



Artificial Intelligence Applications in Sustainable Agriculture

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Abstract

The integration of artificial intelligence (AI) into agriculture has emerged as a transformative approach to addressing global challenges such as food security, climate change, and resource scarcity. This study explores the role of AI-driven technologies in enhancing agricultural productivity, efficiency, and sustainability. By leveraging machine learning algorithms, remote sensing, and data analytics, modern farming systems can optimize irrigation, fertilization, pest control, and crop monitoring processes. AI-based decision support systems enable farmers to make data-driven decisions by analyzing real-time environmental and soil conditions. Precision agriculture techniques, supported by AI, contribute to reducing input costs while increasing yield and minimizing environmental impact. Furthermore, predictive models help anticipate weather patterns, disease outbreaks, and crop performance, allowing proactive management strategies. The paper also examines the adoption barriers of AI technologies in agriculture, including high implementation costs, lack of technical expertise, and data accessibility issues. Despite these challenges, ongoing advancements in digital infrastructure and increasing awareness among stakeholders are accelerating AI adoption in rural and developing regions. In conclusion, AI presents significant opportunities for transforming traditional agricultural practices into more efficient and sustainable systems. Future research should focus on developing accessible, cost-effective AI solutions tailored to small-scale farmers, ensuring equitable benefits across the agricultural sector. The integration of AI with interdisciplinary approaches will play a crucial role in shaping the future of global food systems.

Key Words: *Artificial Intelligence, Precision Agriculture, Decision Support Systems, Machine Learning, Sustainable Agriculture.*

