# Chapter 10
# Artificial Intelligence Applications in Agricultural Sustainability:
## Enhancing Efficiency and Resilience

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## ABSTRACT

*Agriculture plays a crucial role in addressing global challenges such as food security, resource scarcity, and climate change. As the world population continues to grow, the need for sustainable and efficient farming practices becomes paramount. This chapter aims to explore the applications of artificial intelligence (AI) in agricultural sustainability, focusing on how AI technologies can enhance efficiency and resilience in agricultural practices. The chapter provides an overview of the potential benefits and challenges of integrating AI into agriculture, highlighting specific use cases, and discussing the implications for sustainable farming systems. It also examines the role of AI in addressing key sustainability issues including resource management, yield optimization, pest control, and adaptation to environmental conditions. By examining current trends and advancements in AI for agriculture, this chapter contributes to a comprehensive understanding of how AI can revolutionize farming practices and promote sustainable agricultural systems.*

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## INTRODUCTION

On a global level, agricultural production systems are facing significant challenges, particularly due to climate change, reduced water supply for irrigation, increased production costs, and a general decrease in the effective of farm workers over the past few decades. Additionally, the recent COVID-19 pandemic has posed a threat to global food supply and production systems. As agriculture continues to evolve, it is crucial to implement substantial innovations in order to sustain and overcome these challenges. Meeting the responsibility of producing enough high-quality food in sufficient quantities for the rapidly growing global population is an evident challenge. Agricultural exploration specialists have consistently utilized modern technology to seek innovative approaches and methods to integrate into agricultural systems. For many years, researchers and technicians have been gathering data to study and analyze different aspects of agricultural systems. The use of unmanned aircraft systems (UAS) has made a vast amount of data more accessible, leading to increased interest in utilizing artificial intelligence (AI) in agriculture (Hasler & Baysal-Gurel. 2019). By providing advanced analytics to manage agricultural systems, unmanned aerial systems (UAS) present a remarkable opportunity to enhance the resilience and effectiveness of production systems like never before (Coble *et al.,* 2018).

This chapter discusses recent research on data collection trends, specifically focusing on the use of remote sensing technologies in sustainable agriculture. It also explores future perspectives on integrating unmanned aerial systems (UAS) technology with spaceborne remote sensing data for large-scale research on agriculture at national and international levels. The ultimate goal of AI-enhanced agriculture is to maximize agricultural inputs and yields based on supply and demand. Achieving this requires automated data collection, storage, organization, decision-making, and robotic interventions. These processes enable early detection and diagnosis of crop diseases, as well as timely provision of nutrients to animals. Precision agriculture utilizes cutting-edge methods to accurately calculate the precise quantity of fertilizer needed for the soil of a farm. This not only reduces greenhouse gas releases but also enhances crop productivity, resulting in increased yields. Other initiatives, such as integrated pest management systems and pesticide information management, aim to enhance farmer education and awareness. Artificial intelligence, with its powerful learning capabilities, has emerged as a vital tool in addressing various agricultural challenges. AI-powered systems are being developed to assist agricultural specialists worldwide in finding better solutions. By leveraging AI technology, it becomes possible to reduce the impact on natural ecosystems, enhance worker safety, ensure reasonable food costs, and meet the growing food demands of a projected world population exceeding nine billion by 2050. This will require a 70% increase in agricultural output (Béné *et al.,* 2015). Just 10% of the increased output can be attributed to unused land, while the remaining 90% should be achieved by enhancing current production methods. It is crucial, accordingly, to utilize the latest technological advancements to improve farming efficiency in order to meet this goal. The market demands top-notch food quality, and the current intensification strategies in agriculture necessitate significant energy inputs (Khandelwal & Chavhan, 2019).

Robotics and autonomous systems (RAS) are bringing about a revolution in various industries worldwide. One such sector is the agro-food industry, which has traditionally struggled with low productivity. The integration of RAS technologies is expected to have a significant impact in this field. This chapter aims to bridge the gap between different disciplines including agriculture, food, electronics, and computer science. By adopting a comprehensive approach, it explores various cutting-edge areas related to the agri-food-consumer triangle.