Biosphere-oriented urbanization and UNESCO program “Man and the Biosphere”

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Abstract. Metropolitan area urbanization leads to increased pressure on the biosphere and the inability to reproduce the healthy population. Development of society in the future can go in two ways: technological and biosphere. Biosphere direction involves the development of the biosphere-oriented urban planning as a means of resolving the biosphere-social crisis. This will allow on the one hand to ensure the reproduction of biologically and mentally healthy population, and on the other to preserve and develop biocoenoses in areas where infrastructure for life and economic activities of people should be organized. The main condition for the preservation and development of the biocoenoses is the existence a network of nature reserves in the region. Design settlements should be carried out as a landscape and estate settlement with houses providing comfortable family life of several generations under one roof. The concept of biosphere-oriented urbanization and UNESCO biosphere reserves complement each other and may use common approaches. At the present time it is necessary to create one conceptual basis for the social-economic development based on those two independent concepts. It must take into consideration the conservation of biosphere that is aimed to develop intellectual and creative potential of every person. Biosphere-oriented urban planning with UNESCO Man and Biosphere concepts is the only way of existence and development where it is possible to conserve cultural and natural heritage of the humanity and share it with the future generations.

1. Introduction
Contradictions between natural ecosystems and human activity occurred in all natural zones of our planet throughout the history of mankind, ranging from the Paleolithic (gathering food resources) to the present day (modern industry and agriculture). Social evolution implied the technological development of human economic activity in the provision of food, which began with hunting and gathering and has now led to biotechnological technologies at the molecular level.

In ancient times, from the primitive communal society to the emergence of the first agricultural technologies, gathering provided from 0.4 to 20 kg of food per hectare of territory annually, depending on the productivity of vegetation cover of ecosystems in various natural landscape zones [1]. Hunting in all landscape zones of the Earth provided approximately 0.1-50 kg of animal protein per hectare per year, in forest-steppe and steppe ecosystems of the temperate zone of Eurasia, hunting production
ranged from 1 to 10 kg per hectare per year, although, for example, in tropical Africa's savannas people collected up to 250 kg of meat per hectare per year [2]. In this regard, the most ancient technologies of obtaining food such as gathering and hunting, provided mankind with food in the amount of approximately 0.2 x 10^3 - 200 x 10^3 kcal per hectare per year, despite the fact that the cost of such food procurement took approximately 10 - 20% of the energy that ancient man as a whole received from the received nutrition [3].

Despite the fact that hunting gave about 100 x 10^3 kcal/ha of animal protein for food, the transition to primitive transhumance, which first appeared in the Eurasian steppe several thousand years ago, increased this value to 4000 x 10^3 - 8000 x 10^3 kcal per hectare year [4] at the cost of spending almost half of this energy content of domesticated animals. Further development of pasture technologies with an increase in their productivity allowed increasing the amount of energy received from animal products to 15,000 x 10^3 kcal/ha. At the present time, as a result of the recent green revolution in agriculture, innovative feeding technologies, which imply artificial cultivation of highly productive feeds by humans, make it possible to increase the energy intensity of animal food products to more than 25,000 x 10^3 kcal per hectare.

It is known that human culture includes religion, philosophy, art of government, economy, business, literature, science, fine arts, ethics, law and economics, as well as various technological knowledge, expressed in technical structures, artificially created ecological conditions. Of these elements of human culture, economics traditionally includes agriculture, industry, and energy. It is also well known that the productivity of agricultural production has some limitations associated with increasing its intensity and efficiency. The more a person receives products from a hectare of land, the more expensive they are for energy. This implies that there is a special point (level of development) in the production of agricultural products when costs and profits are compared, and further costs for the intensification of production become unprofitable. In practical application, this shows that when using the agricultural technologies created so far, the constant growth of the world's population and the exhaustion of land reserves suitable for agricultural production, humanity should in the near future reach a natural limit in the production of natural food.

A similar picture is observed in relation to the cost of increasing the efficiency of the industry while simultaneously increasing the ecological purity of production. In other words, the complete recultivation of lands disturbed by mining operations or the complete cleaning of factory emissions are economically impossible due to the infinitely increasing cost of the cleaning and recultivation itself. At the modern level of technological development, industrial production will always continue to destroy the natural environment to the extent that is necessary to obtain a minimum profit.

Modern energy is in the same situation, in which the sources of energy that are safer for nature and humans, such as solar, geothermal, wind, etc., turn out to be more expensive. At the beginning of the 21st century, within the framework of the modern economic paradigm, the reserve for enhancing the safety of industrial production has not yet been exhausted, but in the coming decades this point of economic development will be achieved and with the preservation of modern economic models and technological development, industrial and agricultural production will continue to poison the biosphere of our planet. This shows that the solution of the acute environmental problems that have arisen in recent decades through the growth of the industry is hopeless. The way out of the current crisis situation is the development of production technologies that are clean and safe for the biosphere based on completely different ideas. To ensure such a breakthrough, the role of fundamental science is decisive. But besides fundamental science, a big role in overcoming the modern complex (ecological, economic, social, moral and spiritual, military and political) belongs to the development and acceptance by mankind of a new world view and a righteous concept of managing all processes subject to man. Such a concept is currently being created within the framework of the culture of the Russian world and is tentatively called the concept of public security (KOB in Russian abbreviation), which includes several basic books [5-8], This information is easily available on numerous Russian-language Internet sites (for example, http://kob.su or https://mediamera.ru ).
As part of the concept of public security, a concept of a biosphere-oriented economy is being developed, one of the elements of which is the concept of biosphere-oriented urbanization, applicable to the conditions of natural landscape zones of temperate latitudes in which Kazakhstan and Russia are located. The main idea of this concept is aimed at curbing the tendency of the total urbanization of humanity and its further settlement in small settlements of the estate type, taking into account the features of the adjacent natural ecosystems. Such villages have a common structure in the design, considering the cultural code of the peoples living in a particular natural area, as well as the location in the transit zone of UNESCO biosphere reserves. This article focuses on the main conceptual ideas related to biosphere-oriented urbanization.

2. Material and methods
Research methods are: formal-logical, comparative, environmental, historical and inter-sectoral research method.

3. Results and discussion
The concept of biosphere-oriented urbanization is the most effective approach to solve the conflict between the biosphere and conventional model of social-economic development on our planet. The main goal of this concept that is being developed now in the Russian-speaking scientific community is “to ensure by succession of generations the reproduction of biologically healthy population which is capable of culture development, with conservation and development of biocoenoses in the regions, where infrastructures for living and economic activity should be organized” [9]. At the same time, UNESCO’s Man and Biosphere Program (MAB), which had started in the 1970s, also develops its own approaches to find balance between man and biosphere through creation of internationally recognized network of biosphere reserves. By now there is a huge experience of international collaboration concerning not only biosphere reserves’ concept, but also the mechanisms of decision-making and expert evaluation of this biosphere territories’ effectiveness, taking into consideration national and regional peculiarities of social-economic development and nature conservation policy. In our view, the combination of these two concepts and practical experience, collected by UNESCO worldwide, may give a very comprehensive overall concept of bringing the modern humanity to the next level of its social-economic and moral development with conservation of the biosphere to serve as the basis of its biological existence.

3.1 The problem: biosphere and modern city planning
To the beginning of XXI century for than half of planet’s population is living in the cities, many of which in the last 30-40 years rapidly grew to become megacities. This process goes much more rapid in Asia than in the other parts of the planet. It is expected that at the current rate and approaches to social-economic development the number of city population of the planet will almost double by 2050, reaching 6 billion people with total world expenses for development and maintenance of city infrastructure averaging more than 350 trillion US dollars [10]. This type of urbanization means rapid economy increase (especially industrial production) leading to harsh pressure increase on the surrounding ecosystems at the local and regional level and, in the end, on the planet’s biosphere at the global level. At the same time, the scientific research proves that living in the mega cities leads to problems in healthy population’s reproduction due to the influence of various types of pollution factors on the people. The unnatural overcrowding of the people and lack of diversity in the geometrical forms with domination of straight lines causes the increase of psychological and emotional abnormalities leading to the development of aggression and conflicts among the people. As a whole this may lead to gradual genetic degeneration and high mortality rates of the population, as well as destruction of the society through individualism and destruction of the family, and nature destruction [11].

The mega cities usually lack ecological balance, which in city planning is defined as the condition of natural-anthropogenic environment providing its long-term sustainability with reproduction of its
main abiotic (air, water) and biotic (soil, flora and fauna) elements of the biosphere. “Ecological balance might be reached only on spacious territories, because densely built city is not capable of reproduction of the main natural resources. Protected natural reserve and forests, soil and water protection zones are created not only to conserve valuable landscapes, rare flora and fauna species. They acquire a new function – a counterbalance to negative influence of industrialization” [12]. The city planning theory identifies three relative levels of ecological balance in view of population density:

- **Complete ecological balance** is supporting balanced correlation of nature, urbanized environment and industry. Population density in various parts of the world depend on climatic and hydrological situation, and biodiversity richness. In temperate latitudes the population density does not exceed 60 people in a square kilometer, with forests occupying not less than 30% of the area.

- **Conditional ecological balance** – natural resources are not completely reproduced naturally; it is characteristic of urbanized territories. The population density in temperate latitudes in this case does not exceed 100 people in a square kilometer, forests cover 20-30% of the territory.

- **Relative ecological balance** – urbanized territory is used in the acceptable limits, but natural balance is partially broken since the ecosystems may not fully neutralize environmental pollution with conservation of ecosystem elements interaction sustainability. Population density, according to various experts, is from 100 to 210 people in a square kilometer.

At the same time, the modern city planning practice, aimed for the development of the mega cities, does not resolve biosphere-social crisis, because the population density in modern cities goes out of any reasonable limits. It became possible due to domination of capitalistic model of economic development, where profit is the main idea and effectiveness criterion of the economic activity.

Social-economic development of the humanity in the future may take two main ways:

- **Technogenic way** – there is only technosphere on the planet or it plays the leading role in the development, and biosphere is developed only to an extent of satisfying the needs of technosphere and the people. Humanity depends on technosphere and remnants of biosphere are subordinate to technosphere.

- **Biosphere way** – needs and requirements of the biosphere define the limits for anthropogenic activity and technosphere development. One of the most effective approaches is biosphere-oriented city planning.

### 3.2 The solution: biosphere-oriented urbanization – smaller settlements

An alternative of mega cities is biosphere-oriented (landscape-manor) urbanization, which means providing conditions for development of intellectual-creative potential of every person, by generations’ succession provides reproduction of biologically healthy population, capable of culture development, and conserves and develops biocoenoses with organically put infrastructure for people’s living and economic activity.

Both megapolis and landscape-manor urbanization are characterized by a common list of composition parts that form one system of interconnected and interleaved layers of one whole image. These parts are divided into the following set of scales:

- **First scale**: a house for family living (its form, sizes, floors number, material, etc.).
- **Second scale**: a land area where the house is located (its form, sizes, etc.).
- **Third scale**: a region – land areas gathered in one common module.
- **Fourth scale**: the character of the settlement, its plan.
- **Fifth scale**: a group of settlements.
- **Sixth scale**: a network of the settlements in the limits of the countries and of the planet as a whole.

A normal life would be in a settlement of a village type which would combine the comfort of the city, on one hand, and accessibility of nature, on the other. It should be kept in mind that city comfort implies: access to education; developed economical infrastructure and wide spectrum of social services; various opportunities for spending free time; access to various art types; diversity of communication with various people. At the same time there is a natural environment, which supports physical and mental health of the people. Access to nature means that natural environment can
positively influence the health of the people, providing them with clean air, water and food. In this situation a person would constantly interact with the nature and live in the natural landscape, could observe natural phenomena, i.e. live and develop in its natural environment (habitat suitable for our species). The children would grow to base their ideology on the images of nature and build causal relations and logic on the natural phenomena, leading to a comprehensive and holistic view of the world around. This scenario also provides an opportunity for every person to have a private time, to go to a natural scenery (forest, field, park) for a short time to disconnect from the community and think about problems or future plans.

The main condition for conservation and development of biocenoses is the presence of nature reserves’ network in the region (national nature part, strict nature reserves, etc.), in which economic activity must be completely prohibited, and tourism activity regime must be set in accordance with biological species’ reproduction regime. The purpose of such biological reserve is to be a source of biological species’ expansion to the zones where economic activity and human life prevents normal reproduction of the species in biocenoses.

Settlements’ planning must be carried out as landscape-manor settlement. The main requirements to the design are the following:

- The land plots should not border each other, they are divided by stripes of untouched nature or artificial plantations of 10-20 m in width, the size of the land plot varies from 0.25 to 0.4 ha depending on the number of family members (the calculation is about 0.03-0.04 ha per person).
- The perimeter of the land plots should be curvilinear, because nature does not know straight lines and angles, and curvilinear area border eliminates psychological barrier between a person and nature.
- All the major parts of the settlement should be in the limits of a walking distance; the main transport inside the settlement – bicycles and scooters, pedal cars (the means to deal with lack of physical activity should be integrated in the lifestyle).

House architecture should support comfortable life of a family of several generations under one roof, as well as a possibility to modernize and expand the house considering future family growth. Only a family of several generations can provide complete education of the children and solve the social problem of lonely old people.

The total area of the settlement should be calculated for 2500-3000 people, so that everyone would be personally acquainted with about a third part of the total number of the people. Other social connections would be provided by cross-acquaintance. This population number of the settlement means about 250-300 land plots with average of 8-9 people at each land plot. As a result, the total population density is about 115 people in a square kilometer, which is almost twice higher than the optimum recommended by ecologists (60 people in a square kilometer). One of the important conditions of the settlement design is that the route from the settlement’s edge to its center does not take more than 25-30 minutes. If the average walking speed is 3-5 km/h, the optimal settlement’s diameter in the limits of 3-3.5 km, which makes a circle of about 1,000-1,500 ha.

The settlement plan and its structure must contain an algorithm that prevents unsustainable enlargement of its sizes and preserves the balance between sites and of human activity and nature. It means that the places for work and leisure should not be totally separated (work inside the settlement, leisure sites only outside), but nature must be a full component of the settlement, its integral part.

3.3 UNESCO Man and Biosphere Program

The concept of biosphere reserves is being successfully developed in the last half a century in the frames of UNESCO MAB Program. The overall goal of the program is harmonization of the relations between people and nature to overcome contradictions between social-economic development and conservation of the natural complexes. The main approach of this program is in the creation of a global network of biosphere reserves, which include territories with virgin nature as well as areas, used by people for social-economic activity. This combination of the territories in one whole biosphere reserve is reached by clear functional zoning.
According to the Statutory Framework of the World Network of Biosphere Reserves, the biosphere reserves are “areas of terrestrial and coastal/marine ecosystems or a combination thereof which are internationally recognized within the framework of UNESCO’s Program on Man and the Biosphere”.

Within UNESCO’s Man and the Biosphere (MAB) program, biosphere reserves are established to promote and demonstrate a balanced relationship between humans and the biosphere. Biosphere reserves are designated by the International Coordinating Council of the MAB Program, at the request of the State concerned. Biosphere reserves, each of which remains under the sole sovereignty of the State where it is situated and thereby submitted to State legislation only, form a World Network in which participation by the States is voluntary.

Reserves are nominated by national governments; each reserve must meet a minimal set of criteria and adhere to a minimal set of conditions before being admitted to the Network. Each biosphere reserve is intended to fulfill three complementary functions: a conservation function, to preserve genetic resources, species, ecosystems and landscapes; a development function, to foster sustainable economic and human development, and a logistic support function, to support demonstration projects, environmental education and training, and research and monitoring related to local, national and global issues of conservation and sustainable development.

General criteria for an area to be qualified for designation as a biosphere reserve are as follows:

- It should encompass a mosaic of ecological systems representative of major biogeographic regions, including a gradation of human interventions.
- It should be of significance for biological diversity conservation.
- It should provide an opportunity to explore and demonstrate approaches to sustainable development on a regional scale.
- It should have an appropriate size to serve the three functions of biosphere reserves.
- It should include these functions, through appropriate zonation, recognizing:
  - a legally constituted core area or areas devoted to long-term protection, according to the conservation objectives of the biosphere reserve, and of sufficient size to meet these objectives;
  - a buffer zone or zones clearly identified and surrounding or contiguous to the core area or areas, where only activities compatible with the conservation objectives can take place;
  - an outer transition area where sustainable resource management practices are promoted and developed.

  - Organizational arrangements should be provided for the involvement and participation of a suitable range of inter alia public authorities, local communities and private interests in the design and carrying out the functions of a biosphere reserve.
  - In addition, provisions should be made for (a) mechanisms to manage human use and activities in the buffer zone or zones; (b) a management policy or plan for the area as a biosphere reserve; (c) a designated authority or mechanism to implement this policy or plan; (d) programs for research, monitoring, education and training.

It is quite obvious that the concepts of biosphere-oriented urban planning and UNESCO biosphere reserves complement each other and may use common achievements and approaches in practice. For example, landscape-manor settlement type might be successfully used in the design and development of the transition (third) zone of the biosphere reserve. The existence of buffer and core zone of the biosphere reserve close to human settlements perfectly fits into the principles of biosphere-oriented urbanization. In our view, it is necessary to take these two independent concepts and create one unified conceptual basis for the social-economic development considering biosphere conservation, which would serve to develop intellectual and creative potential of every person, support biologically healthy population, conserve natural and develop cultured biocoenoses with harmonically installed infrastructure for human living and economic activity.
4. Conclusion

Biosphere-oriented city planning with consideration of the UNESCO Man and Biosphere Program is the only way of survival and development with possibility to conserve cultural and natural heritage of the humanity and share these values with the future generations. In Kazakhstan, by 2018, there are already 10 biosphere reserves having international status and recognized by UNESCO, as well as the first Asian transboundary biosphere reserve in Altai, joint with the Russian Federation [13]. They are a kind of growth points for the implementation of the concept of biosphere-oriented urbanization in the Republic of Kazakhstan.

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