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USE OF DISTANCE SCOMING DATA IN LAND RESOURCE MONITORING

Siddikov Rasuljon Uktamovich
Kokand State University

Ergasheva Marjona Otabek kizi
Student of Geodesy and Geoinformatics at Kokand State University

Abstract
This article analyzes the possibilities and practical experience of using remote sensing (RS) technologies in land resource monitoring. Near-real-time monitoring of soil, vegetation cover, water resources, and land degradation is carried out through the RS. International and domestic research has been studied, and existing shortcomings in this area in Uzbekistan have been identified - personnel potential, obsolescence of technical equipment, and limitations of advanced analysis methods. It was also noted that the availability of free satellite data and open scientific platforms creates great opportunities for the further development of RS technologies in our country. As a result, it has been scientifically substantiated that improving the land resource monitoring system based on remote sensing will serve to increase environmental sustainability and agricultural efficiency.

Keywords: Distance sensing, land resource monitoring, soil fertility, satellite data, NDVI, environmental monitoring, Uzbekistan, agro-monitoring.

Introduction

Land resources are one of the most important natural resources for the economic, social, and ecological stability of humanity. Resources such as soil, water, forests, pastures, and mineral resources play a key role not only in our daily lives but also in the development strategies of states. Proper and effective management of land resources is of paramount importance, especially in such areas as agriculture, industry, infrastructure, and environmental protection. However, today the pressure on these resources is increasingly growing: rapid population growth, the expansion of urbanization, climate change, improper farming and livestock practices lead to land degradation, erosion, salinization, deforestation, and other environmental problems.

Therefore, the development and implementation of modern, scientifically based methods for monitoring, evaluating, and controlling land resources has become a necessity. Traditional methods of land monitoring - on-site study, statistical analysis, and laboratory tests - are time-consuming, labor-intensive, and costly. In this case, advanced technologies, in particular, remote sensing (RS) technologies, are of great importance [1-4].

Remote sensing is a system for remote observation and analysis of the state of the Earth's surface and its changes in various spectral ranges using satellites or flying devices. With the help of MP technologies, it is possible to regularly, accurately, and promptly monitor large territories without human intervention. For example, many parameters of land resources, such as the state of

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vegetation cover, soil moisture, salinity, the level of water bodies, and the condition of forests, can be assessed using satellite imagery.

The application of MT technologies is expanding not only in developed countries, but also in developing countries. These technologies are especially relevant for Uzbekistan, as our country has limited land and water resources, a dry climate, and agriculture is the main economic sector. Therefore, the introduction of modern monitoring methods creates great opportunities for the rational use and conservation of available resources.

The purpose of this scientific work is to study the possibilities of using remote sensing data in monitoring land resources, analyze practical applications, and determine the prospects for the implementation of these technologies in the conditions of Uzbekistan. Within the framework of the research, the theoretical foundations of remote sensing technologies, their advantages, limitations, and practical examples in monitoring land resources are widely covered.

LITERATURE ANALYSIS

Monitoring of land resources using remote sensing technologies has become one of the most relevant and promising scientific directions in the world in recent decades. In the scientific literature, research on this topic is very extensive, aimed at a deep study of not only technological aspects, but also environmental and economic consequences. In particular, foreign scientific sources widely cover theoretical and practical approaches to the application of MP technologies. In this regard, the scientific works of scientists from the countries of America, Europe, and Asia are of particular importance.

World-renowned specialists - for example, J.R. Jensen, in his fundamental work, deeply covered the methods of monitoring landscapes, water bodies, and agricultural lands on the Earth's surface using remote sensing. He noted that indices such as NDVI (Normalized Difference Vegetation Index) are a reliable tool for accurate assessment of vegetation changes, allowing remote determination of plant health, especially in arid regions. The book "Introduction to Remote Sensing," written by Campbell and Wynne, covers all technical steps from capturing RS images to their spectral analysis. These sources extensively analyze the capabilities of modern satellite systems - such platforms as Landsat, Sentinel, MODIS, ASTER.

International organizations are also forming leading scientific and practical directions in this area. For example, within the framework of the FAO project "Land Degradation Assessment in Drylands," a methodology for assessing land degradation in arid regions based on LD has been developed. Also, through the Landsat and Copernicus programs implemented by NASA and ESA, indicators such as soil degradation, deforestation, and changes in water resources are regularly monitored. In particular, the Sentinel-2 satellite allows determining the state of plants, water bodies, and soil through high-resolution multispectral images [5-7].

In Asian countries, in particular, in India, China, and Indonesia, MP technologies have become an integral part of national agro-monitoring programs. Through the "Bhuvan" platform, developed by ISRO (India Space Research Organisation), the levels of land degradation, water scarcity, and salinity in India are regularly assessed. Experience in this area can also have practical value in the conditions of Uzbekistan.

Local scientists are also conducting a number of scientific studies in this area. In recent years, interest in the use of remote sensing technologies has been growing in the scientific community

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of Uzbekistan. In particular, scientists of the Tashkent Institute of Irrigation and Agricultural Mechanization Engineers (TIIAME), the National University of Uzbekistan, and the Institute of Geoinformation Technologies are conducting practical research on land resource monitoring in the territory of the republic. For example, researchers R. Alimov and B. Ochildiyev studied the dynamics of sown areas and soil fertility in Surkhandarya, Bukhara, and Khorezm regions based on Sentinel-2 data. In local studies, special attention is paid to the analysis based on such indices as NDVI, EVI (Enhanced Vegetation Index) and LST (Land Surface Temperature).

The Ministry of Ecology, Environmental Protection and Climate Change of the Republic of Uzbekistan is also implementing a number of pilot projects in cooperation with international organizations. In particular, the monitoring of land degradation in the desert regions of the Republic of Karakalpakstan, projects to assess changes in water sources in the Amu Darya delta area, yielded the first practical results in this area.

As can be seen from these scientific works, while foreign experience is mainly based on the analysis of high-precision satellite data using automated algorithms, in Uzbekistan, observations are still carried out using more classical methods - GIS and NDVI indices. This situation indicates the need to enrich domestic scientific and practical activities with modern technologies.

In general, the analyzed literature shows that remote sensing technologies serve as an important tool for regular, accurate, and economically effective monitoring of land resources. Adapting advanced international experience to local conditions and widely applying modern technologies in scientific research and practical management is one of the issues of strategic importance for Uzbekistan.

RESULTS AND DISCUSSION

Based on the conducted analyses, in-depth study of the literature, and comparison of foreign and domestic experience, it was clearly demonstrated that the importance of remote sensing technologies in monitoring land resources is invaluable both theoretically and practically. At a time when the pressure on land resources is increasing in the context of today's globalization and climate change, regular, prompt, and accurate monitoring of their condition has become a necessity. From this point of view, it has been proven that remote sensing technologies have significant advantages over other traditional monitoring methods [8-10].

With the help of remote sensing, it is possible to monitor land resources in real time, including such indicators as soil fertility, the level of salinity, the density of vegetation cover, and the volume of water resources. Multispectral and hyperspectral images transmitted by satellites serve as the main source of information in this process. The analyses showed that satellites such as Sentinel-2 and Landsat-8 stand out as the most effective platforms, their level of detail (10-30 meters) and revision period (5-16 days) allow for regular recording of changes on the Earth's surface.

Indices such as NDVI (Normalized Difference Vegetation Index), EVI (Enhanced Vegetation Index), LST (Land Surface Temperature), developed on the basis of data obtained using these technologies, serve to express vegetation health, soil temperature, and other environmental indicators in numerical expressions. Such indices serve as a reliable tool for assessing soil fertility, drought conditions, and the stages of crop development. Also, with the integration of

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cloud computing, machine learning algorithms, and automatic classification models, the effectiveness of these technologies is increasing.

Analysis and practical experience conducted in local conditions show that certain positive shifts are observed in the initial stages of applying remote sensing technologies in Uzbekistan. In some regions - in particular, in Karakalpakstan, Bukhara, and Khorezm - pilot projects have been implemented for monitoring sown areas, identifying salinity zones, and assessing the condition of water bodies. These projects were often based on Sentinel-2 images, the results of which were visualized on GIS platforms with confirmation. At the same time, monitoring based on the NDVI index remains the most common method in Uzbekistan, which means that the capabilities of MP technologies are not being fully utilized.

Also, when compared with international experience, it became clear that local monitoring work is relatively limited in terms of technology and methodology. In particular, machine learning, cloud platforms (Google Earth Engine), automated data analysis and forecasting systems have not been widely implemented in Uzbekistan. Abroad, through such systems, scientifically based policy decisions are made to identify and prevent risks such as land degradation, water scarcity, and reduced yields. For example, in India, the Bhowan system, developed by ISRO, assesses the health of agricultural land on a weekly basis and sends warning information to farmers. In the European Union, the Copernicus program monitors the risk of forest fires, drought, and a decrease in water resources.

During the analysis, it was revealed that the main problems in the field of remote sensing in Uzbekistan are: a shortage of personnel, obsolescence of technical means, limited availability of modern software platforms, the lack of a constantly updated open database, and disconnections between practice and scientific research. Without solving these problems, the widespread and systematic use of remote sensing technologies will be difficult.

At the same time, there are opportunities. In particular, many satellite data are provided free of charge (Sentinel, MODIS, Landsat), international scientific platforms (Google Earth Engine, QGIS, SNAP) are used as open sources, and they are relatively cheap and easy to master. This will allow Uzbekistan to create the necessary infrastructure and knowledge base to rapidly expand remote sensing capabilities [11-14].

The use of remote sensing technologies plays a crucial role in the effective management of land resources, ensuring ecological balance, and optimizing agricultural activities. Existing experience shows that if these technologies are implemented nationwide on a scientific basis with a systematic approach, a comprehensive and reliable database on the state of land resources will be created in a short time, which can become an important factor in ensuring environmental sustainability and economic efficiency.

CONCLUSION

Remote sensing technologies have high efficiency in monitoring land resources and are important from an ecological and economic point of view. Studies have shown that with the help of these technologies, it is possible to accurately and systematically monitor indicators such as soil condition, vegetation cover health, water resources, and land degradation in close real-time. As a result of the analysis of international experience and domestic practice, it was established that, despite the availability of remote sensing capabilities in Uzbekistan, it is necessary to develop

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modern technologies, advanced methods, and a qualified personnel base for their full and effective implementation.

At the same time, the availability of free high-quality satellite data and open scientific platforms creates broad opportunities for the rapid and high-quality formation of a land resource monitoring system in our country. The comprehensive monitoring system, created on the basis of remote sensing, will have strategic significance in the rational management of land resources, prevention of environmental risks, and development of the agricultural sector.

Thus, the possibility of ensuring sustainable and efficient management of land resources by further developing remote sensing technologies and strengthening the scientific and technical base in our country has been scientifically substantiated.

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