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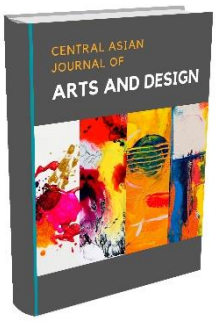

Remote Sensing of the Earth: A Method of Using Gis for Monitoring the Land of Rural Settlements

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Annotation

Modern technologies of remote sensing of the earth from space make it possible to create new information systems for observing and studying changes in the areal nature in each category of the land fund of the republic of Uzbekistan. This is especially important when it comes to studying the land of rural settlements, since their most important elements are perennial plants and soils that provide crops. In this case, it is necessary to create a special information technology for monitoring such objects. This will make it possible to form a series of observations that are homogeneous in time and space and will ensure that the analysis can be carried out with a high degree of reliability in the future.

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Introduction. One of the most important tasks of the development of the economy of the Republic of Uzbekistan and the regions is the development of its agricultural territories. The exchange of operational and reliable information in the field of managing the development of agricultural territories in the regions of Uzbekistan is clearly insufficient and requires the search for new effective mechanisms for interaction and coordination of economic entities in this area.

Currently, satellite observation technologies allow obtaining objective data, quantitative information about various objects and phenomena. This, in particular, makes it possible to create new information technologies and systems for observing and studying various processes occurring both in the structure of the earth and in areal changes. At the same time, it should be noted that the study of areal changes has its own specifics, which requires the creation of specialized information systems that allow obtaining and analyzing information that is homogeneous in time and space. This is especially important when it comes to studying the land of rural settlements, as the correct organization of these lands will improve the life of people engaged in agriculture and attract the younger generation to

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agriculture. In this case, it is necessary to create a special information technology for monitoring such objects. This will make it possible to form a series of observations that are homogeneous in time and space, and will ensure that the analysis can be carried out with a high degree of reliability in the future. At the same time, various characteristics of the studied objects should be determined, which can be restored on the basis of remote observation data and used to assess their condition and development forecasts. These tasks can be effectively solved only in relation to certain types of research objects. [4,5]

The purpose of this work is to develop methodological foundations for the formation of a system of remote diagnostics of land development in rural settlements and agricultural lands in solving problems of improving the efficiency of land use, as well as to create a model of an information system for remote monitoring of land, aimed at solving problems of forecasting, obtaining objective information about changes, solving problems of improving the efficiency of land use, taking into account the economic component of the regions.

The use of data obtained by remote sensing of the earth's surface from space appeared as a scientific and practical direction quite a long time ago-more than fifty years ago, due to the significant scale of the country and individual regions. For example, the area of the Tashkent region is 15,249 km2 and is heterogeneous in physical and geographical conditions, which makes it difficult to monitor the land of rural settlements using traditional methods. Therefore, the most promising methods of monitoring are currently the methods of space monitoring (remote sensing of the Earth) [1].

Given the above, we note that to date, the study of ways of improving the management of development of territories of rural settlements in the regions through the implementation of GIS technologies on the basis of results of space data, integration of their results into the practice of resource-based development in the rural settlements of areas of the Republic is an unresolved issue that determines the need for this study [2, 3].

The territory of rural settlements is the most promising area of application of remote sensing data, as it includes land of settlement development; public land; agricultural land and other land; land occupied by forest plantations; land of industry, transport, communications, defense and other purposes provided for the use of legal entities for these purposes. The changes occurring in these territories are clearly visible on satellite images, they are not hidden by anything, they are single-tiered and well deciphered both in texture and spectral characteristics [4].

It should be noted that the problem of ensuring sustainable development of rural settlements is complex, it should be solved on the basis of the interpenetration (convergence) of space and information technologies, management technologies of large economic entities, as well as methods of systems theory and system analysis.

Given the large area of the territory, monitoring of rural settlements and planning of measures to preserve their fertility on this basis are impossible by traditional methods without the active use of remote sensing methods, primarily using remote sensing methods of the earth, as well as modern digital technologies. [9,10]

There is a high demand for remote sensing data for operational management of rural settlements ' lands. The spatial resolution and temporal frequency of remote sensing images have increased significantly. This allows you to evaluate changes in high spatial resolution by increasing the volume of data and increasing the requirements for their processing. The time frequency of remote sensing images has also increased significantly. In recent decades, satellite methods and technologies have been increasingly used in solving problems of obtaining objective information about the use and

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condition of agricultural land. For these purposes, specialized information systems of various levels are being actively developed and implemented.

In recent years, the demand for modern space products and services has been increasing in Uzbekistan. This is due to several factors: only space systems are able to ensure the continuous operation of global information fields — space monitoring, navigation, data transmission and control, as well as a number of others.

The analysis showed that the technologies of formation, maintenance and use of a common regional information resource (database and knowledge), which has the following properties:

- integration with electronic maps and global navigation satellite system data;
- structuring by economic sectors, territories and other management objects;
- update based on satellite images And other earth remote sensing systems;
- providing data to any users - both state and management-at various levels in the form of visual, accessible and regulated services is most in demand in the regions of the Republic of Uzbekistan.

The results of many years of world economic statistics show that the use of space products and services reduces the cost of such activities as geodetic works, monitoring of objects, resources, phenomena, cartography by 2-3 times. The capabilities of space technologies are such that, when used together, they make it possible to create multi-parameter remote monitoring systems that receive information at an arbitrarily large distance from the object itself, which provides the best conditions for organizing economical, objective and reliable strategic and operational management. [11,12]

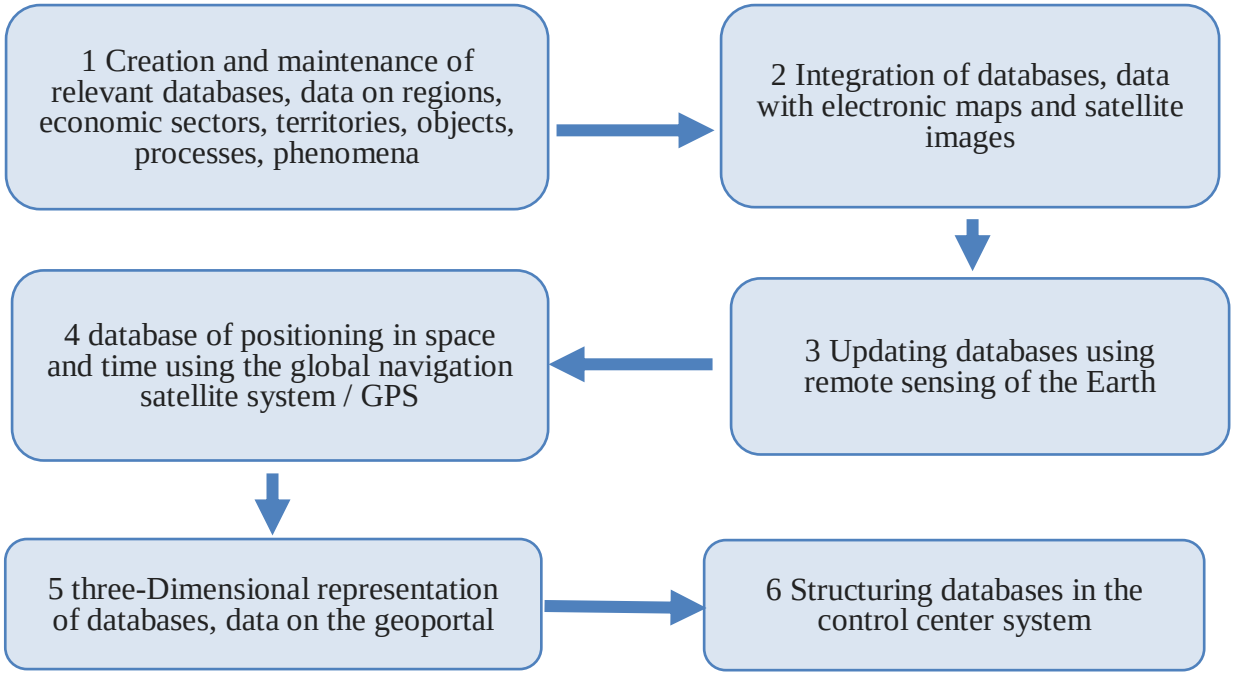

Fig. 1. Opportunities of the domestic geoinformation platform.

Currently, the Uzbek side is working on signing a cooperation agreement with Roscosmos and at the end of August 2020, the President signed a decree on the creation of the space research and technology Agency uzbekcosmos, which allows developing monitoring and control systems that meet the above requirements. The system of all requirements in one software platform is shown in figure 1. [13]

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The basic geographic information platform, as a rule, should have a structure (Fig. 2), which includes the following main components:

- system-wide software that includes raster and vector graphics editors, a graphical user interface for easy access to system tools, database management systems, and analytical software;
- hardware (computers, telecommunications equipment, data storage systems, etc.);
- spatial data:

a) positional (geographical data) - the location of an object on the Earth's surface;

b) non-positional (attributive) - descriptive, text, photo, video;

- technology.

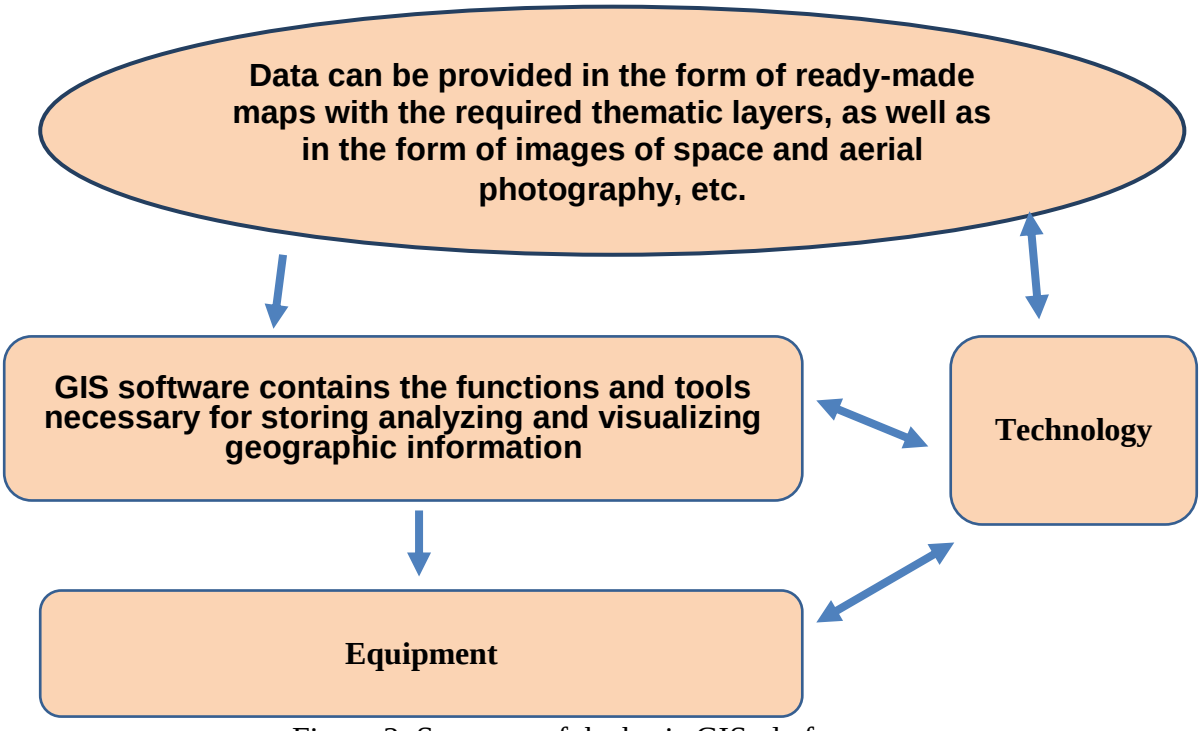

Figure 2. Structure of the basic GIS platform.

The life cycle of processing and application of information received from the satellite can be represented in the form of a diagram in figure 3.

It should be noted that the processing and use of satellite data can be cyclical, and the processing of the same data in separate blocks (Figure 3) can occur repeatedly. Sometimes you have to enter additional blocks to take into account the specifics of the information being processed. [6,7]

Let us consider the technologies necessary for integrated information and navigation support and monitoring of rural settlements, using the example of the hardware and software complex of the target agricultural monitoring system.

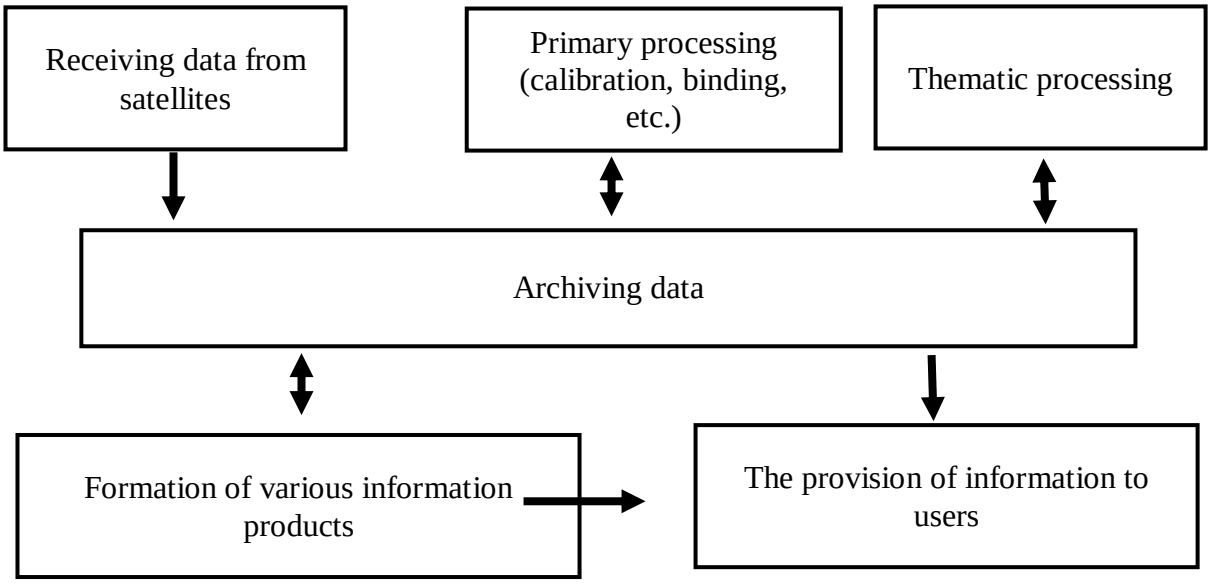

Figure 3. Life cycle of information processing and application.

The target agricultural monitoring system is designed to provide information to the relevant Executive authorities of the Republic of Uzbekistan and business entities on the inventory and accounting of agricultural land in the regions, the state of agricultural land and its classification, monitoring the state of agricultural crops by collecting, processing, modifying and analyzing monitoring information obtained from Russian and foreign spacecraft, creation of cartographic thematic products (layers on an electronic map) throughout the region based on heterogeneous information integrated into a thematically oriented GIS.

The main tasks solved by the target system of agricultural monitoring:

- monitoring of the state of agricultural land (the nature of land use, the state of vegetation cover of agricultural land and its unauthorized or improper use);
- assessment of the projected damage from the impact of negative natural and man-made factors;
- monitoring and evaluation of agricultural activities (monitoring of individual stages of the agricultural cycle, monitoring of sowing and harvesting);
- inventory of agricultural land is regulated by the requirements for cadastral registration;
- forecast assessment of the impact of climate and weather conditions on the main performance indicators of the agricultural sector.

The special software for this module includes the following blocks:

- remote sensing data detection (processing) unit, including modules for preliminary calculations of object parameters and thematic decoding of space information;
- GIS is a technological unit consisting of a module for displaying and analyzing the results of the detection system, as well as a module for presenting the results of work to the relevant specialized bodies.

The result of the application of the considered GIS technology is a thematic map with a layer of illegal vegetation, a layer of camouflage vegetation and attribute information.

Within the framework of a targeted agricultural monitoring system, it is advisable to have a set of

workstations focused on the work of specialists in various industries, for example:

- the workplace of the operator of the agricultural Department, which provides input, storage and editing of geometric and attribute information about agricultural land plots, comprehensive analysis and planning of agricultural work and labor resources based on GIS, web technologies and remote sensing data;
- the workplace of the operator-agronomist, designed for the distributed work of operators (agronomists) with information from a spatial database based on GIS technologies and the use of remote sensing data. [8,12]

The work within the framework of the presented project is carried out on the example of the Tashkent region, but it is advisable to highlight the following as the results obtained or expected:

1. The necessity of using geoinformation technologies based on remote sensing results in monitoring the land of rural settlements to ensure sustainable development of the Republic's regions is conceptually justified;

2. The concept of a target program for the use of geoinformation technologies based on the results of space activities in monitoring the land of rural settlements of the regions of the Republic of Uzbekistan has been developed;

3. The structure of the monitoring system for a large agricultural region was developed, the tasks solved by this system were determined, and the experimental verification of the developed provisions was carried out on models created on the basis of the National geographic information system.

Conclusion. The purpose of this article is to develop proposals for the creation of a system of space monitoring of rural settlements, aimed at ensuring the sustainable development of the regions of the Republic of Uzbekistan. The basic principles, structure, purpose and tasks solved by the basic modules of this system are substantiated. Experimental verification of the proposals formulated in the work, as it was carried out.

It should be noted that it is advisable to build a virtual environment based on University data centers built according to new principles, based on an innovative engineering solution that allows you to scale it and connect new participants as needed, without requiring additional investment.

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