Emerging Innovations in Agriculture: From Theory to Practice

Edited by

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Preface

Inclusive agricultural growth and development relies to a great extent on how successfully knowledge is generated and applied, and indeed knowledge intensiveness has featured prominently in most strategies to promote agricultural development. Yet the changing context for agricultural development has highlighted a strong need to understand and adopt innovation systems thinking. The purpose of this book is to provide a fusion of our empirical studies concerned with diverse aspects of agricultural development across the different corners of the globe, with an objective to draw useful policy implications for sustainable livelihood improvement. The book focuses on the most pertinent issues of basic sciences in agriculture and applied technology innovations on agricultural development, as these are the critical drivers for changes in any form of agriculture.

Chapters consists of emerging and basic disciplines with voluminous and diverse issues in agriculture with converging views of the emerging agenda for an agricultural innovation systems in times to come. Further these collections will provide a much needed platform to discuss the emerging issues and problems in agriculture and will come out with a well defined strategy to overcome the challenges of food, environment and livelihood security. *Emerging Innovations in Agriculture: From Theory to Practice* was made possible by a number of key eminent individuals and partner organizations. I would like to take the opportunity to thank ATINER for its confidence in my work. I thank the contributors for their input . I would like to acknowledge Prof.Gregory T. Papanikos for his guidance and support to the book throughout its preparation. Further, I also thank my wife, Sumita, who, of course, immediately understood the interest in such a book and who has always encouraged me to continue the great task that was its writing.

This book is therefore an extremely valuable contribution towards agricultural sciences with its roots in science disciplines, most notably biology and chemistry. May this edited book be useful as a small building block in meeting the challenges that our agricultural and food system faces.

Amitava Rakshit

About the Author

Dr Amitava Rakshit , an IIT, Kharagpur alumnus is the faculty member in the Department of Soil Science and Agricultural Chemistry at Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, UP, India. His research areas include: nutrient use efficiency, simulations modeling, organic farming, integrated nutrient management and bioremediation. His consulting capabilities are: composting techniques, mycorrhizal bio fertilizer, soil health management and input quality Control. He was involved in participatory research and lab to land programmes of ICAR, Department of Agricultural Cooperation, Govt. of India; Department of Agriculture, Government of West Bengal , NHB, New Delhi and NHM for on farm demonstrations of agro-technologies in cerals/pulses/oilseeds/cash crops/vegetables/fruits. Actively involved in imparting training and dissemination of technical knowledge and information to diversified end users. He has supervised approximately five research projects, many in partnership with industry. He is widely acknowledged for his skills in linking research with the broader community in regional languages. He has been working closely with undergraduate and post-graduate students in BHU presently. He has visited Scandinavia, Europe and Africa number of occasions pertaining to his research work and presentation. Dr.Rakshit has previously worked at Department of Agriculture, Government of West Bengal in research extension and implementation roles and imparted more than 100 state level trainings to progressive farmers, agriculture extension officers, subject matter specialists and other stake holders in agriculture. He is presently the Chief Editor of *International Journal of Agriculture Environment and Biotechnology* (NAAS: 4.1) . He was awarded with TWAS Nxt Fellow (Italy) , Biovision Nxt Fellow (France), Darwin Now Bursary(British Council),Young achiever award(SADHNA), Young Scientist Scheme(Council of Science & technology) and Best Teacher's Award at UG and PG level (BHU & ICAR, New Delhi) and Innovative young scientist award (PGPR, Hyderabad). He is serving as review college member of British Ecological Society, London since 2011. He is the author of nine books (*Springer, CBS,ATINER, ICFAI, Kalyani , Jain Publishers and IBDC*). He has published 70 research papers, 20 book chapters, 28 popular articles, one manual and co authored eight books.

Emerging Innovations in Agriculture: From Theory to Practice: An Introduction

Amitava Rakshit

The most important challenges of today's world are bringing many pressures to bear on agriculture with reference to population growth, unpredictable climate change, need to reduce greenhouse gas emissions in agriculture, rapid development of the emerging economies and growing hassles associated with land, water and energy crunches. In the recent global food crises which have exposed the structural vulnerability of globalized agri-food systems, highlighting local adaptations, adjustments and innovations as drivers generating instability and food insecurity, the impacts of which disproportionately affect poorer groups in marginal environments across the length and breadth of the universe with a target to globally feed 9 billion people in 2050 without deteriorating planet, people and profit. Rather pointing to single causes, there is a need to understand these changes at a systemic level. Improved understanding of and engagement with the adaptive strategies and innovations of communities living in conditions of rapid change provides an appropriate starting point for those seeking to shape agricultural innovation systems responsive to food insecurity and abiotic stresses .

Over all agricultural development enables agriculture and people to adapt rapidly when challenges occur and to respond readily when opportunities arise—as they unavoidably will, because agriculture's physical, social and economic environment changes constantly. In one way or another, agriculture is integral to the physical and economic survival of every human being. Agricultural development demands and depends on innovation and innovation systems. Innovation is widely recognized as a major source of improved productivity, competitiveness, and economic growth throughout advanced and emerging economies.

Innovations in Agriculture is becoming increasingly important to make agriculture a sustainable, profitable and competitive enterprise through engineering interventions of farm mechanization, value addition and energy management in production and post-harvest operations. Precision agriculture is one of the unexpected bright spots in the whole arena of agriculture where innovations hold up as the answer to the world's burgeoning food scarcity, water shortage and climate change challenges. None of the technologies in isolation can address these concerns on its own, but taken in aggregate they could help improve global crop productivity by many folds while reducing food prices. Advances in technology represent one of the most powerful resources for increasing yields and mitigating the impact of changing weather anomalies and resource crunch. No solution stands alone. There are few areas which warrant attention with reference to crop physiology, plant production, agriculture engineering, agricultural biochemistry agricultural home science

and precision agriculture. The extreme reality is that no single agricultural technology or any specific package of practices will provide sufficient food for the world in times to come. As an agricultural technocrat we must advocate for and utilize a range of these technologies in order to maximize yields.

All round agricultural development depends on innovation. Food security, climate change adaptation, poverty alleviation and sustainable management of natural resources rely on innovation processes in which small-scale producers are protagonists. Agricultural innovation typically arises through dynamic interaction among the multitude of actors involved in growing, processing, packaging, distributing, and consuming or otherwise using agricultural products. These actors represent quite disparate perspectives and skills, such as metrology, safety standards, molecular genetics, intellectual property, food chemistry, resource economics, logistics, slash-and-burn farming, land rights—the list is far too long to complete here. For innovation to occur, interactions among these diverse stakeholders need to be open and to draw upon the most appropriate available knowledge.

The reality before us is that no single agricultural technology or farming practice one can advocate in times to come. Instead, it is becoming a mandatory and praise worthy to advocate for and utilize a range of these technologies in order to maximize yields. In the present book there are technologies related to agricultural and natural resource conserving under four key areas of accelerating change: genetical engineering, microbiology, computer software and good agricultural practices.

New developments in technology are making it possible for farmers to be more productive, from the seeds they put into the ground, to the machinery they use to plant and harvest their crops, to the data they obtain about their fields, to the ways they monitor and grow those crops. Keeping up to date on the latest technology in each of these areas is critical to staying ahead of the curve, and to caring for the land in the best way possible. Some of the most innovative technological advances in agriculture are in the area of crop biotechnology. Scientists now understand more about seed genetics than ever before in history, and are creating highly specialized seeds that are able to perform in many varying types of fields with an astonishingly high degree of specificity.

Today’s advancing farm technology makes it an exciting time to be in agriculture, and farmers are doing important work by using it to grow the crops that feed their families and the world. Our natural resource managers understand the importance of this emerging technology and can help landowners determine what kinds of technology are valuable to have on their farm. A wide variety of low cost advanced technologies are needed to cope with the economic conditions of farmers. These requirements aim to save precious natural resources and produce environment friendly and healthy food. As technology is part of farming, engineering must contribute to the development of advanced and efficient agricultural practices. This book draws lessons from selected country experiences of adaptation and innovation in pursuit of sustainable food production systems operating in contrasting regional, socio-economic and agro-ecological contexts. Finally, implications

for policymakers and other stakeholders in agricultural innovation systems are presented. Therefore, the edited book will offer a wide range of topics for discussion and for developing ideas for innovations.