

Advanced Technologies and Societal Change

Kandiah Pakeerathan *Editor*

Smart Agriculture for Developing Nations

Status, Perspectives and Challenges

 Springer

Advanced Technologies and Societal Change

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Kandiah Pakeerathan
Editor

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ISSN 2191-6853

ISSN 2191-6861 (electronic)

Advanced Technologies and Societal Change

ISBN 978-981-19-8737-3

ISBN 978-981-19-8738-0 (eBook)

<https://doi.org/10.1007/978-981-19-8738-0>

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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

Foreword by Leela Devi Dookun-Luchoomun

It was an honour for the Republic of Mauritius, through my Ministry, to host in a virtual mode and in collaboration with the Centre for the Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), the International Workshop on *Smart Agriculture for Developing Nations: Broader Perspectives and Special Challenges for the Island States*.

The subject could not have been more opportune. According to the Food and Agricultural Organization, the agricultural sector is very likely to face enormous challenges in feeding the 9.6 billion prospective inhabitants of the planet by 2050. Food production must increase by 70% by 2050, despite limited arable land, coupled with the decreasing availability of fresh water. The situation can be potentially more drastic for small island developing states whose vulnerability to prolonged periods of droughts and floods caused by climate change increases by the day. As a small island developing state, Mauritius faces several challenges in ensuring access to nutritious food at affordable costs to its population while eliminating food wastage and minimizing post-harvest losses.

It thus becomes imperative for SIDS to upgrade their traditional farming practices. There is absolutely no doubt that climate-smart, data-driven and data-enabled agriculture is the way to go: they must have recourse to a tech revolution to develop and adopt eco-friendly systems and climate-smart techniques for enhancing crop productivity while, simultaneously, encouraging the emergence of young agricultural entrepreneurs.

It is my firm conviction that extensive research would revolutionize the agro industry and lead to the adoption of innovative techniques in crop production. We have already witnessed precision agriculture's benefits of minimizing water, herbicides, pesticides, and fertilizers. Similarly, smart agriculture allows the crops to be monitored constantly and helps detect an early sign of a disease outbreak. It further helps in sharing information crucial for farmers and enhances access to technical details.

This virtual workshop has certainly helped the NAM S&T Centre to fully meet its objectives of rallying a number of stakeholders and experts in the field for them to strengthen their collaborative network and pool their research-based knowledge and

share ideas and practices. In many cases, these are food for thought for more intense and impactful research.

After all, lessons are there to be learnt and new techniques implemented primarily for humanity's benefit.

I am sure readers will enjoy the knowledge contained in this book following this vital workshop on smart agriculture.

I wish you all a pleasant read.

Hon. Mrs. Leela Devi
Dookun-Luchoomun
Vice Prime Minister, Minister
of Education,
Tertiary Education, Science
and Technology
Vacoas-Phoenix, Republic of Mauritius

Preface

Anthropogenic activities and rapid industrialization around the globe have caused catastrophic climate change which poses constant threat to global food security and sustainable development. Due to the impact of ever-increasing human population, greenhouse gas emissions, and temperature, many countries started to experience unpredicted heavy flooding, erratic rainfall associated with long dry spells and/or drought, changes in average temperatures, heat wave strikes, frost, cyclones, hailstorms, and dust storms that not only ruin the agriculture but also lower crop productivity and yield. Apart from the climate, traditional methods of intensive agriculture have over exploited the natural resources, depleted the soil fertility, diminished the fresh water resources, increased the land fragmentation, disturbed the natural balance, and increased pollution. These calamities have also led to poor crop establishment and increased pest and disease attack. In many developing countries, food security and rural development are facing many challenges such as migration of rural population to cities resulting in labour shortage for agricultural production. Shortage of labour at times of peak demand is another limiting factor to expand extent of cultivation in developing countries especially the small island nations. Post-harvest processing and marketing are also limited in the developing countries to make use of technologies needed for value addition.

Considering the above challenges, transformation of conventional agriculture towards “Smart Agriculture” is the only option to improve the farming practices for efficient use of available resources, eliminate the risk of losing yields, optimize the control over production, better cost management, waste reduction and eliminate hunger. Smart farming helps farmers to better understand the important factors such as water, topography, vegetation and soil types and provides options to utilize advanced technologies like artificial intelligence (AI), big data, robotics, drones, and Internet of Things (IoT) to increase crop yield with efficient utilization of precise natural resources without harming the environment. This allows farmers to determine the best uses of scarce resources within their production environment and manage these in an environmentally and economically sustainable manner.

In the post “COVID-19 pandemic” era, multiple economic crises situation and prevalence of food shortage and insecurity highlight the importance of raising crop

yields and adaptation to climate change. The publication of this book is timely as it is essential to create interest and awareness of private and public sectors, policy-makers and investors on the importance of transformation of the developing nations' traditional agriculture towards the "Smart Option". The current smart farming techniques shared in different chapters will not only help to reduce the overall cost and improve the quality and quantity of products but will altogether help improve the sustainability of agriculture in the developing world.

The present book titled *Smart Agriculture for Developing Nations: Status, Perspectives and Challenges* being published by Springer Nature, Singapore, is an initiative of the Centre for Science and Technology of the Non-Aligned and Other Developing Countries (NAM S&T Centre), New Delhi. The book has a total of 18 chapters contributed by the authors from India, Indonesia, Iraq, Malaysia, Mauritius, Myanmar, Palestine, Sri Lanka, and South Africa that intend to provide sustainable and smart technology-based solutions for developing nations. I am sure that the book will be a useful resource guide for research scientists, policy-makers, and students to understand the present scenario of "Smart Agriculture in Developing Countries and Island Nations" and plan future researches to minimize the knowledge and technology gaps present today in the area especially amongst the scientific community in the NAM and other developing countries.



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Introduction by Amitava Bandopadhyay

According to the UN estimates, by 2050 there will be 9.7 billion people in the world—in other words around 2 billion more mouths to feed than in 2020. This increase in population needs to be met through a 70% rise in agricultural production.

The situation poses a serious challenge to the developing countries with regard to the “Sustainable Development Agenda—2030” and specifically SDG-2, which aims *to end hunger and provide access to safe, nutritious and sufficient food to all while ensuring sustainable food production systems and implementing resilient agricultural practices that increase efficiency.*

In addition, the food industry is currently responsible for 30% of the world’s energy consumption and 22% of greenhouse gas emissions. The challenge, therefore, is not just producing more food, but doing it in a sustainable manner.

The concept of smart farming has arisen at the dawn of the “Fourth Industrial Revolution” in the areas of agriculture to increase the production quantity as well as quality, by making maximum use of resources while minimizing the environmental impact.

“Smart farming” is a concept that uses technologies like drones to monitor hundreds of acres of land to assess the health of crops and cattle, smart sensors to help in the early detection of infestations and automatic systems to water, fertilize and fumigate each plot depending on its specific characteristics and on the basis of weather forecast. These are just some of the virtues of smart farming which may help eradicating hunger in an over-populated future.

Increased investment through enhanced international cooperation, agricultural R&D and smart technological innovations to enhance agricultural productivity and capacity is significant for developing countries, particularly for the Least Developed Countries (LDCs).

Also, in the light of the effects of COVID-19 pandemic on the food and agricultural sector, prompt measures are needed to ensure that food supply chains are kept alive to mitigate the risk of large shocks that have a considerable impact on the society.

This book through its 18 chapters intends to provide smart and sustainable technology-based agricultural solutions to the developing countries. It attempts to

ensure that the implementation of technology in agriculture is significant for developing countries to boost their food security and safety while ensuring the overall sustainability of agriculture sector. Some of the chapters specifically deal with special challenges in agriculture related to the Small Island Developing States (SIDS).

The book brings together scientific communities from India, Indonesia, Iraq, Malaysia, Mauritius, Myanmar, Palestine, Sri Lanka and South Africa to share their expertise to make the farming system more connected and intelligent. The smart farming techniques shared in different chapters will not only help to reduce the overall cost and improve the quality and quantity of food production, but will also help to maintain the food supply chain sustainability.

I am honoured by the support extended by Her Excellency Mrs. Leela Devi Dookun-Luchoomun, Vice Prime Minister, Minister of Education, Tertiary Education, Science and Technology, Republic of Mauritius, and writing the “Foreword” of this book.

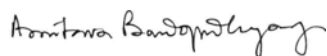
I am thankful to Dr. Loyola D’Silva, Executive Editor, Springer Nature, Singapore for his kind support in bringing out this publication and Ms. Saranya Devi Balasubramanian, Project Coordinator, Springer Nature, India, for managing all technical and administrative tasks of the publication process.

I am grateful to Dr. Kandiah Pakeerathan, Head of Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, Kilinochchi, Sri Lanka, for taking the responsibility to serve as Editor of this book. Dr. Pakeerathan’s role has been essential in complementing the scope of this book, and his expertise and guidance have been instrumental in the selection of the best articles that are published in this book.

I also acknowledge the valuable support of the entire team of the NAMS&T Centre and I am especially thankful to Mr. Madhusudan Bandyopadhyay, Senior Adviser; Ms. Jasmeet Kaur Baweja, Programme Officer; Ms. Rhaeva Bhargava, Research Associate, and Ms. Abhirami Ramdas, Research Assistant, for their contributions in taking this publication project forward and bringing it to a successful conclusion.

I also record my appreciation for the assistance and support rendered by my colleagues Mr. Rahul Kumra and Mr. Pankaj Buttan towards bringing out this publication.

I hope that this publication would be a useful reference material for scientists and researchers from R&D institutions, technology providers and start-ups, agri-business professionals, farming/agriculture technology consultants, project planners, government officials, policy-makers, and other representatives from industry and non-government organizations who are actively engaged in areas of smart agriculture.



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Smart Agriculture for Developing Nations

Status, Perspectives and Challenges

This book in its eighteen chapters provides sustainable and smart technology-based solutions to developing nations. Smart farming is growing in importance due to the increasing demand for higher crop yield, the need for using natural resources efficiently, the rising use and sophistication of information and communication technology and the increasing need for climate-smart agriculture. Some of these chapters deal with the applications of smart agriculture to address the special challenges of the Small Island Developing States for sustainable agriculture. The book brings together scientific communities from India, Indonesia, Iraq, Malaysia, Mauritius, Myanmar, Palestine, Sri Lanka and South Africa to share their expertise to make the farming system more connected and intelligent. The smart farming techniques shared in different chapters not only help to reduce the overall cost and improve the quality and quantity of products but altogether help improve the sustainability of agriculture in the developing world.

'Smart Farming' is a management concept focused on providing the agricultural industry with the infrastructure to leverage advanced technologies—including artificial intelligence (AI), big data, robotics, drones and Internet of Things (IoT)—for tracking, monitoring, automating and analyzing operations. Sometimes known as precision agriculture, smart farming is software managed and sensor monitored.

ISBN 978-981-19-8737-3

