Chapter 8
Harnessing AI for Automated Decision-Making in Farm Machinery and Operations:
Optimizing Agriculture

Mrutyunjay Padhiary
https://orcid.org/0000-0002-2236-568X
Assam University, Silchar, India

Pankaj Roy
https://orcid.org/0009-0002-2014-8574
Assam University, Silchar, India

Poulami Dey
https://orcid.org/0009-0005-3345-4783
Assam University, Silchar, India

Bhabashankar Sahu
https://orcid.org/0009-0008-2253-9361
Parala Maharaja Engineering College, India

ABSTRACT

Automated technology has transformed agriculture by improving processes from tillage to supply chain management. This chapter provides an in-depth exploration of automated decision-making (ADM) applications within the agricultural sector,

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including tillage, planting, irrigation, crop selection, fertilization, pest management, harvesting, storage, and supply chain management. It begins by discussing automated technology concepts and how they enhance efficiency, productivity, and sustainability in farming practices. Real-world examples and case studies demonstrate successful ADM implementations, showing how it is applied and its results. It also discusses challenges and future directions in adopting automated technology in agriculture, such as scalability, data privacy, regulatory frameworks, and insights for stakeholders. The chapter aims to assist farmers, agronomists, policymakers, and industry professionals in utilizing automated technology for innovation, enhancing agricultural processes, and tackling global food security challenges in modern agriculture.

1. INTRODUCTION

Automation of decision-making (ADM) in the field of agriculture is a significant technical progression that includes the adoption of modern technologies such as artificial intelligence (AI) and machine learning (ML) to independently evaluate data and enhance decision-making procedures with limited human involvement (Lezoche et al., 2020; Padhiary, Saha, et al., 2024). The application of ADM enables farmers to benefit from comprehensive data pertaining to soil conditions, weather patterns, crop health indices, and market trends, thereby improving efficiency and production within agricultural operations (**Figure 1**). Through the automation of decision-making processes, it enables farmers to make informed decisions based on data, leading to enhanced crop yields, decreased resource consumption, and heightened profitability (Javaid et al., 2022; Padhiary, 2024a).

The application of ADM is pervasive across the whole agricultural value chain, including various stages from pre-planting activities, such as soil preparation, to post-harvest operations, which includes storage and distribution (Raj et al., 2021). Advanced decision-making applications in agriculture represent a diverse array of innovative practices. These practices include precision farming techniques such as variable rate seeding and fertilization, advanced smart irrigation systems, autonomous machinery for planting and harvesting tasks, predictive analytics for efficient pest and disease management, and optimization of supply chain logistics to ensure smooth operations (Padhiary, Sethi, et al., 2024). The incorporation of ADM technology into farming methods not only improves effectiveness and environmental friendliness but also transforms the way food is produced and distributed, enabling unprecedented levels of agricultural advancement. All-terrain vehicles equipped with ADM technology are capable of efficiently performing various agricultural jobs in diverse situations (Padhiary, Kumar, et al., 2024).