

Siddharth Singh Chouhan
Rajneesh Kumar Patel
Uday Pratap Singh
Sanjeev Jain *Editors*

AgriTech Revolution

Next-Gen Solutions and Challenges in
Modern Agriculture

 Springer

Editors

Siddharth Singh Chouhan
School of Computing Science and
Engineering
VIT Bhopal University
Sehore, Madhya Pradesh, India

Rajneesh Kumar Patel
School of Computing Science and
Engineering
VIT Bhopal University
Sehore, Madhya Pradesh, India

Uday Pratap Singh
Department of Mathematics
Central University of Jammu
Bagla Suchani, Jammu and Kashmir, India

Sanjeev Jain
Central University of Jammu
Bagla Suchani, Jammu and Kashmir, India

ISBN 978-981-95-1267-6 ISBN 978-981-95-1268-3 (eBook)
<https://doi.org/10.1007/978-981-95-1268-3>

© The Editor(s) (if applicable) and The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd. 2025

This work is subject to copyright. All rights are solely and exclusively licensed by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Singapore Pte Ltd. The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

If disposing of this product, please recycle the paper.

Contents

1	AI-Enhanced Agriculture: Cultivating the Future	1
	Arpit Tripathi, Harshlata Vishwakarma, Rajneesh Kumar Patel, Anju Shukla, and Siddharth Singh Chouhan	
2	Artificial Intelligence in Agriculture: A Transformative Direction . . .	15
	Vyshnavi Sunil, Sanhita Chowdhury, Shreya Singh, Nikhil Kumar, Avantika Pandey, Shivendra Singh, Akanksha Adhikari, and Vinod Kumar Dubey	
3	Application of Nanotechnology in Soil Fertility Management and Crop Production: Opportunities and Challenges in African Agriculture.	29
	Parwada Cosmas and Gumbo Albert	
4	A Smart Aeroponics for Sustainable Agriculture: New Horizon and Use Cases	49
	Sharmila and Shashi Bhushan	
5	Mitrika: IoT-Based Fertilization, Watering, and Crop Health Monitoring System for Precision Agriculture	69
	Aastha Saha, Pranay Das, Suvranshu Chowdhury, Bipasha Talukder, Arnab Mitra, Chinmoy Ghorai, and Satyabrata Maity	
6	AgriCloud: Cloud-Based Framework for Scalable Crop Monitoring and Intelligent Decision Support.	89
	Anju Shukla, Siddharth Singh Chouhan, Rajneesh Kumar Patel, and Uday Pratap Singh	
7	Remote Sensing Applications for Precision Farming.	103
	Nikhil Kumar, Subhrajyoti Bhattacharjee, Sanhita Chowdhury, Shipra Yadav, Shreya Singh, Avantika Pandey, and Vinod Kumar Dubey	
8	AI Technologies in Agriculture: Transforming Farming with Intelligent Solutions	127
	Kamal Kant Verma and Ajay Kumar	

9	Smart Greenhouses and Controlled Environment Agriculture	159
	G. Indumathi, J. Alfina Graceline, and A. Nivetha	
10	Machine Vision and Deep Learning for Smart Agriculture	171
	P. Raghavendra Prasad, Nagajyothi Dimmita, T. Swapna, S. Kanakaprabha, and K. Shanthi Latha	
11	Revolutionizing Indian Agriculture: The Role of Mechanization and Emerging AgriTech Innovations	195
	Vinay Kumar and Sushil Sharma	
12	Data Analytics and AI in Agribusiness	221
	Dawa Drakpa, Dhruva R. Rinku, N. Rajeswaran, and S. Kanakaprabha	
13	Agriculture 6.0: Smart and Sustainable Innovations Shaping the Future of Farming	243
	Anu Bansal, Aparna Sharma, Anurag Tewari, Ajit Bansal, and Ishwani	
14	Deep Learning for Precision Agriculture: Predicting Crop Yields in a Changing Climate	253
	Mohit Choubey, Yogesh Kumar Gupta, Aman Dubey, and Rahul Prasad	
15	Sustainability and Environmental Impact of AgriTech Solutions	277
	Rushda Sharf, Ambrina Sardar Khan, and Yusra Sharf	
16	Digitalization in Smart Farming	303
	Parthasarathy Seethapathy, R. Preetha, M. Jeya Rani, K. Kalaichelvi, and P. Murali Sankar	
17	Digitization in Smart Farming: Revolutionizing Agriculture	331
	Shivnarayan Ahirwar, Mohit Choubey, Yogesh Kumar Gupta, and Aman Dubey	
18	Blockchain Technology in Agri-Food Supply Chains	349
	Shubham, Harsh Dagar, Sandeep Kaur, and Anureet Kaur Chandi	
19	Artificial Intelligence Technologies in Agriculture	371
	Harshit Mishra	
20	Cropify: An Intelligent System for Crop Recommendation and Disease Identification	397
	Gathram Kesava Murthy, Riya Sapra, and Shivani Sharma	



Sustainability and Environmental Impact of AgriTech Solutions

15

Rushda Sharf, Ambrina Sardar Khan, and Yusra Sharf

Abstract

AgriTech plays an important role to achieve the sustainable agriculture, which is all about balancing the needs of the environment, society, and the economy. Three key factors of sustainable agriculture, i.e., environmental, societal, and economic, are integrated with agriTech, which plays a vital role in achieving this balance. AgriTech offers an extensive collection of instruments and innovative technologies aimed to reduce the negative ecological impacts associated with traditional agriculture techniques. These technologies enable agricultural experts to make decision in data analysis, enhance operational efficiency, and mitigate risks associated with agricultural activities. Precision agriculture plays an important role in agriTech, using satellite imagery, drones, and sensors to monitor crop conditions, soil health, and weather patterns. This empirical approach enables agriculturalists to manage the application of fertilizers, irrigation, and other vital resources, making it easier to optimize the allocation of resources while reducing waste. AgriTech solutions simplify real-time crop health monitoring, quickly identify pest, and efficiently manage diseases, enabling timely actions to minimize crop losses. While agriTech offers numerous benefits, but its use in sustainable agriculture comes with some challenges. For example, one major challenge is the high initial cost, which can make it difficult for some farmers to get started. AgriTech can negatively impact biodiversity and the environment, leading deforestation and habitat loss from clearing land for farming. The usage of synthetic fertilizers may contaminate soil and water, while also playing a role in climate

R. Sharf (✉) · A. S. Khan

Department of Environmental Science, Integral University, Lucknow, India
e-mail: rsharf@iul.ac.in

Y. Sharf

Department of Zoology, Aligarh Muslim University, Aligarh, India

change. This chapter examines the merits and drawbacks of agricultural techniques and their consequential impact on the environment.

Keywords

Sustainable agriculture · Agritech solutions · Precision agriculture · Agricultural innovations · Resilient agricultural practices

15.1 Introduction

The agricultural sector must work to reduce the harm that feeding the world can do to the environment because it is responsible for producing the necessities of life for the populace. A vital ecosystem service for human well-being, agriculture is the productive sector that confirms the majority of the food supply. Sustainable Development Goal (SDG) 2 and other SDGs listed in the UN Agenda 2030 for Sustainable Development are supported by agriculture because it is essential to ensuring food security. In the years after World War II, there have been some notable changes in agriculture. Food and agricultural productivity have improved significantly by means of favorable government policies and technological advancements that aim to maximize production and reduce food costs.

Specialization in the agricultural sector and increased chemical use have been important factors in this growth. The government has also put policies into place that have helped to maximize production and lower food costs (Haque 2006; Lencucha et al. 2020). Additionally, the need for food to sustain the population and diversify skills grew quickly in response to the exponential population growth (Muluneh 2021). Early developments in chemical and biological sciences resulted in a steady decline in people number working in food production or processing, which encouraged society to diversify and improve quality of life rather than directly contribute to survival (Calicioglu et al. 2019). However, carelessness or improper use of biological and chemical technologies in agriculture can have a detrimental impact on the ecosystem and jeopardize its sustainability (Deguine et al. 2021). As a result, the agriculture sector needs to develop sustainable innovation and technology.

The main goal of sustainable agriculture is to reduce human needs like food and fiber by focusing on site-specific applications. Additionally, it guarantees a given economy's natural resource base and environmental safety (Bathaei and Štreimikiene 2023). The important factors of sustainable agriculture are environmental protection, economic growth, and social justice (Purvis et al. 2019).

15.2 Agriculture That Is Sustainable

Sustainable agriculture can preserve resources, which is advantageous for the environment and social welfare when compared to exhaustive industrial agriculture. By lowering agricultural runoff, sustainable agriculture helps to avoid eutrophication and the contamination of water. Encouraging closed nutrient cycles and recycling