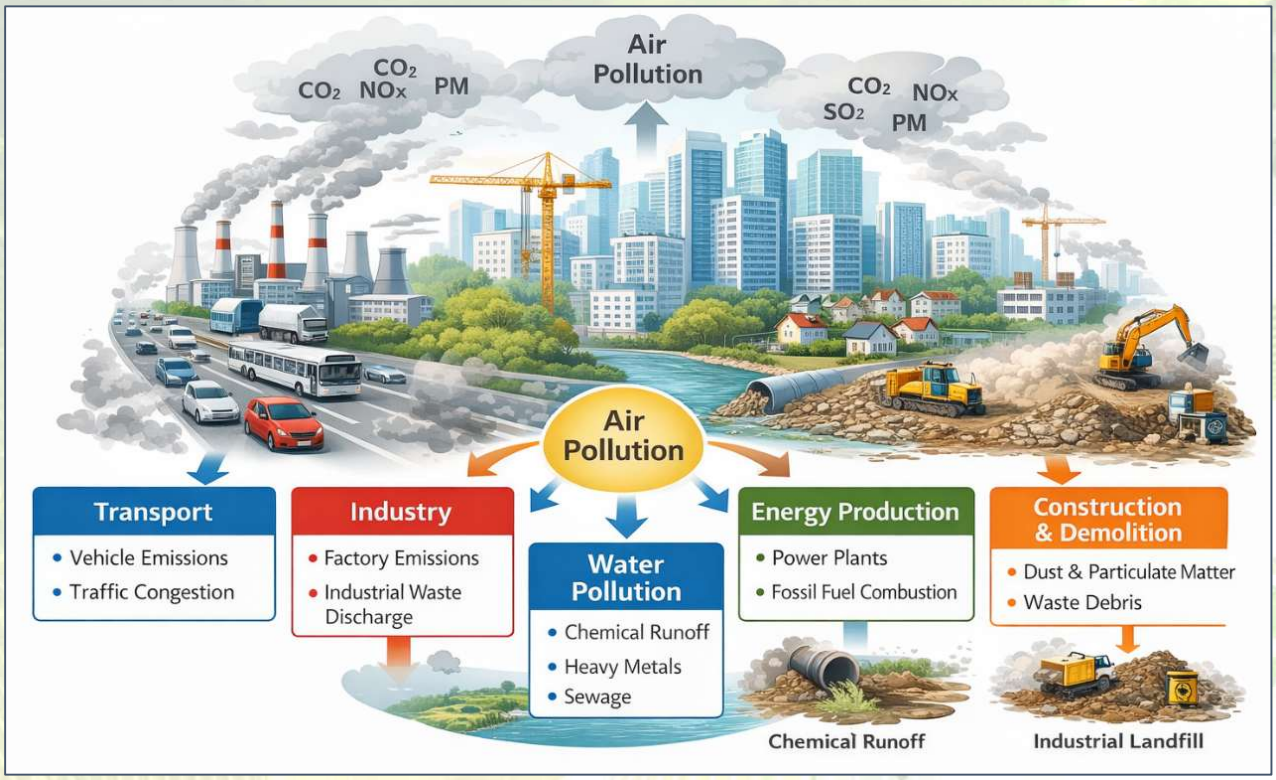


Figure 2. Major sources of environmental pollution affecting peri-urban areas under rapid urban expansion.

The main environmental impacts observed include air pollution from transport and industry, contamination of water bodies through wastewater discharge, soil degradation due to construction and waste disposal, and loss of vegetation cover.

Table 1.

Environmental impacts of rapid urbanization in peri-urban areas

Environmental component	Type of impact	Main cause	Consequences
Atmospheric air	Emission increase	Transport, industry	Health risks, climate effects
Water resources	Pollution	Wastewater discharge	Ecosystem degradation
Soil	Contamination	Construction, waste	Reduced fertility
Vegetation	Degradation	Land-use change	Biodiversity loss

3.2 Resource Consumption and Waste Generation

Cities with populations of approximately one million consume vast quantities of natural resources while generating large volumes of waste on a daily basis. These flows significantly influence environmental conditions in peri-urban zones.

ISSN 3030-3907

Table 2.

Estimated daily resource consumption and waste generation in a large city

Indicator	Approximate value per day
Oxygen consumption	31.5 thousand tons
Water consumption	625 thousand tons
Fuel consumption	9.5 thousand tons
CO_2 emissions	28.5 thousand tons
Wastewater discharge	500 thousand tons
Solid waste	>10,000 tons

3.3 Spatial Dispersion of Environmental Impacts

Environmental impacts generated in urban centers extend far beyond city boundaries. Airborne pollutants and contaminated water flows reach peri-urban and regional territories, forming cumulative environmental stress zones.

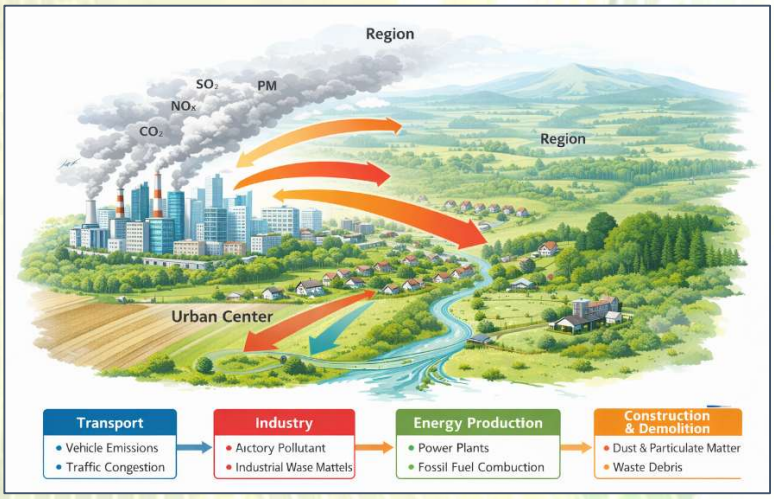


Figure 3. Spatial dispersion of pollutants from urban centers to peri-urban and surrounding regional territories.

4. DISCUSSION

The interaction between urban development and peri-urban environments demonstrates both negative and adaptive dynamics. While dense urbanization intensifies ecological stress, advanced planning tools and technological capacity provide opportunities for mitigation.

ISSN 3030-3907



Figure 4. Contrasting urban pollution with green city living traffic and air quality in sustainable cities Premium AI-generated image

Environmental protection must be implemented at multiple planning levels.

Table 3.

Hierarchical levels of environmental protection measures

Planning level	Protection measures	Expected outcome
Facility level	Emission control technologies	Reduced pollution
District level	Sanitary protection zones	Improved living conditions
City level	Functional zoning	Balanced land use
Regional level	Landscape protection	Ecological stability

Economic evaluation of environmental damage is a crucial component of sustainable planning. Quantifying losses enables comparison between the costs of environmental degradation and investments in protection measures.

Table 4.

Economic consequences of environmental degradation

Sector	Type of damage	Economic effect
Public health	Increased morbidity	Healthcare costs
Housing and utilities	Infrastructure degradation	Maintenance expenses
Industry	Productivity loss	Economic losses

ISSN 3030-3907

Agriculture	Reduced yields	Food security risks

Although economic assessments involve uncertainty, they provide a necessary analytical basis for policy-making and sustainable urban development strategies.

5. CONCLUSION

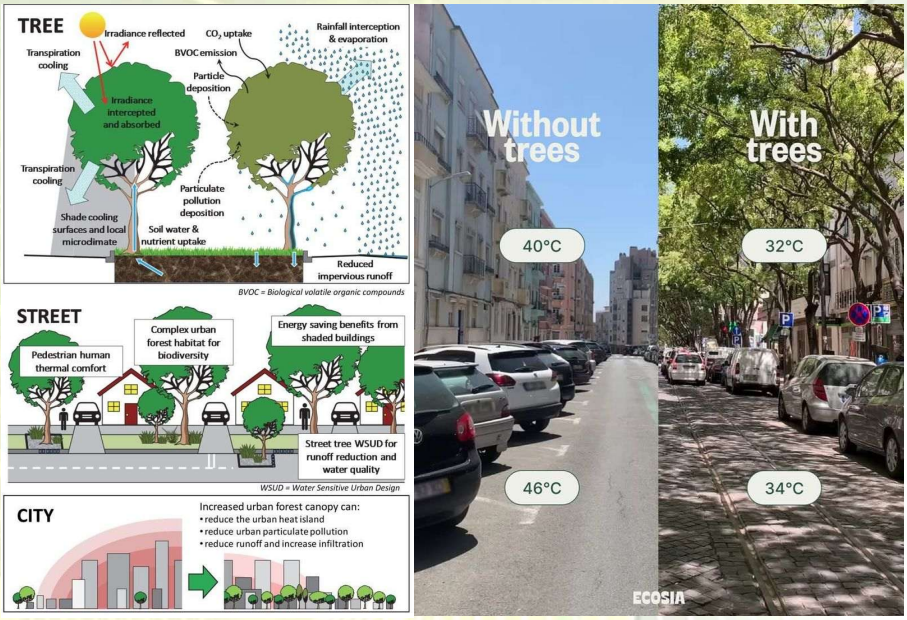


Figure 5. Environmental and thermal regulation benefits of urban trees, illustrating their role in reducing air pollution, surface temperatures, and urban heat island effects through shading, evapotranspiration, and improved microclimatic conditions in peri-urban and urban street environments.

The study confirms that protecting peri-urban environments is a critical component of sustainable urban development under rapid urbanization conditions. Integrating ecological assessment with economic evaluation allows for the formulation of scientifically grounded and practically applicable environmental protection measures. Implementation of these measures can significantly improve environmental quality, reduce economic losses, and support balanced spatial development.

The proposed framework is particularly relevant for rapidly growing cities in Uzbekistan and other developing countries. Future research should focus on refining assessment methods and adapting protection strategies to local environmental and socio-economic conditions.

REFERENCES

1. United Nations, Department of Economic and Social Affairs, Population Division. (2019). *World Urbanization Prospects: The 2018 Revision*. United Nations.

ISSN 3030-3907

2. UN-Habitat. (2020). *World Cities Report 2020: The Value of Sustainable Urbanization*. United Nations Human Settlements Programme.
3. Angel, S., Parent, J., Civco, D. L., & Blei, A. (2011). The dimensions of global urban expansion: Estimates and projections for all countries, 2000–2050. *Progress in Planning*, 75(2), 53–107. https://doi.org/10.1016/j.progress.2011.04.001
4. Seto, K. C., Güneralp, B., & Hutyra, L. R. (2012). Global forecasts of urban expansion to 2030 and direct impacts on biodiversity and carbon pools. *Proceedings of the National Academy of Sciences*, 109(40), 16083–16088. https://doi.org/10.1073/pnas.1211658109
5. McGranahan, G., & Satterthwaite, D. (2014). *Urbanisation concepts and trends*. International Institute for Environment and Development (IIED).
6. Douglas, I. (2012). Urban ecology and urban ecosystems: Understanding the links to human health and well-being. *Current Opinion in Environmental Sustainability*, 4(4), 385–392. https://doi.org/10.1016/j.cosust.2012.07.005
7. Tacoli, C., McGranahan, G., & Satterthwaite, D. (2015). Urbanisation, rural–urban migration and urban poverty. *Human Settlements Working Paper Series*. IIED.
8. Foley, J. A., et al. (2005). Global consequences of land use. *Science*, 309(5734), 570–574. https://doi.org/10.1126/science.1111772
9. Grimm, N. B., et al. (2008). Global change and the ecology of cities. *Science*, 319(5864), 756–760. https://doi.org/10.1126/science.1150195
10. OECD. (2018). *Rethinking Urban Sprawl: Moving Towards Sustainable Cities*. OECD Publishing. https://doi.org/10.1787/9789264189881-en
11. World Health Organization. (2016). *Ambient air pollution: A global assessment of exposure and burden of disease*. WHO Press.
12. Khaydarov, S. Z., & Achildiev, R. (2023). Organization of one-way traffic on urban roads and its impact on transport efficiency. *Trends and Prospects of Urban Development*, 1(1), 91–94.
13. Rahimov, A., & Khaydarov, S. Z. (2023). Theoretical and experimental studies of seismic protection systems. *Trends and Prospects of Urban Development*, 1(1), 234–236.
14. Akram, I., & Zukhra, K. (2022). Problems and prospects of transport development in Samarkand. *Global Scientific Review*, 3, 19–22.
15. Madiev, F. M., & Khaydarov, S. Z. (2020). Architectural and historical responsibilities of Shakhrisabz city. *European Journal of Geography, Regional Planning and Development*, 1(1), 107–111.

ISSN 3030-3907