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Sustainability and Environmental Footprints of AI-Integrated Agrifood Production Systems

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Abstract

Global food systems are facing challenges in meeting the rising demand for food while also reducing their environmental impact, including carbon and water footprints. Artificial intelligence (AI) offers promising solutions to improve efficiency, effectiveness, and resilience throughout the food supply chain. However, the use of AI in food production, particularly in advanced industrial settings such as Industry 4.0 and 5.0, also presents its own environmental and social challenges. This study examines the potential benefits of AI in creating a sustainable food system, including better resource use, less waste, improved water efficiency, and enhanced crop protection. It also considers the significant energy needed to train and operate AI systems. To ensure AI-based technologies truly support sustainability in food production, we need a balanced approach that includes fair access, responsible resource management, and integrating AI with other sustainable agricultural practices. Future efforts should focus on making AI tools easier to use for a wider audience, implementing strong governance rules, and aligning AI advancements with environmental, economic, and social impacts. By preventing these challenges, AI can be used to develop a more efficient, resilient, and environmentally friendly food resource system, contributing to global sustainability goals.

Keywords: Sustainability, environmental footprints, carbon and water footprints, AI-integrated food production, zero waste and water efficiency