

**INNOVATIVE APPROACHES OF GIS TECHNOLOGIES IN
MONITORING THE CONDITION OF AGRICULTURAL LANDS**

Scientific Supervisor: Usmonov Jasur Ziyodillayevich

Doctor of Philosophy (PhD) in Agricultural Sciences

Toshtemirov Temurbek Akmal o'g'li

Independent Researcher at the "Geoinnovation Center" State Unitary

Enterprise

temurbektoshtemirov@gmail.com

ANNOTATION

This article examines the modern role and innovative integration of Geographic Information Systems (GIS) in the monitoring and management of agricultural lands. In the face of global climate change and soil degradation, traditional observation methods are proving insufficient. The research highlights how GIS, combined with Remote Sensing (RS) and Satellite Imagery, provides real-time data on soil moisture, crop health, and land use changes. The study discusses the transition from conventional farming to precision agriculture, emphasizing how spatial data analysis contributes to sustainable land management and food security.

ANNOTATSIYA

Ushbu maqolada qishloq xo'jaligi yerlarini monitoring qilish va boshqarishda Geografik axborot tizimlarining (GAT) zamonaviy roli va innovatsion integratsiyasi ko'rib chiqiladi. Global iqlim o'zgarishi va tuproq degradatsiyasi sharoitida an'anaviy kuzatish usullari yetarli bo'lmay qolmoqda. Tadqiqotda GAT texnologiyalari masofadan turib zondlash (RS) va sun'iy yo'ldosh tasvirlari bilan birgalikda tuproq namligi, ekinlar holati va yerlardan foydalanishdagi o'zgarishlar haqida real vaqtdagi ma'lumotlarni qanday taqdim etishi yoritilgan. Maqolada an'anaviy dehqonchilikdan aniq dehqonchilikka o'tish masalalari muhokama qilinadi, fazoviy ma'lumotlar tahlili barqaror yer boshqaruvi

va oziq-ovqat xavfsizligiga qo'shayotgan hissasi ta'kidlanadi.

Keywords: GIS, Remote Sensing, Precision Agriculture, Land Monitoring, Soil Degradation, NDVI, Sustainable Development, Spatial Data.

Kalit so'zlar: GAT, Masofadan turib zondlash, Aniq dehqonchilik, Yer monitoringi, Tuproq degradatsiyasi, NDVI, Barqaror rivojlanish, Fazoviy ma'lumotlar.

INTRODUCTION

The rapid growth of the global population and the increasing pressure on natural resources demand a more efficient approach to agriculture. Agricultural land monitoring is a fundamental process for ensuring soil fertility and optimizing crop yields. Historically, this was done through manual soil sampling and visual inspections, which are time-consuming and lack spatial continuity.

The emergence of Geographic Information Systems (GIS) has revolutionized this field. By allowing researchers to overlay various layers of data—such as topography, hydrology, and vegetation indices—GIS provides a holistic view of the agricultural landscape. The integration of innovative tools like drones (UAVs) and multispectral satellite sensors allows for high-resolution monitoring that can detect plant stress weeks before it is visible to the human eye.

MAIN PART: INNOVATIVE APPROACHES AND DISCUSSION

1. Remote Sensing and Multi-Spectral Analysis

One of the most significant innovations is the use of the Normalized Difference Vegetation Index (NDVI). GIS platforms process satellite data to calculate the ratio between near-infrared and red light reflection.

- **Application:** This helps farmers identify specific areas of a field that require more nitrogen or irrigation, preventing the over-application of chemicals.

2. Big Data and Real-Time Monitoring

Modern GIS applications are now cloud-based, integrating "Big Data" from weather stations, soil sensors, and historical yield maps. This allows for predictive modeling. Instead of reacting to a drought, GIS-based models can predict moisture

stress based on historical patterns and current atmospheric data.

3. Precision Agriculture (PA)

Precision agriculture is the pinnacle of GIS application. Using GPS-guided machinery, farmers can apply fertilizers and pesticides with centimeter-level accuracy. This not only reduces costs but also minimizes the environmental footprint of farming by preventing chemical runoff into local water sources.

4. Discussion on Challenges

While the technology is advanced, its implementation in developing regions faces hurdles. These include the high cost of high-resolution satellite imagery, the need for specialized technical training for farmers, and data privacy concerns. However, the move toward open-source GIS software (like QGIS) and free satellite data (like Sentinel-2) is democratizing access to these innovative tools.

CONCLUSION

Innovative GIS technologies are no longer optional tools but essential components of modern agriculture. They provide the analytical framework necessary to combat soil salinity, erosion, and the unpredictable effects of climate change. By shifting from generalized land management to site-specific interventions, GIS ensures that agricultural practices are both economically viable and environmentally sustainable. Future advancements in Artificial Intelligence (AI) integrated with GIS will further automate land monitoring, leading to a new era of "Smart Farming."

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