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Monitoring of Land Reclamation Conditions Based on Digital Technologies

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Abstract:

This article discusses the role and significance of modern digital technologies in the effective use of agricultural lands and the monitoring of reclaimed agricultural lands. It highlights the importance of organizing proper control over land reclamation conditions and crops based on Geographic Information System (GIS) data. The article presents scientifically grounded analytical materials, conclusions, and recommendations developed by researchers based on collected data to implement necessary and prompt measures.

Keywords: monitoring, reclaimed lands, ArcGIS software, "R-GIS" portal geodatabase, remote sensing, salinization, groundwater.

Introduction: Currently, it is projected that "the world population will reach 8 billion by the end of 2023, 8.6 billion by the mid-2030s, and approximately 11.2 billion by the 2050s." These demographic trends indicate a growing demand for the efficient use of existing land resources from the perspective of food security. Therefore, increasing the effectiveness of land resource management— the primary means of ensuring food supply— through the use of modern digital technologies has become a necessity. In this regard, improving the methodology of land information systems in the context of the digital economy is one of the pressing tasks.

In order to increase the productivity of irrigated lands, improve their reclamation conditions, and enhance water supply, large-scale irrigation and reclamation measures are being implemented within the framework of state programs. As a result, between 2008 and 2017, the water supply of more than 1.7 million hectares of irrigated land and the reclamation condition of 2.5 million hectares were improved. However, due to global climate change, periodic water shortages observed in recent years and the deterioration of a significant portion of internal irrigation networks have led to the worsening of reclamation conditions of irrigated lands, causing some areas to become unsuitable for use over time.

In recent years, the introduction of modern and innovative technologies—such as unmanned aerial vehicles, satellite imagery, and specialized software—has significantly simplified the land accounting process and improved its accuracy. At the same time, the deepening of land reforms in the Republic, the diversity of land user rights, and the emergence of new forms of land use have created a necessity for ensuring precision and reliability in land accounting and introducing necessary modifications to its management system.

Compared to traditional methods, conducting agricultural land monitoring using modern technologies can lead to higher economic efficiency.

To what extent this problem was investigated. Numerous researchers in Uzbekistan have conducted scientific studies on agricultural land monitoring and improving its efficiency. Several scholars, including R.A. Turaev, E.Yu. Safarov, M.I. Ruzmetov, O.Ö. Davronov, R.N. Sharopov, J.S. Usmonov, B.Yu. Makhsudov, Kh.Kh. Tashbaeva, S.S. Ibrohimov, and others, have carried out research using modern digitalized methods based on remote sensing data for agricultural land monitoring.

In 2021, Dr. R.A. Turaev developed a **Land Information System Portal**, which digitizes administrative and territorial units of Uzbekistan— including regions, districts, land plots, and agricultural production boundaries. This portal allows for real-time updates and improvements to land parcel contours and changes. Through this system, it is possible to identify land users, update information on newly allocated land plots online, and monitor both agricultural crop placement plans and their implementation. The **Land Information System** portal ensures the visualization of these monitoring results.

Figure 1. Appearance of the "Land Information System" Portal.

PhD researchers S.S. Ibrohimov and M.T. Abdullaeva developed the "R-GIS" portal, which demonstrated that the human factor plays a significant role in agricultural crop monitoring. To address this, they proposed a sequential mechanism for effective crop placement planning and monitoring. This mechanism follows the sequence:

Crop placement plan > ArcGIS software > Traditional monitoring > Field Map mobile application > Satellite imagery (Sentinel-2 NDVI) > ArcGIS software > "R-GIS" portal.

By utilizing this method, it becomes possible to rapidly and efficiently collect and store accurate data for proper crop placement. This system provides comprehensive information to land users and offers interactive services to agricultural specialists, improving decision-making in land management and monitoring.

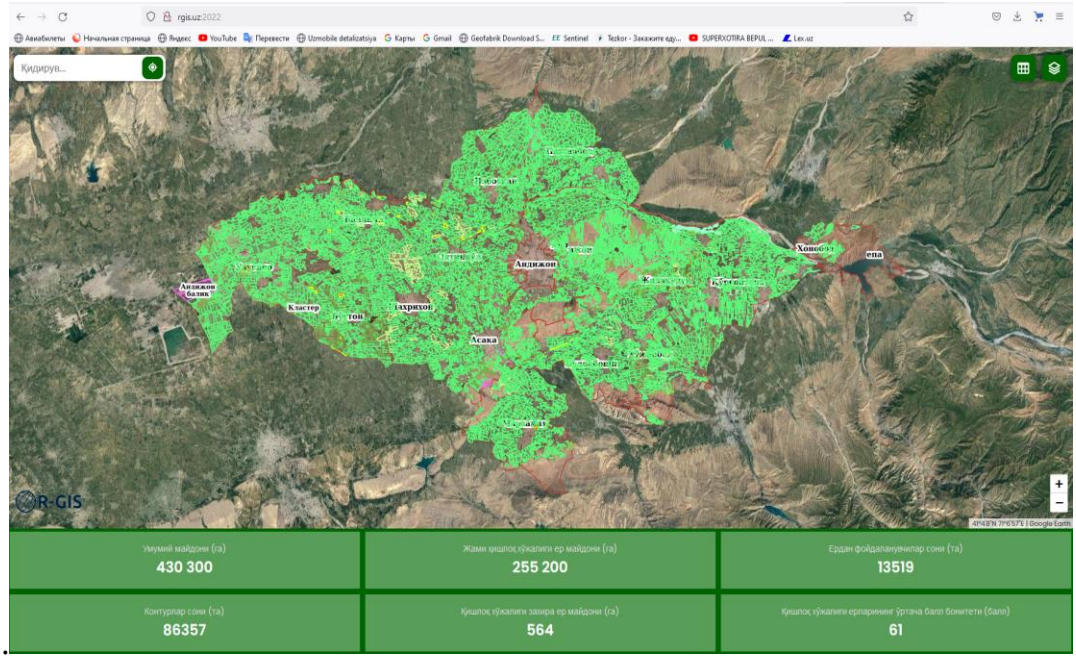

Figure 2. The working interface of the "R-GIS" (Real Geoinformation System) portal.

Research Results and Discussion. The "Meliorative Monitoring Geo-Information System" portal developed by us currently contains electronic data on the borders of the republic, regions, as well as districts and cities. This portal provides real-time information and a sequential representation of all administrative territorial structures of the republic. The portal's data is regularly updated. (Figure 3).

Figure 3. View of the main page of the "Meliorative Monitoring Geo-Information System."

The developed geoportal's side panel displays information about the selected district. For example, data on deteriorated land conditions in Konimekh district of Navoiy region are provided (Figure 4), including:

✓ Total identified deteriorated land (ha);

- ✓ Land with worsened meliorative conditions due to rising groundwater levels (ha);
- ✓ Highly saline land (ha);
- ✓ Land with insufficient water supply and unusable irrigation structures (ha);
- ✓ A summary window displaying general information categorized by land users (Figure 4).

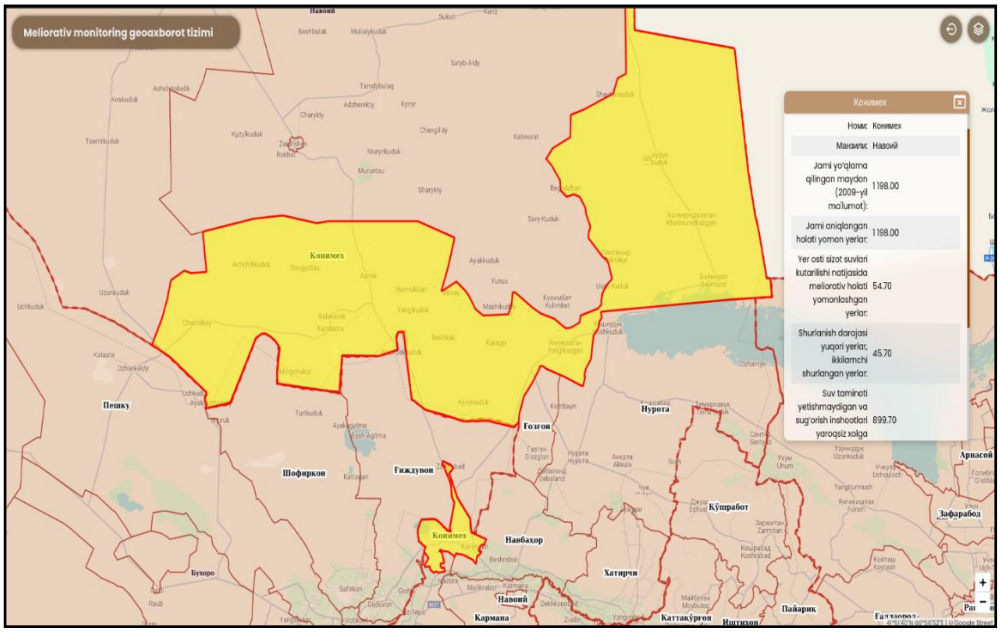

Figure 4. Meliorative condition of agricultural land in Konimekh district, Navoiy region.

Similarly, in the next layer of the program, the currently approved data is displayed for the relevant massif and MFY (OFY, QFY) areas within the district (Figure 5).

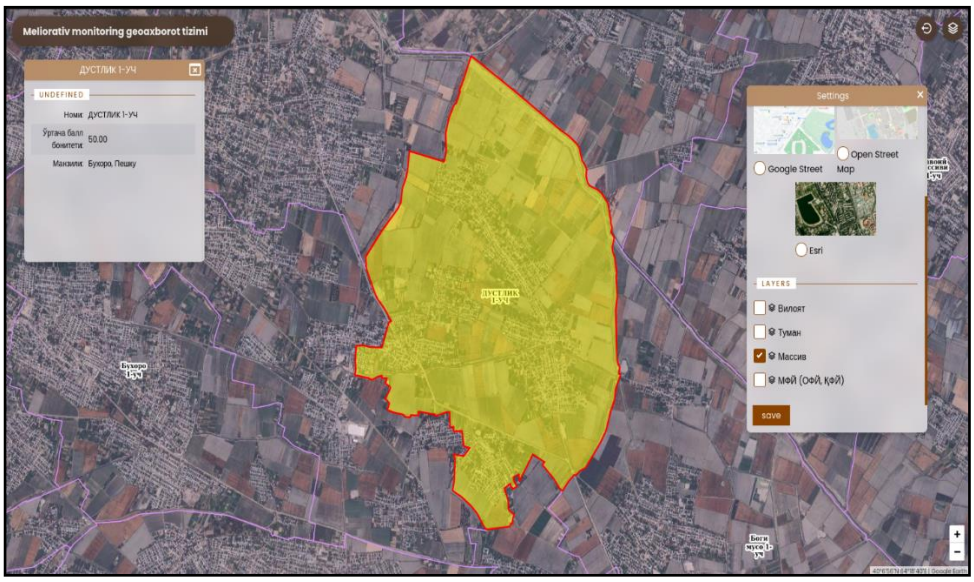

Figure 5. The meliorative condition of agricultural land in the "Dostlik" massif of Peshku district, Bukhara region.

After selecting the necessary region, district, massif, and MFY data from the program, the system allows users to automatically download the information in table format as an Excel file.

Farg‘ona viloyatidagi sug‘oriladigan yerlarning meliorativ xolatini yo‘qlama (inventarizasiya)dan o‘tkazish ishlarini yakuni to‘g‘risida Ma'lumot																
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			Holatini yaxshilash natijasida qayta tiklangnan yerlar	Jami aniqlangan holati yomon yerlar	Shundan											
					Yer osti sizot suvlari kutarilishi natijasida meliorativ holati yomonlashgan yerlar	Shurlanish darajasi yuqori yerlar, ikkilamchi shurlangan yerlar	Suv taminoti yetishmaydigan va sug‘orish inshootlari yaroqsiz xolga kelgan yerlar	Meliorativ tizimlari ishlamasligi oqibatida ishdan chiqqan yerlar	Uta toshloq va gips qatlami mavjud yerlar	Daryo suvlarining ko‘tarilishi oqibatida, qirg‘oq buyi ekin yerlari yuvilib ketgan yerlar	Buloq suvlari qurib qolib foydalanilmayotgan yerlar	Qishloq xo‘jalik ekinlari ekilmasligi oqibatida yaroqsiz xolatga tushgan yerlar	Foydalanilmasdan bo‘z xolatiga aylangan yerlar	Qishloq xo‘jalikekinlari ekilib kelinayotgan yerlar	Surunkali ravishda 2000-yildan buyon foydalanilmayotgan yerlar
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
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2	Buvayda														
3	Bog‘dod														
4	Dang‘ara														
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6	Quva														
7	Oltiariq														
8	Qo‘shtepa														
9	Rishton														
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11	O‘zbekiston														
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14	Furqat														
15	Farg‘ona shahri														
16	Quvasoy shahri														
	Jami viloyat bo‘yicha														

Figure 6. Entry window to the layers panel for the reclamation status of agricultural lands.

On the main page of the Reclamation Monitoring Geo-information System, there is a "Setting" section, which allows users to change the workspace background to one of the following raster maps: Fon, Google Earth, Google Street, Open Street Map, or Esri (Figure 7).

Figure 7. One of the open maps available in the map layer: OpenStreetMap, Google Earth, Google Street, or Esri.

Here:

OpenStreetMap – is an online project that allows the creation and use of free and open maps worldwide. OSM users can contribute their own data to maps, ensuring continuous updates. OpenStreetMap maps are freely available to everyone and are used in various fields such as navigation, geolocation services, geographic analysis, and other applications.

Google Earth – is free software that enables working with 3D maps and images globally. Google Earth allows users to virtually explore the Earth's surface, identify geographic locations, and travel to different places. The program displays the Earth's terrain, cities, mountains, rivers, and other geographic features using 3D models.

Conclusion, Suggestions, and Recommendations. The development of the "Meliorative Monitoring Geo-Information System" portal is a significant step toward effective land resource management and the study of reclamation processes. This portal enables the monitoring of meliorative conditions, rapid and accurate data retrieval, and better control over land improvement activities. The geo-information system visualizes various types of data, facilitating decision-making processes and ensuring the efficient use of agricultural land.

Additionally, proper assessment and recording of meliorative conditions, the implementation of early warning systems, and the effective utilization of natural resources provide a solid foundation for sustainable land management. This portal also plays a crucial role in coordinating scientific research and practical work while enhancing collaboration between the public and private sectors.

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