Chapter 21
Transforming Agriculture With Modern AI: Harnessing Artificial Intelligence to Revolutionize Farming

Rozy Dhanta
Shoolini University, India

Marizvikuru Mwale
Institute of Rural Development, Thohoyandou, South Africa

ABSTRACT

This chapter delves into the transformative impact in agriculture by integrating artificial intelligence (AI), leading the conventional farming practices to revolution. AI-powered smart farming systems enable precision agriculture, facilitating efficient resource management, and boosting productivity. Crop management techniques driven by AI, including disease and pest detection, yield prediction, and optimization, optimize farm operations and enhance crop quality. Similarly, in livestock farming, AI-based animal health monitoring and precision livestock farming systems enhance animal handling, diseases control, welfare, and overall productivity. Moreover, AI's role in sustainability is evident through resource optimization, improved production and productivity, and mitigation of environmental impacts. The abstract concludes by underscoring AI's potential in addressing global food demand and fostering a sustainable future for agriculture, emphasizing the significance of responsible AI integration to shape a resilient agricultural landscape.

DOI: 10.4018/979-8-3693-1902-4.ch021

INTRODUCTION

Agriculture has been the backbone of human civilization, providing sustenance and livelihood for millennia. As the global population continues to grow, reaching new heights each year, the pressure on the agricultural sector to meet the rising food demand has intensified. Traditional farming methods, while having served humanity well and considered as climate smart approach in agriculture (Singh & Singh, 2017), they are facing numerous challenges. According to Singh & Singh (2017), traditional farming practices include agroforestry, cover cropping, intercropping, organic composting (traditional), crop rotation, and crop-livestock farming (integrated) which have potential to enhance crops and livestock productivity thereby mitigating climate change effects and meeting global food demand. However, resource inefficiencies, unpredictable weather patterns, crop and livestock diseases, and environmental degradation hinder their potential. In response to these hindrances, modern artificial intelligence technologies have appeared as a game-changer, revolutionizing agriculture and offering innovative solutions to age-old problems. In recent years, the agricultural sector has witnessed a remarkable transformation with the integration of modern AI technologies (Talaviya, Shah, Patel, Yagnik & Shah, 2020). These advancements in AI have opened up new possibilities and innovative solutions to traditional farming problems, enabling farmers to increase productivity, optimize resource management, and enhance sustainability in agriculture (Talaviya *et al.,* 2020). This chapter explores the numerous ways in which Artificial Intelligence is revolutionizing agricultural industry, from smart farming systems to crop management and livestock monitoring.

The abstract of this chapter sets the scene for exploring the transformative impact of integrating AI in agriculture. The aim of this chapter is to delve deeper into the ways in which AI is revolutionizing traditional farming practices. By harnessing the power of AI, agriculture is transitioning into an era of smart farming systems, precision crop management, and intelligent livestock monitoring. This introduction provides an overview of the key concepts and themes that explored throughout the chapter.

The chapter begins with a synopsis of the challenges faced by traditional farming methods in context of meeting growing global population demands. United Nations Population Division (2022) estimates 9.7 billion increase in the world population. World population increase is associated with increased demand for essential resources such as food, water and energy, coupled with degradation of the environment. Hence, increased population has potential to exacerbate traditional farming challenges such as limited resources, and reduced yield which negatively impacts demand for food. This calls for the need for sustainable farming practices. As traditional methods fall short in addressing these challenges amidst the need for sustainable agriculture, the need for innovation in agriculture becomes apparent.

To address these challenges, the concept of artificial intelligence is introduced. AI, as a branch of computer science, includes the creation of smart machines capable of conducting activities that would normally necessitate human intelligence. In the context of agriculture, AI presents an opportunity to optimize and transform farming practices through data-driven decision-making, automation, and predictive analytics. Machine learning, deep learning, and neural networks are some key components of AI that have shown remarkable success in various agricultural applications (Talaviya *et al.* 2020; Subeesh & Mehta, 2021). An overview of the themes on what was elaborated in this chapter is discussed. Broadly, application of AI in crops, livestock and the limitations of AI use are discussed.