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ADVANCED SERIES IN MANAGEMENT VOLUME 27

AGRI-FOOD 4.0: INNOVATIONS, CHALLENGES AND STRATEGIES

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FOREWORD

सत्यमेव जयते

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कुलपति
Dr. Chindi Vasudevappa
Vice Chancellor

स्वच्छ भारत
एक कदम स्वच्छता की ओर

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KNOWLEDGE · INNOVATION · OUTREACH

राष्ट्रीय खाद्य प्रौद्योगिकी उद्यमशीलता एवं प्रबंधन संस्थान
यूजीसी अधिनियम, 1956 की धारा 3 के तहत सम विश्वविद्यालय (डी–नोवो श्रेणी)
एवं खाद्य प्रसंस्करण उद्योग मंत्रालय, भारत सरकार के अन्तर्गत एक स्वायत्त संस्थान
National Institute of Food Technology Entrepreneurship and Management
(Deemed to be University under Section 3 of UGC Act 1956)
(UNDER MINISTRY OF FOOD PROCESSING INDUSTRIES, GOVERNMENT OF INDIA)

The agri-food industry faces many challenges like food safety, security, demand and supply gaps, maintaining product quality, product traceability, etc. In the current scenario, intelligent digital technologies, including AI, IoT, big data analytics, blockchain, etc., have a complete paradigm shift towards safe, resilient, sustainable, and eventually profit-driven agri-food supply chains. Digital technologies also pave a path to reduce constraints in the supply chain by reducing human interference and improving data accuracy. In this context, the book "Agri-Food 4.0: Innovations, Challenges and Strategies" is scholarly, where researchers from various domains have contributed practice-oriented, case studies based, empirical research and review work.

The concept of 'Agri-Food 4.0' can bring significant changes by reducing food wastage, real-time product monitoring, and reducing scalability issues. The challenges and complexities in the implementation of such technologies have also been addressed well. The book will guide the supply chain and agri-food industry professionals to develop conventional supply chain operations while designing digital technologies. Academicians and researchers will surely be benefitted from this book towards converting the challenges into opportunities through technology-driven smart operations in the agri-be food sector.

(Dr. Chindi Vasudevappa)

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PREFACE

Cost-effectiveness, high productivity and quality are fundamental requirements of any sustainable value chain and have become more crucial with rapid industrialization. In this line, 'Agri-Food 4.0' aims to achieve optimum value chain performance through digitized, resilient, innovative systems along with real-time monitoring and control while achieving sustainability. The term 'Agri-Food 4.0' is analogous to 'Industry 4.0' integrating modern tools and technologies to attain these performance indicators. Such tools and technologies include big data analytics, artificial intelligence, machine learning, IoT, information and communications technology (ICT), blockchain, smart sensors, advanced robotics, and modern drones. This book presents the introduction and applications of such technologies and the practices to reduce food losses and attain a circular economy.

Agri-food quality is crucial to making the product saleable and eventually generating revenue throughout the value chain. Hence, this book elaborates on the implementation of smart technologies like drones to effectively monitor crop quality in real-time. The drone-based quality monitoring system collects image data sets of crop products and classifies them using machine learning methods based on chromatic features, contour features, and texture features.

The integration of IoT in agri-food and supporting hardware tools are most important to achieve agri-food 4.0 and are presented in this book. An IoT-based intelligent irrigation system that controls the water flow based on soil moisture and temperature is also a part of this book. Further, the advancement in food packaging technologies, including smart packaging sensors, is discussed in the book.

Organization of the book: This book is organized as follows.

Chapter 1 describes thematic relationships within the sustainability of agri-food chains oriented toward Industry 4.0, focusing on analyzing scientific production through research articles and technological output according to patents worldwide. Chapter 2 highlights the digitalization of the agri-food supply chain through the implementation of IoT, block-chain, and artificial intelligence and challenges the agri-food supply chain participants perceive in implementing digital technologies. In this line, the Challenges of adopting supply chain 4.0 (SC 4.0) for the agri-food sector and using the total interpretive structural modeling (TISM) tool to analyze those challenges are discussed in Chapter 3. Further, wastage of food is a matter of grave concern, so searching how food waste or food loss could be reduced throughout a supply chain network is addressed in chapter 4. Furthermore, chapter 5 describes, due to growing environmental concern, how Industry 4.0 and blockchain technology (BCT) are transforming circular economy practices and, by employing CB-SEM modeling, provides three key findings. Finally, the role of blockchain technology and most disparate IoT devices in agriculture and the food supply chain for food tracing to address quality and safety is discussed in chapter 6. In Chapter 7, a vision system is introduced that monitors crop product quality with the help of Drone and vision camera technology. Mainly three vegetable crops such as tomato, cauliflower, and eggplant are considered for quality monitoring; hence image data sets are collected for those vegetables only. This chapter extracts three different features information, such as

chromatic features, contour features, and texture features, from the data set to train the Gaussian support vector machine-learning algorithm to identify the product quality.

A holistic overview of the latest trends of IoT in agriculture and other aspects of the ecosystem like storage, warehouse ambiance control, agri-data analytics and decision control, logistics, environmental safety, etc., is highlighted in chapter 8. Further application of IoT in irrigation is discussed in chapter 9, which focuses on how the Internet of Things develops a Smart Irrigation system that leads to the optimization of water resources.

Chapter 10 aims to study artificial intelligence (AI) based product benefits and problems of the agritech industry. The study shows that the topmost AI benefit is better information for faster decision making and the topmost AI problem is resistance to change from employees and internal culture. Packaging plays a crucial role in satisfying consumer's demand for safe and quality foods; the same is discussed in Chapter 11, which focuses on different types of Active and intelligent packaging and its advantage over conventional packaging. In line with the Industry 4.0 technologies, chapter 12 explores the key performance indicators of agri-food supply chain. Finally, chapter 13 covers the innovation and challenges of implementing robotics and authomation technologies toward agri-food 4.0.

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