Chapter 9
Advanced Artificial Intelligence and Multi-Source Remote Sensing for Agricultural Monitoring and Forecasting

S. Ramakrishnan
http://orcid.org/0009-0007-1488-7609
Erode Sengunthar Engineering College, India

S. Maheswari
http://orcid.org/0000-0003-0097-4887
Velalar College of Engineering and Technology, India

G. Pradeepa
Vivekanandha College of Engineering for Women, India

P. Brindha
http://orcid.org/0000-0002-0232-0572
Erode Sengunthar Engineering College, India

Brindha Samarasam
http://orcid.org/0000-0003-4179-4161
Nandha Engineering College, India

Parimala Devi M
http://orcid.org/0000-0003-3955-1339
Velalar College of Engineering and Technology, India

ABSTRACT

Agricultural systems are multifaceted adaptive systems that are constructed through dynamic processes of interaction between climate, soil, vegetation, and management activities, and which are progressively evidently, climate variability and extreme events. Conventional methods of monitoring have constraints of low spatial coverage,

DOI: 10.4018/979-8-2600-0778-5.ch009

Copyright © 2026, IGI Global Scientific Publishing. Copying or distributing in print or electronic forms without written permission of IGI Global Scientific Publishing is prohibited. Use of this chapter to train generative artificial intelligence (AI) technologies is expressly prohibited. The publisher reserves all rights to license its use for generative AI training and machine learning model development.

expensive nature and low sensitivity to the spatiotemporal heterogeneity. Current developments in satellite remote sensing have made available large amounts of multisensory data including optical, SAR, and thermal data, that when combined with the meteorological and edaphic data, can be used to fully monitor the agriculture. This chapter reviews the methods of artificial intelligence (AI) and machine learning, deep learning, and spatiotemporal models to monitor crops, predict yields and assess food security. The focus is put on the time-series analysis, multi-source data fusion, and early-warning applications, including the drought detection and yield-gap analysis.

1. INTRODUCTION

Agricultural production systems represent a primary contact point between the Earth system and the human society. They are the source of world food security and are also sensitive to climatic, environmental, and anthropogenic processes. The interplay of atmospheric conditions, soil characteristics, water availability, crop physiology, and management practices is complex and controls crop growth and yield formation across multiple spatial and temporal scales. Over the past few decades, the interactions have been further destabilized by climate change, land-use acceleration, and the growing resource stress culminating in increased variability in crop productivity and increased vulnerability of food systems in the global context (Lobell et al., 2013; Rockström et al., 2017). In such circumstances, there is a strong need to monitor agriculture and estimate yields in time to assist adaptive management, stabilize food supply chains, and make informed policy interventions on regional to global levels.

The traditional agricultural monitoring methods such as field-based surveys, administrative statistics and empirical yield models still have a significant role in production assessment. These techniques are, however, usually limited in terms of spatial representativeness, operational cost, reporting delays, and data reliability. These limitations become more pronounced when applied to large and heterogeneous agricultural regions (Becker-Reshef et al., 2020). These restrictions are particularly strong in low-income and middle-income nations, whereby the sparse network of observation, and lack of the institutional capacity, limit the availability of quality and timely agricultural information. This means that traditional surveillance systems do not tend to record intra-season, spatial heterogeneity, and quick transformations caused by extreme weather conditions.

Remote sensing has evolved into satellite-based observation systems. These systems serve as a cornerstone for large-scale agricultural monitoring by providing systematic, repeatable, and spatially explicit measurements of land surface condi-

38 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: www.igi-global.com/chapter/advanced-artificial-intelligence-and-multi-source-remote-sensing-for-agricultural-monitoring-and-forecasting/406556

Related Content

New Approach of Diagnosis by Timed Automata
Olfa Azzabi, Chakib Ben Njimaand Hassani Messaoud (2017). *International Journal of Ambient Computing and Intelligence (pp. 76-93).*
www.irma-international.org/article/new-approach-of-diagnosis-by-timed-automata/183621

Influential Nodes Identification Based on Activity Behaviors and Network Structure With Personality Analysis in Egocentric Online Social Networks
Dhrubasish Sarkar, Soumyadeep Debnath, Dipak K. Koleand Premananda Jana (2019). *International Journal of Ambient Computing and Intelligence (pp. 1-24).*
www.irma-international.org/article/influential-nodes-identification-based-on-activity-behaviors-and-network-structure-with-personality-analysis-in-egocentric-online-social-networks/238051

Machine Learning Integration to Analyze Student Behavior in an Online Digital Learning System
Somdeep Dasand Pinaki Pratim Acharjya (2025). *Integrating Artificial Intelligence in Education: Enhancing Teaching Practices for Future Learning (pp. 217-242).*
www.irma-international.org/chapter/machine-learning-integration-to-analyze-student-behavior-in-an-online-digital-learning-system/360572

A Basic Toolkit for Instructional Design by AI in Elementary Level Teaching
Gamze Türkmenand Sinem Sözen Özdoan (2025). *Effective Instructional Design Informed by AI (pp. 1-54).*
www.irma-international.org/chapter/a-basic-toolkit-for-instructional-design-by-ai-in-elementary-level-teaching/369662

Leveraging Artificial Intelligence to Enhance Ultrasound Imaging: A New Era in Medical Diagnostics
Prince Khandelwaland Sahil Gupta (2026). *AI in Diagnostic Radiology: Clinical Applications and Case-Based Insights (pp. 131-174).*
www.irma-international.org/chapter/leveraging-artificial-intelligence-to-enhance-ultrasound-imaging/385006