Organizing geographic and environmental monitoring for urban cadastral appraisal

L A Mezhova, A M Lugovsky, V S Gorbunov, Z M Sagova and O Yu Sushkova

1 Voronezh State Pedagogical University, 86, Lenina ave., Voronezh, 394043, Russia
2 Moscow State University of Geodesy and Cartography (MIIGAiK), 4, Gorokhovsky lane, Moscow, 105064, Russia
3 State University of Land Use Planning, 15, Kazakova str., Moscow, 105064, Russia
4 Voronezh State University, 1, Universitetskaya Square, Voronezh, 394018, Russia

E-mail: mezhova@vspu.ac.ru

Abstract. Cities of today are multifunctional geosystems accumulating various anthropogenic activities. However, the modern system of land cadastral appraisal does not pay enough attention to geography and environment of urban lands. This article defines the geographic and environmental indicators to be included in urban cadastral appraisal. The outlined logical and structural models introduce to a comprehensive system of coordinated and interrelated organizations involved in land cadastral appraisal. The model can serve as a foundation for identifying existing problems within administrative arrangements in a city and proves the importance of looking at geography, time factor, and environment for each city district in particular. The article provides some recommendations to enhance land use and ensure a more comfortable public environment. It also shares some ideas on using different kinds of geographic and environmental models and proves the need for creating a specialized geographic and environmental monitoring service.

1. Introduction
Urban lands are natural, industrial, and biosocial geosystems that are changing with time and geography. Urban environment appears to be a sphere of human activity, which is being formed as a comfortable geosystem. A geographically and environmentally comfortable urban area is an integral concept that includes social, ecological and economic criteria. Integrated indicator systems are essential in order to provide suitable living conditions for public; such indicators can be obtained from organizing monitoring. Urban land geographic and environmental monitoring is an organized system of observing, assessing, analysing and forecasting the state of urban environment, which is being shaped by urbanization processes. Intensive anthropogenic processes within urban areas affect public health. Therefore, urban land cadastral appraisal should also address the detrimental impact of environmental media on public health.

Assessing cadastral value enables to locate and justify macro- and micro- social, environmental, and economic issues of urban land use.

2. Materials and methods
Modern cadastral system pays special attention to social and environmental problems of urban lands. T.
M. Abelashchev, N. A. Kravchenko, O. Y. Lepikhin, A. V. Sviridova, I. S. Pudyakov, V. K. Popov, M. V. Kozin, V. S. Gorbunov, V. B. Kalmanova, R. M. Koganov, Y. A. Mandra, A. N. Esaulko, V. P. Klushin, E. E. Stepanenko, T. G. Zelenskaya, O. A. Pospelova, Stepanenko, S. V. Okrut, B. I. Kochurov, Y. A. Khaziakhmetova, I. V. Ivashkina, E. A. Sukmanova, V. M. Yablokov, S. Kolios, A. Vorobev, G. Vorobeva, C. Stylios, R. K. Tahir, V. V. Vershinin, D. A. Shapovalov, P. V. Klyushin, V. A. Shirokova, A. O. Khutorova, A. F. Gurov, S. V. Saprin, R. S. Shirokov, S. V. Savinova et al. studied environmental media in terms of urban land cadastral value appraisal [1, 2].

The researchers prove that on the one hand, different cities tend to have different geographic and environmental situations, and on the other hand the cities do not use their land resources efficiently. In this regard, there is a strong urge to revise the comprehensive functional structure of urban environment in order to fit the needs of our modern society. When defining urban land cadastral value, one does not have a theoretically grounded pricing policy. Urban land cadastre is greatly affected by regulatory and economic policies, as well as by corrupted municipal officials. Its economic value is changing and has an upward trend.

3. Results and Discussion

Environmental monitoring system has received little use thus far in terms of designing urban setting. Figure 1 shows the cadastral system for appraising urban lands with their geographic and environmental situation taken into account.

![Figure 1. Cadastral system for appraising urban land regarding their geographic and environmental situation](image-url)
Today’s cadastral system is a complex system of interrelated elements that are not harmonized, which poses hurdle to solving existing problems. This illustrates that no environmental monitoring system has been implemented in urban areas. Environmental analysis, assessment and forecast are the basis of land cadastral monitoring for urban geosystems, which are not effective at present.

Geographic and environmental monitoring system shall include:
- observing environmental media;
- assessing geography and environment of urban lands;
- forecasting geographic and environmental quality of urban lands.

Statistical data on urban lands collected by the Federal State Statistics Service lacks comprehensive coverage, and urban environment function analysis tends to be fragmentary. Both are carried out by various institutions and sometimes the data is inconsistent. One should consider geographic and environmental problems of a region, its degree of environmental stress, its type of environment, and its territory.

The pattern we developed for geographic and environmental monitoring is presented in Figure 2.

![Figure 2. Geographic and environmental monitoring pattern](image)

The methodology of land cadastral appraisal disregards natural and environmental features of urban lands, such as landscape and geography, climate, hydrology, environment and factors that minimize anthropogenic impact. Each section has its indicator system. Factoring in geography and environment makes appraising cadastral value more expensive. It is regarded as a transitional stage from points to
percentage. The percentage points assess each factor at a wider range and provide a more objective description of environmental and ecological conditions for urban development.

Assessing detrimental ecological, environmental and anthropogenic factors will help predict emergency situations in different neighbourhoods and identify public risks, which shall be included in the land cadastre for environmentally challenging regions of Russia.

The land fund thoroughly studies geographic and environmental indicators and defines the standard of living. Geographic and environmental monitoring for cadastral appraisal is holistic and requires a customized GIS, which implies processing and providing information to ensure environmental management.

Environmental management strategy includes pre-observation materials, regulatory and methodological guidelines, a database and a decision-making algorithm.

The choice of geographic and environmental factors is subjective. Natural background of urban lands is considered a shared environmental factor as it does not depend on human activities. Not all geographic and environmental factors can be expressed in numerical form; moreover, they can be given in different units. With geographic and environmental ecological monitoring one should consider all the factors arising from anthropogenic activity during city planning. It is essential to recognize the functions for urban lands and to embrace the connection between human activities and environment. Stratified zoning is also being carried out.

At the current stage of urbanization geographic and environmental monitoring considers air, water, soil and vegetation pollution to be the main factors while assessing the quality of urban environment. Over the last years, they have made allowance for the factors detecting aesthetic impact of architecture in urban environment. Besides, special attention is paid to protection of cultural and national heritage.

Geographic and environmental monitoring involves developing environment quality models which characterize how urban environment pollution affects public health.

If combined with models of natural and industry-related processes, one gets the opportunity to forecast urban environmental quality.

For that matter, cartographic, mathematical, geochemical, and geophysical models are applicable to make management decisions within urban lands.

To enhance urban environment one needs to find rational ways of dealing with geographic and environmental problems of urban lands.

4. Conclusion
Thus, organizing geographic and ecological monitoring for urban cadastral appraisal shall include:
- geographical, social, cultural, engineering, environmental, economic indicators;
- geographic and environmental monitoring to track pollution;
- environmental risks to be budgeted and covered by city’s urban land insurance system and, moreover, public health and safety to be guaranteed.

The data obtained from geographic and environmental monitoring can be used by urban areas to put environmental certificates, standards, and audit into practice, as well to assess social, ecological and economic damage.

Building a complex database is of vital importance for working out urban development strategy and creating efficient cadastre system.

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