

Agricultural Sustainability

Progress and Prospects in Crop Research



Edited by
Gurbir S. Bhullar and Navreet K. Bhullar



*This work was inspired by
the celebration of golden jubilee year of establishment
of
Punjab Agricultural University (PAU), India
which pioneered the green revolution on Indian sub-continent
and
we dedicate this book to
all the hard working farmers
and dedicated agricultural researchers
across globe*

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Foreword

With an increase in the frequency of occurrence of extreme weather events such as drought, flood, tsunami, and sea level rise, there is also increased volatility in the price of major staple grains in the international market. There was a big rise in the price of rice, wheat, and other cereals in 2008, as a result of which nearly a billion additional children, women, and men went to bed hungry. In 2012 again there is increased price volatility caused partly by the drought in North America and also by the use of corn for the production of ethanol. Hence, for sustainable food security, it is important that we have sustained production of adequate quantities of food grains. This will call for an “evergreen” revolution in agriculture leading to the improvement of productivity in perpetuity without associated ecological harm.

For a long time, sustainability was measured only in economic terms. After the 1972 Stockholm conference on the human environment, environmental parameters were also added to measure sustainability. Fifty years ago Rachel Carson, in her book *Silent Spring*, drew attention to the harmful effects of excessive use of pesticides. Also the loss of biodiversity resulted in some cases in genetic homogeneity in crops, thereby increasing genetic vulnerability to pests and diseases. This was clear during the potato famine of the 1840s in Ireland.

In addition to economic and environmental sustainability, social sustainability has also become important. With increasing emphasis on research for private profit rather than for public good, there will be social exclusion in access to technology depending on the purchasing power of the small farmer. The year 2014 has been declared by the UN as “International Year of Family Farming.” The aim is to rekindle and sustain family farming around the world. In developing countries, farming is not only a way of life but a means to livelihood. Agriculture therefore will have to help in generating more income and more jobs, in addition to more food.

In the context outlined above, this book on agricultural sustainability, edited by Gurbir S. Bhullar and Navreet K. Bhullar, is a timely contribution. The book covers different aspects of sustainability in a holistic manner. It also shows how to improve the efficiency of the use of market-purchased inputs such as mineral fertilizers. Sustainable agriculture is the pathway to avoid price volatility and human suffering. I therefore hope that this book will be widely read and used by professionals and policy makers as well as farmers and farm dwellers. We owe a deep sense of gratitude to Gurbir and Navreet, as well as to the authors of the chapters, for their labor of love toward sustainable advances in agricultural productivity.

Prof. M. S. Swaminathan
Member of Parliament of India (*Rajya Sabha*)
Emeritus Chairman, M S Swaminathan Research Foundation

Preface

Provision of sufficient amounts of nutritious food for the ever-increasing global population is probably the largest challenge facing mankind. Despite a number of hunger eradication programs a large portion of the human population still remains undernourished. Land degradation and changes in land use patterns limit the area that could be brought under crop cultivation. Diminishing stocks of natural resources (fossil fuels and nutrients such as phosphorus) question the continuation of current agricultural practices, which depend heavily on high-energy inputs. The ongoing environmental changes are projected to seriously hamper agricultural production by increased frequency and intensity of extreme events such as drought and floods, more so in underprivileged parts of the world. Anthropogenic activities have not only contributed towards the climatic changes but have also resulted in degradation of natural resources (e.g., water and air pollution) and loss of biodiversity. Biodiversity losses—that affect a number of ecosystem services—are not only limited to natural habitats; with intensive monoculture farming on a large scale and use/misuse of cultivation and pest control practices, the agricultural landscape has also been deprived of a lot of diversity at species, varietal, and microbial scales. It is also noteworthy that, with changing food habits, we are increasingly shrinking the number of species from which we source a major portion of our food. For example, only 12 plants and five animal species currently contribute 75% of the world's food production; and 60% of plant-based calories and proteins are obtained from only three crops: namely, rice, maize, and wheat.

Agriculture being the primary anthropogenic activity for provision of basic needs for human beings, it is no surprise that agricultural sustainability is one of the most discussed subjects of our times. This book, *Agricultural Sustainability: Progress and Prospects in Crop Research*, presents the views of agricultural experts from across disciplinary and geographical boundaries. The 15 chapters—contributed by internationally recognized scientists from Europe, North America, Australia, and Asia—have been grouped into four distinct sections, each representing a crucial thematic area. The vast array of subject areas discussed in the book range from agrobiodiversity to biotechnology, from marginal crops to industrial approaches, from resource conservation to nutritional enhancement of crops and crop products, and from strengthening of human resources for agricultural research and development to economic and political priorities for effective production, marketing, and distribution of agricultural commodities. The authors of most of the chapters have experienced agricultural research and/or development both in developed and developing worlds

and hence benefit from a wider vision in presenting a balanced view. As far as possible, the language of the chapters has been kept simple so that educated non-expert readers may enjoy reading and may benefit from the information provided herein. This book will serve as an educational tool for budding scientists, will provide a comprehensive overview for advanced researchers, and will lay guidelines for important policy decisions.

The Editors

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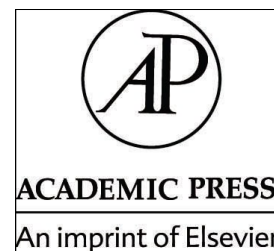
Progress and Prospects
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Gurbir S. Bhullar and Navreet K. Bhullar



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Collaboratively written by a number of international experts, this work covers a vast array of topics pertaining to agricultural research (see contents below). In addition to providing an overview of scientific solutions for enhancing crop productivity and conservation of natural resources, the book also reflects on the economic policy priorities for attaining sustainability.

- Provides cutting edge scientific tools and available technologies for research
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