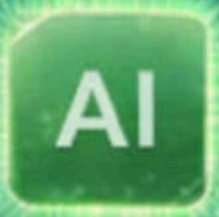
Artificial Intelligence

for

Smart And Sustainable Farming



Dr. Deepak Bornare
Ms. Lalita Randive
Dr. Praksh Kumar Jha
Dr. Kuzmin Anton

Artificial Intelligence for Smart and Sustainable Farming

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Artificial Intelligence for Smart and Sustainable Farming

Authored by:

Dr.Deepak Bornare
Associate Professor and Head
Department Agricultural Engineering
Maharashtra Institute of Technology (An Autonomous Institute)
Chhatrapati Sambhajingar, Maharashtra State-431010, India

Ms. Lalita Randive
Assistant Professor
Department Artificial Intelligence and Data Science
Maharashtra Institute of Technology (An Autonomous Institute)
Chhatrapati Sambhajingar, Maharashtra State-431010, India

Dr. Prakash Kumar Jha
Director
Mississippi Agroclimatology Collaboratory,
Department of Plant and Soil Sciences
Mississippi State University USA

Dr.Anton Kuzmin
Associate Professor
Department of Mechanization of Agricultural Products Processing
National Research Mordovia State University
Saransk, Russia

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Preface

Agriculture stands at a critical crossroads, facing the dual challenge of feeding a growing global population while preserving natural resources for future generations. Rapid advancements in Artificial Intelligence (AI), data analytics, robotics, and digital technologies have opened new pathways for transforming traditional farming into a smart, efficient, and sustainable system. Artificial Intelligence for Smart and Sustainable Farming has been conceived to explore these emerging possibilities and present a comprehensive understanding of how AI-driven solutions can reshape modern agriculture.

This book aims to bridge the gap between technological innovation and agricultural practice by presenting interdisciplinary perspectives that integrate computer science, agronomy, environmental sustainability, and policy frameworks. The chapters highlight practical applications of AI such as precision farming, crop monitoring, soil health assessment, pest and disease prediction, automated machinery, and climate-resilient agricultural systems. Emphasis is placed on sustainability, resource optimization, and farmer-centric innovations, ensuring that technological progress contributes meaningfully to ecological balance and rural livelihoods.

Designed for researchers, academicians, students, policymakers, agribusiness professionals, and technology developers, this book provides both theoretical foundations and real-world insights. We hope this work will inspire further research, innovation, and collaboration in the field of smart and sustainable farming.

Acknowledgement

The successful completion of this book is the result of collective efforts, intellectual contributions, and institutional support. The authors express their sincere gratitude to their respective academic institutions, research organizations, and colleagues for providing a conducive environment for research and scholarly engagement.

We are deeply thankful to fellow researchers and experts in the domains of agriculture, artificial intelligence, and sustainability whose studies and innovations have laid the foundation for this work. Special appreciation is extended to reviewers and subject experts for their valuable suggestions, constructive feedback, and critical insights that enhanced the quality and relevance of the content.

We also acknowledge the support of farmers, practitioners, and industry professionals whose experiences and challenges continue to inspire practical and impactful research. Finally, we express heartfelt gratitude to our families and well-wishers for their constant encouragement, patience, and unwavering support throughout the development of this book.

About the Authors

Dr. Deepak Bornare is an academician and researcher in Agricultural Engineering with over two decades of experience in teaching, research, and applied consultancy. He serves as Associate Professor and Head, Department of Agricultural Engineering, at MIT (Autonomous), Chhatrapati Sambhajinagar, Maharashtra, India, and holds additional roles as Deputy Director, MIT-CARS, and Director, MIT-ARDC.He earned his Ph.D. from IIT Bombay, with post-doctoral research exposure at Ben-Gurion University of the Negev, Israel, and is pursuing a Post-Graduate Certificate in Drone Technology from IIT Ropar under the AICTE-QIP Fellowship. His research focuses on precision and climate-smart agriculture, AI-driven crop nutrient diagnostics, drone-based agritech systems, soil health and biochar technologies, and sustainable water and environmental management.Dr. Bornare has published in Scopus-indexed journals, books, and book chapters, holds patents in AI-enabled agricultural diagnostics, and actively contributes to professional bodies, curriculum development, and policy-oriented academic initiatives, with a commitment to interdisciplinary research and education.

Ms. Lalita Bhagwat Randive is an Assistant Professor in the Department of Computer Science and Engineering at MIT, Aurangabad, with over a decade of teaching experience in computing and engineering education. She holds an M.E. in Computer Science and Engineering with distinction and is pursuing a Ph.D. in Computer Engineering at Dr. Babasaheb Ambedkar Marathwada University, Aurangabad. Her academic interests include digital image processing, data science, artificial neural networks, and artificial intelligence, with applications to crop nutrition deficiency detection and intelligent systems

Dr. Prakash Kumar Jha is Director of the Mississippi Agroclimatology Collaboratory in the Department of Plant and Soil Sciences at Mississippi State University. His work integrates climate science, crop ecophysiology, machine learning, and digital agriculture to support climate-resilient, sustainable farming systems. He leads projects in soil moisture modeling, crop simulation, evapotranspiration, and remote sensing–based decision support. He received his PhD in Crop and Soil Sciences from Michigan State University, MS from the Indian Agricultural Research Institute, and BSc (Agriculture) from Banaras Hindu University. He has extensive publications and international recognition in agronomy, climate impacts, and precision agriculture.

Anton Kuzmin holds a PhD in Engineering and the academic title of Associate Professor. He is an Associate Professor in the Department of Mechanization of Agricultural Products Processing at National Research Mordovia State University, Saransk, Russia. He is also affiliated with the Scientific Laboratory of Advanced Composite Materials and Technologies at Plekhanov Russian University of Economics, Moscow, Russia, where he contributes to research-led teaching and supervision in materials science. His academic work focuses on polymer and wood-polymer composites, biodegradable materials, and the mechanical performance of advanced composite systems. He actively serves as a reviewer and editorial contributor for scientific journals in agricultural engineering and materials science.

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ABOUT THE AUTHORS

Dr.Deepak Bornare
Associate Professor and Head
Department Agricultural Engineering
Maharashtra Institute of Technology (An Autonomous Institute)
Chhatrapati Sambhajingar, Maharashtra State-431010, India

Ms. Lalita Randive
Assistant Professor
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Department of Plant and Soil Sciences
Mississippi State University USA

Dr.Anton Kuzmin
Associate Professor
Department of Mechanization of Agricultural Products Processing
National Research Mordovia State University
Saransk, Russia

ABOUT THE BOOK

Artificial Intelligence for Smart and Sustainable Farming presents a comprehensive exploration of how AI-driven technologies are revolutionizing agricultural systems worldwide. The book covers a wide range of topics including machine learning applications in crop yield prediction, smart irrigation systems, remote sensing, drone-based monitoring, robotics, decision support systems, and sustainable farm management practices.

By combining technological innovation with sustainability principles, the book emphasizes efficient resource utilization, reduced environmental impact, and enhanced agricultural productivity. Case studies, conceptual frameworks, and future research directions provide readers with a holistic understanding of emerging trends and challenges.

This book serves as a valuable reference for students, researchers, and professionals seeking to understand and apply artificial intelligence in agriculture, while contributing to global goals of food security, environmental sustainability, and rural development.

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