

# THE ROLE OF BIOTECHNOLOGY IN EXPLORING AND PROTECTING AGRICULTURAL GENETIC RESOURCES



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Edited by

**John Ruane**

and

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# Preface

One of FAO's major roles is to provide member countries and their institutions with factual, comprehensive and current information on issues related to food and agriculture, including biotechnology applications. It provides this information through the FAO Web site on biotechnology, an e-mail newsletter *FAO-BiotechNews*, and a series of e-mail conferences hosted by the FAO Biotechnology Forum. This e-mail-based forum was launched in 2000 with the aim of providing quality, balanced information on agricultural biotechnology in developing countries and to make a neutral platform available for people to exchange views and experiences on this subject. It has around 3 000 members worldwide, and in its first five years it has hosted 13 moderated e-mail conferences.

Each conference of the FAO Biotechnology Forum takes one particular topic and discusses it for a limited amount of time, normally four weeks. Before each conference begins, a background document is sent to the Forum members, which gives a good background to the conference theme, in a balanced neutral way, and is written in easily understandable language so that people with little knowledge of the area may understand what the theme is about. The conferences are moderated, open to everyone, and normally 350 to 650 people join in. Despite the fact that there are tremendous global inequalities in use of the Internet, there has been very active participation from developing countries, with roughly 50 percent of all messages posted coming from people living in these countries. After each conference, a summary document is sent to the Forum members, which summarizes the main issues discussed during the e-mail conference, based on the messages posted by the participants during the conference. Although it is an e-mail-based forum, all documents and messages are also made available on the Internet ([www.fao.org/biotech](http://www.fao.org/biotech)).

On the occasion of World Food Day 2004, the United Nations Secretary-General Kofi Annan urged "individuals and institutions alike to give greater attention to biodiversity as a key theme in our efforts to fight the twin scourges of hunger and poverty and achieve the Millennium Development Goals". He also noted that the unprecedented loss of biodiversity over the past century was a major cause for alarm, where

"many freshwater fish species, which can provide crucial dietary diversity to the poorest households, have become extinct, and many of the world's most important marine fisheries have been decimated. Food supplies have also been made more vulnerable by our reliance on a very small number of species: just 30 crop species dominate food production and 90 per cent of our animal food supply comes from just 14 mammal and bird species - species which themselves rely on biodiversity for their productivity and survival. There has been a substantial reduction in crop

genetic diversity in the field and many livestock breeds are threatened with extinction”.

On the same occasion, FAO's Director-General Jacques Diouf also underlined that although forests are among the world's most important repositories of biological diversity, the world forest cover is decreasing at an alarming rate.

It is in this context of declining agricultural biodiversity that the FAO Biotechnology Forum decided to dedicate Conference 13 to “the role of biotechnology for the characterization and conservation of crop, forest, animal and fishery genetic resources in developing countries”, which took place between 6 June and 4 July 2005. Biotechnology is a broad collection of tools, which can be applied for a range of different purposes (e.g. genetic improvement of populations; disease diagnosis and vaccine development; improvement of feeds). The focus in the e-mail conference was on biotechnology tools, such as molecular markers or cryopreservation and reproductive technologies that can be used directly for the characterization and/or conservation of genetic resources for food and agriculture. About 650 people subscribed to the conference and 127 messages were posted from people living in 38 different countries. Over 60 percent of messages posted were from people living in developing countries. As part of the preparations for the conference, an international workshop was held from 5 to 7 March 2005 in Turin, Italy, on the same subject that was organized by the FAO Working Group on Biotechnology in collaboration with the Fondazione per le Biotecnologie, the Econogene project (a European Union-funded project on biodiversity and conservation of sheep and goat breeds in marginal areas) and the Italian Society of Agriculture Genetics.

In this book, we are happy to bring together papers from the meeting in Turin and the background and summary documents from the subsequent e-mail conference. The book aims to provide an updated overview of the current status of the world's genetic resources for food and agriculture, of the use of biotechnology tools for characterizing and conserving these genetic resources, and of the many specific issues involved in applying them in developing countries. Section I contains four papers on the status of the world's livestock, fishery, crop and forest genetic resources. Section II considers the use of cryopreservation and reproductive technologies for conservation of animal and plant genetic resources. Section III is dedicated to the use of molecular markers for characterization and conservation of genetic resources. Finally, Section IV contains the two documents from the e-mail conference. We hope the book will be useful to individuals interested in the utilization of biotechnology for characterization and conservation of genetic resources for the good of humanity today and tomorrow.

**Shivaji Pandey**

Chairperson, FAO Working Group on Biotechnology

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# Acknowledgements

Chapters 1 to 14 of in this book are based on papers presented at Sessions I, II and IV of an international workshop held from 5 to 7 March 2005 entitled, *The Role of Biotechnology for the Characterisation and Conservation of Crop, Forestry, Animal and Fishery Genetic Resources*, organized by the FAO Working Group on Biotechnology (FAO-WGB), the Fondazione per le Biotecnologie and the Italian Society of Agriculture Genetics (SIGA). The workshop took place at the Villa Gualino Congress Center in Turin, Italy and would not have been the success it was without the efficient and scrupulous attention to detail of Claudia Mondino and Elena Spoldi and their co-workers from the Fondazione. The programme for the workshop was developed by Paolo Ajmone Marsan (Catholic University of Piacenza), Sergio Lanteri (University of Turin), Luigi Monti (University of Naples), Andrea Sonnino (FAO-WGB) and Fabio Veronesi (University of Perugia), with the support of John Ruane and helpful inputs from Devin Bartley, Kwame Boa-Amponsem, Elcio Guimarães, Irene Hoffman, Beate Scherf and Pierre Sigaud (all from the FAO-WGB). The support of SIGA, in particular of its President Michele Stanca, is also gratefully acknowledged in this context.

The remaining two chapters, 15 and 16, are from the e-mail conference organized by the FAO-WGB roughly three months after the Turin workshop. Comments from Christel Palmberg-Lerche and Pierre Sigaud on a previous draft of the background document to the conference (Chapter 15) are gratefully acknowledged. During the conference, about 650 people subscribed and 127 e-mail messages were posted from 64 people, whose comments and opinions formed the basis for Chapter 16. We are extremely grateful to all of the individuals who submitted messages, for devoting their time and effort to sharing their views, insights and experiences with the other Forum members. Barbara Hall is thanked for assistance with editorial and layout aspects. Finally, we wish to express special thanks to Jim Dargie, the former Chairperson of the FAO-WGB, and to his successor, Shivaji Pandey, for supporting these activities regarding the role of biotechnology tools for the characterization and conservation of genetic resources for food and agriculture.

# Acronyms and abbreviations

ABA	Abscisic acid
AB-QTL	Advanced back cross quantitative trait locus
AFLPs	Amplified fragment length polymorphism markers
AI	Artificial insemination
AnGR	Animal genetic resources
BAC	Bacterial artificial chromosomes
BECA	Biosciences Eastern and Central Africa
CBD	Convention on Biological Diversity
cDNA	Complementary DNA
CGIAR	Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture
CPA	Cryoprotective agents
CV	Coefficient of variation
EG	Ethylene glycol
EST	Expressed sequence tag
ESU	Evolutionary significant unit
FAO	Food and Agriculture Organization of the United Nations
FAO-WGB	FAO Working Group on Biotechnology
FGR	Forest genetic resources
GIFT	Genetic improvement of farmed tilapia
<i>He</i>	Expected heterozygosity
<i>Ho</i>	Observed heterozygosity
ICRAF	World Agroforestry Centre
ILRI	International Livestock Research Institute
INIBAP	International Network for Improvement of Banana and Plantain
IPGRI	International Plant Genetic Resources Institute
ISAG	International Society for Animal Genetics
ISSR	Inter-single sequence repeat
IUCN	World Conservation Union
IUFRO	International Union of Forest Research Organizations
LD	Linkage disequilibrium
mtDNA	Mitochondrial DNA
<i>Ne</i>	Effective population size
OECD	Organisation for Economic Co-operation and Development
PCR	Polymerase chain reaction
PGRFA	Plant genetic resources for food and agriculture
PIC	Polymorphic index content

QTL	Quantitative trait loci
RAPD	Random amplified polymorphic DNA
RFLP	Restriction fragment length polymorphism
SAMPL	Selective amplification of microsatellite polymorphic loci
SIGA	Italian Society of Agriculture Genetics
SNP	Single nucleotide polymorphism
SoW-AnGR	State of the World's Animal Genetic Resources
SoW-PGRFA	State of the World's Plant Genetic Resources for Food and Agriculture
SSR	Simple sequence repeats
UNEP	United Nations Environment Programme
UNFF	United Nations Forum on Forests
UPGMA	Unweighted pair-group method arithmetic average