

THE ROLE OF AUTOMATION IN SUSTAINABLE FARMING PRACTICES

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Abstract

As the global agricultural sector faces the dual challenges of rising food demand and severe environmental degradation, the integration of automation has emerged as a critical pathway toward sustainability. This literature review synthesizes recent peer-reviewed findings on the ecological and operational impacts of automated technologies specifically precision drone mapping, autonomous weeding robotics, and (Internet of Things) IoT-driven smart irrigation systems in minimizing resource depletion. By evaluating quantitative data across multiple recent field trials and agronomic meta-analyses, this study highlights significant efficiencies achieved through tech-driven conservation. Aggregated research findings indicate that the implementation of (Artificial Intelligence) AI-controlled, computer vision targeted spraying reduces chemical herbicide volume by 40% to 55% compared to traditional blanket broadcast application methods, mitigating chemical runoff. Additionally, the adoption of lighter, autonomous field vehicles lowers soil compaction rates by an average of 18%. Furthermore, automated variable-rate irrigation systems optimized via real-time soil moisture telemetry demonstrate up to a 31% reduction in total water consumption without compromising baseline crop yields. The synthesized literature demonstrates that while high initial capital expenditures and technological complexity remain significant adoption barriers for smallholder operations, the deployment of agricultural automation significantly reduces the ecological footprint of modern farming.

Keywords

automation, sustainable farming, precision agriculture, agricultural robotics, automated irrigation, sustainable agriculture.