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УПРАВЛІННЯ ЗЕЛЕНОЮ ІНФРАСТРУКТУРОЮ УРБОЕКОСИСТЕМ

Актуальність. Суттєві зміни в довкіллі викликають екологічні проблеми, які загострюються, особливо на урбанізованих територіях. Водночас, зростає усвідомлення необхідності призупинення негативних процесів на цих територіях шляхом застосування альтернативних методів та технологій використання природних компонентів для вирішення проблем різного характеру. Зазначеному відповідає концепція зеленої інфраструктури, яка знайшла втілення в багатьох країнах, а застосування її технологій допомогло вирішити екологічні, соціально-економічні проблеми малих та великих міст.

Мета та завдання полягає в обґрунтуванні теоретико-методологічних основ управління зеленою інфраструктурою урбоекосистем.

Матеріали та методи. Системний та структурний аналіз, просторовий та порівняльний аналіз, методи синтезу знань, абстракції та аналогії.

Результати. У статті обґрунтовано визначення зеленої інфраструктури як складової урбоекосистеми, яка об’єднує сукупність природних об’єктів, що виконують економічну, екологічну, безпекову, естетичну, культурну, рекреаційну функції та забезпечує формування сприятливого життєвого простору усім елементам урбоекосистеми. Уточнено сутність та обґрунтовано особливості об’єктів зеленої інфраструктури (стаціонарність, нетранспортабельність, потреба у вкладанні коштів (інвестиційних, експлуатаційних), динамічність у своєму розвитку, здатність до підвищення вартості, інвестиційна привабливість). Обґрунтовано доцільність розгляду зеленої інфраструктури як природних активів міського господарства з усіма передумовами та наслідками (відображення в Генеральних планах розбудови, стратегіях розвитку, планах та проєктах, облік на рахунках муніципалітетів, розподіл відповідальності за створення, експлуатацію, відновлення тощо), що безпосередньо відображається на системі управління зеленою інфраструктурою. Обґрунтовано концептуальні основи формування системи управління зеленою інфраструктурою приморських урбоекосистем як сукупності принципів, методів, критеріїв, засобів, форм та інструментів ефективної взаємодії елементів міського середовища та процесів, які в ньому відбуваються, з метою забезпечення високої якості урбоекосистем загалом, її екологічної безпеки, соціальної привабливості та економічної ефективності зокрема. Розроблено методологічні складові системи управління зеленою інфраструктурою приморських урбоекосистем, а саме: принципи формування, критерії формування та оцінки ефективності; методи, засоби, форми та інструменти забезпечення ефективної взаємодії елементів міського середовища та процесів, які в ньому відбуваються.

Висновки. Сучасна екологічна ситуація виступає обмежувальним чинником як для розвитку суспільства загалом, так і для розвитку окремих територій. Тому, формуючи місію та концепцію розвитку міських територій, всі більше акцентують увагу на екологічній складовій, що включає створення та підтримання зелених зон, впровадження безвідходних технологій, екологічно чистого виробництва, впровадження сучасних технологій енерго- та теплозабезпечення, каніздації та утилізації відходів, тобто використання зеленої інфраструктури. На основі сучасних трендів розвитку зеленої інфраструктури обґрунтовано доцільність та правомірність її використання для поліпшення екологічного середовища, соціально-економічних умов життя та відпочинку, оздоровлення, всебічного розвитку населення міст.

Ключові слова: урбоекосистема, зелена інфраструктура, система управління зеленою інфраструктурою урбоекосистем.
GREEN INFRASTRUCTURE MANAGEMENT OF URBAN ECOSYSTEMS

Topicality. Significant changes in the environment cause aggravation of ecological problems, especially in urban areas. At the same time, there is growing awareness of the need to stop negative processes in these territories by applying alternative methods and technologies of using natural components to solve various problems. This corresponds to the concept of green infrastructure, which has been implemented in many countries, and the use of its technologies has helped to solve the environmental, social and economic problems of small and large cities.

Aim and tasks. The aim of the study is to substantiate the theoretical and methodological foundations for the green infrastructure management of urban ecosystems.

Materials and Methods. System and structural analysis, spatial and comparative analysis, methods of knowledge synthesis, abstraction and analogy.

Research results. The article substantiates the definition of green infrastructure as a component of the urban ecosystem, which unites a set of natural objects that perform economic, ecological, safety, aesthetic, cultural, recreational functions and ensures the formation of a favorable living space for all elements of the urban ecosystem. The essence and specifics of green infrastructure objects are clarified (stationarity, non-transportability, need for financing contribution (investment, operational), dynamism in their development, ability to increase value, investment attractiveness). The study substantiates the expediency of considering green infrastructure as natural assets of the urban economy with all the prerequisites and consequences (display in the General Development Plans, development strategies, plans and projects, recording on the municipalities accounts, distribution of responsibility for the creation, operation, restoration, etc.), which will directly reflect on the green infrastructure management system. The article justifies the conceptual foundations for the formation of the green infrastructure management system of seaside urban ecosystems as a set of principles, methods, criteria, means, forms and tools for effective interaction between the elements of the urban environment and the processes occurring in it in order to ensure the high quality of the urban ecosystem in general, its environmental safety, social attractiveness and economic efficiency in particular. The methodological components for green infrastructure the management system of seaside urban ecosystems have been developed, namely: the principles and criteria for the effectiveness formation and evaluation; methods, means, forms and tools for ensuring effective interaction between elements of the urban environment and the processes occurring in it.

Conclusion. The current environmental situation acts as a limiting factor both for the development of society in general and for the development of individual territories. Therefore, while forming the mission and concept of the urban areas development, more and more emphasis is placed on the ecological component, which includes the creation and maintenance of green areas, the introduction of waste-free technologies, environmentally friendly production, modern technologies of energy and heat supply, sewage and waste disposal, that is, the use of green infrastructure. On the basis of modern trends in the green infrastructure development, authors justified the expediency and legality of its use for the enhancement of the ecological environment, socio-economic conditions of life and recreation, health improvement, and comprehensive development of the urban population are.

Keywords: urban ecosystem, green infrastructure, green infrastructure management system for urban ecosystems.

Problem statement and its connection with important scientific and practical tasks.

The modern world is changing rapidly. The mutual influence in the “society - nature” system is becoming increasingly apparent. Significant changes in the environment are reflected in the quantitative and qualitative parameters of human development, and the growing scale of its activities cause irreversible total changes in the environment. This has led to ecological problems that are worsening, especially in urbanized areas. In Ukraine, the level of urbanization is quite high, as of 01/01/2020 it is equal to 69.54%, in particular, there were 189 Ukrainian cities with the status of
republican and regional significance, and 882 settlements had the status of urban-type settlements (Statistical Yearbook, 2020)\(^1\). The average population density in the country in the pre-war period was 74 persons/km\(^2\), which is not high by European standards.

This indicator is largely formed under the influence of natural conditions, resources and landscapes, which, accordingly, affects the increase in the level of urbanization and the increase of anthropogenic load on the environment. At the same time, there is growing awareness of the need to stop negative processes in urbanized areas by applying alternative methods and technologies of using natural components to solve a variety of problems – from the management of living space in general to certain areas of the urban economy, in particular, the management of stormwater volumes, the creation of green spaces networks etc.

This corresponds to the concept of green infrastructure, which has been implemented in many countries, and the use of its technologies has helped to solve the environmental, socio-economic problems of cities.

**Analysis of recent publications on the problem.**

The appearance of the terminology ecological infrastructure, green infrastructure is associated with the use of new approaches to urban greening, due to the environmental movement in the USA as a new approach to managing living space. Green infrastructure is viewed as "an interconnected network of green spaces that preserves the values and functions of natural ecosystems and provides the associated benefits to the public" (Benedict M. A. & McMahon E. T., 2001).

The US Environmental Protection Agency (EPA) has published regulations for MS4 municipal separate sewer systems (EPA, 1990). It was EPA that expanded the concept of green infrastructure to apply it to runoff management through the use of natural and engineered systems that mimic nature. EPA announced a Strategic Agenda for Protecting Water and Building More Liveable Communities through Green Infrastructure and the Selection of Green Infrastructure Partner Communities, identified green infrastructure funding opportunities (Schueler T., 1987).


The US President's Council on Sustainable Development identified green infrastructure as one of the key strategies for achieving sustainable development (Benedict, M. A. & McMahon, E., 2006), which gave a new impetus to the formation of the concept and meaningful content of this concept.

In Sweden, the concept of green infrastructure has expanded on the basis of the principle of multifunctionality, that is, the creation of a multifunctional urban environment, which includes the following components: technical, blue-green infrastructure, ecosystem services. This contributed to the formation of a complex system of energy supply, water supply and waste disposal and the performance of such a function as the formation of the microclimate of the urban environment and its aestheticization (Maksymenko N. V. & Burchenko S. V., 2019).

The development of the concept of green infrastructure was significantly influenced by the modern theory and methodology of ecosystem services (early 2000s). The provision of ecosystem services is considered by many scientists as one of the main criteria for classifying territories and objects as green infrastructure (Ecosystems and Human Well-Being, 2003). Arguments for using this approach are the close connection of green infrastructure with ecosystem services that provide environmental, social and economic benefits. Therefore, most scientific publications deal with the assessment of ecosystem services of green infrastructure (Liquete C. et al., 2015). The authors (Liquete C. et al., 2015) believe that all ecosystems outside the urban environment should not be classified as green infrastructure. The selection is based on the multifunctionality of ecosystem services and relationships that support the preservation of ecological networks.

The work (Maes J., Barbosa A., Baranzelli C. et

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\(^1\) The map of Ukraine clearly shows urbanized zones and areas where they are absent. For example, a low population density is observed in the territory with the highest coefficient of forest cover and wetlands, correspondingly, in these territories there are smaller areas of fertile land. In particular, this situation is observed in certain districts of Kyiv, Zhytomyr, Volyn, Rivne, Sumy and Chernihiv regions. The population density is low in the mountainous areas of the Carpathian and Crimean mountains. The same applies to the arid regions of our country - the Kherson steppes, certain regions of Odesa, Mykolaiiv, Zaporizhzhya, and Kryvorizka regions.

High population density is characteristic of areas with favorable climatic conditions, located near water sources, mineral, recreational and other resources. Highly urbanized areas include: Kyiv, Kharkiv, Dnipropetrovsk, Odesa, and Lviv regions.
al., 2015) links green infrastructure with land use and the ability of landscapes to provide ecosystem services. The result of the study is a reference scenario that reflects changes in land use and green infrastructure in Europe for 2020 and 2050.

Most of the studies on the allocation of territories and objects of green infrastructure concern urban areas and the use of landscape planning tools, mapping, GIS technologies (Andreucci M. B., 2013; Mell Ian, 2011; Karsten Rusche, Mario Reimer, Rico Stichmann, 2019).

Based on the results of the research, the main goals of green infrastructure management are the preservation of biodiversity, maintenance of sustainability of ecosystems and ecosystem services, social well-being, support of green economy and sustainable management of land and water resources.

Allocation of previously unsolved parts of the general problem.
The conceptual foundations for the development of green infrastructure and the basic principles for managing its components and objects were formed under the influence of increasing attention to the qualitative state of individual natural components of urban ecosystems. Nevertheless, among the unresolved problems of the development of green infrastructure management, there remain issues of methodological support for the consistency and complexity of such management, the content and essential characteristics of green infrastructure.

Formulation of research objectives (problem statement).
The purpose of the study is to substantiate the essence of the green infrastructure management system of urboecosystems. To realize the goal, the following tasks have been set: to determine the essence and content of green infrastructure as a priority for the development of urban ecosystems; to develop the theoretical and methodological foundations of the formation of the management system of the green infrastructure of urboecosystems, which involves the definition of its subjects, objects, fundamental principles, criteria, tools of formation and ensuring functioning.

Materials and Methods.
The development of the theoretical foundations for the management of green infrastructure facilities was carried out on the basis of a systemic-structural analysis, which allowed a comprehensive consideration of these processes; comparative analysis was used to determine the tools of strategic environmentally oriented management, methods of knowledge synthesis, abstraction and analogy – to justify a set of regulatory tools to stimulate the development of green infrastructure.

An outline of the main results and their justification.
Modern urboecosystems are characterized by high dynamism of socio-economic relations, information exchange and significant weakening of natural mechanisms of self-renewal. The organization of the elements of the urban ecosystem is ensured by the appropriate set of intra-system connections and mechanisms for the implementation of managerial influence.

To substantiate the essence of green infrastructure, the following generally accepted provisions are taken into account (Table 1).

<table>
<thead>
<tr>
<th>Explanation of the term &quot;green infrastructure&quot;</th>
<th>Authors</th>
<th>Note</th>
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<tbody>
<tr>
<td>A network of objects that provide &quot;components&quot; for solving territorial and climate problems is a prerequisite for the implementation of the principle of &quot;building with nature&quot;.</td>
<td>J. Foster, H. Foster, A. Lowe, S. Winkelman</td>
<td>Green infrastructure</td>
</tr>
<tr>
<td>A tool that provides water quality management, air quality improvement, measures to adapt to climate change, stable production of environmentally clean energy, reduction of heat loss, construction of energy-saving structures, increase of biodiversity, production of ecologically clean food products, ensuring ecologically balanced use of water resources and resources soils</td>
<td>US Environmental Protection Agency</td>
<td>Green infrastructure management</td>
</tr>
<tr>
<td>Potential green assets or their physical components or the benefits they bring, may be man-made, natural or semi-natural, and may vary in scale</td>
<td>EEA Technical Report &quot;Green Infrastructure and Territorial Unity&quot;</td>
<td>Green infrastructure</td>
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</table>
A means of maintaining a healthy ecosystem in certain areas so that they can continue to provide valuable benefits to society, such as clean air and fresh water. The international Natura 2000 development program "The new European Green Deal". Green infrastructure management

A concept related to the spatial structure of natural and semi-natural areas, as well as other ecological features that enable citizens to benefit from a variety of services. «Natural Water Retention Measures». Green infrastructure

Natural systems such as forests, floodplains and soils that, when used properly, can contribute to clean, reliable water supplies and protection against floods and droughts. World bank. Green infrastructure

A set of natural objects with a healthy ecosystem (healthy forests, wetlands, coral reefs, etc.). World Resources Institute. Green infrastructure

A tool whose integration into the main planning of projects and investments can contribute to the cheap and effective improvement of the state of traditional, or "gray" infrastructure. World Resources Institute. Green infrastructure management

An interconnected network of green space that preserves the values and functions of natural ecosystems and provides the associated benefits for the public. Benedict M. A., McMahon E. T. Green infrastructure


Agreeing with the accepted definition of infrastructure in general as a set of management measures, objects, structures, institutions that provide the necessary production, material and cultural and household needs of people, we will use object-subject and component approaches in the study, which involves specifying above concepts.
and ensures the formation of a favorable life space with all elements of the urban ecosystem.

Objects of green infrastructure have a number of characteristics: they are stationary, non-transportable, not capable of accumulation, have peculiarities in preservation, or preservation is impossible at all. Their formation, maintenance in proper condition and use requires investment of funds (investment, operating), which can be multi-variant with significant seasonal fluctuations in volumes.

Objects of green infrastructure are closely related to the land, most of them are dynamic in their development, therefore they have the property of increasing value. Factors such as the shortage of land plots in cities, antagonism of interests in their use, and inflationary processes also affect the increase in value. That is, they are attractive for investment and can be considered as an investment object that brings income.

So, the main characteristics of green infrastructure facilities are:
- multifunctional purpose;
- functioning in material and value forms;
- territorial localization, a high degree of preservation of natural forms and properties, as well as their uniqueness;
- the presence of investment and consumer value, which is formed under the influence of natural factors and human labor;
- provision of physiological, social, intellectual, cognitive, cultural and aesthetic needs of a person;
- the use of the same resource or territory in a certain form for a long time, with the possibility of providing different services;
- different effect from consumption (use) for different purposes.

The above determines the expediency of considering green infrastructure as natural assets of the city economy with all the prerequisites and consequences (reflection in General development plans, development strategies, plans and projects, accounting in the accounts of municipalities, distribution of responsibility for creation, operation, restoration, etc.), which will be directly reflected on to the green infrastructure management system.

As mentioned, the development of the theoretical and methodological foundations of the formation of the green infrastructure management system of urban ecosystems involves the definition of its subjects, objects, fundamental principles, criteria, tools of formation and ensuring functioning, which will allow to offer an author's definition and meaningful filling of this system.

The management system of the green infrastructure of urboecosystems should be based on the following principles:
- greening of urban planning activities;
- integrity and stability (self-sufficiency);
- inclusiveness;
- capitalization of ecosystem services;
- optimization of society's life activities
- balance of economic, environmental and social interests at all levels of management;
- bioethics as mental transformations of worldview and ecologically oriented (green) movements, which are a manifestation of an active and conscious civil society.
- economic-ecological optimism, which asserts social dominance, socio-economic progress and progressive development of society in harmony with nature based on the system of economic-ecological relations, the main categories of which are "quality of life", "welfare" and others;
- adaptability, since the management system must constantly respond to new challenges and provide the necessary changes in order to improve the living environment;
- risk minimization. Any activity is associated with one degree or another of the probability of a negative impact on the environment in general and the danger of deterioration of the quality of the environment. Risk management involves the study of the causes, factors and characteristics of a particular risk situation in order to minimize negative consequences. This problem is especially acute today, when short-term benefits are taken as the basis of activity;
- orderliness and rationality of actions, which involves determining priorities and carrying out activities in accordance with the developed and adopted strategy, system of strategic, tactical and current plans for the development of the city;
- limited opportunities, which implies the need to allocate resources, primarily investment resources, for the implementation of the most important projects and measures for the formation of an environmentally safe, socially attractive and economically efficient city;
- preventiveness as the monitoring of the ecological imperative in the activities of all stakeholders at all stages of the management process in order to prevent the deterioration of the ecological situation and the quality of the urban ecosystem;
- responsibility as a clear establishment of responsibility both for incorrect decisions made, especially of a corrupt nature, and for low-quality work in the field of urban construction and economy.

These principles require a review of existing
approaches to the management of the green infrastructure of the urban ecosystem.

First, the object of management must be clearly defined, which is one of the most problematic issues of green infrastructure management. That is, it is advisable to compile registers of such objects, which are based on a unified approach to defining the essence of the green infrastructure of urboecosystems, in order to ensure compliance with the use of terms in new legislative acts, cadastres, regulations, and state standards.

Secondly, the object of management must have clear physical boundaries, quantitative and qualitative parameters, organizational and territorial affiliation and subordination.

Thirdly, an important aspect is the formation of the valuation of green infrastructure objects as assets of the city economy and their capitalization processes.

Fourth, green infrastructure should be considered as a component of urban construction and economy, and green infrastructure management should be a component or a separate direction of the municipal management system.

The main objects of green infrastructure that are actively used in practice today are:
- urban forests, the structure and species composition of which, on the one hand, ensures air purification, carbon absorption, moisture retention, water resources management, formation of "urban heat islands", recreational and aesthetic functions, and, on the other hand, minimizes maintenance costs. At the same time, they increase property value; improve people's mental health and well-being, mitigate the social and economic consequences of environmental degradation. Squares, groves, parks perform the same functions;
- wetlands (natural and artificial), which work as a biofiltration system to adjust the water level, increase the efficiency of water use and water quality. Wetlands have low operating and maintenance costs;
- green and blue roofs, which improve air and water quality, reduce energy costs, reduce runoff into sewer systems, retain precipitation, sequester rain and carbon pollution; reduce the urban heat island effect in combination with reflective roofing material;
- waterproof coverings of sidewalks, roads, basketball courts, parking lots for stormwater management;
- rain gardens, which are used to disconnect the drain, collect rainwater from roofs or pavement and allow stormwater to slowly penetrate into the ground;
- bioworlds are vegetal or mulched channels that slow down and filter storm flows along streets and parking lots, and similar to rain gardens, absorb flows or transfer storm runoff from heavy rains into sewers or directly into surface water;
- green alleys, which are designed to reflect more light to mitigate the effect of heat islands, capture stormwater and make the space aesthetic and useful for communities;
- green schoolyards, which are created instead of asphalt schoolyards and which include a rain garden, groves with water-permeable paving stones and an artificial field with a turf base;
- green corridors, which, in addition to the above-mentioned functions, ensure the movement of living organisms and the preservation of biodiversity;

The subjects of management of the green infrastructure of the urban ecosystem are local self-government bodies, public organizations, management of enterprises and other organizations of the city.

The traditional list, however, the content should be different, since it is not proposed to take one-time actions regarding the implementation of individual green infrastructure development projects, but permanent processes with built-in tools of regulatory, administrative, and economic influence.

First of all, this involves changing the management apparatus of local self-government bodies with corresponding adjustments in its organizational and functional structures.

Secondly, the implementation of system-value ecological guidelines involves the formation and improvement of ecological culture, consciousness, worldview of the population, clarification of the essence of the ecological imperative of social development; strengthening the function of informing the population and providing access to environmentally significant information; formation of the environment of local ecological entrepreneurship, providing support and access to local environmental funds through the simplification of state subsidy mechanisms; conducting systematic environmental trainings, seminars and educational events with an environmental orientation.

Thirdly, specialists of the appropriate profile with special knowledge and skills capable of performing the tasks of creating and managing green infrastructure facilities are needed.

We believe that the biggest problem is the use of situational management aimed at the realization of short- and medium-term goals of the city's development, and the solution of its environmental problems requires the use of strategic ecological
management tools, however, its classic scheme provides for adjustments to ensure the justification, adoption and implementation of management decisions regarding achieving ecologically safe and economically efficient strategic development of the city, namely:

1) formation of an ecologically oriented concept of the city's development, based on which the directions and boundaries of the analysis of its environment and surroundings are determined, forecasting methods and strategic development alternatives are selected;

2) strategic analysis of the environment, including socio-ecological and economic situation. Environmental monitoring and auditing are used to obtain the necessary information. At the stage of strategic analysis, it is advisable to use the method of portfolio analysis, which allows you to process large arrays of heterogeneous information, determine the main indicators for diagnosing socio-ecological and economic security, and forecast their changes for the future;

3) diagnosis of the state of quality of urban space, the factors of which are determined by compliance with ISO 9001, ISO 14000, OHSAS 18000 standards;

4) forecasting changes in the strategic environment of the city;

5) ecologically oriented goal setting;

6) substantiation of the strategic set of the city's development, including the environmental strategy;

7) development of environmental policy. The implementation of the environmental policy is designed to ensure: the saving of costs and resources (primarily natural - raw materials, water, energy) through the introduction of energy-saving technologies, the use of alternative energy sources, environmentally friendly production at the city's enterprises, secondary processing of waste from the main activity; reduction of discharges, emissions of harmful substances into the natural environment; ensuring (control) the quality of water, air, and food in accordance with international standards;

8) improving the image as an economic unit by implementing environmentally-oriented innovations;

9) strategic planning for the implementation of the selected strategy, which is carried out on the basis of the data of the previous stages and consists in the development of a program of actions, justification of terms, necessary material, financial and other resources;

10) environmental monitoring, audit and control over the implementation of the strategy and environmental policy. When developing measures for the implementation of the selected strategy, the city management must establish compliance with: development priorities of the selected strategy; between the chosen strategy and organizational processes; in the "authority-responsibility" system when making strategic changes; organizational structure to strategic changes; communications, rules and procedures to new operating conditions;

11) selection of tools, methods, levers of influence to ensure the implementation of the chosen strategy, programs and projects. It is important that at the same time all of them are organically connected with the set goals and stimulate stakeholders to their implementation;

12) evaluation of the effectiveness of the chosen strategy and environmental policy. The control process involves comparing the indicators of the desired state with those actually achieved and making corrections if the results differ significantly from the desired ones.

The general criteria for the effectiveness of the management of the green infrastructure of the urban ecosystem are: environmental safety, social attractiveness and economic efficiency. Partial - satisfactory state of health of the city's population; Life Safety; proper level of ecological, sanitary and hygienic state of the city territory; high level of living comfort; opportunities for independent material support of residents, their self-realization and development.

Tools for managing the green infrastructure of the urban ecosystem deserve special attention.

Regulatory and legal nature. Ukraine has set a goal to integrate into the European Union, and this involves the fulfillment of certain requirements. More than 300 legal acts (conventions, directives, regulations, rules and recommendations) have been formed in the EU, which determine its environmental policy. There are processes of creation and implementation of integrated quality management systems (DSTU ISO 9001, DSTU ISO 14000, OHSAS 18000), which meet the requirements of international standards. In Ukraine, there is a sufficiently developed environmental law, an appropriate institutional structure has been created. Provisions on environmental monitoring and environmental forecasting have been introduced.

Developed system:
- project environmental documentation for environmental impact assessment during new construction, expansion, reconstruction and technical re-equipment of industrial and civil facilities. The purpose of the EIA is to determine the expediency and acceptability of the planned
activity and the justification of economic, technical, organizational, sanitary, state-legal and other measures to ensure the safety of the environment;

- normative and permissive environmental documentation - official permits and positive conclusions of central or local executive authorities, the mandatory registration of which is determined by the current legislation of Ukraine when carrying out economic activities or operating objects with a high or medium degree of risk for the natural environment;

- documentation on the results of inspections, on the protection of atmospheric air, surface water, on the management of production waste, which determine responsibility for violations of current legislation.

The disadvantage is the use of mainly administrative management methods, the performance of usually fiscal, inspection, control functions by management bodies. Another shortcoming, in our opinion, is the inflexibility of this system and the inability to solve the problems of harmonizing the economic, social and environmental interests of the state, business entities, and individual members of society within a certain territory. A rigidly centralized system of management, formed according to the hierarchical principle, which has no alternatives, will not encourage the development of local initiative and independence and consideration of problems specific to individual urban areas.

Environmentally oriented architectural and planning activity, which includes green infrastructure objects at the pre-project, project stages of urban planning, at the stage of landscape planning, zoning, reconstruction or renewal of old residential areas, urban ecosystem revitalization.

The modern toolkit of urban planning modeling allows you to determine the contours of a specific territory based on various scenarios of ecologically acceptable socio-economic and technological development, taking into account the possibilities of using green infrastructure facilities.

Researchers emphasize the significant potential of innovative activity in the formation of urban ecosystems as a powerful tool for system creation and modernization of social planning. Digitalization of urbanization infrastructure is mostly considered under the innovative component, however, Mizrahi M.V. (2013), within the framework of the "smart city" concept, emphasizes the relevance of sustainable economic growth, which is possible thanks to: rational investments in human capital, traditional and innovative communications, optimal and integrated management of natural resources, coordination and fruitful cooperation of the urban population in matters of formation and transformation of the cultural space of the city, as well as an increase in the number of urban socio-cultural and environmental projects.

Conclusions and perspectives of further research.

The current ecological situation is a limiting factor both for the development of society in general and for the development of individual territories.

Therefore, when forming the mission and concept of the development of urban areas, more and more emphasis is placed on the ecological component, which includes the creation and maintenance of green areas, the introduction of waste-free technologies, environmentally friendly production, the introduction of modern technologies of energy and heat supply, sewage and waste disposal, i.e. the use of green infrastructure. On the basis of modern trends in the development of green infrastructure, the expediency and legality of its use for the improvement of the ecological environment, socio-economic conditions of life and recreation, health improvement, and comprehensive development of the urban population are substantiated.

The formation of the management system of the green infrastructure of the urban ecosystem involves the development of appropriate mechanisms of state and local regulation; building relationships between business entities, local self-government bodies, relevant control structures based on the application of a set of regulatory tools that have an encouraging effect on environmentally-oriented activities, ensuring high quality of the city environment; implementation of a system of permits, limits, procedures and rules, which are based on the norms of international standards of environmental quality and quality of life; the use of modern territorial forms of urban space organization.

Thus, it is advisable to consider the management of the green infrastructure of the urban ecosystem as an effective tool for ensuring environmental safety, human development, and the quality of life of the city population.
REFERENCES


