

# Chapter 11

## Harnessing Artificial Intelligence for Circular Economy in Agriculture: Reducing Waste and Maximising Efficiency

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### ABSTRACT

*Artificial intelligence (AI) is highlighted as a crucial enabler of a circular agriculture economy. Utilising advanced data analytics and predictive modeling, AI allows precise monitoring, analysis, and optimisation of various agricultural processes. AI-driven predictive analytics further optimise resource allocation, reducing the overuse of fertilisers, pesticides, and water while maximising yields and profitabil-*

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*ity. Furthermore, AI-powered supply chain management enhances traceability and transparency, enabling stakeholders to identify inefficiencies, mitigate risks, and minimise food loss and waste. Additionally, AI facilitates the valorisation of agricultural by-products and waste through innovative recycling and upcycling initiatives, transforming organic waste into valuable inputs such as biofuels, fertilisers, and animal feed. Overall, this chapter delves into the transformative potential of AI-driven circular economy approaches within the agricultural sector, emphasising the critical need for waste reduction, resource optimisation, and enhanced efficiency.*

## **1. INTRODUCTION**

The worldwide agriculture industry is facing a rising challenge: how to feed a world population that is expanding while also lessening its environmental effect (Hertel & Baldos, 2016). Traditional farming methods can lead to substantial resource loss and environmental damage. As a result, creative and sustainable methods of agricultural production are desperately needed. The circular economy, which stresses the idea of reducing, reusing, and recycling resources to build a more sustainable agricultural system, is one such potential strategy (Selvan et al., 2023). The use of artificial intelligence (AI) in agricultural processes offers a revolutionary chance to improve circularity in the industry. AI-driven solutions that maximise efficiency throughout the whole production process, minimise waste and optimise resource use have the potential to completely transform agriculture. By 2050, there will be 9.7 billion people on the planet, greatly increasing the need for food. To make sure that food production can keep up with this rising demand, waste reduction, and agricultural practice efficiency optimisation are critical (Doering & Sorensen, 2018; Smil, 2001). It is possible to increase the amount of food available to feed the people by reducing losses and making the best use of the resources. One of the main causes of environmental problems including water shortages, deforestation, and greenhouse gas emissions is agriculture. By using fewer resources and producing less pollution, waste reduction helps reduce agriculture's environmental impact (Technology, 2021). By ensuring that resources like water, electricity, and fertilisers are utilised sparingly, maximising efficiency helps to further prevent environmental damage. By minimising losses and lowering inputs, efficient agricultural methods may drastically cut production costs. This improves farming's economic viability and increases its long-term profitability and sustainability. Improved yields and cost savings for farmers provide for more financial security and the possibility of reinvesting in sustainable practices. Soil, water, and fossil fuels are just a few of the limited natural resources that are essential to agriculture. To ensure that these resources are preserved for future generations, efficient usage is essential (Lal, 2008; Pimentel

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