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A GEOGRAPHIC INFORMATION SYSTEM FOR TERRITORIAL DEVELOPMENT OF THE MARINE REGIONS OF CHINA*

ГЕОІНФОРМАЦІЙНА СИСТЕМА ТЕРИТОРІАЛЬНОГО РОЗВИТКУ МОРСЬКИХ РЕГІОНІВ КИТАЮ

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Abstract. The necessity of using geographic information systems to ensure the territorial development of land use in the regions is substantiated, taking into account the influence of spatial, urban, investment and environmental factors, as well as the experience of coastal regions of China. The aim of the study is to develop directions and features of the formation and use of geographic information systems for the territorial development of land use in the coastal regions of China. To achieve this goal, the following tasks are solved: the formation of a system of factors of territorial development of land use in the coastal regions of China; definition of geographic information systems of territorial development of land use in coastal regions; formation of directions for the development and implementation of geographic information systems of territorial development of coastal regions of China. The factors affecting the territorial development of the use of coastal regions are determined: spatial, urban, investment and environmental. They form a system of indicators that allow for an integrated assessment and to build on its basis the geoinformation support for the territorial development of land use in the coastal regions. The components that influence the formation of the geographic information system of the territorial development of land use in coastal regions are identified. An algorithm is proposed and a scheme is created for the creation and operation of geodatabases of indicators of territorial development of land use in the coastal regions of China. The developed system of geoinformation support for the territorial development of land use in the coastal regions of China allows us to build geoinformation maps of systemic spatial, urban, investment, and environmental factors. This makes it possible to build a three-dimensional geoinformation model for monitoring the state of territorial development of land use in the coastal regions of China as an innovative tool for monitoring and making informed decisions in the system of territorial development of land use in the coastal regions of China.

Key words: geographic information systems, territorial development, coastal regions of China, spatial, urban planning, environmental, investment factors, land use, geoinformation maps, geoinformation three-dimensional model for monitoring the state of territorial development.

Анотація. Доведена необхідність застосування геоінформаційних систем для забезпечення територіального розвитку використання земель регіонів, враховуючи вплив просторових, містобудівних, інвестиційних та екологічних чинників і досвід функціонування приморських регіонів Китаю. Метою дослідження є розробка напрямів формування й використання геоінформаційних систем територіального розвитку використання земель приморських регіонів Китаю. Для досягнення поставленої мети вирішуються такі завдання: окреслення системи чинників територіального

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розвитку використання земель приморських регіонів Китаю; визначення геоінформаційних систем територіального розвитку використання земель приморських регіонів; формування напрямів розробки та реалізації геоінформаційних систем територіального розвитку приморських регіонів Китаю. Визначені чинники, що впливають на територіальний розвиток використання приморських регіонів: просторові, містобудівні, інвестиційні й екологічні. Вони формують систему показників, які дозволяють здійснити інтегральну оцінку та побудувати на її основі геоінформаційне забезпечення територіального розвитку використання земель приморських регіонів. Визначені компоненти, що впливають на формування геоінформаційної системи територіального розвитку використання земель приморських регіонів. Запропоновано алгоритм і побудована схема створення та роботи баз геоданих показників територіального розвитку використання земель приморських регіонів Китаю. Розроблена система геоінформаційного забезпечення територіального розвитку використання земель приморських регіонів Китаю дозволяє побудувати геоінформаційні карти системних просторового, містобудівного, інвестиційного й екологічного чинників. Це дозволяє побудувати геоінформаційну тривимірну модель моніторингу стану територіального розвитку використання земель приморських регіонів Китаю як інноваційного інструментарію здійснення моніторингу та прийняття обґрунтованих рішень у системі територіального розвитку використання земель приморських регіонів Китаю.

Ключові слова: геоінформаційні системи; територіальний розвиток; приморські регіони Китаю; просторові; містобудівні; екологічні; інвестиційні чинники; використання земель; геоінформаційні карти; геоінформаційна тривимірна модель моніторингу стану територіального розвитку.

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Problem statement. Ensuring the development of regions and the country as a whole requires the determination of features and the formation of areas of territorial development of land use. In modern conditions at the regional level, land resources are the main factor ensuring the development of the state. In this context, it is necessary to take into account the system of spatial, urban, investment and environmental factors and modern tools – geographic information systems (GIS) of the territorial development of regions. In states, especially in China and Ukraine, coastal territories play an important role. They have their own characteristics in the context of land use, forming the modern aspects of regional development. Consequently, the relevance of the study lies in the formation of directions and features of geographic information systems to ensure the territorial development of land in coastal regions.

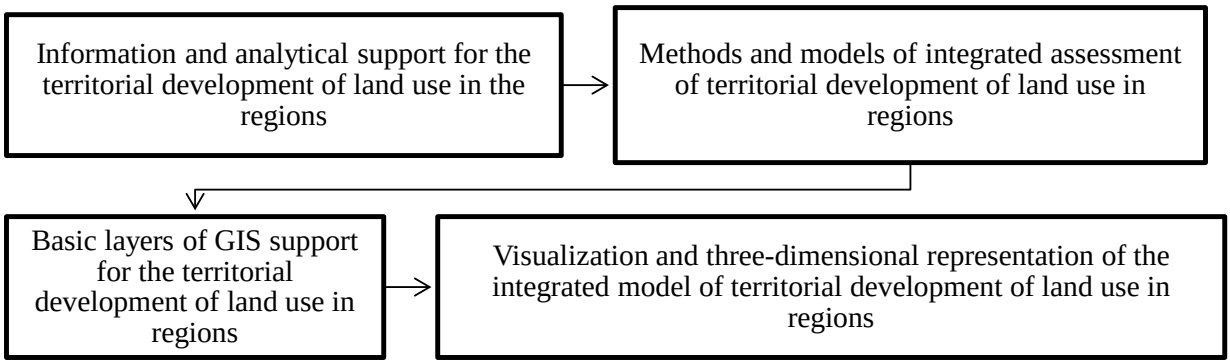

Fig. 1. Components of the geographic information system of territorial development of land use in the regions

Latest research and publication analysis. The problems of land use at the state and regional levels were addressed by scientists J. Williamson [1], J. Larsson [2], K. Mamonov [3–5], A. Martyn [6], Yu. Palekha [7], I. Perovich [8], A. Petrakovska [9], V. Sidorenko [10] and others. To ensure territorial development, the theoretical provisions are applied: J.-P. Blandinier [11], V. Ponomarenko, V. Trided, M. Kizim [12] and others.

Separation of previously unsettled parts of the general problem. Along with this, the issues of using modern tools of geographic information systems to ensure the territorial development of land in coastal territories remain unresolved.

The aim of the study. The aim of the study is to develop directions and features of the formation and use of geographic information systems for the territorial development of land use in the coastal regions of China.

To achieve this goal, the following tasks are solved: the formation of a system of factors for the territorial development of land use in the coastal regions of China; determination of geographic information systems of territorial development of land use in coastal regions; the formation of directions for the development and implementation of geographic information systems for the territorial development of coastal regions of China.

Methods, object and subject of study. The study uses methods of systematization and generalization, structural logical and geoinformation analysis. *The object of the study* is the processes of ensuring the territorial development of land use in the coastal regions of China. *The subject matter* is a set of theoretical and methodological provisions and practical recommendations for the development of a geographic information system for the territorial development of land use in the coastal regions of China.

The basic material (results). Summarizing the presented scientific and methodological developments, factors are identified that affect the territorial development of the use of coastal regions: spatial, urban planning, investment and environmental. They form a system of indicators that allow for an integrated assessment and to build on its basis the geoinformation support for the territorial development of land use in the coastal regions.

The geographic information system is an important element of the regional territorial development information system, which includes the following components: information and analytical support for the territorial development of land use in the regions; development and application of methods and models for the integrated assessment of the territorial development of land use in regions; the formation of the basic layers of GIS support for the territorial development of the use of land in the regions; visualization and three-dimensional representation of the integrated model of territorial development of land use in regions.

The components of the geographic information system of territorial development of land use in the regions are presented in Fig. 1.

The formation of the geographic information system for the territorial development of the use of land in the regions is carried out on the basis of the developed relevant information and analytical support and the application of methods and models within the framework of the methodological approach of integrated assessment of territorial development.

The peculiarities of the use of the geographic information system is the visualization of the state, directions and features of the territorial development of land use at the regional level, which allows to determine the relationship between spatial, urban, investment and environmental factors. The proposed geographic information system of territorial development creates the basis for a permanent response to changes in this system and to implement a monitoring system.

To create a geographic information system for the territorial development of land use in the regions, GIS analysis tools are used, for the implementation of which the study adopted the spatial dependence of generalizing and integrated indicators of the territorial development of land use in the coastal regions of China.

A feature of the application of indicators of the territorial development of land use in the coastal regions of China is their mutual dependence in the spatial model and the set of GIS layers. At the same time, a structure has been formed for spatial modeling and analysis that takes into account the algorithms for creating and operating geodatabases, as well as the process of determining and

analyzing the territorial development of land use in the coastal regions of China in terms of the influence of spatial, urban, investment, and environmental factors. It should be noted that geographic information analysis is implemented in the ArcGIS software package using software modules:

– ArcCatalog – development and work with a geodatabase of generalizing spatial, urban, investment, environmental and integrated indicators of the territorial development of land use in the coastal regions of China;

– ArcMap – visualization of a vector data set for evaluating the generalizing spatial, urban, investment and environmental factors of the territorial development of land use in the coastal regions of China;

– ArcScene – development and modeling of a three-dimensional scenario representation of the layers of the system of territorial development of land use in the coastal regions of China.

The GIS application technology for determining and applying generalized indicators of the territorial development of land use in the coastal regions of China, as well as modeling their influence on the integrated indicator, provides for the development of an algorithm for creating and determining the features of geodatabases. The specified algorithm consists of the following steps:

1. Creation of an information base for the analysis of the territorial development of the use of regional lands in ArcCatalog: development of basic generalizing groups of indicators of the territorial development of land use in the coastal regions of China; the formation of a geodatabase of general indicators and the creation of a geodatabase of integrated indicators of the territorial development of land use in the coastal regions of China; creating a shapefile and linking certain indicators by region.

2. Geoinformation analysis of generalizing and integral indicator in the ArcMap module: visualization of assessment data summarizing spatial, urban, investment and environmental indicators of territorial development of land use in the coastal regions of China; creation of a set of layers of general indicators, development and visualization of integrated indicators of the territorial development of land use in the coastal regions of China; development of a standardized scale of levels of indicators of territorial development of land use in the coastal regions of China; analysis of integral indicators of the territorial development of land use in the coastal regions of China by territorial characteristics.

3. Construction and modeling of a three-dimensional scenario representation of the layers of the system of territorial development of land use in the coastal regions of China in the ArcScene software module.

Thus, a scheme has been developed for the creation and operation of geodatabases of indicators of the territorial development of land use in the coastal regions of China (Fig. 2), stages and information support for its implementation as a component of the GIS application technology have been identified.

The scheme for creating spatial information for modeling and analyzing data on the territorial

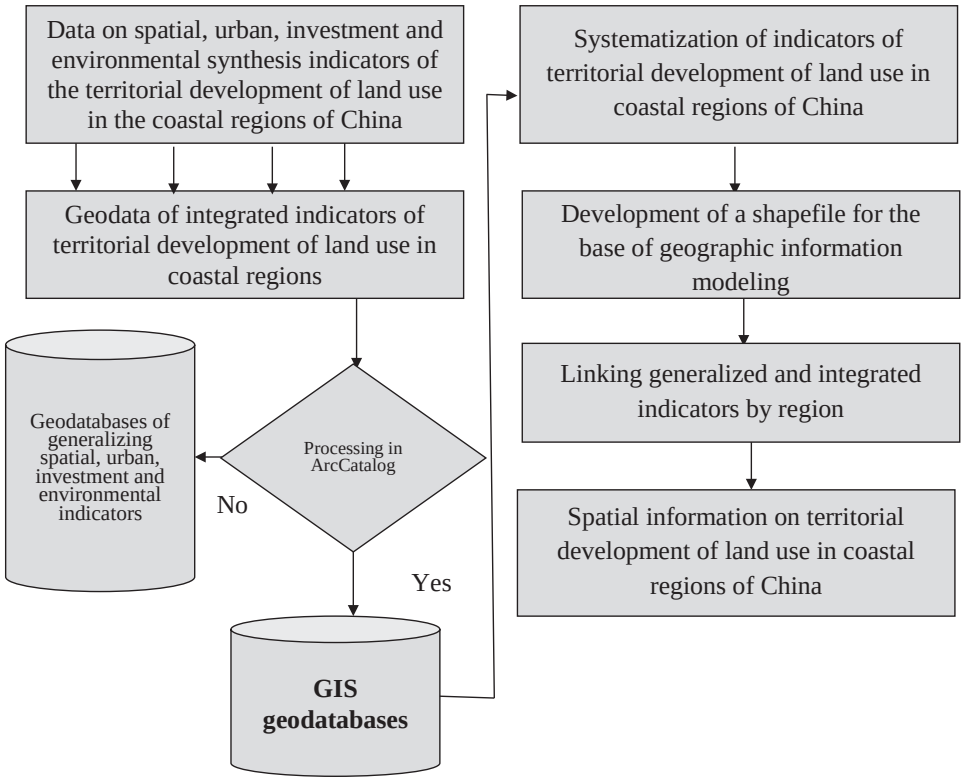

Fig. 2. Scheme for the creation and operation of geodatabases of indicators of territorial development of land use in coastal regions of China

development of land use in the coastal regions of China is presented in the form of a set of interrelated operations for the development and preparation of geodatabases of indicators in the GIS software environment.

The system of geographic information support for the territorial development of land use in the coastal region of China, taking into account spatial, urban, investment and environmental syn thesis data, is implemented according to the following components:

1. The use of software to develop a geographic information system for the territorial development of land use in the coastal regions of China.
2. Using the geodatabase of indicators of territorial development of land use in the coastal regions of China to create a set of layers of the geographic information system.
3. Analysis of generalized integral indicators of the territorial development of land use in the coastal regions of China, taking into account territorial and legislative characteristics.
4. The choice of technology for assessing the integral indicators of the territorial development of land use in the coastal regions of China.
5. Application of the GIS software module and the technology of mathematical modeling of indicators of territorial development of land use in the coastal regions of China.
6. Creating process models and analysis of indicators of the territorial development of land use in the coastal regions of China.
7. Development of a set of layers of spatial, urban, investment and environmental synthesis indicators.
8. Analysis and development of a layer of integrated indicators of the territorial development of land use in the coastal regions of China.
9. The use of the scale of influence of data from modeling indicators of territorial development of land use in the coastal regions of China.
10. Data visualization, presentation of the scene of the geographic information system of territorial development of land use in the coastal regions of China.

The developed scheme for the implementation of the GIS of the territorial development of land use in the coastal regions of China is presented in Fig. 3.

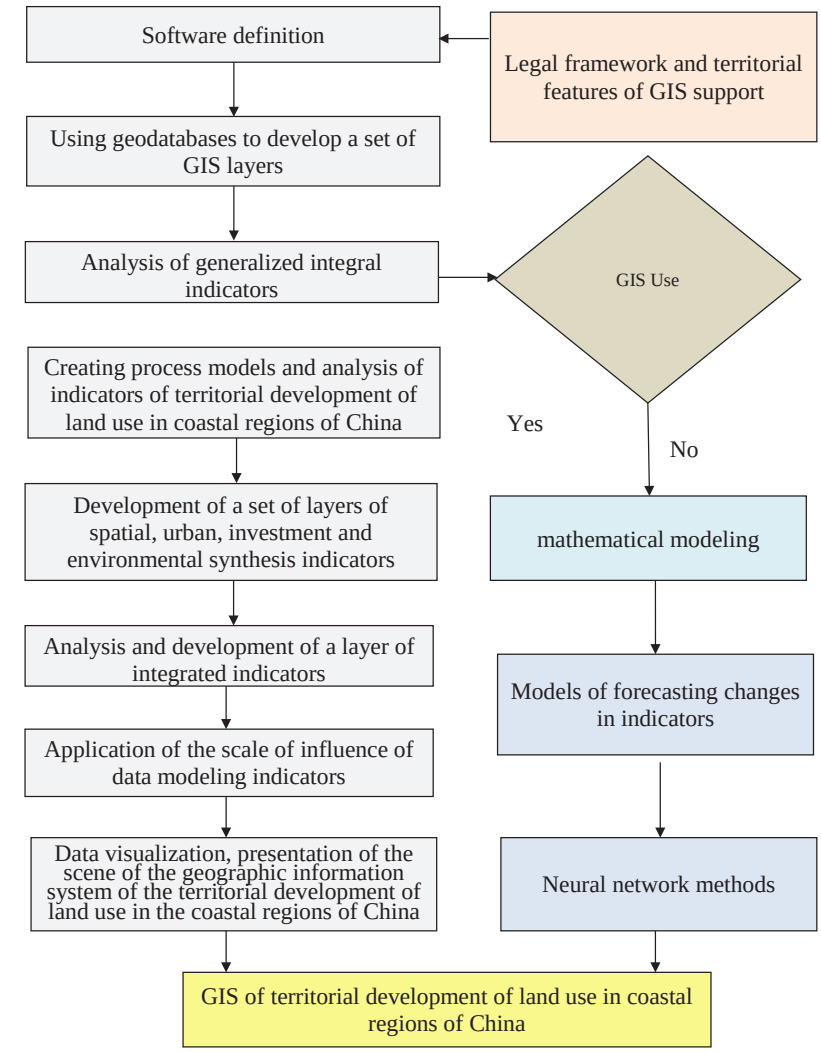

Fig. 3. GIS implementation plan for the territorial development of land use in the coastal regions of China

The discussion of the results obtained consists in the proposed directions for the formation and implementation of the geographic information system of the territorial development of the coastal regions of China. It allows you to create an information system for making informed decisions on the use of land in the coastal regions of China. In addition, the directions of the development and use of the geographic information system create a theoretical basis for the instrumental support of the territorial development of the use of the coastal lands of China.

Conclusions. Thus, on the basis of the presented scheme for the implementation of the geographic information system for the territorial development of land use in the coastal regions of China, opportunities have been formed for conducting geographic information modeling of generalizing spatial, urban, investment and environmental indicators.

The developed system of geoinformation support for the territorial development of land use in the coastal regions of China allows us to build geoinformation maps of systemic spatial, urban, investment, and environmental factors. This makes it possible to build a three-dimensional geoinformation model for monitoring the state of territorial development of land use in the coastal regions of China as an innovative tool for monitoring and making informed decisions in the system of territorial development of land use in the coastal regions of China.

The use of geographic information systems forms quantitative and spatial support for increasing the efficiency of managing land and property complexes and increasing their investment attractiveness, taking into account the peculiarities of the development of coastal regions of China.

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