

SUSTAINABLE AGRICULTURE IN THE DIGITAL ERA: BALANCING PROFITABILITY AND ENVIRONMENTAL STEWARDSHIP

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Agriculture is continuously facing different critical challenges in controlling pests, weeds, and pathogens across different spatio-temporal scales of crop growth and development. The modern agricultural practices create a serious threat of depleting natural resources and cause environmental pollution. Besides that, absolute reliance on and injudicious use of agrochemicals, like pesticides, herbicides, and fungicides, have emerged, raising concerns about the sustainability of agroecosystems and human health. Different transformative approaches, including the integration of the Internet of Things, artificial intelligence, remote sensing, machine learning, and precision farming with drones, sensors, and robots, are broadly under the digitization of agriculture. Digitization of agriculture provides real-time and site-specific solutions, thereby maximizing use efficiency of resources and ensuring economic viability with ecological resilience. The comprehensive approach to the sustainability of digital agriculture assures work accessibility and efficiency of reduction of agricultural labour. The article mainly focuses on the applications of integrated IoT and smart sensors for farming, along with a bibliometric analysis on artificial intelligence in agriculture. The widespread adoption of IoT enabled smart farming depends on supportive economic policies, data encryption, and strengthening capacity-building programs. The concept of digitalization in sustainable agriculture is not about increasing production, but it's about optimizing the on-farm and off-farm resources by leveraging the advanced technologies and enhancing economic profitability with environmental stewardship.

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