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Monitoring Of Agricultural Lands: Relevance, Results And Scientific Conclusions

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Abstract

This scientific article is devoted to the analysis of the results of monitoring conducted on agricultural lands. The problems identified during the monitoring, ways to eliminate them and recommendations for the rational use of land in the future are outlined. The results of the study are important in shaping state policy in the field of agriculture and developing regional development programs. The study examined the shortcomings of existing monitoring methods and assessed the feasibility of obtaining high-resolution data using drones and satellite imagery. A 22-hectare experiment demonstrated that drones provide information with 90-95% accuracy, but are difficult to implement over large areas. Satellite monitoring, meanwhile, offers 80-90% accuracy and covers large areas in a short time. Based on this, the cost effectiveness, time consumption, and resource efficiency of both methods are compared.

Keywords: Land and water resources, irrigation, resource management, submission farming, drone monitoring, Sputnik imaging, GIS technologies, Water Resources, Land efficient use, agrarian innovation, *digital agriculture.*

In recent years, large-scale reforms have been implemented in the agricultural sector of the Republic of Uzbekistan, aimed at ensuring sustainable development, strengthening food security, and increasing export potential. Land and water resources are among the main factors of production in our country's agriculture, and their rational and innovative use is a strategic priority for the national economy. Since a significant portion of Uzbekistan's territory is located in arid and semi-arid climates, irrigated lands account for the bulk of agricultural production. Therefore, an in-depth study of the scientific and practical foundations of applying irrigated agronomic technologies to improve the efficiency of irrigated land use is crucial for ensuring economic stability.

In the context of innovative development, special attention should be given to the development and implementation of integrated resource management systems in agriculture. This includes the development of comprehensive strategies aimed at optimizing the use of water, soil, and energy resources, as well as reducing negative environmental impacts. At the same time, it is necessary to implement precision farming methods based on information on soil conditions, weather conditions, and crop needs [3, 4]. This will create the opportunity to reduce excess resource consumption and increase productivity.

Modern technologies, such as smart irrigation systems, GIS monitoring technologies using drones, and satellite data, can significantly improve the efficiency of agricultural production [5, 6]. The widespread use of sensors, automated control systems, and GIS technologies enables monitoring and forecasting processes based on current needs, which reduces costs compared to traditional methods of improving land use efficiency. Drone monitoring allows for the prompt identification of problem areas in fields, such as disease outbreaks or moisture stress, and prompt intervention.

Until now, traditional agricultural land monitoring required dozens of specialists. Given these circumstances, our research focused on improving crop monitoring methods. To this end, we set the following objectives [1, 2]:

1). Analysis of existing monitoring methods and identification of their deficiencies: Currently used monitoring methods, their accuracy, timeframes, and coverage were studied. It was found that many methods are ineffective due to resource-intensiveness and the complexity of data processing.

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2). Study of the possibilities of using modern technologies for high-precision data collection: The possibilities of assessing the condition of crops by analyzing data obtained using remote sensing methods, in particular, satellite images and unmanned aerial vehicles (UAVs), are considered.

3). Development of data processing and analysis methods: Algorithms for filtering, calibrating, and classifying collected data have been developed. These algorithms allow for the determination of various agricultural crop indicators (e.g., vegetation index, biomass, water stress).

4). Development of methods for visualizing and presenting monitoring results: Graphs and maps have been created that are understandable to agricultural specialists and farmers. These visualizations allow for the rapid and accurate acquisition of information on crop status.

Analytical data on economic indicators of monitoring work carried out using various methods on 22 hectares of agricultural land in the Karasuvsky MFYu massif of the Orta-Chirchik district of the Tashkent region:

METHOD 1: Using drones – time spent 1 day, staffing 2 pilot-operators, and data processing time 2 days. Of this, the monthly salary amounted to 4 400 000 soums, and the accuracy of the obtained information was noted at 90-95%. A positive aspect is the significant reduction in human error, and data processing takes only 3 days. A negative aspect is the difficulty of covering large areas due to the influence of weather conditions on drone flight and the limited battery capacity of the drone.

METHOD 2: Satellite Earth sensing – the time spent is only 1 hour, one specialist is involved, and one day is allocated for data processing. Of this, the monthly salary amounted to 2 200 000 soums, and the accuracy of the obtained information is estimated at 80-90%. A positive aspect is the minimal human intervention and one day for data processing. Furthermore, this method is not dependent on weather conditions. A negative aspect is that the cost of satellite imagery can be quite high.

Therefore, when choosing a method for remote sensing agricultural crops, it is necessary to consider factors such as the size of the survey area, budget, accuracy level, and time. For small areas, drones may be optimal, while for larger areas, satellite sensing is advisable. Drones serve as an important tool in the agricultural sector for land monitoring, crop area assessment, and yield forecasting. Using the data they provide, it is possible to optimize irrigation systems, apply fertilizers at the correct rate, and implement timely pest control measures. This, in turn, facilitates the rational use of resources and improves crop quality. Highly accurate data obtained by drones is valuable not only for farmers and farmers, but also for agricultural research institutes and government organizations. This information can be used to conduct scientific research on improving soil fertility, developing new crop varieties, and improving agricultural technologies.

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Precision farming based on GIS data reduces the environmental impact on the environment and increases resource efficiency [7]. As a conclusion, it is worth saying that ensuring the effective use of irrigated lands is not just a matter of agricultural technology or water management, but a complex problem that can be solved through a management system that combines economic, environmental and technological factors. Through the introduction of innovative technologies, the use of resource-saving methods and the implementation of climate change adaptation policies, it is possible to ensure the sustainable development of agriculture in Uzbekistan.

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