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Khamroev M.O.<sup>1</sup>, Ruzmetov D.R.<sup>2</sup><sup>1</sup>Urgench State University, Urgench, Uzbekistan<sup>2</sup>Khorezm Mamun Academy, Khiva, Uzbekistan**SCIENTIFIC AND THEORETICAL ISSUES OF URBOEKOLOGICAL RESEARCH**

**Abstract.** *The article describes urban-ecological problems and general scientific and theoretical issues of their study. The ecological problems of cities are considered in connection with their social and urban development. The change of urban-ecological concepts and views in the modern world, the strengthening of environmental imperatives in urban planning, the gradual transformation of the organization of the urban environment of the life of the population are shown. The problems of urban energy, transport and waste disposal, the concept of "smart city" and "eco-city", the world experience in their implementation are analyzed. It is emphasized that the solution of this problem is at different stages in the developed and developing countries of the world. The problems of implementing the principles and approaches of sustainable development of urban ecosystems, adopted by leading international organizations, and some scientific views on their future development are described.*

**Key words:** *city project, urban ecology, urban environmental research, environmentally sustainable development*

Хамроев М.О.<sup>1</sup>, Рузметов Д.Р.<sup>2</sup><sup>1</sup>Ургенчский государственный университет, Ургенч, Узбекистан<sup>2</sup>Хорезмская Академия Маъмуна, Хива, Узбекистан**НАУЧНО-ТЕОРЕТИЧЕСКИЕ ВОПРОСЫ УРБОЭКОЛОГИЧЕСКИХ ИССЛЕДОВАНИЙ**

**Аннотация.** *В статье описаны урбоэкологические проблемы и общие научно-теоретические вопросы их изучения. Рассматриваются экологические проблемы городов во взаимосвязи с их социальным и градостроительным развитием. Показано изменение урбоэкологических концепций и взглядов в современном мире, усиление экологических императивов в градостроительстве, постепенная трансформация организации городской среды жизни населения. Анализируются проблемы городской энергетики, транспорта и утилизации отходов, концепция «умного города» и «экогорода», мировой опыт их реализации. Подчеркивается, что решение данной проблемы находится на разных этапах в развитых и развивающихся странах мира. Описаны проблемы реализации принципов и подходов устойчивого развития городских экосистем, принятых ведущими международными организациями, и некоторые научные взгляды на их перспективное развитие.*

**Ключевые слова:** *планировка города, урбоэкология, урбоэкологические исследования, экологически устойчивое развитие*

**Introduction and problem statement.** Social development is directly related to the social status and health of the population. Population health is related to social development, including social, economic and ecological conditions of population settlements as well as natural non-ecological conditions.

After the independence of the Republic of Uzbekistan, serious attention is being paid to the health of the population, improvement of the ecological situation, including urban ecological conditions, in various regions of the country. A clear proof of this is the fact that Uzbekistan has carried out a number of reforms in the field of medicine in connection with the health of the population. Regarding the improvement of the social conditions of the population, the President of the Republic of Uzbekistan Sh.M. Mirziyoev said "... whether it

is providing people with housing, fundamental reform of the health care system, providing the population with cheap and high-quality medicines, trade and transport services, electricity, natural gas, improvement of drinking water supply, kindergartens, new schools, art and sports facilities, construction of smooth roads - we have developed specific programs and plans for all this and will implement them without hesitation."<sup>1</sup>

Major socio-economic reforms are being implemented in our republic. In particular, extensive work is being done on the development of settlements and medical infrastructure, protection of public health, development of social spheres. This is done by different years, in particular, 2000 "Healthy Generation Year", 2005 "Healthy Year", 2006 "Year of Sponsors and Doctors", 2014 "Healthy Child Year", 2016 "Healthy Mother and Child Year" 2021 It can be seen from the fact that it is called "The Year of Youth Support and Public Health Promotion".

**Study of the problem.** Although urbo-ecological study has origins in more recent history, studies on urban growth and the design of ideal city plans are regarded as its primary pillars. Hippodamus (498–408 BC), Vitruvius (460–370 BC), and others in antiquity wrote a number of works on urban planning, the ideal size of settlements and how to improve them, as well as on various issues relating to building and architecture. Urban ecology's applicability even in the Middle Ages T. More, J. Vazari, T. Urban planning has been the subject of a number of utopian "ideal" proposals made by Campanella and other writers [3, 5, 6, 10, 122].

Urboecological issues grew more severe during the industrial era, which was the second part of the 19th century and the first half of the 20th century. The works of E. Howard ("Future City-Parks," 1898) and Tony Garne ("Industrial Cities," 1911") stand out in this age of urbo-ecological research.

In the 1950s and 1960s, the "optimal city" (Le Corbusier, V.G. Davidovich, G.M. Lappo, etc.), the companion city (Avercrombie), I. Friedman's "city-content", the "spatial city" of the group of Japanese metabolists (Kenzo Tange and others), J. Fitzion's "suspended city", "cybernetic city" by N. Sheffer, "biotechnical city" by P. Soleri, "skyscraper city" by F. L. Wright, J. Bernard et al.'s "labyrinth city" or "total city" by K. Doxiadis developed utopian, semi-fantastic projects for his time, such as "ecumenopolis" [5, 17].

In the 1970s, a new age in urban planning and urban ecological practices started. The ecopolis (1987 year) by R. Register, the "biotic city" (1992) by A.N. Tetior, the "sustainable settlement," and V.A. Many initiatives were proposed, including Kolyasnikov's "noosphere city" (2000). Studies on urban ecology are becoming more popular today.

**The aim and objectives of the work.** The main purpose of the research work is to describe the formation and development of urboecological studies, modern issues and problems.

To achieve this goal, the following tasks were defined in the research work:

- definition of ecology, including urboecology;
- stages of development of urban planning and urboecology;
- analysis of today's issues and directions of urboecological research and views of leading figures.

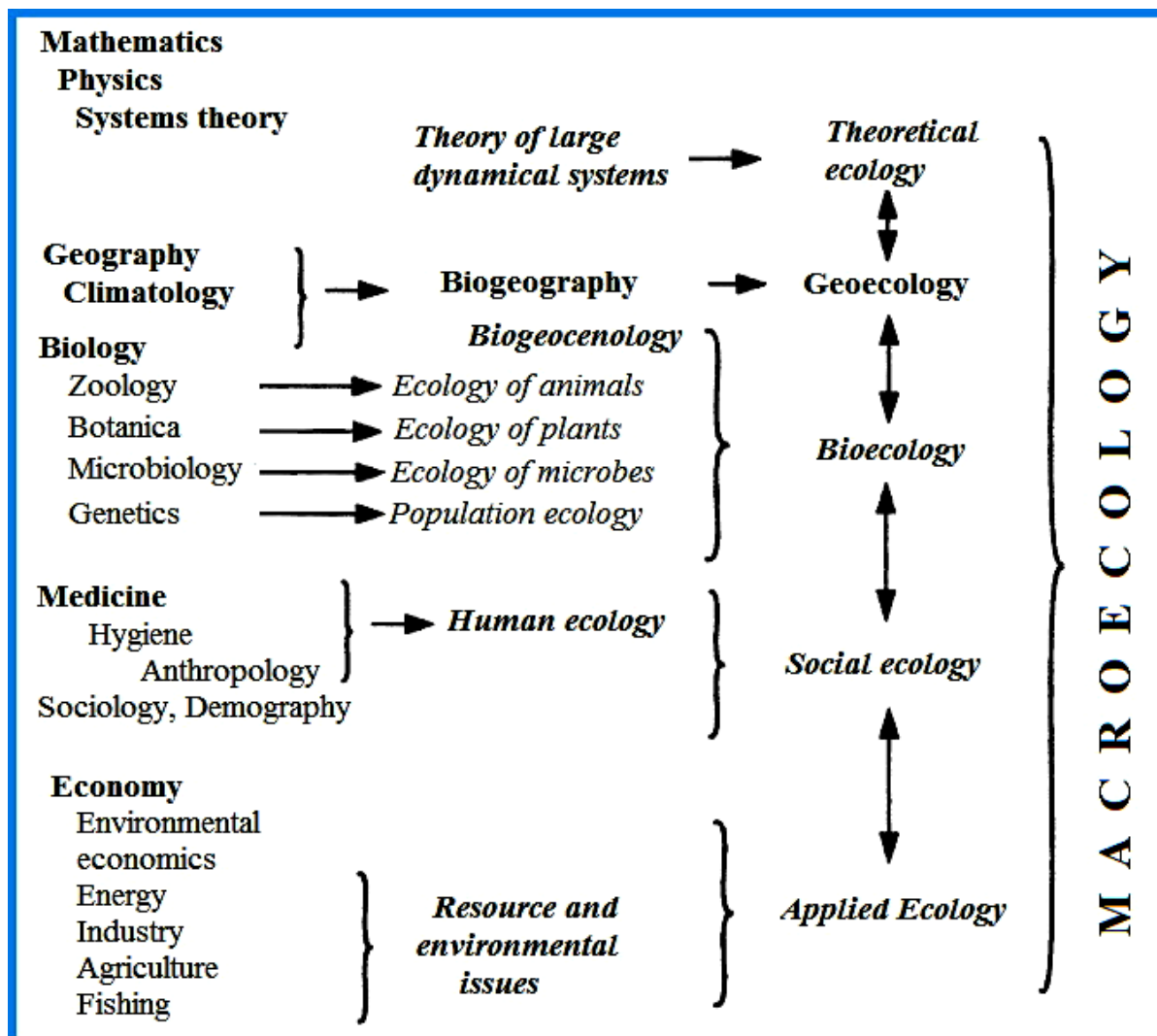
**Materials and methods.** The work employed systematic scientific material composition, analysis, and synthesis as well as visual sophisticated approach methodologies and techniques. Scientific theories in the field are organized and categorized based on scientific materials.

**Main part.** The main concepts and methodological foundations of urboecology were formed in the 70s and 80s of the last century. Conceptual approaches (principles) forming the basis of urboecological studies are based on structural-ecological, landscape-ecological, architectural-ecological, social-ecological principles.

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<sup>1</sup> Mirziyoev Sh.M. (2017), *Resolutely continuing our path of national development, we will raise it to a new level*, Tashkent, pp.346-347. (In Uzbek).

The concept of systemic ecology or ecosystem was introduced by A. Tensley, and then the concept of biogeocenosis, a synonym, was introduced by V. Sukachev [3]. A systematic approach to the use of matter and energy in the environment was formed in the middle stages of the transformation of ecology into macroecology (biogeocenology) (Fig. 1). The landscape-ecological approach (biogeography) has a similar aspect, and the eco-city or eco-architectural views put forward in the 20s of the last century are similar to them.



**Fig. 1. Sources and components of modern ecology in the process of ecologicalization of science and practice**

Source: Akimova T.A., Haskin V.V. (1999), *Ecology*, p. 18. (In Russ.).  
 Edited by the authors.

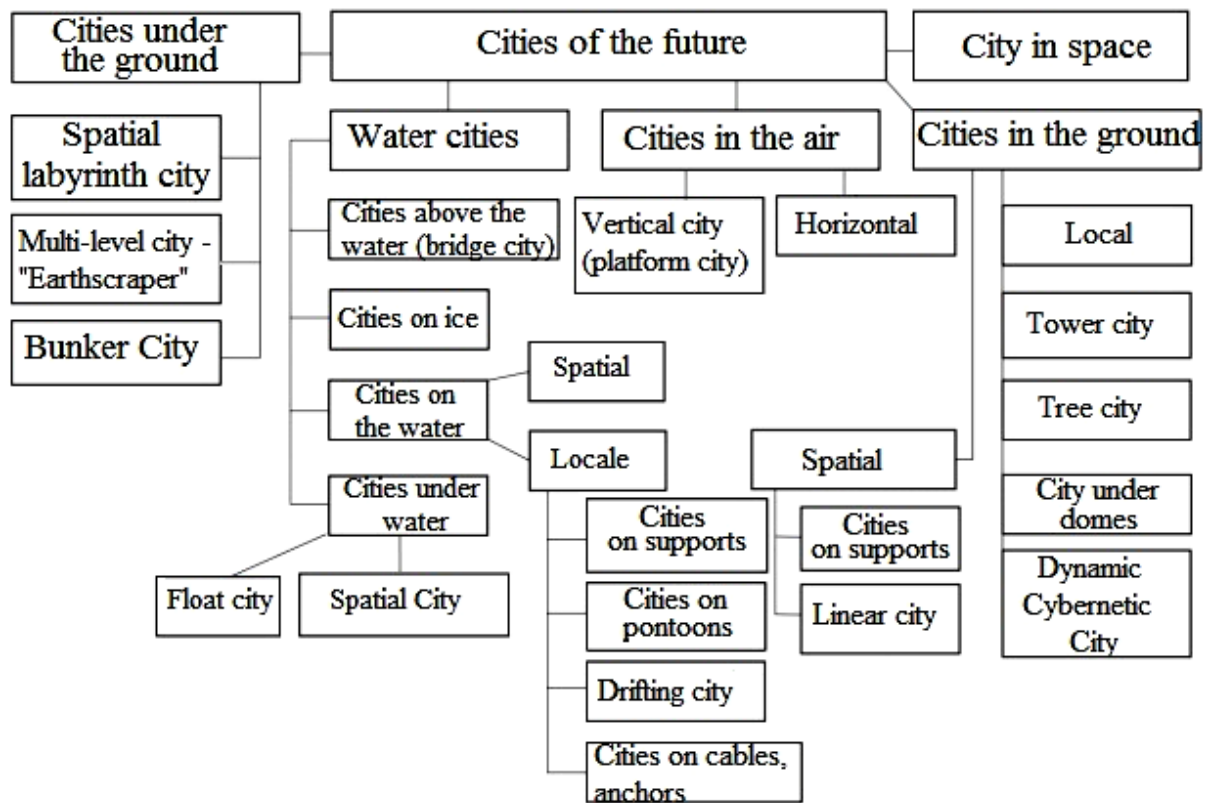
At the initial stage, the basis of urboecological views is the construction of a city in a way that is convenient for the economic and social life of a person, since the 70s of the last century, social-ecological projects promoting the symbiosis of the urban system with the environment have been formed as a concept that forms the main scientific and theoretical basis of urboecology [5, 7, 9].

Corbuse and his followers designed city projects not according to the ecological balance, but according to the household and socio-ecological conditions of the population [4, 12]. Of course, it is good that the city's household and environmental conditions are comfortable for the population, but it does not mean that it does not release tons of gas, solid and liquid waste into the environment. Cities, especially large industrial centers, cause changes in natural landscapes not only in the city and its immediate surroundings, but also

tens, hundreds and even thousands of kilometers away. For example, "ArcelorMittal Italia" ferrous metallurgical plant located in the city of Taranto, Italy, and enterprises related to metallurgical activity have turned the city into one of the most ecologically dangerous cities in Europe. Iron ore and coal are brought to the city from the developing countries of the world, that is, its ecological "hand" begins thousands of kilometers away. Currently, the environmental activists of Italy and Europe are constantly demanding the closure of this enterprise.

Literally, the principles of an eco-city, that is, a city in harmony with nature, as we have seen above, began to be developed in the 70-80s of the last century, and based on the tradition of urban development, it can be said that it will take several centuries to "trace" all cities on Earth in harmony with nature.

The issues of urban planning are naturally closely related to the socio-economic development of the countries of the world and their achievements in this field. In particular, in developed countries of the world, eco-cities and houses are being built taking into account the criteria of ecological programs in newly built cities and urban areas [14], but in developing countries, the main focus is on meeting the needs of the population for housing, and naturally, such cities in most cases have a technological solution of the middle of the 20th century. . In small towns, centralized sewage, water supply, and centralized disposal of waste are lagging behind.



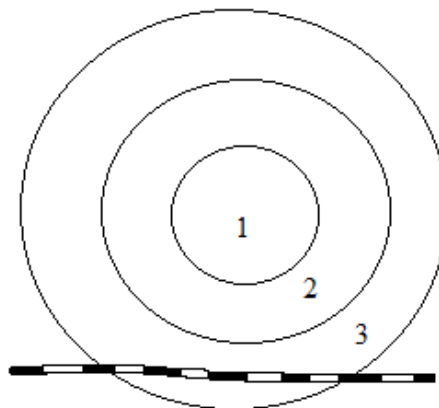
**Fig. 2. Conceptual classification of "Cities of the Future"**

**Source:** Romanova A.Yu. (2015), Transformation of idea: "the ideal city" to "the city of the future", *AMIT*, No. 1 (30). (electronic journal), URL: <https://marhi.ru/AMIT/2015/1kvart15/romanova/abstract.php>

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As noted, many projects have been proposed to design the cities of the future (Figure 2). However, most of them are currently not economically - technically feasible, or have a utopian appearance.

In general, the tradition of continuous urbanization of the countries of the world will be preserved. By 2025, about 75% of the world's population will live in cities. Urbanization is the evolutionary development of population settlements, which is further enhanced by the development of industrial production and service sectors. Therefore, the main task of urban planning, including urboecology, is to rationally organize the living and social activities of the population in a compact area, while maintaining the stability of the environment as much as possible and reducing the anthropogenic impact on it.



**Fig. 3. General scheme of the city plan: 1st management; 2-residential buildings; 3rd industry, transport logistics part**

Image courtesy of the authors.

Due to the constant growth of cities and their population (mainly due to migration), proper scientific organization of urban planning is important. It is important not only to divide the city into functional and residential areas (Fig. 3), but also to properly organize recreation and service areas.

In the 20th century, scientists used the aerospace method (lidar) to identify a number of cities under the jungles of the Yucatan Peninsula. Research has shown that the decline of large cities is linked to limited transportation options [4]. Transport plays a very important role in city life. It consumes 50 percent of the city's energy. At the same time, transport is considered the main polluter of the city's ecology (air) and the shaper of the noise-city "timbre". Motor vehicles release dozens of gases, metal compounds, especially lead compounds, into the atmosphere, along with CO<sub>2</sub>. In large cities, the concentration of gas and solid compounds emitted by cars reaches a high level in the evening, creating smog, in some cases, absorbing ultraviolet rays and forming a colorful dawn [16].

Therefore, it is of urgent importance to create an ecological, first of all, comfortable and sustainable urban environment for people, to improve urban transport logistics, and to introduce ecological types. As the city grows, the type of transport increases, it goes underground, above the surface - into the air. As it was mentioned that it pollutes the city air, it is necessary to zoning the city area according to the categories of transport, to speed up the city transport, to organize various overpasses to reduce traffic jams, to introduce the concept of "smart city", that is, to manage the traffic flow rationally through computer technologies. Digital technology will reduce the "CO<sub>2</sub> and CO footprint" of road transport by ensuring that transport reaches its destination as quickly as possible.

Modernization of urban transport modes, transport routes and tracks to modern requirements will further improve the urban environment by reducing the second inconvenience of urban transport - noise. The sound wave does not harm human health between certain decibels (0-70 dB). Although the subway is harmless to the air and water environment, the noise (100 dB) does not correspond to human health [6, 12, 13, 18, 19]. Therefore, it should be taken into account in the construction of quarters where the metro is underground.

Urboecological studies pay great attention to urban transport issues [9, 13, 14]. Establishing traffic-free zones in the city, or studying the technical and technological possibilities of increasing movement zones for bicycles, electric vehicles (scooter, gyroscooter, vehicles for the disabled, etc.) are among the main issues.



**Fig. 4. A view of Beijing when the air is clear and smoggy**

Source: <https://www.gazeta.ru/social/2015/12/18/7976093.shtml>

One of the main factors determining urban ecology is urban energy. Large cities can consume entire regions of electricity and heat. With the exception of some of the new industrial (non-ferrous metallurgy and related industries) cities, large cities are supplied with electricity from thermal power plants, rarely from nuclear power plants. Thermal power plants, especially IEMs, are built close to the city in order to efficiently provide electricity and heat energy. Since not all countries are well supplied with relatively ecologically clean (low SO<sub>2</sub> trace) natural gas, environmentally dangerous fuels such as coal and fuel oil are used in energy, and smog is common. In such a period, people in cities cannot walk without a special mask (Fig. 4).

The above situation was often repeated in most cities of the USA and Europe in the 20th century. Even in some industrial cities, smog has caused respiratory diseases and deaths among the population. Therefore, it is no coincidence that since the 60s and 70s of the last century, ecological principles have been promoted in Europe and the USA, and the concepts of environmentally sustainable development have been included in the development programs of the UN. Currently, by 2050, plans have been developed in Europe to reduce carbon emissions by 2-3 times compared to today, to increase the use of natural gas, biogas, and hydrogen fuel, to burn coal and fuel oil in thermal power plants, and to completely or gradually abandon nuclear power plants. Road transport is also planned to be entirely electric and run on environmentally friendly hydrogen fuel, and their purchase is being encouraged. Transitioning to self-supply of houses using alternative energy sources is one of the practices in this area [14, 16].

Due to the high concentration of population in cities, buildings naturally develop vertically, buildings are several hundred floors. The foundations of such buildings go into the ground several tens of meters. Excavated pits for its foundations naturally disrupt the integrity of groundwater, soil-dwelling organisms, plant cover, and naturally the landscape (site,

facies). At the same time, the use of pressurized water in large quantities in places where drinking water is limited or easy to get from underground has a negative effect on the tectonics of the area. The area becomes seismically active, the land subsides, buildings fall into disrepair, and the balance between social benefits and ecology changes to the negative side. Transport, industrial activity, by giving additional vibration to the environment, causes the soil to shift in different directions, subsidence, and this vibration, which is not suitable for life activity, leads to the destruction of the ecological chain of the animal world.

Issues of environmentally sustainable development are included in the "Millennium Development Program" (2000 year) and "Development Program" announced by the UN. In particular, in the sub-items of these items, improvement of the conditions of city dwellers living in dilapidated huts, and in the items containing social development, there are various directions of improvement of living places and health of the population. In the "Millennium Development Program" a number of issues were set to be completed by 2015, but they have not been fully completed yet.

There are big differences between developed and developing countries in terms of the architectural appearance of cities, building construction materials, and city plans. In densely populated countries, there is a big difference between the architectural appearance of cities and residential quarters (Figure 5). Especially when the urban system developed irregularly, the presence of rich quarters and poor quarters led to the diversification of the natural and social environment within one city. In such cities, let alone managing the environmental situation, the social conditions are also out of whack. There is no waste collection and disposal, and in many cases there is no centralized drinking water, gas, or electricity supply to the population (Figure 5). In such regions, improving the way of living of the population and creating a full-fledged urban environment is considered the first issue, and environmental issues are pushed to the second and third places.

As it can be seen from above, organization of household and social conditions of urban residents is considered an urgent issue even in the 21st century. Therefore, in the "Millennium Development Program" announced by the UN, 100 million people living in slums will be targeted by 2015. It is not for nothing that the issue of improving the living conditions of the city's residents has been raised.



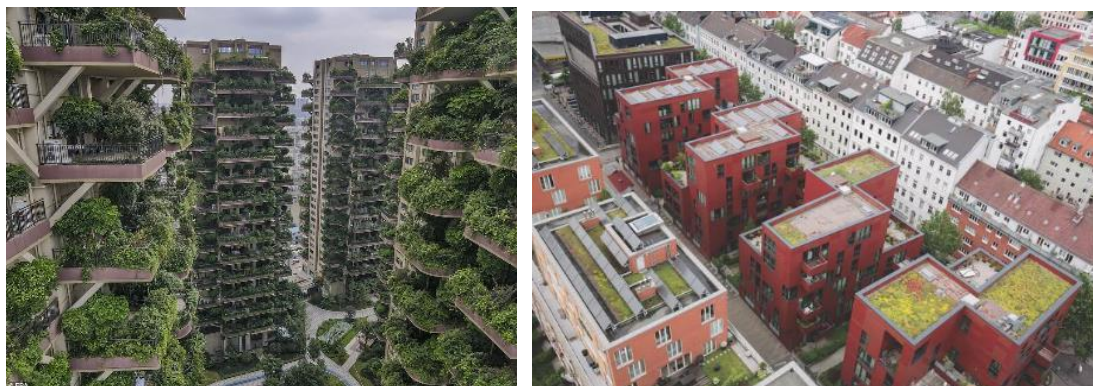
**Fig. 5. Jakarta (Indonesia) city center and suburbs**

**Source:** 1. <https://ecotechnica.com.ua/ekologiya/4122-dzhakarte-grozit-ekokrizis-stolitsu-indonezii-perenesut.html>

2. <https://dic.academic.ru/dic.nsf/ruwiki/149285>

Another way to improve the ecological situation of the city is to increase the number of green zones in the city, to strengthen the symbiosis of the streets or city buildings with the world of flora. Filling city streets and structures with plant and tree cover, creating parks and gardens has been around for a long time. An example of this is the hanging gardens of Semiramis in ancient Babylon, one of the seven wonders of the world.

Currently, projects to increase greenness on the balconies and roofs of buildings in addition to city green zones are being developed and put into practice (Fig. 6). However, a scientific approach is necessary in their organization. In particular, as the plant cleans the air and gives an aesthetic taste, it can become a habitat for insects and even birds that do not correspond to human ecology.



**Fig. 6. Green balcony (China, Chengdu), green roof (Germany, Hamburg)**

**Source:** 1. <https://www.ukrinform.ru/rubric-technology/3102772-kitajskij-proekt-zila-s-lesom-na-balkone-pogubili-komary.html>

2. <https://zstrela.ru/projects/magazine/sections/dizayn-sada/zelyonye-kryshi-gamburga-ekonomicheskoe-obosnovanie>

One of the factors that directly and indirectly affects the ecology of the city is the correct territorial organization of services to the population. In modern cities, transportation costs are reduced by the close proximity of daily paid services to the population, pre-school, primary and secondary education, primary health care networks. This allows to limit excess gas emissions from transport, reduce traffic congestion in residential areas, improve the health of residents by walking or using environmentally friendly vehicles. It is important to study these issues and to study them thoroughly in the planning of city quarters.

A huge amount of raw materials, water, food and non-food products used for various purposes are transported to the city based on its social and economic function. Naturally, raw materials and these products are not fully converted into energy value or consumed, and a large amount of gaseous, solid, sewage household and industrial waste is generated. In the near future, technologies will make it possible to recycle food waste into biofuels at home. However, the collection and disposal of waste in the city today is a big problem. Therefore, it is necessary to establish enterprises that process secondary raw materials (waste) in the city, its surroundings and in megapolis landfills. Currently, almost one hundred percent recycling of metal, paper, and glass waste has been established. However, recycling of pet bottles, industrial solid waste and sewage remains a problem. Around large cities there are landfills occupying hundreds of hectares of land, as we have seen above, in some cities streets and bays are polluted with waste and sewage (Figure 5).

Today, even green energy has its waste "tail". For example, technologies for the development of wind turbine blades (wings) for disposal or their secondary processing are now being created [9, 13, 14].

In general, urboecological research is currently being conducted in the following directions:

- correct division of the city into functional parts;
- proper organization of city transport routes and logistics and introduction of digital technologies to its management;
- "greening" of city energy;
- "greening" of city quarters, taking into account climatic and landscape factors;



- increase of green zones in the city, zones free from transportation that destroys the city's ecology;
- reducing the impact of city buildings on soil and water layers;
- bringing the social service cluster in the city as close to the population as possible and facilitating it;
- improvement of the waste disposal system, minimization of the impact on the environment, etc.

At the beginning of the 21st century, a contradictory problem situation was formed, which included, firstly, the issue of providing new economic opportunities to humanity and reducing social inequality, and secondly, reducing the man-made pressure on the environment. In order to solve this conflict, the concept of sustainable development was put forward by the UN, which envisages connecting the economic development of countries with the possibilities and productivity of the ecosystem that surrounds us, without harming nature and future generations of people.

As some authors have pointed out, the concept of sustainable development has been received differently by the public. In particular, scientists and the public who do not support this principle have criticized it by interpreting it as a myth, utopia, metaphor. They point out that the issues of creating and developing a sustainable social ecosystem are not sufficiently scientifically based. As we have mentioned, in developed countries, while the programs that envisage the sustainable development of man with nature are being implemented, the problems of housing, food, epidemic diseases and ending poverty are considered to be the first priority. Therefore, the American scientist D.R. Winner considers the idea of achieving absolute environmental sustainability as a myth [8, 16].

Other scientists consider the concept from a general philosophical point of view (V.A. Koptuyug, N.P. Leverov, V.M. Matrosov, A.D. Ursul), including from an architectural point of view (V. N. Belousov, Vladimirov, A. V. Ikonnikov, G. V. Mazaev, T. A. Savarenskaya, I. M. Smolyar, V. A. Kolyasnikov and others) defend [8, 9].

Some researchers rightly argue that recognizing the idea of sustainable development as a utopia, myth or metaphor does not exclude its use in urban planning. As we have seen above, these visions have started to be implemented in urban planning in the form of creating green balconies and roofs, independent houses using alternative energy, buildings with unusual design, but energy saving. These approaches gave rise to views on the possibility of interpreting the concept of sustainable urban development as an ideal system, "sustainable city" projects were put forward [9].

**Conclusions.** Thus, in our opinion, the concept of sustainable development and sustainable cities should not be promoted by some experts as ideal or utopian projects, but their useful elements should be introduced into projects of sustainable eco-cities through scientific research. Because in a short period of history, man seriously damaged the ecology of our planet, and its scale threw us into a vortex of extremely complex social and ecological problems. Excessive densification of the social environment, increased migration processes related to poverty, food, housing and other problems, various epidemic diseases are on the rise, their solution first of all requires solving the problem of human development in harmony with the natural landscape.

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