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GEOMORPHIC ASSESSMENT OF TERRESTRIAL RESOURCES

ABSTRACT. Building of scientific basis for harmonious exploitation and spatial organization of the economy (land use) is one of the key issues of present-day geography. The study of land resources includes consideration of the relations between economic development, profitability and potential opportunities for further development of the territory, possibility of disturbed lands recovery and returning to the economic turnover, and preservation – all of those things which are necessary for human life worth living. Identification and analysis of land use types and forms is a necessary step of any economic-and-geographic study of a certain territory on the basis of statistical data and field survey. The creation of optimal land use schemes, taking into account the assessment of the conditions for certain types of management placement in given territory, has practical importance.

This paper presents the logical model of the area natural conditions influence on the evolution of urban land, shows the ways of creating the model of comfortable environment, where all types of the place attractiveness – ecological, social and economic – should be balanced.

A constructive formula for the geomorphic assessment of territorial resources includes the synthesis of benefit and profit. That is an engineering and ecologic-and-geomorphic assessment of lands in terms of the convenience for some sort of economic activity, taking into account the ecologic-and-geomorphic restrictions, as well as the economic evaluation of the engineering site preparation, taking into account the availability of recreational and specially protected areas, as well as environmental insurance against adverse processes and phenomena – maintaining of favorable living conditions.

KEY WORDS: ecologic-and-geomorphic assessment, terrestrial resources, land use, natural-and-anthropogenic risk, environmental management, constructive formula, logical model

CITATION: Emma A. Likhacheva, Larisa A. Nekrasova, Mariya E. Kladovschikova (2019) Geomorphic assessment of terrestrial resources. Geography, Environment, Sustainability, Vol.12, No 2, p. 78-86
DOI-10.24057/2071-9388-2018-28

INTRODUCTION

General trend of modern science – greening and harmonious exploitation – requires specification of research, which allows reducing actual knowledge to a certain constructive formula. In order not only to learn how to create anthropogenic-and-geomorphic systems, presenting them as a harmonious combination of natural and artificial components of relief and architecture, but also to manage, use and preserve them (Gerasimov 1985; Gettner 1930; Gorshkov 1998; Demek 1977; Kolbovskiy et al. 2001).

Building of scientific basis for harmonious exploitation and spatial organization of the economy (land use) is one of the key issues of present-day geography (Zvorykin et al. 1988; Simonov et al. 1993; Simonov et al. 2002). The study of land resources from the perspective of assessing the natural environment is a complex procedure, including consideration of the relations between economic development, profitability and potential opportunities for further development of the territory. The possibilities of restoration (attractiveness, value) or disturbed lands returning to the economic turnover should be considered, as well as the preservation of the natural complex as an essential component for human life worth living (Krogius 1979; Lastochkin 1992; Legget 1996; Sen-Mark 1977).

State of the problem

Territorial (land) resources represent a spatial basis for the allocation of economic facilities and population distribution; they are the leading means of production (firstly in agriculture and forestry). The assessment and use of land resources at the state level is based on the Land Code cadastral data and land valuation.

Identification and analysis of land use types and forms is a necessary step of any economic-and-geographic study of a certain territory. It is based on statistical data (Federal Law… 2000) and field survey. The creation of optimal land use schemes on the base of assessment of the conditions for certain types of management placement in given territory, has practical importance. Studies related to agriculture obtained the highest development. The term "land use" specifies the works in systematization and mapping of agricultural types, taking into account local natural and economic conditions (undertaken by English geographer L. Stamp for the first time in 1930) (Varlamov et al. 2006; Sizov 2006; Federal Law… 2000; Federal Law… 2002).

Agenda

Geomorphic assessment of territorial resources is based on the theoretical concepts of the anthropogenic-and-geomorphic system as a special morpholithodynamic system consisting of natural and anthropogenic components (mineral and biological) that are interrelated not only by natural flows of matter, energy and information, but also by the structures of socio-technical management. This is *anthropoecosystem*, complex in time and space. *Morphological and spatial orderliness* determines the engineering properties of the morpholithosystem (and, in particular, the territorial organization), while morphodynamics organization determines the stable functioning (Likhacheva et al. 2002; Likhacheva et al. 2004; Likhacheva 2007).

The tasks requiring geomorphic research are the following:

1. functional zoning of the territory according to the favorable geomorphic conditions for conducting some sort of economic activity;

2. zoning of the territory according to the geotechnical hazard and risk of geomorphic processes development;

3. identification of zones of ecological discomfort, geo-ecological hazard and risk (geochemical, ecologic-hygienic and geophysical), geopathic zones and zones favorable for public health;

4. identification of sanatorium-resort, recreational (including aesthetic) and other resources;

5. determination of priority forms of land use considering their natural potential, as well as their historically established (traditional) economic functions and, most importantly, considering their "geoecological transformation". By this term we define all the deep changes in the morpholithosystem (morphosculpture) – the whole complex of forms, content (properties and composition of the lithogenic base) and the functioning processes changes;

6. modeling, design (creation) of the engineering-natural environment – a stable-equilibrium morpholithosystem, and forecasting its development.

The purpose of the research is to study the "co-creation" of various components in case of the human environment development, as well as to identify the mechanisms of functioning and development on the basis of system analysis.

The system-constructive model of research can be defined as follows: environmental *benefit* – creation of an environment of life = economic *profit* = the continued *preservation* of favorable living conditions (environmental protection). This fine, but rather contradictory and, importantly, hard-to-reach formula determines retrieval route of the *reconciliation* and *elimination* (or reduction) of conflicts between human and nature – "profit" and "preservation of favorable living conditions". This is also an "environmental benefit". The only way is to make preservation (generally "protection of nature") of living environment *profitable* (and therefore to receive income).

People have learned to make profit and to get benefit, yet with causing great damage to nature. That is why various "requirements", regulatory standards and recommendations are being formulated nationwide. In particular, all necessary conditions for "protection of the (human) environment" have been formulated and codified by law in the Russian Federation (Federal Law… 2017).

Protection of the human socio-economic and natural environment (habitats) is a combination of international, state, regional and local administrative-and-economic, technological, political, legal and social activities aimed at ensuring the socio-economic, cultural-and-historical, physical, chemical, biological comfort necessary to preserve human health (protection of landscapes, subsoil, forests, soils, nature, etc.). The list of actions on environmental protection includes its improvement (for human), recultivation, optimization and reclamation (Federal Law… 2017).

Solutions

Typification and land rating for housing, industrial and road development sector is necessary for environmental management system generating, as well as for private economy and agricultural sector management, recreational zones planning in respect of "protective" (valuable) properties of lands, which include scientific, historical-and-cultural, aesthetic, recreational, health-improving and other valuable properties.

The aim of land assessment in old-cultivated areas has an extremely wide range of problems, and its solving should ensure the sustainable use of territorial resources (with the greatest outcome for economy and least damage for nature) and preservation of the engineering, ecological and historical-and-cultural potential of the territories.

These territories have long been attractive for comfort habitable environment creating, because they met the basic human needs, his physical and material capabilities, the development was *economically* profitable. That's why the degree of their development is high enough.

Urban territories show peak concentration of anthropogenic morpholithogenesis. It occurs not only due to purposeful actions, but also under impact of natural

and technogenic-activated processes, which provide *autoregulation* of the system: new relief and *run-off structure* are being formed; new *quality* (geochemical, hydrogeological, etc.) appears. Using P. Velev (1985) glossary, natural morpholithosystem suffers *"metamorphic transformation"* within the urban territory. Herewith stochastic character of development is common to the urbanized morpholithosystem, little-known to natural phenomenon category of "singularity".

A city is human ecosystem, his natural habitat, special *geosystem* – geographical, geological, geophysical, geochemical, and geomorphological. This system is developing and existing according to the *law of natural system development due to environment, due to* substance exchange in the system (entity of the city) and constant substance exchange with environment. This process was defined by P. Velev (1985) as substance exchange *(metabolism)* of organo-mineral (living) system - *"city"*. Natural, anthropogenic and technogenic factors are involved in metabolism, they interact together, being reprocessing and become transforming. New components or metabolites appear as a result of cooperation – technogenic sediments, soils and subsoils (technoliths) with organo-mineral structure (Likhacheva et al. 1997).

A "second nature" is formed on the urban territory with its own microclimate, vegetation, relief and soils, surface water and groundwater, and, what is highly important, with the elements of management.

Modeling of the geosystems operation (both natural and natural-and-anthropogenic), as well as *forecast management*, is the basis for the *management* of territorial resources and natural-and-anthropogenic risks. Using modern methods of data processing (including data on climate change), it is possible to present scenarios for the natural complex development and provide recommendations for land management, for human comfort maintaining, transport infrastructure, resting-places and income provision from land users (subsoil, water, forest users) and other shareholders and insured persons.

The Fig. 1 shows the logical model of the local natural specifics influence on the habitable environment development (and, in particular, on the urban territory). Here you can see the ways of solution the problem of comfortable environment model development, where all types of the local attractiveness – ecological, social and economic – must be balanced (Likhacheva et al. 1997; Forrester 1974).

MONITORING OF URBAN LANDS

Analysis of the existing literature shows, that theoretical and especially methodological foundations of monitoring of urban lands as a specific group within the category of settlement lands, have not been sufficiently issued, which troubles comprehensive monitoring in the frame of activities.

Unfortunately, geomorphological researches is the least considered part of the investigation, whether in environmental monitoring statement or in cadastral valuation of land. Challenges for geomorphological monitoring of urban areas are determined by the needs of relief study, not only as morphogenetic formation, but also as an engineering and environmental factor, as urban planning resource. Relief plays a key role in the urban ecosystem, making a significant impact on the formation of urban ecosystem structure:

1) on the landscape-architectural solutions of urban built-up area;

2) on the construction and management of buildings and facilities, roads and other communications;
3) on sanitary and hygienic conditions (including the formation of physical technogenic fields: noise-induced, vibrational, electromagnetic; geochemical fields, affecting the distribution and concentration of pollutants throughout the urban area, the atmospheric and stream-born transmission, the urban air condition) and generally on the population health.

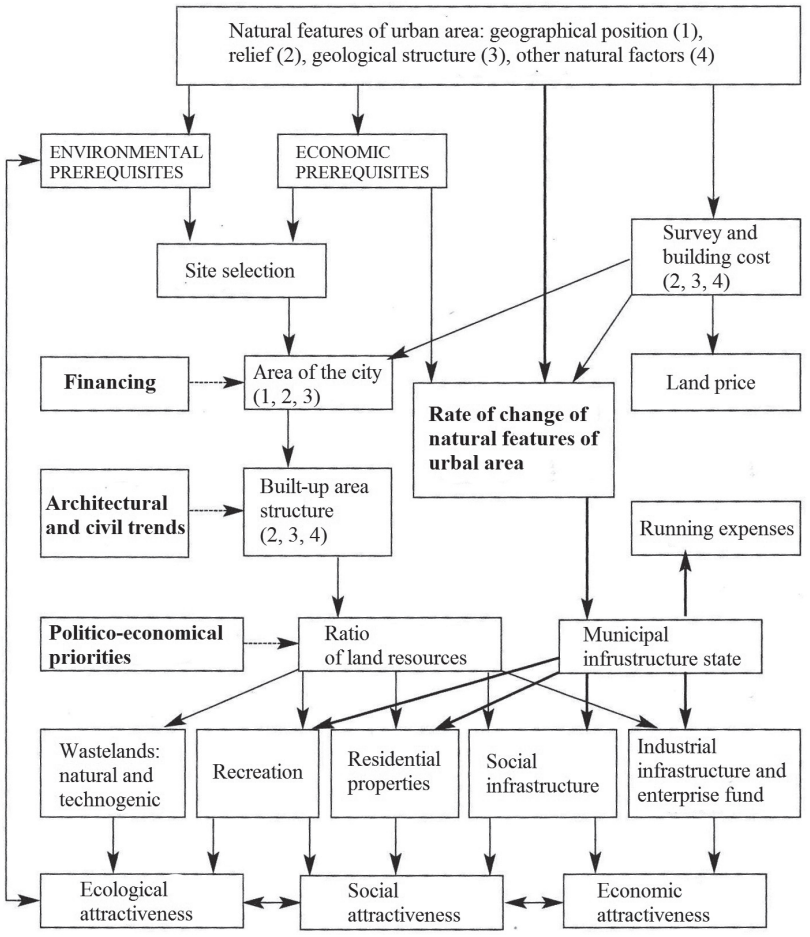

Fig. 1. Outline: logical model of the natural features influence on the anthropoecosystem (1, 2, 3, 4 – the role of natural factors in the descending order of their influence)

Transformations of the morphometric and morphodynamic characteristics of the relief change its functions as a surface that determines land and underground runoff and denudation-accumulation processes development. Inadvertently there are arising conditions for developing processes, compensating disrupted material-energetic balance, for developing natural-technogenic processes. Natural-technogenic processes may also have a negative character, especially after change of economic activity within giver part of urban area (Likhacheva et al. 1997).

Land value in Moscow is high and constantly increasing. To justify the efficient land use, the efficient exploitation of terrestrial compartment and underground space means to consider the land evaluation in efficiency calculations of capital investments, to solve a number of engineering-and-geological, environmental problems, to link the socio-economic and city-planning goals of Moscow development with environmental problems.

The way to solve the above listed challenges is to define the city-planning opportunities of city territory in accordance with their natural resources: the development of scientifically based recommendations for administrative and engineering activities, united by the common name "environmental protection", which can also be termed as harmonious exploitation.

This aim is also pursued by the Moscow Mayor's decree from April 6, 1993, "Towards the Monitoring of Lands in Moscow", which defines the range of necessary observations, primarily for: changing the boundaries of Moscow, administrative-territorial entities, land properties, security and technical zones; land use efficiency; dynamics of urbanization of agricultural exploitation lands, lands of urban forests and green spaces; implementation of landscape-ecological zoning of Moscow territory with allocation of negative processes; state of lands, soil and vegetation cover. These observations had provided studies undertaken by the Department of Land Resources of Moscow, in particular:

1) the subject content of urban lands monitoring as an independent type of scientific-information and operating activities of civil services and specialized organizations have been formulated;

2) an optimal version for the distribution of powers between the executive authorities was proposed, and recommendations for the use of information on the land quality assessing have been given;

3) a basic list of environmental requirements for land use and land users, fixed in the land legal documentation, have been prepared; Atlas of the city lands cadastral valuation was produced;

4) the methodological basis for calculating the size of the monetary equivalent of environmental damage from technogenic processes on the urban lands have been developed, and calculations of damage from littering up and chemical pollution of Moscow lands have been completed; the city already has a Unified Ecological Monitoring System (network of territorial level), observations are conducted over the atmospheric air and surface and groundwater state, karst-suffusion and landslide processes, green spaces, and physical factors of influence (noise);

5) the technological solutions for monitoring the actual use and state of lands by means of remote sensing and new equipment, monitoring of securing the land-legal relations and social processes for Moscow have been recommended (Varlamov et al. 2006; Sizov 2006).

The system of city-forming actions also includes government and public control over the state of the natural environment and the sources of its pollution; protection of natural and cultural monuments, and in the broadest sense – of all material and spiritual living and development conditions of human society and future generations, increase the social standards of living, develop the project environmental impact assessment, databanks creation, organization of monitoring system, and increase the level of urban residents' environmental culture (Shmidt 2013; Kotlyakov and Tishkov 2014; Likhacheva and Bolysov 2017). Huge scientific capability of Moscow, development and implementation of active environmental policy by the Government allow count on major restructuring of the environmental research activities organization of Moscow, which in turn will avoid the environmental disasters in the urban area. These are challenges not only for specialized organizations, but also for academic and higher education institutions (Fig. 2).

DISCUSSION AND CONCLUSION

A constructive formula for the geomorphic assessment of territorial resources includes the synthesis of benefit and profit. That is an engineering and ecologic-and-geomorphic assessment of lands in terms of the convenience for some sort of economic activity, taking into account the ecologic-and-geomorphic restrictions, as well as the economic evaluation of the engineering site preparation, taking into account the availability of recreational and specially protected areas, as well as environmental insurance expenditure against adverse processes and phenomena – maintaining of favorable living conditions:

1) to suggest actions for maintain the evolutionary development of the natural complex, taking into account climate change, natural selection and formation of a new natural-anthropogenic complex based on modeling;

2) to develop assessment criteria of land degradation aiming to determine the optimal complex for recultivation based on modeling.

Generally, a constructive formula of harmonious exploitation > economic development (benefit) > profitability (profit) > the possibility of expanding the economic activity (additional profit) > long-term preservation of favorable living environment (habitat protection).

ACKNOWLEDGEMENTS

The present study was supported by state assignment project № 0148-2019-0005, research, development, and engineering study № AAAA-A19-119021990091-4.

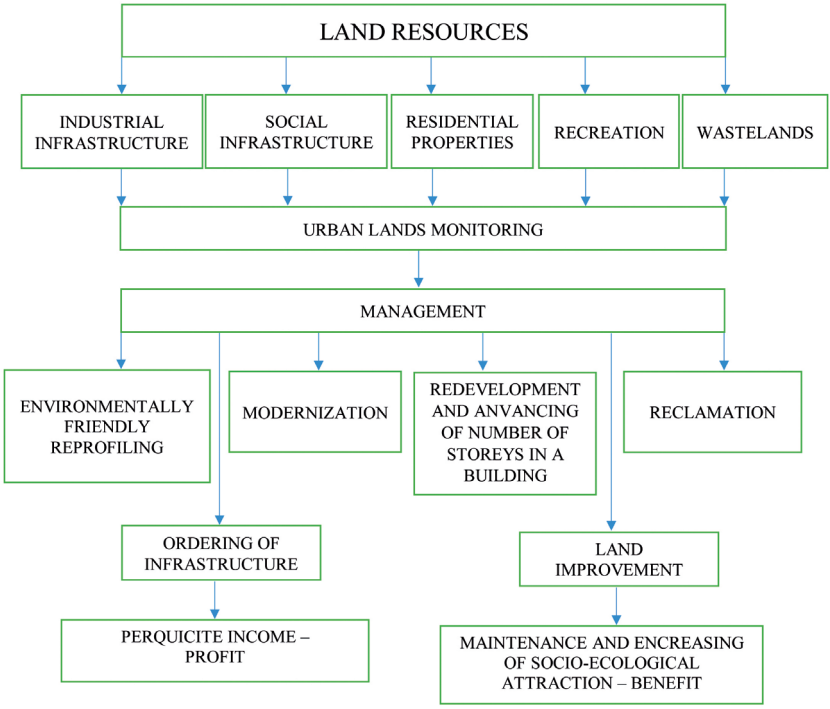

Fig. 2. The scheme of the city land resources management with the benefit and profit on the basis of urban lands monitoring

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Received on July 2nd, 2018 Accepted on November 15th, 2018