FOREWORD

World population is forecast to grow from 7 billion to 9 billion by 2050. One in eight people – some 827 million – are already hungry, and food production must increase by 70–100 per cent during this period. No single solution will resolve the problem, but the new genetic technologies of plant breeding developed during the last 30 years can do much to increase agricultural efficiencies and save people from hunger in a sustainable manner, particularly in African nations where the need is greatest.

Advanced molecular plant breeding based on genomics, marker-assisted screening, phenotype analysis, computer modelling and, when necessary, genetic modification (GM), have greatly accelerated the breeding process. Substantial efforts in basic scientific research and agricultural practice over the last 30 years have yielded dramatic results, particularly in North America, South America and a number of other emerging economies, as the new technologies have spread worldwide. This has contributed to:

- higher yields;
- resistance to pests, diseases, drought and soil salinisation;
- lower energy consumption and pesticide use and a reduction in soil damage thanks to low-till agriculture;
- enhanced nutritional quality;
- increased efficiency of nutrient uptake and water use.

The latest advances can help meet demands on world farming by rapidly incorporating traits from the immense genetic variability of wild relatives into established crops, combining many genes to enhance desirable traits and tailoring existing crops to meet new environmental challenges, for example from climate change. They can reduce the time and costs taken to improve research on neglected local crop varieties and so-called orphan crops found in emerging economies. And they can be used to domesticate new crops from semi-wild plants, providing practical and economically feasible new crops.

The problems and challenges now lie in the implementation of these impressive scientific advances where they are desperately needed. And this is the issue that has not so far received adequate attention or support.

This book owes its origins to its parent volume, *Successful Agricultural Innovation in Emerging Economies: New Genetic Technologies for Global Food Production,* published by Cambridge University Press in 2013 and edited by David Bennett and Richard Jennings. The parent book was published because of the need to address the many environmental, technical, political, legal and ethical issues involved in implementing the new biotechnologies. The need to put these scientific advances into practice to feed the 9 billion mouths was already widely recognised, yet there was still no source of information for a much wider, non-specialised readership on how this may be effected. The parent book was thus compiled as a series of essays for those wishing to understand the key issues in depth. It was an attempt by experienced people – who have through a good part of their lives worked in the sciences involved and on the policies and practices surrounding them – to explain and promote these advances in the developed and emerging worlds.

The present book provides a collected, reliable and succinct account of those same issues in a more accessible format. Its various chapters explore the issues from different angles, but all of them deal expressly with the successful implementation of the new plant genetic sciences in emerging economies in the context of inter-related key social, ethical, political, regulatory and trade matters. Its aim is to contribute to global efforts to "feed 9 billion", so its main focus is on food crops, but it also includes information on some non-food crops – such as cotton – because the issues surrounding them are similar to those of crops grown for food. It is a resource for students in many disciplines undertaking courses, in-service training, workshops, extension work and similar activities worldwide, whether in developed or emerging economies.

We would like to express our sincere gratitude, both to Cambridge University Press for permitting material in *Successful Agricultural Innovation in Emerging Economies: New Genetic Technologies for Global Food Production* to provide the basis for this book, and to the John Templeton Foundation for support in writing the parent volume, and for funding the writing and production of the present book. Without their considerable support, this would not have been possible.

David Bennett and Richard Jennings

Structure and content

This book is designed to cover our current knowledge of novel crop technologies in the context of global food production and demand by splitting a complex topic into four main sections.

- *Plant science and food security*, which ranges over population growth and the benefits of innovatory crop science for food security; the economic, agricultural and environmental impacts of biotech crops; and some of the general techniques being deployed in emerging economies.
- *New agricultural genetics across the emerging world* – a series of detailed analyses of transformative agricultural practices in Africa, South America, China and India, along with case studies of particular crops and their impact in particular contexts.
- *Policy factors* that shape the enablement and regulation of crops developed through the new genetics, biotechnology research for innovation and sustainability, and matters of international trade.
- *The social, legal, ethical and political implications of GM crops* and other biotech innovations in agriculture.

Each section consists of a series of chapters illustrated with case studies and graphics. At the head of each chapter is a summary of the key ideas, and at the end of every section comes a brief list of suggested discussion, essay or research topics for individual or class follow-up, as well as guidance on further reading and useful websites.

Given the wide-ranging nature of the issues discussed here, every effort has been made to keep scientific – and other – technicalities to a minimum in terms of language and concepts. A glossary is provided for further reference (page 193).