Chapter 5
Harnessing Precision Agriculture and Artificial Intelligence in Sustainable Farming

Muhammad Safdar
https://orcid.org/0009-0006-1779-6967
Agricultural Remote Sensing Lab, University of Agriculture, Faisalabad, Pakistan

Wasiq Farooq
Agricultural Remote Sensing Lab, University of Agriculture, Faisalabad, Pakistan

Muhammad Sajid Mehmood
https://orcid.org/0000-0002-2055-3505
School of Tourism and Planning, Pingdingshan University, Pingdingshan, China

Abdul Rauf
Department of Irrigation and Drainage, University of Agriculture, Faisalabad, Pakistan

Amina Rashid
https://orcid.org/0000-0001-9772-1063
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan

Kashif Mehmood
Department of Irrigation and Drainage, University of Agriculture, Faisalabad, Pakistan

Muntaha Munir
https://orcid.org/0009-0005-3404-3636
Institute of Botany, University of the Punjab, Lahore, Pakistan

Nalain E. Muhammad
Department of Irrigation and Drainage, University of Agriculture, Faisalabad, Pakistan

Hafiz Muhammad Bilawal Akram
https://orcid.org/0000-0001-6720-7266
Department of Agronomy, University of Agriculture, Faisalabad, Pakistan

Hafiz Muhammad Mohsin Raza
Department of Agricultural Sciences, Allama Iqbal Open University, Islamabad, Pakistan

DOI: 10.4018/979-8-3373-6608-1.ch005

Aisha Nazir
Institute of Botany, University of the Punjab, Lahore, Pakistan

Hafiz Muhammad Awais
https://orcid.org/0000-0002-1757-9747
Agricultural Remote Sensing Lab, University of Agriculture, Faisalabad, Pakistan

ABSTRACT

The chapter explores the role of Artificial Intelligence (AI) in revolutionizing precision agriculture, focusing on data-driven, adaptive, and efficient practices. It traces the evolution of AI-integrated digital farming systems, including GNSS, drones, sensors, and IoT technologies. Key AI applications include crop classification, yield forecasting, pest detection, irrigation scheduling, and nutrient management. The chapter also discusses technologies like UAVs, hyperspectral imaging, edge computing, and cloud-based platforms for improved farm-level decision-making. The chapter discusses the potential of AI in large-scale and smallholder farming systems but also highlights challenges like heterogeneous data, economic barriers, limited digital literacy, and low adoption among smallholder farmers. The chapter discusses future opportunities in AI-integrated robotics, blockchain-based supply chains, and big data analytics for climate-resilient agriculture and calls for inclusive policy reforms, capacity-building initiatives, and collaborative innovation for equitable scale.

I. INTRODUCTION

Agriculture is a practice of cultivating the soil, planting and harvesting crops. Agriculture is the backbone of human civilization which is facing severe challenge. The world is entering a phase of food security with increasing population the demand of food is expected to rise significantly placing immense pressure on the agriculture system. Increasing population, changing land and climate are putting drastic stress on agricultural land. Urbanization, rapid soil degradation and unstable farming practices are reducing cultivable land. World full demand is anticipated to increase by 50% till 2050. All the challenges underline the critical need for better and sustainable farming practices. Sustainable practices are no longer optional but are the need for meeting future food requirements.

Till now agriculture has relied on traditional farming practices. In the face of modern challenges these traditional farming practices are proving to be unsustainable as they require high level of water and chemical inputs which not only escalate production but also contribute to soil degradation, water wastage and long term environmental pollution. Climate change continue to challenge crop productivity.

The Consideration of Children's Rights in Corporate Action: Current Developments in Germany

Christopher Bohlens (2025). *Gender, Environment, and Human Rights: An Intersectional Exploration (pp. 417-440).*
www.irma-international.org/chapter/the-consideration-of-childrens-rights-in-corporate-action/358276