

# Plant breeding and farmer participation



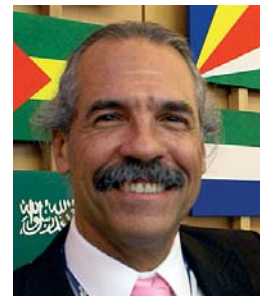
# Plant breeding and farmer participation

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**FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS**  
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## Foreword

Participatory Plant Breeding (PPB) originated in the early 1980s as part of a movement promoting the concept of participatory research, in response to criticisms of the failure of post-green-revolution, experiment-station-based research to address the needs of poor farmers in developing countries. Rooted in debate over the social consequences of the narrow focus of the scientific type of research, PPB gained recognition as an activity mostly promoted by social scientists and agronomists based in anti-establishment non-governmental organizations (NGOs). In consequence, rather than being perceived from the beginning as an additional option available to breeders, PPB for a long time had the image of being one of two contrasting types of plant breeding, with PPB being more “socially correct” than conventional plant breeding.

Even now, nearly thirty years later, this view is still common. Few professional breeders accept that farmers can be full partners in a plant breeding programme, even though everyone agrees that it was farmers that domesticated crops about 10 000 years ago and, in some regions of the world, continued to modify and manipulate them to the present day. Even before the re-discovery of Mendel’s laws of inheritance, the work of a number of amateur breeders became an inspiration for Darwin’s theories. In several respects, the relationship with farmers on which PPB is based is similar to the ways in which plant breeders worked with producers in North America and Europe in the early twentieth century. At that time it was commonplace for breeders to spend time interacting with producers, and to test new materials collaboratively in farmers’ fields in order to understand what producers considered to be desirable traits for an improved variety. However, the combination of industrialization of agriculture and formal training for plant breeders created a gap between breeders and farmers, a gap that was exported to developing countries in the post-war era. As the profession of plant breeding lost the habit of interacting closely with producers, concern for how to address farmers’ needs and constraints fell by the wayside. PPB revived this as a central issue, because by the late 1970s it was increasingly evident in developing countries that post-green-revolution “improved” varieties were too often failing to satisfy farmer requirements and were being shunned.

Today there is widespread recognition that the conventional package of new varieties and external inputs, while successful in the more favourable production areas, has often failed to benefit small-scale farmers in marginal areas. As a result, the vital role of PPB as an additional strategy is better understood. Experience has taught that PPB is complementary to conventional plant breeding rather than an alternative type of plant breeding. Demand for a complementary approach has expanded considerably because of pressure to ensure the relevance of research to poor farmers and their diverse agricultural systems, and because PPB allows selection for the specific adaptation required for such a diversity of target environments. Today, about 80 participatory breeding programmes are known worldwide, involving various institutions and various crops. In 2000, an international review of plant

breeding research methodologies concluded that PPB should be an “organic” part of every plant breeding programme aimed at benefiting small-scale farmers in difficult, high-risk environments. In fact, traditional farming and low-input systems, including organic agriculture, are a very heterogeneous population of target environments and not easily served by centralized, conventional plant breeding.

The book demonstrates that PPB is in essence no different from conventional plant breeding, being based on the very same principles of Mendelian, quantitative and population genetics, and therefore has complemented the traditional approach to plant breeding with a number of chapters addressing issues specifically related to the participation of farmers in a plant breeding programme.

The authors of the various chapters have been carefully selected to represent three groups of scientists: the first comprises internationally recognized experts in genetics as related to plant breeding, and in the various aspects of plant breeding (from general methodological issues to more specific issues, such as breeding for resistance to biotic and abiotic stresses, high yield potential, molecular breeding and genotype  $\times$  environment interactions); the second group is represented by professional breeders who have actually practised participatory plant breeding with a number of different crops and in a number of socially and climatically different areas, using the range of methods presented by the first group; and, finally, the third is represented by a group of scientists with specific expertise in areas not usually covered in classical plant breeding books, such as variety release mechanisms, seed diffusion, institutional issues associated with PPB, and intellectual property rights. A chapter documenting the impact that participatory plant breeding has had after about thirty years of practice has been chosen to be the logical conclusion of the book.

The book is aimed at plant breeders, social scientists, students and practitioners, with the hope that they all will find a common ground to discuss ways in which plant breeding can be beneficial to all and can contribute to alleviate poverty.

Finally, we would like to acknowledge everyone who has, directly or indirectly, contributed to the book: the CGIAR Participatory Research and Gender Analysis Program (PRGA) for the initial idea of producing such a book, the contributors of the chapters for sharing their scientific experience and for enduring a number of revisions of their respective chapters, Dr P.G. Rajendran for his help in the initial editorial efforts and the Directors-General of our Institutions for their continuous support. Final editing and preparation for publication was done by Mr Thorgeir Lawrence.



## Abbreviations and acronyms

<b>AB-QTL</b>	Advanced Backcross QTL Analysis
<b>AFLP</b>	Amplified fragment length polymorphism
<b>AMMI</b>	Additive main effects and multiplicative interaction
<b>AMOVA</b>	Analysis of molecular variance
<b>ANOVA</b>	Analysis of variance
<b>AOSCA</b>	Association of Official Seed Certifying Agencies
<b>ABS</b>	Accelerated Breeding System [for sweet potato]
<b>ASSINSEL</b>	International Association of Plant Breeders for the Protection of Plant Varieties
<b>AVP</b>	Asexually or vegetatively propagated
<b>BC<sub>n</sub></b>	Back-cross generation <i>n</i>
<b>BLUE</b>	Best Linear Unbiased Estimate
<b>BLUP</b>	Best Linear Unbiased Prediction
<b>BPE</b>	Before present era
<b>BSA</b>	Bulked Segregant Analysis
<b>Bt</b>	<i>Bacillus thuringiensis</i> [gene]
<b>BYDV</b>	Barley Yellow Dwarf Virus
<b>CBD</b>	Convention on Biological Diversity
<b>CBP</b>	Centralized breeding programmes
<b>CCN</b>	Cereal cyst nematode
<b>CE</b>	Common era
<b>CGIAR</b>	Consultative Group for International Agricultural Research
<b>CIDA</b>	Canadian International Development Agency
<b>CIE</b>	Commission Internationale l'Eclairage
<b>CIAL</b>	Local agricultural research committees [in Latin America]
<b>CIAT</b>	International Center for Tropical Agriculture
<b>CIMMYT</b>	International Wheat and Maize Improvement Center
<b>CIP</b>	International Potato Center
<b>CPB</b>	Conventional plant breeding
<b>cv</b>	Cultivar [= cultivated variety]
<b>DArT</b>	Diversity Arrays Technology
<b>DBP</b>	Decentralized breeding programmes
<b>dES</b>	Diethyl sulphate [a mutagen]
<b>DF</b>	Degrees of freedom
<b>DH</b>	Doubled haploid
<b>DHPLC</b>	Denaturing high performance liquid chromatography
<b>DM</b>	Dry matter

<b>DPBP</b>	Decentralized-participatory breeding programmes
<b>DUS</b>	Distinctness, Uniformity, Stability
<b>DW</b>	Dry weight
<b>ELISA</b>	Enzyme-linked immunosorbent assay
<b>EMS</b>	Ethane methyl sulphonate [a mutagen]
<b>EPA</b>	Environmental Protection Agency [United States of America]
<b>F<sub>n</sub></b>	Filial generation <i>n</i>
<b>FAO</b>	Food and Agriculture Organization of the United Nations
<b>FDA</b>	Food and Drug Administration [United States of America]
<b>FFS</b>	Farmer field school
<b>FIPAH</b>	La Fundación para La Investigación Participativa con Agricultores de Honduras
<b>FK</b>	Farmer knowledge
<b>FPB</b>	Formal plant breeding
<b>FR</b>	Farmers' Rights
<b>FV</b>	farmer variety [ $\pm$ locally selected]
<b>G<math>\times</math>E</b>	Genotype $\times$ Environment (Interaction)
<b>GGE</b>	Genotype main effect (G) plus Genotype $\times$ Environment (GE) Interaction
<b>GIS</b>	Geographical Information System
<b>GMO</b>	Genetically modified organism
<b>GURT</b>	Genetic Use Restriction Technology
<b>G<math>\times</math>L</b>	Genotype $\times$ Location
<b>G<math>\times</math>Y</b>	Genotype $\times$ Year
<b>HPLC</b>	High performance liquid chromatography
<b>IAEA</b>	International Atomic Energy Agency
<b>IARC</b>	International Agricultural Research Center
<b>ICARDA</b>	International Center for Agricultural Research in the Dry Areas
<b>ICP</b>	Inductively coupled plasma [mass spectrometry]
<b>ICPOES</b>	Inductively Coupled Plasma Optical Emission Spectrometer
<b>ICRISAT</b>	International Crops Research Institute for the Semi-Arid Tropics
<b>ID</b>	Inbreeding depression
<b>IDRC</b>	International Development Research Centre [Canada]
<b>IFPRI</b>	International Food Policy Research Institute
<b>IITA</b>	International Institute of Tropical Agriculture
<b>INCA</b>	National Institute for Agricultural Science [Cuba]
<b>IP</b>	Intellectual property
<b>IPGRI</b>	International Plant Genetic Resources Institute [now Bioversity International]
<b>IPM</b>	Integrated pest management
<b>IPR</b>	Intellectual Property Rights
<b>IRRI</b>	International Rice Research Institute
<b>ITPGRFA</b>	International Treaty on Plant Genetic Resources for Food and Agriculture
<b>LD</b>	Linkage disequilibrium

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<b>LD<sub>50</sub></b>	Lethal dose killing 50% of target
<b>LD<sub>100</sub></b>	Lethal dose killing 100% of target
<b>MAS</b>	Marker-assisted selection
<b>MCA</b>	Multiple correspondence analysis
<b>MET</b>	Multi-environment Trials
<b>MFN</b>	Most favoured nation
<b>MNU</b>	Methylnitrosourea [a mutagen]
<b>MRRS</b>	Modified reciprocal recurrent selection
<b>MS</b>	Mean square
<b>MTA</b>	Material Transfer Agreement
<b>MV</b>	Modern variety
<b>MVD</b>	[FAO/IAEA] Mutant Varieties Database
<b>NARS</b>	National agricultural research system
<b>NDVI</b>	Normalized Difference Vegetation Index
<b>NERICA</b>	New Rice for Africa
<b>NIL</b>	Near-isogenic line
<b>NIRS</b>	Near Infrared Spectroscopy
<b>NIR</b>	Near-infrared [spectrum]
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>OFSP</b>	Orange-fleshed sweet potato
<b>OPC</b>	Open-pollinated cultivar
<b>PBK</b>	Plant breeder knowledge
<b>PBR</b>	Plant breeder's rights
<b>PC</b>	Principal components
<b>PCR</b>	Polymerase chain reaction
<b>PGR</b>	Plant genetic resources
<b>PPB</b>	Participatory plant breeding
<b>PRA</b>	Participatory rural appraisal
<b>PRGA</b>	[CGIAR] Participatory Research and Gender Analysis [Program]
<b>PRI</b>	Photochemical reflectance index
<b>PSD</b>	Participatory seed dissemination
<b>PVP</b>	Plant Variety Protection
<b>PVS</b>	Participatory varietal selection
<b>PVX</b>	Potato virus X
<b>PVY</b>	Potato virus Y
<b>QTL</b>	Quantitative trait locus
<b>R&amp;D</b>	Research and development
<b>RAPD</b>	Random amplified polymorphic DNA
<b>RCB</b>	Randomized complete block [experiment design]
<b>REML</b>	Restricted Maximum Likelihood
<b>RFLP</b>	Restriction fragment length polymorphism
<b>RFSRS</b>	Reciprocal full-sib recurrent selection
<b>RIL</b>	Recombinant inbred line

<b>RRS</b>	Reciprocal recurrent selection
<b>S<sub>n</sub></b>	Selfed generation <i>n</i>
<b>SD</b>	Standard deviation
<b>SE</b>	Selection environment
<b>SE</b>	Standard error
<b>SFNB</b>	Spot form of Net blotch
<b>SMTA</b>	Standard Material Transfer Agreement
<b>SNP</b>	Single nucleotide polymorphism
<b>SPCSV</b>	Sweet potato chlorotic stunt virus
<b>SPFMV</b>	Sweet potato feathery mottle virus
<b>SPVD</b>	Sweet potato virus disease
<b>SR</b>	Simple Ratio Vegetation Index
<b>SS</b>	Sum of squares
<b>SSR</b>	Simple sequence repeat
<b>SSTW</b>	Small-scale Third World
<b>TGV</b>	Transgenic crop variety
<b>TILLING</b>	Targeting Induced Local Lesions In Genomes
<b>TLC</b>	Thin-layer chromatography
<b>TPE</b>	Target population of environment
<b>TPS</b>	True potato seed
<b>TRIPs</b>	[Agreement on] Trade-Related Aspects of Intellectual Property Rights
<b>UPOV</b>	International Union for the Protection of New Varieties of Plants
<b>USDA</b>	United States Department of Agriculture
<b>UV</b>	Ultraviolet [radiation]
<b>VCU</b>	Value for Cultivation and Use
<b>VIS</b>	Visible spectrum
<b>WARDA</b>	Africa Rice Centre [formerly the West Africa Rice Development Association]
<b>WI</b>	Water index
<b>WIPO</b>	World Intellectual Property Organization
<b>WTO</b>	World Trade Organization
<b>WUE</b>	Water-use efficiency

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