International Symposium on Sustainable Agricultural Development and Use of Agrobiodiversity in the Asia-Pacific Region

Suwon, Republic of Korea
13 - 15 October 2010

PROCEEDINGS

Organized by:
Asia-Pacific Association of Agricultural Research Institutions
Rural Development Administration
Bioveristy International
Global Forum for Agricultural Research

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Editors
P.N. Mathur, Raj Paroda and L. Sebastian

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The Organizers

APAARI (Asia-Pacific Association of Agricultural Research Institutions) is a regional association that aims to promote the development of NARS in the Asia-Pacific region through inter-regional and inter-institutional cooperation. The overall objectives of the Association are to foster the development of agricultural research in the Asia-Pacific region so as to : promote the exchange of scientific and technical information, encourage collaborative research, promote human resource development, build up organizational and management capabilities of member institutions and strengthen cross-linkages and networking among diverse stakeholders. To meet these needs, the Association: i) convenes General Assembly once in two years, holds regular Executive meetings yearly and organizes consultations, workshops, trainings etc, ii) collects, collates and disseminates research findings, iii) maintains links with other fora in the region and outside through meetings/participation and information exchange, and iv) promotes need based collaboration in research projects among member institutions, analyzing priorities and focusing on regional agricultural development. For details, please visit: http://www.apaari.org/

Rural Development Administration (RDA) of the Republic of Korea is responsible for extensive agricultural research and services in Korea. The missions of the RDA are research and development of agricultural technologies, dissemination of agricultural technologies, quality control of fertilizers, pesticides, and agro- machineries, and guidance and training for rural development and improvement. RDA's efforts are directed towards highly competitive agriculture and efficient rural development. It endeavors to support farmers to produce agricultural commodities with better quality; advancing low-input, labor-saving and environment-friendly cropping technologies; promoting modern and automated production facilities; and nurturing future farmers.

Bioversity International is an independent international scientific organization that seeks to improve the well-being of present and future generations of people by enhancing conservation and the deployment of agricultural biodiversity on farms and in forests. It is one of 15 centres supported by the Consultative Group on International Agricultural Research (CGIAR), an association of public and private members who support efforts to mobilize cutting- edge science to reduce hunger and poverty, improve human nutrition and health, and protect the environment. Bioversity has its headquarters in Maccarese, near Rome, Italy, with offices in more than 20 other countries worldwide. The Institute operates through four programmes: Diversity for Livelihoods, Understanding and Managing Biodiversity, Global Partnerships, and Commodities for Livelihoods. Financial support for Bioversity's research is provided by more than 150 donors, including governments, private foundations and international organizations. For details of donors and research activities, please see Bioversity's Annual Reports, which are available in printed form on request from bioversity-publications@cgiar.org or from Bioversity's website (www.bioversityinternational.org).

GFAR (Global Forum for Agricultural Research) is a multi stakeholder-led initiative that serves as a neutral forum for dialogue and action on strategic issues in agricultural research for development (ARD). It facilitates and promotes cost-effective partnerships and strategic alliances among ARD stakeholders in their efforts to alleviate poverty, increase food security and promote the sustainable use of natural resources. GFAR is comprised of the following group of stakeholders: the National Agricultural Research Systems from the south (Southern NARS) through their regional fora, National Agricultural Research Systems from the north (Northern NARS), the Consultative Group on International Agricultural Research Centres (CGIAR) and Non-CGIAR International Agricultural Research Centres (IARCs), Farmers' Organizations (FOs), Non Governmental Organizations(NGOs), the Private Sector (PS), Donors and Development Agencies. To know more about GFAR, please visit the website: http://www.egfar.org/egfar/

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Foreword

Ensuring the availability of and access to food, in both quantity and quality (nutrition and food safety) for the world's population remains a daunting challenge. This is even more so, given the background of declining natural resources, increasing human populations, and the growing phenomenon of climate change. Agriculture would need to both adapt to these changes, and increase production of nutritious food for the world's population; especially for the poor in developing countries and regions.

Agricultural biodiversity is a key resource that will be needed for achieving this food and nutritional security. The benefits from agricultural biodiversity include its use as source of traits for crop and livestock improvement, through breeding and biotechnology applications. Agricultural biodiversity is also important in its direct use; through wise deployment of diversity, agricultural systems benefit from greater resilience, stability and sustainability, and contribute to the provision of better ecosystem services. Direct use of agricultural biodiversity also contributes to better nutrition and health, and is a source of increased incomes and improved livelihoods.

The Asia-Pacific region is the largest supplier of the world's food and agricultural products. It houses about 58% of the world's population but has only 38% of the world's agricultural land. Attainment of Millennium Development Goals (MDGs), particularly alleviating poverty, assuring food security and environmental sustainability, presents a major challenge to development in this region. Fortunately, the region is the centre of diversity of many important species of crops, livestock and forest tree species. Furthermore, resource poor farmers in the region are largely dependent on agrobiodiversity of minor crops, wild relatives of plant and animal species for their food security and livelihood.

Despite the seeming importance of agrobiodiversity for food and agriculture in the region, there is a continuing loss of this important resource, due to human interventions and natural events. The large scale adoption of a few improved varieties of a limited number of crop species has resulted in displacement of many traditional varieties and the loss of traditional knowledge associated with them. Recognizing these concerns, efforts have been ongoing by various international and regional organizations and the national governments towards collecting, documenting and conserving agricultural genetic resources. This has culminated in the establishment of genebanks in some international centres and countries.

The need for further strengthening agricultural biodiversity conservation and use, particularly at the regional level is widely felt. In view of this, an International Symposium on "Sustainable Agricultural Development and Use of Agrobiodiversity in the Asia-Pacific Region" was jointly organized by the Asia-Pacific Association of Agricultural Research Institutions (APAARI), Bioversity International and the Rural Development Administration (RDA) of the Republic of Korea at Suwon, Republic of Korea, on 13-15 October, 2010. The symposium provided an opportunity to review, identify and redefine the role and direction of agricultural R&D for the conservation and use of agrobiodiversity for development. It was attended by eighty four participants from 32 countries, as well as from regional and international organizations.

The symposium was structured into five technical sessions and four working groups. In-depth deliberations resulted in useful outputs and recommendations. The participants also adopted the Suwon Agrobiodiversity framework that shows the way forward for access and benefit sharing of genetic resources and evoking required awareness concerning genetic resource management. These recommendations are expected to be translated into action by the respective countries and organizations and build on the momentum for future agrobiodiversity research and development activities in the region. We look forward partnering with NARS, regional and international organizations and donors in developing appropriate actions to implement the recommendations of the symposium.

This publication summarizes the proceedings and recommendations of the symposium and we hope that its wide circulation will generate awareness and draw attention for appropriate action by NARS and other partners/ stakeholders to implement the recommendations. This will also be immensely useful to policy makers, research managers, development agencies, farmers and students.

We are very thankful to all the participants, special invitees and the lead speakers for their active participation. We also express our sincere thanks to the Rural Development Administration (RDA) of the Republic of Korea for hosting this important symposium and to GFAR, FAO, CIMMYT, ICARDA, ICRISAT, ILRI, IRRI, and AVRDC for their support in organizing this event.

Emile Frison
Director General
Bioversity International

Raj Paroda
Executive Director
APAARI

Acronyms and Abbreviations

AARINENA: The Association of Agricultural Research Institutions in the Near East and North Africa

ABS: Access and Benefit Sharing

AnGR: Animal Genetic Resources

APAARI: Asia Pacific Association of Agricultural Research Institutions

APFORGEN: Asia Pacific Forest Genetic Resources Programme

APO: Asia, the Pacific and Oceania

AusAID: The Australian Government's Overseas Aid Programme

ARD: Agricultural Research and Development

AVGRIS: AVRDC Vegetable Genetic Resources Information System

AVRDC: The World Vegetable Center

BAPNET: Banana Asia Pacific Network

BDA: Biological Diversity Act

BUCAP: Biodiversity Use and Conservation in Asia Programme

CACAARI: Central Asia and the Caucasus Association of Agricultural Research Institutions

CARP: Council for Agricultural Research Policy, Sri Lanka

CBD: Convention on Biological Diversity

CBDC: Community Biodiversity Development and Conservation

CEDAC: Cambodian Center for Study and Development in Agriculture

CePaCT: Centre for Pacific Crops and Trees

CFF: Crops for the Future

CFF-RC: Crop for the Future - Research Center

CGIAR: Consultative Group on International Agricultural Research

CIMMYT: International Maize and Wheat Improvement Center

CLAN: Cereals and Legumes Asia Network

COGENT: International Coconut Genetic Resources Network

CSC: Central Selection Committee

CSOs: Civil Society Organizations

CWANA: Central, West-Asia and North-Africa

CWR: Crop Wild Relatives

EA-PGR: East Asia Plant Genetic Resources Network

EPM: Ecological Pest Management

EURISCO: European Plant Genetic Resources Search Catalogue

FAO: Food and Agriculture Organization of the United Nations

FARA: Forum for Agricultural Research in Africa

FIGS: Focused Identification of Germplasm Strategy

GCDT: Global Crop Diversity Trust

GEF: Global Environment Facility

GFAR: Global Forum for Agricultural Research

GFU: Global Facilitation Unit for Underutilized Species

GIPB: Global Partnership Initiative for Plant Breeding Capacity Building

GIS: Geographic Information System

GlobalHort: Global Horticulture Initiative

GMO: Genetically Modified Organism

GPA: Global Plan of Action

IBPGR: International Board for Plant Genetic Resources

ICAR: Indian Council of Agricultural Research

ICARDA: International Center for Agricultural Research in the Dry Areas

ICCAI: AusAID International Climate Change Adaptation Initiative

ICRISAT: International Crops Research Institute for the Semi-Arid Tropics

ICT: Information and Communications Technology

ICUC: International Centre for Underutilized Crops

ILRI: International Livestock Research Institute

INBAR: International Network for Bamboo and Rattan

IPGRMS: Indian Plant Genetic Resources Management System

IPR: Intellectual Property Rights

IRIS: International Rice Information System

IRRI: International Rice Research Institute

ITPGRFA: International Treaty on Plant Genetic Resources for Food and Agriculture

JIRCAS: Japan International Research Center for Agricultural Sciences

LGM: Lembaga Getah Malaysia/ Malaysia Rubber Board

MARDI: Malaysian Agricultural Research and Development Institute

MASIPAG: Magsasaka at Siyentista Tungo sa Pag-unlad ng Agrikultura

MDGs: Millennium Development Goals

MIFAFF: Ministry of Food, Agriculture, Forestry and Fisheries, Republic of Korea

MLS: Multilateral System

MoU: Memorandum of Understanding

MPOB: Malaysian Palm Oil Board

MTA: Material Transfer Agreement

NAC: National Agrobiodiversity Centre, Republic of Korea

NAGS: National Active Germplasm Sites

NAP: National Action Plan for Salinity and Water Quality, Australia

NARS: National Agricultural Research Systems

NBPGR: National Bureau of Plant Genetic Resources

NGO: Non-Governmental Organizations

NHT: Natural Heritage Trust, Australia

NISM-GPA: National Information Sharing Mechanism for the Global Plan of Action

NLWRA: National Land and Water Resources Audit, Australia

NPGRL: National Plant Genetic Resources Laboratory

NTFP: Non-Timber Forest Products

NUS: Neglected and Underutilized Species

PAPGREN: Pacific Plant Genetic Resources Network

PCARRD: Philippine Council for Agriculture, Forestry and Natural Resources Research and Development

PGR: Plant Genetic Resources

PGRC: Plant Genetic Resources Center, Sri Lanka

PGRFA: Plant Genetic Resources for Food and Agriculture

PPVFRA: Protection of Plant Varieties and Farmers' Right Act

RDA: Rural Development Administration, Republic of Korea

RECSEA-PGR: Regional Cooperation for Plant Genetic Resources in Southeast Asia

RS: Remote Sensing

RSC: Research Supply Chain

SANPGR: South Asia Network on Plant Genetic Resources

SAT: Semi Arid Tropics

SEARICE: Southeast Asia Regional Initiatives for Community Empowerment

SGRP: System-wide Genetic Resources Programme

SINGER: System-wide Information Network for Genetic Resources

SMTA: Standard Material Transfer Agreement

SOW2: 2nd State of the World Report on Plant Genetic Resources for Food and Agriculture

SPC: Secretariat of the Pacific Community

SRI: System of Rice Intensification

TARF: Tropical Agricultural Research Front, Japan

TFNet: International Tropical Fruits Network

TK: Traditional Knowledge

TRIP: Trade Related Aspects of Intellectual Property Rights

UNCED: United Nations Conference on Environment and Development

UNEP: United Nations Environment Programme

UPOV: International Union for the Protection of New Varieties of Plants

VJRs: Virgin Jungle Reserves

WISM: Web Information Systems Modeling

WTO: World Trade Organization

Rationale and Objectives

Agrobiodiversity is the foundation of sustainable agricultural development. Plant Genetic Resources for Food and Agriculture (PGRFA) are an essential resource to enhance productivity and thus ensuring the future food security. However, the threats to these resources are growing due to large-scale adoption of a few improved varieties which has resulted in the loss of diverse genetic variability. Also the traditional knowledge (TK) associated with the use of old varieties/landraces, has largely been ignored and is rather disappearing. The reduced agricultural biodiversity on-farm can significantly increase the vulnerability of farmers and existing agroecosystems. In view of these concerns, concerted efforts are being made by various international/regional organizations and some national governments towards collecting, characterizing, evaluating, documenting, conserving and utilizing the available crop diversity. As a result, currently a large number of *ex situ* collections, including wild relatives, are being maintained.

Several scientific studies in the past have alerted both the public and the Governments about the danger of basing crop improvement programmes on a narrow genetic base. The world leaders did explicitly recognize this fact. As such, the Food and Agriculture Organization of the United Nations (FAO)-Global Plan of Action (GPA) and the Convention on Biological Diversity (CBD) have laid considerable emphasis on conservation of agricultural biodiversity. At its 9th Session in 2002, the Commission of Genetic Resources for Food and Agriculture emphasized "the importance of promoting the sustainable use of PGRFA, through germplasm characterization, evaluation and enhancement, plant breeding (including participatory plant breeding), seed production and distribution; and its contribution to food security". Promoting sustainable use of biodiversity is also one of the seven 2010 Biodiversity Targets of CBD (Decision VII/30). These priorities are endorsed by the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)-Article 6: Sustainable Use of Plant Genetic Resources. "Genetic Resources Partnership" is also identified as one of the four areas for elaboration under the Global Partnership Initiative for Plant Breeding Capacity Building (GIPB) being implemented by the FAO.

It is now increasingly accepted that future crop productivity increases can only be achieved sustainably through an increased use of PGRFA, including wild relatives and exotic materials. Therefore, the sustainable conservation of agrobiodiversity through use is central to any sustainable food production initiative and can improve the livelihoods of poor farmers as well as help in achieving the Millennium Development Goals (MDGs). However, this can only be possible through easy access and benefit sharing (ABS) of PGRFA. The legally non-binding International Undertaking on Plant Genetic Resources was adopted in 1983 by the state members of the intergovernmental FAO Commission on Genetic Resources. The underlying principle of the undertaking originally was that plant genetic resources are common heritage of humankind and should be available without restrictions.

However, this principle lost its favour, in particular with the recognition of sovereign rights of countries over their own genetic resources, as envisaged under the CBD. Considering this paradigm shift for access of genetic resources for the betterment of humankind, it is of paramount importance to devise ways and means for effective conservation through use of these resources.

In recognition of the critical role played by biodiversity in sustaining lives and livelihoods, the United Nations General Assembly at its 61st session decided to designate 2010 as the International Year of Biodiversity (Resolution 61/204 dated 20 December 2006). The declaration hopes to bring greater awareness to the importance of biodiversity by promoting different initiatives that can reduce the current rate of loss occurring globally and enhance PGRFA activities aimed mainly at conservation through use.

The Asia-Pacific region encompassing South, Southeast, East Asia and the Pacific sub-regions, is the largest supplier of the world's food and agricultural products. It houses about 58% of the world's population and 74% of the agricultural population, but, has only 38% of the world's agricultural land. Attainment of Millennium Development Goals (MDGs), particularly alleviating poverty, assuring food security and environmental sustainability against the background of declining natural resources, together with changing climate scenario, presents a major challenge to most of the countries in the Asia-Pacific region during 21st century. Bioversity International in partnership with several international and regional organizations in the Asia-Pacific has initiated several programmes to promote conservation and use of agrobiodiversity for sustainable agricultural production. Four sub-regional networks have been organized to promote regional collaboration for strengthening PGRFA conservation and use. These are: (i) South Asia Network on Plant Genetic Resources (SANPGR), (ii) The East Asia PGR Network (EA-PGR), (iii) Regional Cooperation for Plant Genetic Resources in Southeast Asia (RECSEA-PGR) and (iv) The Pacific Plant Genetic Resources Network (PAPGREN). In addition, there are also several commodity focused PGR networks like the Banana Asia Pacific Network (BAPNET) and the International Coconut Genetic Resources Network (COGENT).

The sub-regional networks are operated in close partnership with the Asia-Pacific Association of Agricultural Research Institutions (APAARI). APAARI, in collaboration with its stakeholders, especially the Consultative Group on International Agricultural Research (CGIAR) Centers, Global Forum for Agricultural Research (GFAR), other regional fora, and the National Agricultural Research Systems (NARS) continue to review the role and direction of agricultural R&D to efficiently address especially the above challenges. As part of these on-going efforts, APAARI in collaboration with Rural Development Administration (RDA), Korea; Bioversity International; GFAR; International Rice Research Institute (IRRI); International Maize and Wheat Improvement Center (CIMMYT); International Livestock Research Institute (ILRI); The World Vegetable Center (AVRDC); International Crops Research Institute for the Semi-Arid Tropics (ICRISAT); FAO; and International Center for Agricultural Research in the Dry Areas (ICARDA) organized an International Symposium on "Sustainable Agricultural Development and Use of Agrobiodiversity in the Asia-Pacific Region" with the aim to provide an opportunity to the major stakeholders in the Asia-Pacific region to review, identify and redefine the role and directions of agricultural R&D especially in the context of conservation through use of valuable agrobiodiversity for sustainable agricultural development. It also helped in deciding the 'Way Forward' for access and benefit sharing of valuable genetic resources for the posterity and efficient use for better future of our younger generation.

The symposium was organized with the following four objectives:

- To review the current status and trends for the conservation through use of agrobiodiversity for sustainable agricultural development at national, regional and global level;
- To bring together stakeholders to discuss issues that hinders currently the use and exchange of agrobiodiversity;
- To discuss issues and concerns relating to access and benefit sharing of agrobiodiversity in the region; and
- To discuss policy framework and research priorities of NARS in the region aiming at effective conservation and use of agrobiodiversity for sustainable agricultural production.

The following outputs were expected and achieved as an outcome of this symposium:

- Better understanding on the status of conservation and utilization of genetic resources for sustainable agricultural development in the region;
- Strengthened partnership to ensure access and benefit sharing of agrobiodiversity for improved livelihood in the region;
- Redefined the policy and research agenda for conservation through use of agrobiodiversity in the Asia-Pacific region; and
- Endorsed "The Suwon Agrobiodiversity Framework: The way forward for managing agrobiodiversity for sustainable agriculture in the Asia-Pacific region".

During the symposium, several presentations were made under the following technical sessions:

- Technical Session I: Global and Regional Initiatives
- Technical Session II: Status of Global Plan of Action and the Treaty
- Technical Session III: Agrobiodiversity Conservation for Use: Country Status Reports
- Technical Session IV: Recent Advances for Managing Agrobiodiversity
- Technical Session V: Promoting Agrobiodiversity in the Asia-Pacific Region

In addition to these, discussions were also organized in four working groups on the following themes:

- Working Group I: Areas of R&D Collaboration on Agrobiodiversity Conservation and Use for Sustainable Agricultural Development
- Working Group II: Strengthening Agrobiodiversity Capacity, Education and Public Awareness in Asia-Pacific
- Working Group III: Enhancing Exchange and Use of Genetic Resources in Asia-Pacific (implementing the ITPGRFA through MLS and SMTA)
- Working Group IV: Role of International and Regional Organizations and Networks in Strengthening Agrobiodiversity Conservation and Use in Asia-Pacific

Summary of the deliberations in each of the technical sessions and working groups and the major recommendations are given in the ensuing pages.

Sessions

Inaugural Session

The inaugural session was chaired by Dr. Seung-Kyu Min, Administrator, RDA. The welcome statements were made by Dr. Abd Shukor bin Rahman, Chairman, APAARI and Dr. Seung-Kyu Min, Administrator, RDA. During their welcome addresses, they recognized the significance of timely organization of this important symposium, especially in the context of recent climate change, environmental pollution and ecosystem destruction as they have been threatening the conservation of biodiversity. They also highlighted the importance of genetic resources with its infinite values as a key for enhanced food production and contributing towards food security and also as source of medicines, fuel and raw materials for biotechnology research aimed at the welfare of humankind. Dr. Seung-Kyu Min commented that the organization of "International Symposium on Sustainable Agricultural Development and Use of Agrobiodiversity in the Asia-Pacific Region" would serve as a platform to celebrate the 'International Year of Biodiversity' where the world-renowned scholars and experts would share knowledge and experiences to seek better ways of utilizing biodiversity for sustainable agricultural development. The Symposium would lay a foundation for conserving biodiversity and facilitating utilization. It will provide an opportunity to review the insights on the significance of biodiversity, draw out new strategies for conservation and use of genetic resources and ensure food security for the future generations. They also emphasized that the organization of this symposium could be possible only through partnerships with various agencies.

On behalf of APPARI, Dr. Raj Paroda welcomed the participants and briefed about the symposium's objectives and outputs. He mentioned that this symposium will provide an opportunity to review, identify and redefine the role and directions of agricultural R&D towards conservation and use of agrobiodiversity for sustainable development. It would also help in deciding a 'Way Forward' for access and benefit sharing of genetic resources, being common heritage of humankind. Dr. Paroda also highlighted that the consultation would also evoke required awareness concerning genetic resource management in the region.

The opening speech was delivered by Dr. William Dar, Director General, ICRISAT, who welcomed the participants and thanked the distinguished APAARI Executive Secretary and mentioned that ICRISAT genebank was named in the honour of Dr. Raj Paroda, because he has always been a passionate advocate of conservation through use of agrobiodiversity. The ICRISAT genebank is helping to conserve the germplasm of five important dryland crops, viz., sorghum, pearl millet, groundnut, pigeonpea and chickpea and also the small millets. It holds more than 119,000 diverse landraces, varieties and wild relatives of these crops collected/assembled from 144 countries. The seed material is held in trust for the benefit of humankind and is now being duplicated in Svalbard Global Seed Vault, Norway to ensure backup security.

"Use it or lose it" was a key message of Dr. Dar. He emphasized that genebanks provide a crucial strategic backup against losses of agrobiodiversity as it is impossible to collect and preserve every landrace. These landraces stored in genebanks do not continue to evolve to adapt to a changing climate while being in storage. Genetic erosion is also accompanied by knowledge erosion. Therefore, genebanks must be complemented by greater *in situ* use and conservation of agrobiodiversity. By helping farmers to access markets and earn money from this diversity, a sustainable mechanism can be created for preserving it for posterity. He informed that ICRISAT's "Inclusive Market-oriented Development Strategy" stands up to these challenges as the root problem is poverty.

They are indeed too poor to buy even the very cheap grain that is available today. Even if they could, grain alone will not provide them the well-balanced diet that they need to take care of malnutrition Therefore, this indicates that agrobiodiversity is a crucial tool for raising farm incomes while diversifying diets to reduce malnutrition. By adding value to farming, farmers will have an incentive to preserve and sustain this agrobiodiversity for future generations.

As an outcome of the new Strategic Plan, Dr. Dar indicated that ICRISAT is accelerating this type of research, especially, on moringa or drumstick (*Moringa oleifera)* and the Pomme du Sahel (*Ziziphus mauritania)*, fruits of which are very rich in vitamins and in strong demand in the parched Sahel zone of Africa. In his concluding remarks, he emphasized that through partnership-based strategy we could reduce poverty and hunger in the Asia-Pacific with a systems perspective that harnesses agrobiodiversity for the benefit of the small holder farmers and the poor.

The keynote lecture on "Agricultural Biodiversity and Sustainable Development' by Dr. Emile Frison, Director General, Bioversity International was delivered by Dr. Kwesi Atta-Krah, Deputy Director General, Bioversity International. During the presentation, it was mentioned that according to FAO estimates, the number of chronically hungry people have now exceeded 1 billion mark. Roughly 2 billion people, most of them women and young children, suffer with malnutrition associated with lack of micronutrients and vitamins and 60% child deaths linked to poor nutrition. The problem of stunted growth among young children is particularly acute in Asia, despite the increased productivity through the Green Revolution. Furthermore, the diseases of affluence, such as type 2 diabetes, cardiovascular disease, obesity and cancer are increasing more rapidly in developing countries in which 80% of chronic health diseases occur in low and medium income countries and 70% of deaths in Western Pacific region. The underlying reason for these observations is that diets have become simpler. In this context, Dr. Frison indicated that agricultural biodiversity can deliver better nutrition, enhanced ecosystem resilience, greater sustainability and higher farm incomes, in addition to food security. However, its importance is under-recognized in the context of nutrition and health, resilience and stability, adaptation to stress, income linked to market and socio-cultural dimension, all of which are essential elements of sustainable development.

He also mentioned that mostly the current agricultural research for development is focused on increasing major nutrients, such as protein, carbohydrate and fat at the expense of micronutrients, fortified foods and biofortified staples. He indicated that there is an argument that better nutrition and health would be just one outcome of more research into the wider use of agricultural biodiversity. Growing different varieties of crop species can control pest and disease outbreaks, augmenting farm profitability and also allows the best use of diverse growing conditions. Access to a range of varieties gives farmers more options for dealing with capricious weather; a variety that helps recovery after drought or flood by maturing quickly can mean the difference between life and death. In addition, livestock and fish also add to human nutrition, can contribute to soil fertility and farm incomes. Furthermore, agricultural biodiversity will be essential for adapting agriculture to climate change. A changed paradigm that gives renewed emphasis to the multiple roles of agricultural biodiversity is thus an essential component of sustainable development, not only in Asia-Pacific, but globally. The full presentation is attached as Annexure I.

The inaugural session was concluded with a vote of thanks delivered by Dr. Leocadio Sebastian, Regional Director, Bioversity International-APO, who echoed the views of previous speakers and stressed the importance of genetic resources for the welfare of humankind.

Technical Session I: Global and Regional Initiatives

Dr. S. Ayyappan, Director General, Indian Council of Agricultural Research (ICAR) and Vice-Chairman of APAARI chaired the session. He was supported by Dr. Shui-Ho Cheng (Co-Chair) and Dr. Ehsan Dulloo (Rapporteur). The topics of discussion under this session were on current and emerging global and regional initiatives to tackle the sustainable use and conservation of food crops, vegetables and animal genetic resources.

Dr. Leocadio Sebastian, Regional Director, Bioversity International presented a paper on the "Role of Networks in Strengthening Collaboration on Conservation and Use in Asia-Pacific". The Asia-Pacific region covers 45 countries. The region is characterized by diverse culture, ecosystems and landscapes. It is home to more than half of the world's people, many of whom are economically very poor but rich in culture and traditional knowledge about agricultural biodiversity. To promote collaboration on the conservation and sustainable use of the genetic diversity in the Asia-Pacific region, several regional and crop networks on plant genetic resources (PGR) were established through the assistance and facilitation of Bioversity International and other international organizations. These networks operate under the umbrella of the Asia-Pacific Association of Agricultural Research Institutions (APAARI). He indicated that the success of the networks has depended to a large extent on the commitment and willingness of partners to share time and resources, and for the lead organization providing administrative, financial and technical support. He emphasized on the following opportunities for regional PGR networks: research on common problems; facilitate exchange of germplasm and information; joint collection and evaluation; joint activities on low priority crops by national governments; developing links with advanced laboratories and collaboration using resource members; and policy makers' awareness on policy issues. The four sub-regional networks in the Asia-Pacific region are the East Asia PGR Network (EA-PGR) comprising China, Japan, North Korea, South Korea and Mongolia; South Asia Network on PGR (SANPGR) comprising Bangladesh, Bhutan, India, Maldives, Nepal and Sri Lanka; Regional Cooperation for South East Asia on PGR (RECSEA-PGR) comprising Cambodia, Indonesia, Malaysia, Myanmar, PDR Lao, Philippines, Thailand and Vietnam; and Pacific Agricultural PGR Network (PAPGREN) comprising Fiji Islands, Kiribati, Micronesia, Palau, Papua New Guinea, Samoa, Solomon Islands, Tuvalu, Vanuatu, Cook Islands, French Polynesia, New Caledonia, and Niue. There is also the Forestry PGR Network (APFORGEN) and several crop based networks (COGENT, BAPNET, CLAN). He presented the significant accomplishment of the different PGR networks in recent years. He also discussed the role of the different regional networks played in developing and implementing the regional strategy for conservation and use of crop diversity in the region (including crop-based conservation and utilization strategies for coconut and banana) together with Global Crop Diversity Trust (GCDT). The networks are also playing an important role in developing national capacity for the implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). While concluding, he reiterated that the sustainability of the networks will depend on the willingness of the member countries to share the responsibility of managing the network. It will also depend on the recognition that the networks have evolving role of catalysing, linking-up, integrating and facilitating. He also indicated the need for the networks to strengthen partnerships with civil societies and the private sector for more effective public awareness, education and advocacy, and to broaden global/regional initiatives to strengthen and sustain existing activities.

Dr. Fiona R. Hay of IRRI gave a presentation on "The Global Strategy for the *Ex situ* Conservation of Rice Genetic Resources". She explained the need for a global strategy in the context of population growth, food security, changing climate, and weeds, pests

and disease problems. The strategy was developed through surveys and consultation in order to develop a framework and action plan. She emphasized on how a global strategy for the *ex situ* conservation of rice genetic resources will promote rational, efficient, and effective rice diversity conservation at regional and global levels, and facilitate multilateral access and benefit sharing under the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). Initial targets of the strategy addressed the following key points: (i) Rescue of threatened accessions through regeneration, (ii) Upgrading of selected genebanks, (iii) Improved documentation, (iv) Identification and filling of gaps in the conserved gene pool and associated knowledge, (v) Increased efficiency and effectiveness through collaboration and sharing of responsibilities, and (vi) Increased coordination. The synthesis of survey reports indicated a total of 575,029 rice accessions conserved globally, of which, at the time of the survey during 2007 only 56.5% were safety duplicates, either in the same or in different continents. Dr. Fiona proposed a framework which can be illustrated by a triangle, with millions of farmers at the base representing the end-users of rice germplasm. At the apex is the Svalbard Global Seed Vault, which provides the ultimate, long-term secure conservation of rice (and other crops) germplasm. In between are collections of rice germplasm, decreasing in number but increasing in size moving towards the top of the triangle: breeder's working collections, active collections, base collections, and safety back-ups. She also indicated that a total of 70,180 accessions of rice from IRRI genebank were dispatched to Svalbard Global Seed Vault and another consignment of 40,000 accessions was planned by the end of 2010. Dr. Fiona also discussed the regeneration plans for rice being funded by the Global Crop Diversity Trust (GCDT) and the use of the International Rice Information System (IRIS) to identify duplicates. In her concluding remarks, she emphasized the need for access to the entire rice genepool and the associated knowledge in order to maintain a supply of high yielding varieties that are resistant to a wide range of biotic and abiotic stresses that are needed to sustain the human population in the future.

Dr. C.L.L. Gowda of ICRISAT gave a presentation on "Conservation and Use of Agrobiodiversity in the SAT region". He indicated that more than 7.4 million germplasm accessions of different crops are being conserved in about 1750 genebanks worldwide, of which 11% are being held in trust by the CGIAR Centers' genebanks. At present 119,735 germplasm accessions of sorghum (37,949), pearl millet (22,211), chickpea (20,267), pigeonpea (13,632), groundnut (15,445), and small millets (10,235) are being conserved at ICRISAT genebank. A total of 710,079 accession samples have been supplied to over 144 countries for their utilization. In addition to this, ICRISAT plans 111,000 accessions of its mandate crops for safety duplication at Svalbard Global Seed Vault by 2012. In spite of such large collections, only a very small proportion (1%) of germplasm lines is being used by the scientists in the crop improvement programmes. This is mainly due to the lack of data on traits of economic importance, some of which show genotype x environment (G x E) interactions. In order to enhance the use of these conserved genetic resources, he presented the concept of mini core collection approach formulated by ICRISAT scientists (10% of core collection or 1% of entire collection), representing over 80% diversity present in the entire collection. This mini core collection approach provides a gateway to the scientists for efficient multilocational evaluation and identification of trait specific, genetically diverse, and agronomically desirable parental lines for use in crop improvement programmes. Molecular characterization of mini core collection and trait specific germplasm will help identify genetically diverse parents and for efficient gene mining. Mini core collections of chickpea, sorghum, pigeonpea, groundnut, pearl millet and finger millet have been developed and shared with the NARS partners (84 sets of mini core collections in 20 countries) for use. New sources of genetic variation for resistance/tolerance to various biotic and abiotic stresses and for agronomic and quality traits have also been identified at ICRISAT and by the NARS partners through joint evaluation of the mini core collections. The utilization of these new sources of variation in crop improvement programmes would have a great impact in developing new and

improved high yielding cultivars with a broad genetic base for cultivation under diversified cropping systems and varied environmental conditions.

Dr. Ashutosh Sarker of ICARDA gave a presentation on "ICARDA's Efforts to Promote *Ex situ* and *In situ* Conservation and Sustainable Use of Dryland Agrobiodiversity". During his presentation, he briefly mentioned the significance of agrobiodiversity for the improved livelihood of rural communities in the non-tropical dryland regions globally. Presently, ICARDA genebank holds 135,256 accessions of barley (24,975), wheat (34,227), wild cereals (7,671), forage legumes (28,469), food legumes (33,313), wild food legumes (857), and forage and range grasses (5,744). These include 45% of unique accessions of landraces and wild relatives of species of global importance collected from the countries of Central, West-Asia and North-Africa (CWANA). More than 75% of these genetic resources are characterized for agro-morphological traits and evaluation is conducted in collaboration with partners inside and outside ICARDA. ICARDA also distributes more than 20,000 samples yearly for research, education, and repatriation purposes, and recently Focused Identification of Germplasm Strategy (FIGS) is used to supply best-bet sets to requestors. The FIGS approach is basically used for linking environmental data collection sites to traits of interest. ICARDA also initiated programmes for the promotion of on-farm/*in situ* conservation and sustainable use of dryland and agrobiodiversity following a holistic approach aiming at using low-cost technologies, diversification and sustainable intensification of farming systems, investigation of add-value technologies and alternative sources of income, institutional and policy options to empower local communities, and the conduct of ecogeographic surveys and use of Geographic Information System/ Remote Sensing (GIS/RS) tools to assess and monitor the status and threats and hot-spot areas for conservation and management. In addition, ICARDA initiated significant pre-breeding activities for its mandate crops in partnership with national programme. ICARDA also provides training on best practices for conservation and utilization of genetic resources and technical backstopping for enhancing national capacities for efficient conservation of biodiversity. It also works with other international and regional organizations to strengthen global and regional collaboration.

Dr. Bonnie J. Furman of CIMMYT gave a presentation on "Monitoring Maize and Wheat Genetic Resources" and indicated that the long-term strategy of the CIMMYT genebank proposes to work with selected partners to genetically characterize global maize and wheat genetic diversity to ensure global food security and reduce poverty. It also proposes to identify, capture and facilitate the use of novel, high-value alleles from underexploited pools of diversity, while pursuing three basic aims to: (i) fully characterize the unknown diversity of maize and wheat crops that provide 40% of the world's food and 25% of calories consumed in developing countries, (ii) enable breeding programmes worldwide to use maize and wheat diversity to ensure food security in the face of population growth, climate change, a declining agricultural resource base, and (iii) deliver knowledge about the native diversity of these essential food crops as a global public good to the international community, before proprietary interests monopolize important genetic building blocks for future breeding programmes. Presently, CIMMYT genebank holdings include approximately 27,000 accessions of maize from 64 countries comprising 23 species. Wheat germplasm holdings include 129,000 accessions from over 100 countries comprising 63 taxa of cultivated and wild relatives. CIMMYT's Genetic Resources Center (GRC) provides germplasm free of charge to users worldwide with the acceptance of the SMTA.

Dr. Han Jianlin of ILRI gave a presentation on "Farm Animal Genetic Resources-An Overview of Current Knowledge on the Molecular Diversity". He pointed out that there has been a significant explosion in our knowledge and understanding of the origin and distribution of diversity of livestock and poultry genetic resources through the intensive use of molecular

tools in the past three decades. These studies revealed remarkably complex picture of the origins of major livestock and poultry species and subsequently of their dispersal patterns to the entire world following the expansion of farmer societies. Therefore, improving characterization, quantification and mapping phenotypic diversity is essential to improve livestock conservation and utilization. Mitochondrial DNA studies have not only revealed the ancestral wild species of major livestock and poultry species but also the multiple domestication and/or maternal introgression events. The large number of mitochondrial control region sequences provided new and unique opportunities to reveal the distribution pattern of maternal diversity and to compare the models and routes of domestication and migration among major livestock and poultry species. Y-specific markers similarly revealed multiple male lineages and challenged the extrapolation of history of livestock from single genes. Autosomal microsatellite markers applied at large geographical scales and on geo-referenced indigenous livestock and poultry populations allowed mapping of continental distribution of livestock and poultry diversity hotspots. The legacy of these molecular studies has not only improved achaeozoological knowledge on the origin of livestock and poultry species but also contributed to the design of sustainable utilization and conservation strategies for farm animal genetic resources. In his concluding remarks, he mentioned that breed or population of livestock is a set of individuals reproductively isolated with unique adaptive attributes under the genetic control of many interacting genes and the results of complex interaction between the genotypes and the environment, and therefore, there is a need to develop new genomics tools for monitoring the dynamic evolution of livestock and poultry genetic resources along with the rapid changes of climate and human interventions.

Dr. Andreas Wilhelm Ebert of AVRDC gave a presentation on "Conservation and Use of Vegetable Germplasm at AVRDC-The World Vegetable Center." During his presentation, he noted that diverse and readily accessible genetic resources are vital to crop improvement programmes oriented toward high and stable yields, resistance against biotic and abiotic stresses, and specific consumer preferences. With its wide range of genetically diverse vegetable germplasm, the AVRDC genebank is the world's most important public-domain source for vegetable crops and thus actively contributes to the conservation of agricultural biodiversity as well as food and nutritional security for an increasing global population at a time when more than one-fifth of the world's plants are threatened with extinction. The genebank currently holds 57,937 accessions comprising 169 genera and 430 species from 155 countries. AVRDC also maintains a field genebank of garlic (262 accessions), shallot (30 accessions) and moringa (44 accessions). AVRDC shipped 9102 accessions to the Svalbard Global Seed Vault for long-term safety duplication. The AVRDC Vegetable Genetic Resources Information System (AVGRIS) provides direct web-based access to information concerning passport, characterization, and evaluation data pertaining to the accessions in the genebank. AVRDC scientists use and screen genebank materials extensively to identify new sources of specific genes responsible for resistance against biotic and abiotic stresses, desired horticultural traits, high micronutrient content and health-promoting factors, both in cultivated germplasm and crop wild relatives. These vegetable improvement efforts have led to the development and release of numerous vegetable lines resistant to specific pests and diseases, heat-tolerant lines, and lines rich in micronutrients and health-promoting compounds. So far, AVRDC has released 112 improved lines of mungbean in 27 countries, which accounted for 25% of world production.

Dr. Ebert indicated that extensive screening of the capsicum germplasm collection at the Center's Headquarters led to the identification of a small number of promising accessions of *C. chinense* (PBC 932) and *C. baccatum* (PBC80 and PBC81) with resistance to anthracnose (*Colletotrichum* spp.) leading to the release of the first anthracnose-resistant

lines in 2004. Several of the Center's elite lines also have been used by the private sector as parental lines or as a source of particular traits in backcrossing programmes. The Center's actively pursues collaboration with the private seed sector as research outcomes can be spread much more quickly to farmers with the help of the private sector's strength in commercial seed multiplication and marketing.

Dr. Andreas Wilhelm Ebert of AVRDC also gave a presentation on "Beyond Conservation: Enriching Diets and Enhancing Incomes with the Genetic Diversity of Vegetables" authored by Dr. Jacqueline d'Arros Hughes, Deputy Director General (Research) of AVRDC. He noted that vegetables are an excellent source of vitamins and micronutrients for the daily dietary requirements for human health. Production of vegetables provides higher profits per hectare compared with cereal production, providing opportunities for increased income and employment generation. Most well-known and widely cultivated vegetable crops, such as tomato, chilli, pepper, or lettuce, were introduced into different geographic areas beyond their centers of origin. However, despite the vast number of vegetable species that can be consumed as food - around 1500-2000 species worldwide – only about 20 are cultivated intensively. Although underutilized indigenous vegetables often are restricted in distribution, they are usually hardy, resilient to harsh climatic conditions, and thrive with a few or no production inputs. In this context, Dr. Ebert explained the significance of three important crops: African nightshade (*Solanum scabrum*), Malabar or Ceylon spinach *(Basella alba*) and Bird's nest fern (*Asplenium australasicum*). Limited non-commercial cultivation is usually confined to small groups of farmers. In Southeast Asia alone, approximately 1,000 plant species are being used as vegetables. Of these, relatively a few have been collected properly and their rich diversity conserved. Under *in situ* protection, 500 species led to primitive cultivars and the most suitable (200 species) were grown in home gardens; 80 out of the 200 species are profitable for some form of commercial production. He also mentioned that indigenous vegetables are poorly represented in genebanks and their genetic diversity is threatened, noting slippery cabbage (*Abelmoschus manihot*) in the Pacific Islands as an example. Temperate vegetables (cabbage, tomato, carrot) replaced many traditional 'tropical' vegetables. Proper conservation of vegetable diversity assures the availability of vegetables to contribute to the nutritional security of an expanding global population. Conserved germplasm provides genetic variability, a pre-requisite for vegetable breeding programmes, but germplasm must be accessible and usable. AVRDC – The World Vegetable Center's genebank conserves 57,937 accessions of vegetables, many of which are distributed and used globally. The Center's indigenous vegetable collection provides opportunities for improving currently available populations or lines, or to expand the range of available vegetables. Using conserved genetic material, the nutritional content of vegetables can be enhanced to improve the bioavailability of nutrients to the body and enrich diets, and beneficial medicinal characteristics can be exploited, opening opportunities for income generation at household, local and regional levels. In his concluding remarks, Dr. Ebert indicated that with better access to a greater diversity of nutritious vegetables, 'Prosperity for the Poor, and Health for All,' the motto of AVRDC is an achievable goal.

All the presentations were well received and generated significant discussion. The following major issues/recommendations emerged:

- Limited use of germplasm is a critical issue, and enhanced use of germplasm is essential to develop broad based cultivars. Molecular characterization of mini core collections and trait specific germplasm is needed to identify genetically diverse parents and efficient gene mining. In view of this, it was recommended that the use of germplasm be accelerated. Also, it should be properly stored, shared and repatriated.

- It was observed that networking is not as effective as it used to be in the past. Therefore, national plans and collaborative research programme on genetic resources should be implemented through regional collaborative frameworks. Hence, regional benchmarking and information sharing of key good practices is essential for the conservation and use of agrobiodiversity.

- Knowledge sharing among different partners has to be increased. It was noted that exchange of materials was easier in the past, which has now become a concern due to legal issues. Though the Treaty has provided a clear mechanism of sharing without any apprehensions, it is important to build the confidence among stakeholders for sharing the germplasm. Also, an intensive effort is needed to convince the countries to become members of the Treaty.

- Under the "Seeds for Discovery Programme", improved methodologies are being developed by CIMMYT to create new populations and to ensure that the maize diversity is usable and accessible. This will be done at the global level and all the lines need to be made available.

Dr. Ayyappan, Chairman thanked the organizers for inviting excellent speakers for this session. Presentations from international organizations showed enormity of the area and the efforts being made. He also emphasized the need to strengthen networks, the techniques on phenotyping, enhanced use and conservation of neglected and underutilized species and development of core and mini-core sets for breeding. He also endorsed the concern of germplasm exchange and safety duplication. Pre-breeding efforts need to be promoted particularly for the disease and stress resistance. There is also need to revisit the issue of sharing information for better agriculture and posterity.

Technical Session II: Status of Global Plan of Action and the Treaty

Dr. Nicomedes P. Eleazar, Director, Bureau of Agicultural Research (BAR), Department of Agriculture, Philippines chaired this session together with Mr. Somchai Charnnarongkul as Co-chair and Dr. Zongwen Zhang as Rapporteur. The main focus of the session was to assess the progress regarding the implementation of FAO Global Plan of Action and ITPGRFA. Two presentations were made in this session.

Dr. Duncan Vaughan from FAO gave a presentation entitled "NISM-GPA-National Information Sharing Mechanism for the Global Plan of Action: A Mechanism for Monitoring Progress in Global PGRFA Activities". He mentioned that to understand the extent to which Plant Genetic Resources for Food and Agriculture are conserved or not conserved requires accurate and up-to-date information. A conference organized by the Food and Agriculture Organization of the United Nations in 1996 in Leipzig, Germany resulted in the first review of the State of the World's PGRFA and formulation of a Global Plan of Action (GPA) which serves as a "road map" for the conservation and sustainable use of PGRFA. More recently, the second report on the State of the World's PGRFA was released in 2010. FAO, following a recommendation from the FAO Commission on Genetic Resources, has developed comprehensive software based on the GPA that permits all PGRFA stakeholders to share the information relating to PGRFA. This software is called the National Information Sharing Mechanism for the GPA (NISM-GPA) and recognizes the importance of monitoring GPA implementation in terms of planning, priority setting and achieving the mobilization of financial resources to support national programmes. NISM-GPA has now been implemented in more than 70 countries and has been translated into 22 different languages. This information system allows countries to monitor the progress being made on conservation and sustainable use of PGRFA and importantly helps to foster interaction among the multiple stakeholders involved in this work at the national level. The national NISM-GPA databases are linked to a global portal (WISM) based in FAO headquarters, Rome, Italy and these can be viewed at (http://www.pgrfa.org/gpa/). NISM-GPA is particularly useful in helping to develop national strategies for conservation of PGRFA as it focuses on all the components – *in situ* and *ex situ* conservation, use and capacity building. NISM-GPA fulfills a role in national programme efforts to comprehensively monitor PGRFA activities and complements various information systems for genebank management. NISM-GPA also assists countries with their reporting obligations to international organizations in relation to PGRFA. In his concluding remarks, he mentioned that plant breeding and genetic resources cannot be seen in isolation and hence maintenance and enhancement of genetic resources are vital for effective plant breeding.

Mr. Lim Eng Siang gave a presentation on behalf of ITPGRFA entitled "Global Status of Treaty Implementation, Regional Cooperation, Information Gaps and Capacity Building". He mentioned that International Treaty on Plant Genetic Resources for Food and Agriculture (the Treaty) entered into force on 29th June, 2004. At the end of August 2010, there were 126 Contracting Parties. FAO's Asian sub-region comprises 25 members out of which 9 are not party to the Treaty (including China, Japan, Kazakhstan, Mongolia, Sri Lanka, Timor-Leste, Uzbekistan and Vietnam; Thailand having signed but not ratified the Treaty). The objective of the Treaty is the conservation and sustainable use of Plant Genetic Resources for Food and Agriculture and the fair and equitable sharing of the benefits arising out of their use, in harmony with the Convention on Biological Diversity (CBD), for food security and sustainable agriculture.

The important element of the Treaty is the establishment of the Multilateral System of Access and Benefit-Sharing (MLS) of the Treaty. The MLS is an important international instrument for the provision of access to PGRFA for genepool enrichment and development of new plant varieties at the global level. Access to PGRFA of Annex 1 crops in the MLS is provided through the Standard Material Transfer Agreement (SMTA). There were 1.3 million accessions in the MLS and about 8500 transfers with SMTA were conducted every week. Benefits in terms of technology transfer, capacity building and information flow to farmers in developing countries were provided through projects financed by the Benefit Sharing Fund. Farmer's Rights is one of the most important provisions of the Treaty that Contracting Parties have given due recognition to the enormous contribution of the local, indigenous communities and farmers of all regions of the world to food and agriculture production. During his presentation, he also mentioned about the modules and application of information technology tools developed by the Treaty. Thus, the Treaty is an important agreement for the international management of PGRFA. It recognizes the enormous contributions from international and regional cooperation with efforts towards the conservation and sustainable use of Plant Genetic Resources (PGR) for world food security.

Both the presentations were followed by in-depth discussions and the following issues/ recommendations emerged:

- Information sharing mechanism is recognized as an important component for sharing and using germplasm. However, its usefulness depends on the quality of information provided by the national and international partners, which is presently lacking. In view of this, active participation was recommended by all stakeholders to provide quality information and contribute this to global portal such as GENESYS, SINGER and EURISCO.

- Many countries have ratified the Treaty but its implementation process is very slow. The major reason for this is the lack of understanding for the implementation process and its reconciliation with existing national policies. Therefore, it is important to identify mechanisms for speeding up implementation of treaty at the country level. It will also be desirable to organize country level workshops for capacity building for its effective implementation.

- The Treaty has to be administered in an efficient way so that the cost is manageable.

The Chairman thanked both the speakers for their excellent presentations and concluded that a manageable approach is necessary for monitoring and implementation of GPA and the Treaty.

Technical Session III: Agrobiodiversity Conservation for Use: Country Status Reports

This session was chaired by Dr. William Dar, Director General, ICRISAT accompanied by Mr. Thierry Mennesson as Co-chair and Dr. Paul Quek as Rapporteur. Nine country reports were presented, which provided an update on the challenges being faced by these countries in managing and conserving their rich agrobiodiversity.

Australia

Dr. Simon Hearn of Australia delivered a presentation on "Agrobiodiversity Conservation for Use in Australia" and indicated that about 84% of plant species, 83% of mammal species and 45% of bird species are endemic to Australia out of which only 25% of Australia's species have been taxonomically described. Biodiversity is more than just crops and should include the wild relatives of crops as well as fish and animal species. True food security is more than just calories and proteins and includes micronutrients which (if taken together) leaves 2 billion with nutritional deficiencies. Food security covers reliable access to sufficient safe, nutritious and affordable food. Food diseases attributable to affluence are starting to affect developing countries (e.g. diabetes) because dietary diversity is being increasingly ignored. Hence, there is a lack of focus on local biodiversity and food systems. He informed that the Australian Government has announced Aus. $ 2 billion programme 'Caring for Our Country' which will support 6 national priority areas, viz., national reserve system, biodiversity and natural icons; coastal environment and critical aquatic habitats; sustainable farm practices; natural resource management in northern and remote Australia; and community skills, knowledge and engagement. In addition, he informed that significant investment has been made through the Natural Heritage Trust (NHT) and the National Action Plan for Salinity and Water Quality (NAP). Therefore, funding of regional projects through these programmes resulted in increased awareness, interest and community involvement in biodiversity conservation. Australia's National Land and Water Resources Audit's Australian Terrestrial Biodiversity Assessment (NLWRA 2002) provides an important review of information and trends related to various elements of biodiversity at a bioregional scale across the continent. Australia's Biodiversity Conservation Strategy 2010-20 was drawn up to address biodiversity conservation and this strategy is a follow up to the 1996 'National strategy for the conservation of Australia's biological diversity' and fulfills Australia's international obligations under the CBD. He also highlighted the importance of traditional indigenous knowledge in contributing to the maintenance of biodiversity. He suggested that effective management planning requires a commitment to significant increase in research on understanding and measuring biodiversity and its roles in ecosystem function, mapping of vegetation and ecosystems at appropriate scales, and development and implementation of monitoring framework at a range of scales (regional, state and national). Genebanks (including in situ and on-farm conservation) need better linkages to research and extension. Over 650,000 samples are held in genebanks by eleven CGIAR centres - of which 40% are unique. In his concluding remarks, he emphasized that the Natural Resource Management Ministerial Council would be responsible for monitoring the implementation of the strategy and would conduct a formal review every five years with the assistance of an independent panel. For the strategy to be successful, monitoring and evaluation of biodiversity conservation needs to be done to allow for adjustment of programmes, multi-sectoral engagement and policies according to changing circumstances.

China

Dr. Wang Shumin of China made a presentation on "Conservation and Sustainable Use of Agrobiodiversity in China". In his presentation, he informed that the Chinese Government attaches great importance to the conservation and utilization of agrobiodiversity. Presently, China cultivates 600 species for the various purposes (food, industry use, vegetables, fruits, feed and manure, ornamentals, medicines). A significant diversity of crop wild relatives (rice, soybean, wheat, barley, buckwheat, apple, cherry, sugarcane) has also been reported from China and the Ministry of Agriculture in China has initiated identification of *in situ* sites for protection of wild relatives of crops since 2001. Currently, there are 116 *in situ* protected sites established in 26 provinces. In these sites, more than 30 target wild relatives of crops are protected. He also indicated that conservation of landraces is an integrated part of production system and the Government has developed incentive mechanism to encourage farmers to grow landraces or diversity rich varieties. In addition to national genebank for long-term conservation located in Beijing conserving 351,332 accessions, China also has 64 genebanks and repositories, which include 10 medium-term national genebanks (286,604), 20 medium-term provincial genebanks, 2 national *in vitro* genebanks (1,784) and 32 national germplasm resources nurseries (38,803). He also indicated that in last 10 years, 32,956 accessions were collected through undertaking local exploration missions. To promote utilization of the conserved germplasm, almost all accessions were characterized for major agronomic traits using descriptors developed for 110 crops. This information is documented along with passport data. More than 250,000 accessions were distributed out of which 8% were used for breeding, 9% for basic research, 21% for evaluation and pre-breeding and 62% for other uses. China has invested 100.8 million Yuan RMB for activities related to crop genetic resources and genetic improvement, which provides a platform among states for identifying genotypes and exploring new genes, however, China still needs to strengthen the programme with cooperation from other countries and international organizations. In his concluding remarks, he emphasized to further establish and perfect the conservation systems for PGR, the genetic base of the breeding material should be expanded and protected, only then can China sufficiently share and further improve the utilization efficiency of its resources. Regarding international agreements, he mentioned that China has ratified CBD and is a member of UPOV; however, endorsement of ITPGRFA is still pending.

India

Dr. D.C. Bhandari of India presented the "Status Report on Plant Genetic Resources of India". In his presentation, he highlighted that India has proactively carried out scientific research to better understand agrobiodiversity, quantify its loss, and develop strategies for conserving and using it, for more than six decades. The National Bureau of Plant Genetic Resources (NBPGR), New Delhi, under the auspices of the Indian Council of Agricultural Research (ICAR) in the Ministry of Agriculture, Government of India, is entrusted with the mandate of sustainable management of Plant Genetic Resources (PGR) at the national level. He indicated that over the years, NBPGR has undertaken 2430 explorations which have resulted in the collection of ~255,066 accessions, including crop wild relatives (39,938 accessions). These accessions are being conserved *ex situ* through field genebank (51,473 accessions), seed genebank (381,032 accessions of 1580 species), *in vitro* genebanks (2007 accessions of 139 species) and cryobanks (9445 accessions of 727 species). Presently, NBPGR imported 2,241,155 accessions and exported 686,238 accessions out of which 395,931 accessions supplied nationally and the remaining were exported to 103 countries.

He also pointed out that 390,000 accessions were given to researchers for utilization out of which ~3000 accessions are promising genetic stocks. In addition, DNA fingerprinting

protocols have been developed using DNA marker techniques for 2215 cultivars in 33 crops. NBPGR developed genomic markers in sesame (850), green gram (27), pigeonpea (250), finger millet (17) and watermelon (40). The NBPGR with its 10 Regional Stations/Base Centres and with 59 National Active Germplasm Sites (NAGS) constitutes the Indian PGR Management System (IPGRMS). These genetic resources were characterized/evaluated (~200,000), documented and exchanged, both within and outside India. NBPGR has also developed core collections of sesame, brinjal, okra and *mung* bean in order to promote their utilization. India has also undertaken to maintain or enhance access to PGR located outside the country by signing work plans under MoU's and collaborative/bilateral research programmes with over 40 countries and IARCs. In addition to offering M.Sc. and Ph.D. programmes, training to professionals, students and grassroot workers is imparted under various national, regional and international training programmes. Further, important legislations have been enforced in response to international developments on PGR related activities. These are the Biological Diversity Act (BDA) 2002, Protection of Plant Varieties and Farmers' Rights Act (PPVFRA) 2001 and Geographical Indications of Goods (Registration and Protection) Act 1999. International agreements that are relevant to the implementation of Farmers' Rights, viz., Convention on Biological Diversity (CBD), Global Plan of Action (GPA) and ITPGRFA have been subscribed. Further, he mentioned that a new bill has been placed before the Indian Parliament on Biotechnology Regulatory Authority of India, as per the Cartagena Protocol on Biosafety, to regulate all aspects of biotechnological research and use of GMOs in the country including liabilities and redressal issues. While India gave high priority to PGR exploration missions in the past, there is now a paradigm shift for managing the Indian bio-resources, with greater focus on the *in situ*/ on-farm conservation and the livelihood of the primary conservers and users, with the *ex situ* collections, serving as a backup function. In his concluding remarks, he informed that future programmes would focus on PGR conservation and sustainable use and its role in increasing food and nutritional security and in mitigating climate change impacts.

Republic of Korea

Dr. Chung-Kon Kim made a presentation on "The Status of Agrobiodiversity Conservation and Use in Korea" and mentioned that national management programme for agricultural genetic resources is carried out under the supervision of the Ministry of Food, Agriculture, Forestry and Fisheries (MIFAFF). The MIFAFF developed 5-year basic plan for the agricultural genetic resources and also the annual implementation plan. The ex situ conservation of plant genetic resources is carried out by the National Agrobiodiversity Center (NAC) of the Rural Development Administration (RDA) in cooperation with respective experimental stations in each province. The NAC is mandated to plan and implement national projects on introduction, documentation, regeneration, characterization, evaluation, conservation, exchange, distribution and infrastructure development relating to plant genetic resources in the country. Presently NAC holds 159,767 accessions belonging to 1,777 seed crop species and 27,148 accessions of 996 species of vegetatively propagated crops. In addition, NAC and other RDA institutions also hold germplasm collections of microorganisms (19,230), animals (65,051) and silkworms (361). He indicated that during 1913-2007, NAC developed 2477 varieties using 34% local genetic resources and 66% exotic genetic resources. Recognizing the infinite value of genetic resources as the common assets of humankind, RDA has collaborated with different countries in the Eastern Europe, Central Asia, China, and the Southeast Asia, through the collaborative projects such as joint research, and collection and exchange of genetic resources.

With regards to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) of FAO, which took effect in 2004, he pointed out that the Republic

of Korea has made a national level endeavour to implement the Treaty, aiming at the conservation and sustainable utilization of agricultural genetic resources as well as the fair and equitable sharing of benefits arising from these genetic resources. Furthermore, the country will continue to collaborate in the international efforts for agricultural sustainability, food security, economic development and poverty alleviation. Additionally, NAC has a target to provide 13,185 accessions of local varieties belonging to 30 species of its mandate crops to Svalbard Global Seed Vault for safety back up and is presently organizing an expert training on "Genebank Management System" in cooperation with Bioversity International.

Malaysia

Dr. Mohd Yusoff Abdullah made a presentation on "Current Status and Recent Progress of Conservation and Use of Plant Genetic Resources in Malaysia". In his presentation, he highlighted that the Ministry of Agriculture, through Malaysian Agriculture Research and Development Institute (MARDI), is actively engaged in the exploration, collecting, conservation and utilization of crop genetic resources. Other institutions include Malaysian Palm Oil Board (MPOB) for the conservation and use of oil palm genetic resources, Malaysian Rubber Board (LGM) for rubber, Cocoa Board for cocoa, the Department of Agriculture, and the various institutions of higher learning. Currently, Malaysia is among World's mega-diverse countries, ranked 12th with high species endemism in Sabah and Sarawak, estimated over 15,000 flowering plant species (9% of the world's total), 2,500 species of trees, 200 different palms and 3,000 species of orchids. He indicated that approximately 60% of the land still forested and the remaining 40% is covered by agricultural crops and plantations, urban and other uses. A total of 5177 accessions of 658 species are conserved ex situ at MARDI. Only about 300 native species are being exploited and utilized and the remaining species are still growing wild or semi-wild. At MARDI, sizeable collections of rice, fruits, vegetables, coconut, coffee, spices, ornamentals, roots and tuber crops and medicinal plants, representing both indigenous and exotic diversity and their wild relatives are currently being conserved. With the exception of rice and vegetables which are conserved in the seed genebank, the wild relatives are normally conserved in situ because it requires effective protected large areas of undisturbed forests such as Virgin Jungle Reserves (VJRs) having ideally, the maximum species diversity and high intra-specific diversity for different species of wild relatives. In Peninsular Malaysia, 85 VJRs cover 23,002 ha representing various forest types while Sabah has 63,300 ha and Sarawak 290,086 ha of protected reserves and parks. He emphasized that there is a growing trend for moving into on-farm conservation where landraces, traditional varieties and underexploited or underutilized crop species grown and maintained by farmers in their orchards and farms will compliment the present institutional ex situ collections. By 2010, the expected herbal market value in Malaysia would be >RM 8 billion. As a party to Convention on Biological Diversity (CBD) as well as the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), Malaysia has been collaborating in conservation projects and is in the process of implementing some of the articles contained in both the conventions especially articles related to Access and Benefit Sharing. Additionally, he highlighted the activities relating to PGR utilization, registration of plant germplasm, PGR policies at national level, and human resource development activities on PGR conservation and use. He pointed out that at present the country is in the course of putting in place a 'National Strategy and Action Plan on Plant Genetic Resources Conservation and Sustainable Utilization', which is expected to be completed by the end of 2010.

In his concluding remarks, he stressed that addressing the agrobiodiversity issues effectively is expected to contribute significantly towards future food, medicinal and pharmaceutical development.

Pacific Sub-Region

Dr. Mary Taylor from the Secretariat of the Pacific Community (SPC) made a presentation on "Status of Agrobiodiversity Conservation and Use: Pacific Region". She informed that communities have been conserving and utilizing agrobiodiversity for generations to a large extent in the region. Therefore, in 1996, the Pacific Ministers of Agriculture pledged to put in place at the national and regional levels, policies to conserve, protect and utilize plant genetic resources. A regional approach was suggested due to fragmented nature of these island countries, limited capacity and common challenges and lack of resources. The SPC, an inter-governmental organization of 22 countries and territories, supported this Ministerial recommendation through the implementation of a number of initiatives. In 1998, the Regional Germplasm Centre, [now the Centre for Pacific Crops and Trees (CePaCT)] was established to assist both for conserving the region's genetic resources and to facilitate access to Plant Genetic Resources for Food and Agriculture (PGRFA). In 2001, the Pacific Agricultural Plant Genetic Resources Network (PAPGREN) was launched and an action plan for the network developed in partnership with national institutes through their PGR focal points. The major focus of PAPGREN was to address strengthening national PGR programmes, capacity building, linking national PGR programmes, information exchange, awareness at all levels and documentation of genetic resources. CePaCT now holds the largest in vitro collection of taro (Colocasia esculenta) globally and is establishing collections of other crops. For this collection and also the collection of Pacific yams, CePaCT has received long-term funding from the Global Crop Diversity Trust (GCDT) and it actively facilitates the supply of germplasm within the region to the member countries of the SPC, in most cases through National Agricultural Research System (NARS). She highlighted that regeneration for specific crops: sweet potato, yam, breadfruit, swamp taro and taro are being carried out successfully with the support from GCDT. SPC and PAPGREN members have developed strategies for the conservation of banana and breadfruit which are being implemented. SPC has been identified as an "agent" to support implementation of the Treaty in the Pacific. So far, five countries have acceded to the Treaty and two French Territories (as France is a Contracting Party); other countries are making progress. She also mentioned that during the 3rd Session of the Governing Body to the Treaty, the region placed its Annex. 1 crop collections held by CePaCT into the MLS of the Treaty, which is a significant achievement. The AusAID International Climate Change Adaptation Initiative (ICCAI) is funding a number of PGRFA-focused activities, including the establishment and evaluation of a "climate-ready" collection comprising crops and varieties with climate tolerant traits such as drought tolerance. She also mentioned in her presentation about the achievements of the animal genetic resources work carried out by the SPC Animal Health and Production Programme in 6 selected countries. This programme collaborates with FAO in documenting the diversity of animals in the Pacific region.

The Philippines

Dr. Patricio Faylon, in his presentation on "Agrobiodiversity Conservation and Use in the Philippines," mentioned that the Philippine Integrated Science and Technology Agenda in Agriculture, Forestry and Natural Resources 2006-2010 identified biodiversity as priority commodity under the environmental services sub-cluster. As a country, the Philippines boasts of its impressive biodiversity, with its rich potential and vast opportunities for development.

He showed that the Philippines ranks 7th in the world in species diversity and endemism and among top three of the world's 17 megadiversity countries. In the Philippines, 52,177 species of flora and fauna were identified, of which 67% are highly endemic. Most extensively grown crops are rice, coconut, maize, sugarcane, banana, cassava, coffee,

mango, sweet potato and Manila hemp. Formal seed supply system accounts for 10-15% of total seed requirement, whereas informal seed system provides the mechanism to reproduce the seeds of traditional varieties and underutilized crops. Realizing the importance of plant genetic resources (PGR), the Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) supported and implemented undertakings to boost biodiversity with focus on the conservation and utilization of PGR. The National Plant Genetic Resources Laboratory (NPGRL) of the Institute of Plant Breeding, University of the Philippines, Los Baños and other institutions in the country conserve and manage PGR. The Philippines holds 918 taxa of PGR for food and agriculture with 170,807 accessions maintained as seeds, living plantsor in vitro. NPGRL holds 33,287 accessions of cereals, food legumes, vegetables, small fruits, plantation/ industrial crops, root crops, indigenous orchids, medicinal plants, and other fruits. He indicated that various projects (ex situ PGR collections) are already in place concerning mainly the collection, propagation, conservation and utilization of selected crops with local and international market potential. These projects were set to determine new export products/varieties and income-generating sources. Other projects addressed standard development in selecting areas for ecotourism and feasibility for site rehabilitation and management. He mentioned that a manual is being prepared on how to assess a potential ecotourism site as a showcase of the Philippines' biodiversity. Considerations for identifying potential sites, preliminary site evaluation, full site diagnostic assessment, feasibility study and participatory planning are all included in the manual. He pointed out that rehabilitation of facilities and continuous training of staff are required to achieve specific skills and competence. Research and Development areas that need to be addressed are: (i) Ethno-botanical, socio-economic and socio-cultural studies of ecologically important endemic flora and fauna; (ii) Genetic resources conservation, management and utilization; (iii) Natural resources valuation; and (iv) Determination of the carrying capacity of various priority areas/sites, such as for resource conservation and ecotourism.

Sri Lanka

Mr. P.W. Ratnasiri in his presentation on "Status of Agrobiodiversity Conservation and Use in Sri Lanka" emphasized that national plant genetic resources conservation activities are largely formulated and implemented through the government agencies functioning under the Ministry of Agriculture in Sri Lanka. At present, Plant Genetic Resources Centre (PGRC) which was established in 1988 has been identified as the national institute in Sri Lanka which is actively engaged in various activities such as exploration, database management, characterization and evaluation, genebank management, biotechnology and distribution of PGR. Ratification of Convention on Biological Diversity (CBD) and preparation of national biodiversity strategy and conservation action plan can be identified as key initiatives. Presently, PGRC holds a total of 15,294 accessions of which 245 accessions belong to wild relatives of cereals (37), legumes (28), vegetables (39), oilseeds (3), fruit crops (90), fibre crops (6), root and tuber crops (8), spices and condiments (24) and others (10). Sri Lanka comprises 3400 species of flowering plants (26% endemic), 300 species of ferns (57% endemic), 575 species of mosses, 110 species of lichens, 896 species of algae and 1920 species of fungi. Sri Lanka's Department of Forest manages 148,512 ha for conservation. PGRC participates in a number of on-farm conservation programmes, including "*In situ* Conservation of Crop Wild Relatives".

PGRC is actively contributing information for NISM-GPA database. He also indicated that PGRC organizes regular training programmes for students, farmers, Government officers and NGOs and also actively participates in M.Sc. programme being implemented by the University of Peradeniya. Sri Lanka is now in the process of considering signing the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). As

a member State of World Trade Organization (WTO), Sri Lanka is signatory to the Trade related aspects of Intellectual Property Rights agreements (TRIP) and the agreement on the application of sanitary and phytosanitary regulations. However, the plant genetic resources from international institutions such as IRRI, CIMMYT and ICRISAT, etc, are freely available to Sri Lanka as the country has entered into bilateral agreements for the exchange of germplasm for the mutual benefit as PGRC has also developed bilateral Material Transfer Agreement (MTA) for this purpose. In addition, Sri Lanka has signed Memorandum of Understanding (MoU) with India and Pakistan in 1998 through Sri Lanka Council for Agricultural Research Policy (CARP) and also for SL-USA germplasm exchange program in order to facilitate access to plant genetic resources between Sri Lanka and other countries. Sri Lanka values the importance of safeguarding farmer's rights for access to plant genetic resources, but so far Sri Lanka has not subscribed to any international agreements in this regard. However, draft act for the protection of new plant varieties (breeder's rights) and safeguarding farmer's rights is still in the process.

Asia-Pacific Region

Dr. S.K. Singh in his presentation on "Livestock Genetic Resources in the Asia-Pacific Region" mentioned that State of the World's Animal Genetic Resources for Food and Agriculture revealed that at global level, a total of 7616 animal breeds had been reported of which 20% breeds were at risk and one breed per month was lost during 2000 - 2006 and non-availability of population data on 36% breeds is a matter of global concern for conservation and improvement of valuable animal genetic resources. This information reveals that enough work has not been done on conservation and improvement of livestock genetic resources at regional level. He indicated that farmers of a few countries of the region, especially China (27), India (23) and Indonesia (16) together maintain 66 buffalo breeds which is 37.9% of world and 55% of Asian buffalo breeds. The population share of buffaloes of these countries at world and Asian level is 68.6% and 94.4%, respectively. Also the goat and sheep population at the world level is reported as 59.80% and 52.44%, respectively, indicating that countries and regions in the Asia do have preferences for livestock species and therefore, policies and programmes are to be framed both, at macro and micro levels for conservation and improvement of animal genetic resources. Additionally, as the pastoralists and traditional livestock keepers have been custodian of most of the animal genetic resources of the world, programmes and policies should be prepared in a manner that help these custodians. While Europe and North-America help livestock keepers through massive subsidies and structured and organized programmes on AnGR, the Asia-Pacific region lacks such intensive programmes. He further mentioned that in order to explore the population structure and genetic diversity of local and indigenous livestock, massive programmes at local, sub-regional and regional level must be initiated for identification, evaluation and documentation. The Global Plan of Action for Animal Genetic Resources (FAO 2007) is a great plan and countries of the region should join hands to mobilize funds, make programmes and policies so as to implement it in transparent and honest manner. By doing so, Asia-Pacific region will not only be saving valuable livestock genetic resources which are at risk but also be providing livestock related human food products to ever growing human population in sustainable and affordable manner.

The presentations were followed by intensive discussions which led to the following recommendations:

- Asia, the Pacific and Oceania (APO) region is characterized by diverse ecosystems and landscapes: highlands, semi-arid tropics and humid coastal plains with climates varying from temperate to tropical. It is also home to more than half of

the world's people, many of whom are economically very poor but rich in culture and knowledge about agricultural biodiversity.

- Regional approach/framework must be reinforced in APO countries. Greater international cooperation would improve the management of genetic resource conservation and use.

- There is an emergent need for developing national strategy/action plan on agrobiodiversity for each country in the region and concerted efforts must be made in this direction.

- Need was felt to catalyze the ratification of the Treaty especially in PNG, China and other countries which hold a large collection of biodiversity.

- For the strategy to be successful, monitoring and evaluation of biodiversity conservation need to be done effectively to allow for adjustment of programmes and policies according to changing circumstances.

- There is a need to provide incentives for *in situ* conservation to communities and this can be achieved through providing better access to markets for the local diversity and also to look at sustainable production management.

- Issue was raised to have a set of indicators to monitor the progress and the process requires regular national audits, which are however quite expensive. Therefore, regional efforts need to be made to develop at least a minimum set of indicators to measure the progress.

The Chairman in his concluding remarks appreciated the efforts being made in the APO region which is the home of rich diversity of plants and animals and significant activities relating to conservation and use of this diversity are underway. However, there is a need to further accelerate these efforts. It was suggested to develop a regional framework that includes Asia-Pacific approaches to agrobiodiversity use, reviewing and enhancing biodiversity covering food, nutrition and economic security.

Session IV: Recent Advances for Managing Agrobiodiversity

This session was chaired by Dr. Masami Yasunaka accompanied by Dr. Bhartendu Mishra as Co-chair and Dr. Mary Taylor as Rapporteur. Six presentations were made focusing on the recent steps taken by the national and international agencies to address the current agrobiodiversity loss particularly in view of the climate change.

Dr. Ehsan Dulloo delivered a presentation on "Trends, Advances and Research Needs in *Ex situ* and *In situ* Conservation of Agricultural Biodiversity". He stated that agricultural biodiversity refers to all components of biological diversity relevant to food and agriculture, including the agroecosystems, component species and their genetic diversity. While much is known about the status of ecosystems and species, very little is known about the global status of genetic diversity, which is under severe threat due to replacement of large number of landraces/local cultivars by high yielding modern varieties, changes in land use practices, deforestation, and climate change. The State of the World Report on Plant Genetic Resources for Food and Agriculture (SOW2) reported that the total number of accessions of plant genetic resources conserved in over 1750 genebanks in the world has risen to about 7.4 million accessions representing more than 70% of the genetic diversity of 200-300 crops. He informed that for some of the major crops (wheat, rice and maize) it is believed that these collections represent most of their genetic diversity. But other minor crops, neglected and underutilized species (NUS) and crop wild relatives (CWR) are under-represented in genebanks. Much of their diversity is still within the *in situ* realm. He indicated that over 2,500 botanic gardens maintain samples of some 80,000 plant species *ex situ*. The Global Crop Diversity Trust is also supporting the regeneration of globally important priority genebank collections at risk, for 22 priority species in Annex. 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture. Although the techniques for *ex situ* conservation of the major crops have been well established, there still remain major challenges in conserving crops which are difficult to conserve using seeds. In the last decade, research on *ex situ* conservation has allowed a greater understanding of the mechanisms of seed tolerance to desiccation and the opportunities provided by the advances made in biotechnology in developing cryopreservation protocols for conserving crops with recalcitrant seeds. He also mentioned about the creation of Crop Genebank Knowledge Base, which provides crop specific procedures for genebank management of nine major crops through a project funded by World Bank and implemented by the CGIAR System-wide Genetic Resources Programme (SGRP). Much knowledge on the *in situ* conservation of CWR was generated as a result of the United Nations Environment Programme (UNEP)/Global Environment Facility (GEF) funded project entitled '*In situ* conservation of crop wild relatives through enhanced information management and field application'. Key products of this project include a CWR Portal (http://www.cropwildrelatives.org/) and a manual on *in situ* conservation which has been published. In conclusion, Dr. Dulloo pointed out that the diversity is critical for sustainable production and food security. A good understanding of the extent and distribution and functions of genetic diversity and a monitoring system are extremely important to enhance the use of agricultural biodiversity.

Dr. Devra Jarvis's presentation on "Crop Biodiversity and Ecosystem Resilience: Adaptive Capacity within the Agricultural Production System" was delivered by Dr. Ehsan Dulloo. In her presentation, she informed that the current practices to reduce vulnerability in production systems focus predominantly on using agronomic management techniques including the addition of chemical inputs, with little use of intra-specific diversity among cultivars maintained by communities.

These methods that support communities to sustainably use local crop genetic diversity to reduce vulnerability and crop loss and to sustain the resilience, resistance and ecosystem services of their production systems are not yet mainstreamed but are very much required as climate change is also the main concern now a days. Hence, some of the current options that have been successfully used to reduce crop vulnerability and restore ecosystem services through enhancing the use of diversity in production systems, as an alternative to external inputs for biotic (disease and arthropod pests) and abiotic (unpredictable rainfall) stress conditions. She indicated that practices involve the support of local seed systems, communities and institutions that provide and maintain crop genetic resources in production systems. Therefore, focus is on increasing the adaptability of agricultural ecosystems, through the use of crop varietal diversity, such that the communities and agroecosystems are able to respond to changing climatic conditions without debilitating losses in productivity.

Dr. Kwesi Atta-Krah in his presentation entitled "Climate Change, Agriculture and Food Security in Asia" indicated that climate change with its associated global warming may lead to genetic erosion and extinction of species, within agricultural systems and beyond. Genetic diversity is a major resource for adaptation to climate change and for ensuring resilience for adaptation and sustainability. During his presentation, he briefly mentioned the various parameters leading to climate variation and also the work done by some CGIAR centers on suitability crop models. Based on the outcomes of these suitability models, it has been indicated that area under cultivation for cold weather crops such as strawberry, wheat, apple and oats are likely to decrease. Whereas, crops like pearl millet, sunflower, common millet, chickpea and soybean are likely to have increases in suitability areas for cultivation. He also mentioned that although agriculture has high green house gas emission, it also has great opportunities for abatement, through increased efficiencies and technologies that could lead to reduction in green house gas emissions, and also enhance mitigation through carbon sequestration. Dr. Atta-Krah suggested a need for research to understand the coping mechanisms used by small holder farmers, indigenous people and rural communities in their adaptation to climate change. He also stressed the need for strong research emphasis to build upon such local adaptations, which includes maintenance and use of agricultural biodiversity to cope with climate change. Dr. Atta-Krah also announced that a special CGIAR research programme on climate change is currently under development, and Bioversity is a key partner in this initiative. Bioversity's comparative advantage in climate change research is in maintaining and facilitating the use of species and genetic diversity to support adaptation of agriculture and other production systems to climate change. This involves aspects such as: resilience in production systems, studies of seed systems and other practices to sustain and use diversity; effective approaches to the management and use of genebank collections; analysis of the threats posed by climate change to *in situ* conservation of diversity; and research on the use of diversity on-farm, including CWR conservation and maintenance of the genetic diversity of other useful plants, as key elements of climate change adaptation. In his concluding remarks, he mentioned that APO region is an important region in global climate change research which will include specific issues on genetic resources and their role in climate change adaptation. This, he said, could form the basis for actions in support of better management of the region's agricultural biodiversity, as a tool for strengthening the resilience of agricultural systems, enhancing food and nutrition security, and in the adaptation to climate change.

Dr. Ruaraidh Sackville Hamilton gave a presentation on "Gene-mining and other Effective Strategies in Using Plant Genetic Resources". In his presentation, he mentioned that one of the earliest tenets developed by International Board for Plant Genetic Resources (IBPGR) was the concept that "genebanks characterize, breeders evaluate". This tenet recognized the special challenges of evaluation.

It contrasted highly heritable traits that can be usefully and easily quantified for entire collections, against traits that need more sophisticated strategies, typically using specialized subsets of collections combined with genetic analysis of progeny. Presently, IRRI genebank holds more than 110,000 rice accessions, and supplies over 20,000 samples per year to recipients worldwide. In addition, over 40,000 improved breeding lines per year are supplied by IRRI breeders to various national partners. However, only a small percentage of the samples sent are used as parents in the breeding programmes. For more effective use, better methods are needed for choosing samples that are more likely to meet the needs of breeders. The core collection concept and Focused Identification of Germplasm Strategy (FIGS) were presented as two strategies that have served a valuable purpose for analyzing diversity within the collections. FIGS uses Geographical Information System (GIS) technologies as a predictive tool and knowing the location in which a landrace was developed, it enables "best-bet" assessments as to which accessions may be worth including. The new genetic technologies promise a revolutionary change in how effectively genetic resources can be used. An entire genome of an accession can be sequenced at lower cost than evaluating it for one complex trait. Being perfectly heritable, the sequence gives us the ultimate characterization trait - a single assessment, in one location without replication without treatments suffices as a permanent fixed record. In view of cost-effectiveness, it is becoming feasible to sequence every accession in a collection. Combined with functional genomics and related genetic analyses to understand the genotype-phenotype relationship in targeted subsets of the collection, the possibility now exists to predict likely phenotype from knowledge of sequence data. Completing the sequencing of accessions and further research on the genotype-phenotype relationship is critical for the more effective use of genetic resources.

Dr. Yoshinobu Egawa in his presentation on "Germplasm Enhancement and Development of Crop Breeding Materials" mentioned about the Japan International Research Center for Agricultural Sciences (JIRCAS) and its activities. He informed that Tropical Agricultural Research Front (TARF) was originally established in 1970 as a branch of JIRCAS to carry out research on introduction of new crop germplasm accessions from tropics and sub-tropics and their evaluation for agricultural characteristics. TARF has a long experience of germplasm collecting since it was established. By evaluating these germplasm accessions, TARF has successfully developed several crop varieties so far. At present, TARF is carrying out agrobiodiversity research for enhancing germplasm and developing breeding materials of several crop species to: (i) develop high biomass producing plants in sugarcane; conducted intergeneric crosses between commercial sugarcane clones (*Saccharum* spp.) and the wild germplasm accessions including *Erianthus, Miscanthus*, etc. TARF has already produced sugarcane strains which are much higher in sugar content and, stem yields than conventional cultivars by backcrossing sugarcane to the F_1 hybrids between sugarcane and wild sugarcane (*S. spontaneum*); (ii) develop new breeding materials in 'Irwin' mango (*Mangifera indica*) by crossing with 77 germplasm accessions; and (iii) develop mung bean (*Vigna radiata)* lines resistant to bruchids infestation using wild and cultivated blackgram (*V. mungo*).

Dr. Michael C. Mackay made a presentation on "Exploring Agrobiodiversity through the Integration of ICT, GIS and Other Technologies". In his presentation, he highlighted that agrobiodiversity information is the key for improving our ability to identify those genotypes providing possible solutions to specific production challenges. Just as nature has shaped much of the available genetic variation due to evolutionary processes based on location, climatic and edaphic and also human influences, information can also be garnered about how to link variation for specific traits to eco-geographical regions. To better understand these links and thereby more effectively explore agrobiodiversity, information must be integrated across different technologies. Traditional agrobiodiversity information was

handed down from one generation to the next, through informal means. From the older documentation approaches of the mid-20th Century to the more modern Geographic Information Systems (GIS), new technologies and types of information have become available, such as enormous quantities of molecular data, to assist in the efficient use of agrobiodiversity. GIS, for instance, offers tools to understand links between environment and genotypes that were previously less clear. When these data elements are combined through the integration of technologies, we begin to see much more powerful and useful approaches for the exploration of agrobiodiversity, such as the Focused Identification of Germplasm Strategy (FIGS) which targets small, discrete sets of genotypes for novel genetic variation of adaptive traits. Therefore, a valid system for exploring agrobiodiversity through integrating technologies relies greatly on the persons and organizations generating this information. In the case of the plant kingdom, the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) calls for a global information system to facilitate the exchange of data that will contribute to the sharing of associated benefits. Furthermore, scientists and others generating information, are invited to share their data through a global portal on plant genetic resources to be launched early in 2011. This portal, called GENESYS, which has already integrated the standard passport data with characterization and evaluation data as well as environmental data for accessions with geo-references, provides a single point of access to more than 2 million samples of crop diversity worldwide. A planned next phase of GENESYS would introduce genetic information to the portal.

The presentations were followed by in-depth discussions. The following recommendations emerged from these discussions:

- Participants appreciated the GENESYS approach developed by Bioversity International for information sharing at global level. However, a concern was raised regarding identification of duplicates. It was suggested that the national programmes should actively participate for information sharing through GENESYS.

- Since IRRI is much involved in gene mining of rice, it was suggested that IRRI could play a major role for capacity building of national partners in Asia-Pacific region in this important field. In this context, CIMMYT also showed interest to support such training programmes.

- It was suggested that Japan should play a lead role in providing training to the plant breeders from other countries in the region for marker-assisted selection in breeding programmes.

- APPARI highlighted its collaboration with JIRCAS that led to the Tsukuba declaration on adapting agriculture to climate change. This declaration clearly showed that reorientation of the research agenda was needed to support adaptation towards climate change.

- Concern was raised regarding the implementation of regional strategies by the Trust. Bioversity and APAARI should follow on the implementation of the regional strategy with the Trust. It was also suggested to approach the Trust to enhance financial support to the national partners as the current support for *ex situ* conservation is not sufficient in the developing countries.

Technical Session V: Promoting Agrobiodiversity in the Asia-Pacific Region

Dr. Abd Shukor bin Rahman, Director General, Malaysian Agricultural Research and Development Institute (MARDI), chaired this session together with Dr. Ajit Maru as Co-chair and Dr. C.L.L. Gowda as Rapporteur. Three presentations were made during this session relating to important issues concerning farmers, scientists, administrators, and policy makers' role in conserving agrobiodiversity and create awareness on the global loss of agrobiodiversity and ways in which we can manage and conserve them effectively.

Fr. Francis Lucas made a presentation on "Role of NGOs in the Conservation and Use of Agrobiodiversity through Sustainable Agriculture". He mentioned that sustainable agriculture and agrobiodiversity are vital in stimulating development processes and poverty reduction in poor countries particularly in the Asian region, which is home to 75% of the world's farming households, of which 80% comprise of small-scale farmers and food producers. For over two decades, there has been a shift of emphasis in the development orientation among NGO practitioners involved in sustainable agriculture. He indicated that the 1992 United Nations Conference on Environment and Development (UNCED) has strongly influenced many NGOs to incorporate environmental sustainability and equity dimensions into their development programmes and activities. A substantial number of these programmes have addressed the negative social and environmental impact of the Green Revolution technologies that resulted in: (i) increasing rural indebtedness, (ii) negative effects of chemicals on soils, water and human health, (iii) loss of biodiversity and indigenous farming systems, and (iv) neglecting poor farmers and marginal lands in favour of better-off farmers in irrigated lands. Hence, at the forefront of these programmes is the campaign of many NGOs to mainstream sustainable agriculture and reduce the intensive application of chemical fertilizers/pesticides. These programmes are promoting sustainable agriculture through crop diversification and livestock integration in the farming systems thereby preserving agrobiodiversity. He highlighted the roles played by various NGOs which are as follows:

- MASIPAG (Philippines) farmers already recovered 1,090 traditional rice varieties and bred 1,069 rice varieties and 273 farmer-bred lines. Currently, there are 64 farmer rice breeders across 635 farmer organizations in 47 Philippine provinces.

- Cambodian Center for Study and Development in Agriculture (CEDAC) implements programmes for skill enhancement of farmers on the System of Rice Intensification (SRI) and involves them in soil conservation, Ecological Pest Management (EPM), natural fertilizers, aquaculture and biodiverse farming to help increase yields with less inputs, less costs and upholding the ecological balance of the natural farming system. CEDAC already has some 60,000 SRI practitioners.

- SEARICE (Southeast Asia Regional Initiatives for Community Empowerment) implements the Community Biodiversity Development and Conservation and Biodiversity Use and Conservation in Asia Programme (CBDC-BUCAP). It involves farmers in Bhutan, Lao PDR, the Philippines, Thailand and Vietnam to secure their local seed systems through conservation, crop improvement and sustainable utilization. In 2008, this programme was able to build the capacity of farmers to select and develop rice varieties. He also indicated that local governments and the scientific community recognize farmers' capacity to produce good quality seeds in some countries. Research conducted proves that small-scale agriculture is more sustainable, environmentally-sound and can lead poor food producers to enhance crop productivity to a greater extent.

In his concluding remarks, Fr. Francis informed that effective linkages through partnerships and network building are being established worldwide to acquire multiple perspectives and technical capabilities supporting agrobiodiversity and sustainable agriculture. He stressed the importance of putting a premium on the effective community practices on sustainable agriculture that can help combat climate change and achieve sustainable agrobiodiversity.

Dr. Michael Hermann from Crops for the Future presented the paper on "Contribution to Sustainable Agriculture and Food Systems through the Enhanced Use of Underutilized Species: The Role of Crops of the Future, a new International Organization". He stated that abandonment of traditional lifestyles and increasing globalization of trade and food systems have tended to favour only a few major crops and these have come to dominate agricultural as well as horticultural production, value-adding and commerce. Funding of agricultural research and development has concentrated on these commodities. As a result, a large number of food species have fallen into disuse and have been replaced by the major crops and the products derived from them. However, these neglected and underused plant species are part of a rich cultural and food diversity. Many have the potential to play a much more important role than they do today in sustaining livelihoods and human wellbeing and in enhancing ecosystem health and stability. In addition, agrobiodiversity helps to keep options open for adaptation to climate change. He indicated that in response to the need of promoting underutilized species in the general context of diversifying current production and food systems, a new organization "Crops for the Future (CFF)", has been established through the merger of International Centre for Underutilized Crops (ICUC) and Global Facilitation Unit for Underutilized Species (GFU), co-hosted by Bioversity and University of Nottingham Malaysia Campus. CFF works closely with networks such as GlobalHort, NTFP network, TFNet, GFAR, APAARI, FARA, SPC, etc. and supports international conferences and seminars, chairs working groups and discussion fora. It plans to strengthen national and regional efforts to enhance the use of neglected species. These species often face demand or supply constraints that have led to their neglect. Such constraints need to be properly addressed rather than engaging in mere promotional rhetoric. Crops for the Future will focus on four major areas: (i) Advocacy of a favorable policy environment in terms of improved access to germplasm, removal of market access barriers, and improved seed systems; (ii) Increasing the awareness of the nutritional, livelihood and ecosystem benefits of greater use of neglected agrobiodiversity; (iii) Strengthening capacities of national programmes to undertake research on neglected crops; and (iv) Improving access to information on neglected crops. He also indicated that a new Crop for the Future Research Center (CFF-RC) will be established in Malaysia in 2011, with considerable funding from the Malaysian Government. Operated by Nottingham University (Malaysia Campus) and responding to CFF's global priorities, CFF-RC will add significantly to regional crop research on neglected crops, and it will engage in regional capacity building.

Dr. Paul Quek gave a presentation on "Understanding Traditional Knowledge in Managing and Enhancing Agrobiodiversity". In his presentation, he informed that TK related to the managing and enhancing agrobiodiversity include the range of traditional good practices related to agricultural crops and crop wild relatives. Some traditional practices may appear non-sustainable due to initial lack of understanding of the local and cultural context of the practice.

For example, reducing forest destruction by limiting land for subsistence communities involved in shifting cultivation results in poor soil fertility and lower yields making subsistence farmers vulnerable. He also indicated that the availability of TK to the communities affected by climate change is an important key indicator of the usefulness of TK in managing agrobiodiversity for climate change. Climate change will necessitate

the promotion of networking between communities over a wider geographical area and the exchange of seeds and associated knowledge. The rising language challenge on the other hand will force the need for scientists' support in such community to community interactions until Information and Communication Technology (ICT) tools become accessible at the community level. Hence, more efforts on the community seed exchange are needed especially where culture and agrobiodiversity are tightly linked. The cultural linkage of crops would also have impact on the type of services that genebanks could provide.

In addition, three short presentations were also made in this session whose description is given below:

The first presentation was made by **Dr. Ralf Kwaschik** of International Network for Bamboo and Rattan (INBAR) on the "Collective Action for Pro-poor Specialty Crops, Species and Products". In his presentation, he emphasized on the importance of specialty crops and species, especially the reasons why they are important for rural poor and forest dwellers. He indicated that neglected and underutilized crops (> 700 taxa) have an underexploited potential to contribute to food security, nutrition, health, income generation and environmental services. They have often been overlooked by scientific research and by development workers, donors, policy makers, extension, etc., and their nutritional and economic contributions are underestimated due to a lack of data. They play important role in combating hidden hunger and complementing nutritionally unbalanced diets; basic healthcare (alleviating the effects of HIV/AIDS, malaria, etc.); income generation; greater species diversity of agroecosystems contributing to their sustainability; crucial role in adaptation, mitigation and resilience to climate change; and life-savers in marginal areas and emergency situations (drought, famine, etc.). However, it is argued that collective action can improve the presently fragmented nature of existing efforts and it is suggested that the way ahead is to identify common challenges, based on independent, aligned units collaborating within the framework of the Global Forum for Agricultural Research (GFAR) and addressing important challenges identified by the mega programmes of the 'new' CGIAR.

Dr. Sayed Azam Ali of the University of Nottingham (Malaysia Campus) made a presentation on the "Crop Simulation Modeling: A Catalyst for Research Collaboration." He indicated that amongst the various stakeholders and priorities for the development of underutilized crop species, there is a role for scientific assessment of the properties and potential of particular species. Crop simulation models have been widely applied to major crop species for many years but their application to underutilized crops remains piecemeal and sporadic. In this brief presentation, the opportunities of using crop simulation models to assess the current and future potential of underutilized crops are discussed and comparative/mapping basis within underutilised species (e.g. landraces), between underutilized species (e.g. crop options) and against major crop species are highlighted. The various aspects required in the crop simulation model are: (i) overview of `farm to fork' process from cultivation to marketing; (ii) identify key researchable factors along the research supply chain; and (iii) decision support system to guide interventions along CSC. The role of models in identifying key researchable constraints to the wider usage and distribution of underutilized crops is discussed as part of an integrated programme of evaluation and improvement.

Dr. Keun Jin Choi, President of Council of UPOV made a presentation on "Interface between the UPOV Convention and Other International Treaties". In his presentation, he emphasized on international treaties, key elements within those treaties and UPOV's views on those matters. He indicated that UPOV comprises of 68 members, TRIPS/WTO (158 members), CBD (193 members) and ITPGRFA/FAO (126 members). These members

shall provide the protection of plant varieties either by patents or by an effective *sui generis* system or by combination. He stated that plant varieties are important genetic resources and UPOV encourages plant breeding efforts as breeding increases the value of genetic resources. UPOV encourages the maintenance of plant genetic resources and considers access to genetic resources a key requirement for sustainable and substantial progress in breeding. UPOV's view is that breeders need access to all forms of breeding material to sustain the greatest progress in breeding and, thereby, to maximize the use of genetic resources for the benefit of society. UPOV does not allow provision of information on the origin of plant material and prior informed consent (PIC) to be a condition of protection. He also mentioned that ITPGRFA recognizes the concept of the breeder's exemption and are not subjected to any restriction, and breeder of protected varieties are not entitled to financial benefit sharing with breeder varieties developed from initial varieties. In his concluding remarks, he mentioned about the Farmer's rights under ITPGRFA that farm saved seed is an optional mechanism under UPOV convention i.e. UPOV members may permit farmers to produce seed of the protected varieties for subsequent planting on their own farm.

The following important recommendations emerged from these discussions:

- It was suggested that all the publications should be placed in the public domain for open access as it is one of the ways to enhance information dissemination.

- It was pointed out that many NGOs are taking up the extension of technologies to farming communities produced by research centers but are not always accepted by farmers. Therefore, there is need to refine the technologies in order to meet farmers' needs.

- Information flow of available technologies to farmers through extension services or directly to farmers should be strengthened and enhanced.

Group Discussions

Four Working Groups were constituted on different aspects, viz., (i) Areas of R&D collaboration on agrobiodiversity conservation and use for sustainable agricultural development; (ii) Strengthening agrobiodiversity capacity, education and public awareness in Asia-Pacific; (iii) Enhancing exchange and use of genetic resources in the Asia-Pacific (implementing the ITPGRFA through MLS and SMTA); and (iv) Role of international and regional organizations and networks in strengthening agrobiodiversity conservation and use in Asia-Pacific. Summary of the discussions in these Working Groups is presented below:

Working Group I

The Working Group I on "Areas of R&D collaboration on agrobiodiversity conservation and use for sustainable agricultural development" was chaired by Dr. Raghunath Ghodake and Dr. Sayed Azam-Ali was the convenor. The discussion was focussed on areas of collaboration on agrobiodiversity conservation and use for sustainable agricultural development. The following recommendations emerged from the discussion:

1. Climate change will be the main driver to decide on future research activities and collaboration in the region as it will have main impact on all components of agrobiodiversity and hence needs to be given due attention.

2. A twin- pronged approach was suggested focussing on major crops and their wild relatives and underutilized crops. It was observed that for major crops, there are well established systems and networks. However, it is not clear as to how we can use available genetic resources of underutilized crops and their wild relatives and what adapted traits are linked to genes and hence this needs urgent attention. Also, there is a need for setting up of crop wild relatives genetic resources networks for key crops.

3. Regarding the enhanced utilization of underutilized crops, it was suggested that national programme should focus on evaluation of available genetic resources of these crops at different locations and specific traits should be identified for use. This will also lead the identification of suitable genetic resources for abiotic and biotic stresses for climate adaptation. Special emphasis should be given on the nutritional and health benefits of these crops and their genetic resources compared to major crops for income generation and nutritional security. A strong need was felt for strong capacity building of national partners for *in situ*/on-farm conservation and documentation of traditional knowledge; and strong market chain analysis for better livelihood of the farmers involved in the conservation and use of genetic resources of underutilized crops.

4. Cross-cutting themes were suggested for coordination of research at national, regional and international levels, capacity building, information systems and policy research to identify researchable areas.

Working Group II

This Working Group on "Strengthening agrobiodiversity capacity, education and public awareness in Asia-Pacific" was chaired by Fr. Francis Lucas and Dr. Michael Hermann was the convenor. The discussion was focussed on strengthening agrobiodiversity capacity, education and public awareness in Asia Pacific. The following recommendations emerged from the discussions:

1. Education of agrobiodiversity must take place across society. The message should not be limited to agrobiodiversity conservation but rather it should also cover other important aspects relating to food, nutrition and health for the benefit of humankind.

2. The education regarding agrobiodiversity conservation should be initiated at an early age (primary level). University curriculum should have at least the minimum standards to address food sciences, nutrition and health to make university research more innovative so that it would address the need of farmers and consumers. Researchers need better access to donor and grant related information.

3. There is a need for policy makers for investments in curriculum, revamping of extension services and support of informal seed systems. There is need to strengthen extension services and better coordination mechanism among multi-stakeholders; strengthen local food systems to educate consumers regarding advantage of local food diversity.

Working Group III

The Working Group III on "Enhancing exchange and use of genetic resources in the Asia-Pacific" was chaired by Dr. Patricio S. Faylon and Dr. Ruaraidh Sackville Hamilton was the convenor. The discussion was focussed on enhancing exchange and use of genetic resources in the Asia-Pacific through the implementation of ITPGRFA using MLS and SMTA. The following recommendations emerged from the discussions:

1. It was recommended that APAARI needs to develop and implement a communication strategy to increase learning opportunities, foster knowledge exchange, and enhance capacity in communication for AR4D in the region.

2. It was observed that as of today, the Treaty is not perfect. However, it could be implemented in its present form because any further delay in its implementation will lose its momentum. In this context, it was suggested that APAARI could play a lead role in strengthening required communication between the NARS and the Treaty Secretariat as well as between NARS and policy makers.

3. Although the Treaty has legal status under International law, it was recommended that the countries in the region should develop their own national legislations in order to avoid any possible conflict.

4. It was recommended that there is need for capacity building of national partners for successful implementation of the Treaty. APAARI should coordinate with the Treaty Secretariat and other agencies to implement capacity building for practitioners.

5. It was also suggested that APAARI should provide guidance to NARS and play advocacy role for developing regional grant proposal for benefit sharing fund and adaptation to climate change as possible focus and outputs requiring greater exchange and use within the region.

6. It was also observed that a few countries have ratified the Treaty in the Asia-Pacific region. Therefore, efforts should be made to create awareness for better understanding of the complexities of ABS and Intellectual Property Rights (IPR) issues in different countries.

7. Since most Asian countries use non-UN languages, it was recommended that APAARI could help in facilitating translation of the Treaty and the Treaty documents such as SMTA and Governing Body decisions into regional languages.

8. It was suggested that PGR networks should be further strengthened to assist the network member countries for their effective participation in the treaty related activities and focus on enhancing benefits to exchange by linking to users.

Working Group IV

The Working Group IV on "Role of international and regional organizations and networks in strengthening agrobiodiversity conservation and use in Asia-Pacific" was chaired by Dr. Ajit Maru and Dr. Prem Mathur was the convenor. The group discussed the role of international and regional organizations and networks in strengthening agrobiodiversity conservation and use in Asia-Pacific. The activities, strengths and weaknesses of several regional networks and international organizations, namely, EA-PGR, RESCEA-PGR, PAPGREN, SANPGR, AARINENA, APAARI, CACAARI, INBAR, GFAR, and ILRI were discussed. The following recommendations emerged:

1. It was suggested that regional and crop-based networks should be owned by network countries with required support by regional and international organizations. However, it was also suggested and agreed upon that international organizations should provide greater support and accept more facilitation role for promoting and implementing network activities.

2. It was suggested that 'Delivery Networks' should be based on national programmes' needs looking more at common core issues. Network functions should be reframed to develop a number of research areas and seek partnership with research institutes.

3. Concern was raised regarding lack of funding support by donors in the recent past. Following donor direct support, the international organizations also did not include the network activities as their core activities. The main reason for lack of donors' interest was their lack of awareness of the impact/benefits of network activities and outputs. In this context, it was suggested that genebank

maintenance and genetic resources enhancement should be highlighted as core activities for getting donors attention. Also need for proper awareness of donor community was considered important.

4. It was also suggested that network activities and focus should become an integral part of thematic proposal such as climate change, nutrition and health.

5. It was also suggested that both tangible and intangible benefits should be assessed as an outcome of these networks. Since donors are more concerned and are aiming at larger impact, incremental improvement should be properly documented for each and every activity of the network, especially impacting on poverty alleviation.

6. APAARI and Bioversity International have agreed to continue providing facilitation role to support the four sub-regional PGR networks in the Asia-Pacific.

7. It was also suggested that PGR networks should consider inclusion of activities/ programmes relating to animal and fish genetic resources in the region.

Plenary Session

The Plenary Session was Chaired by Dr. Raj Paroda and Co-chaired by Dr. Kwesi Atta-Krah of Bioversity International, whereas Dr. Prem Mathur of Bioversity International was the Rapporteur. In the Plenary Session, the outcomes of discussions held in each of the four Working Groups were presented. Also various recommendations and issues emerged in different Technical Sessions were deliberated in detail and the following general recommendations emerged:

- It was recommended that there is need to emphasize on the role of genetic resources in removing hidden hunger, address climate change and nutrition as they are important for food, nutrition and sustainable agriculture. Plant genetic resources are the building blocks of agriculture as they play unique role in the development of new cultivars including the restructuring of existing ones.

- It was suggested that there are several unexplored/underused plant species in many countries which have vast economic potential and hence call for enhanced research for their immediate use. Therefore, documentation and sharing of information on these species are very much required as a matter of priority.

- Need was expressed to relook at the regional and sub-regional strategy for Asia-Pacific developed earlier by the sub-regional PGR networks and endorsed by APAARI for funding support from the Global Crop Diversity Trust (GCDT). More stakeholders should be involved such as those of private sector, NGOs, and farmers/food producers to have effective implementation of PGR strategy in the region.

- Concern was raised for the greater awareness towards ratification and effective implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) in the Asia-Pacific region to facilitate more exchange and benefit through use of genetic resources. Sincere efforts are also needed by different countries in the region for effective implementation of the Treaty.

- It was also recommended that sincere efforts be made for expanding the scope of crop coverage under Annex. 1 of the Treaty based on recommendations of the regional and sub-regional consultations to be held for developing strategies in this regard.

- More support was recommended to promote the networks and their activities and CGIAR centers should consider this as a core activity while reorientating their research agenda.

- Bioversity International could identify this as a niche for its future strategy and mandate since no other organizations have this comparative advantage.

- Capacity building was highlighted as important for institutional strengthening, especially for weaker NARS and due attention needs to be given on training activities on genetic resource management.

- Benefit sharing would require careful handling. There is a need to move forward for sharing of genetic resources as it was done in the past which could be facilitated

by planners/policy makers at regional and international level by adopting the Standard Material Transfer Agreement (SMTA).

- It was also suggested that there is a need to do more on new crop/crops for the future as these are not researched much and hence become increasingly important in the context of climate change and environmental sustainability. Also, countries will have to diversify their food systems to ensure food and nutritional security.

- Emphasis was also laid on the use of new technologies now available for efficient conservation and use of genetic resources for sustainable agriculture.

All the participants of the symposium endorsed that the vast agrobiodiversity in the Asia-pacific region is a valuable resource to achieve the MDGs, especially food and nutrition security and agricultural sustainability. These resources are to be used and conserved to ensure productivity and quality, adaptation to climate change and sustainable agricultural development. Effective conservation and utilization of this capital would obviously require increased focus and investment both at the national, regional and international levels, through greater involvement of all stakeholders. Also there is a need for greater public awareness and policy advocacy for enhanced support for AR4D efforts in the region. International and regional agencies, CSOs, private sector and regional networks have a crucial role to play in strengthening agrobiodiversity conservation and use in the Asia-Pacific. Enhanced collaboration between national and international research institutions and civil society organizations would help in holistic approach to understand the importance of conservation and use of the agrobiodiversity.

It was also agreed that there is a strong need to form new partnerships involving farmers and other stakeholders who ultimately guard the agrobiodiversity and its associated knowledge. Active collaboration with them will ensure recognition of farmers' needs and concerns, optimal planning and monitoring of activities, participation in plant and animal breeding activities, adoption of innovations, documentation and use of traditional knowledge and usefulness of research for the poor. All above initiatives will contribute to better understanding of the agrobiodiversity conservation and effective use for the benefit of humankind. Based on these discussions and outcomes of the technical sessions and working groups, a draft framework "The Suwon Agrobiodiversity Framework: The Way Forward for Managing Agrobiodiversity for Sustainable Agriculture in the Asia-Pacific Region" was developed and circulated to all participants for their comments/ suggestions. Based on the comments/suggestions received from the participants, the Suwon Agrobiodiversity Framework was finalized, published and distributed to all national partners. The Framework is presented as Annexure II in this report.

Annexes

Keynote Lecture: Agricultural Biodiversity for Sustainable Development by Dr. Emile Frison

Agricultural Biodiversity
for Sustainable Development

Emile Frison
Director General, Bioversity International

International Symposium, Suwon, Korea, 13 October 2020

The "B" Challenge

Of all global environmental challenges,
the loss of biodiversity, and the concomitant
degradation of ecosystem services, is the only one
likely to be irreversible.

At the current scale, the loss of
biodiversity from habitat change, overexploitation,
invasive alien species, and climate change,
is threatening the life support systems
that sustain societies
and economies.

UNEP-GEF, 1990

Sustainable Development

- Some key elements:
  - **Food Security**
  - Good Health and Nutrition
  - Employment and Reasonable Income
  - Recognition and Dignity
  - Good governance
  - Peace

➔ Agricultural Biodiversity

ABD …More than just Crops

Genetic variation used in agriculture:

- ⇨ Plants / crop
- ⇨Trees (and forest)
- ⇨ Livestock / Animal
- ⇨Fish
- ⇨ Wild relatives of crops
- ⇨Micro-organisms (e.g. soil microbes)
- ⇨Invertebrates (Pollinators, natural ener

..... **In Agriculture**

Importance of Agricultural Biodiversity

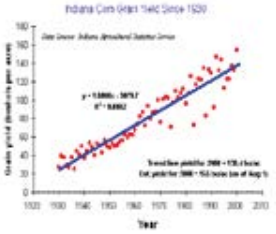
- Classic view, as source of traits and improvements

"Breeding new varieties and their dissemination to farmers."

Gains in Breeding

From 1935 t0 1996 - increased yield for corn in Indiana over the last 70 years –

From 35 bushels to 120 bushels per acre



ANNEX

…. More than Breeding

Under-recognized

- Nutrition and health
- Resilience and stability
- Adaptation to stress
- Income: linked to markets
- Socio and cultural dimension

Biodiversity delivers Diversity for …

- Resistance to disturbances,
- pests and diseases
- Stable and productive harvests
- Environmental services

More than Conservation …

Conservation is important

But ….

- …. It is not an end in itself
- It needs to be related to USE,
  - Characterization
  - Information and Documentation
  - Pre-breeding and base broadening,
    - Breeding
    - Biotechnology
  - Direct Use (food, nutrition, well-being, etc.)

The Global Reality

- **Hunger and Poverty**
- **Malnutrition and disease**
- **Climate change**

Hidden Hunger

- True Food Security
  - More than calories and protein
- Missing micronutrients
  - At least 2 billion worldwide
  - Mostly women and children
- 60% of child deaths linked to poor nutrition

India

- One sixth of the world's population
- One third of the world's malnourished under-fives

ANNEX

Double Burden

- Diseases of "affluence"
  - Type 2 diabetes, obesity, heart disease, cancers
  - 80% of chronic health disease deaths occur in low- and middle-income countries
  - 70% of deaths in Western Pacific region

"Medicalisation" of Nutrition

- The medical establishment currently sees three approaches to tackling malnutrition:
  - supplements,
  - fortified foods and
  - biofortified staples.
- The dietary diversity option largely ignored

Agricultural Biodiversity for Nutrition and Health

- Eating diverse diets
  - Minor crops
  - Neglected and Underutilised
- Rural / Urban links
- Awareness, promotion
- Conducive policies
- Research

India: Pilot studies

- Focus on neglected, underused, traditional crops and varieties
- Improve cultivation, product diversification, consumption, marketing
- Partners: MSSRF, local universities, communities
- IFAD funded

Minor millets

- Reliable and thrive under difficult conditions, thus sparing wider environment
- High nutrition and low glycemic index

IFAD

ANNEX

Nutritious

		Protein	Fibre	Ca	Fe	Riboflavin
	Brown rice	7.9	1.0	33	1.8	0.04
	Wheat	11.6	2.0	30	3.5	0.10
Millets	Finger	7.7	3.6	350	3.9	0.19
Millets	Foxtail	11.2	6.7	31	2.8	0.11
Millets	Little	9.7	7.6	17	9.3	0.09

Value added

- New Products
  - Cheaper
  - Healthier
- Marketing
  - Income
- Education
  - Empowerment
  - Self Esteem

Other examples

Kenya: leafy vegetables

Bolivia: Andean grains

African Leafy Vegetables

- Hundreds of species:
- Much more nutritious
- Focus on women
  - Home gardens
  - Feeding the family
- New seed systems and agronomic techniques
- Market links and Value chain

Vitamin A

Children need about 600 µg/day
Adults need about 800 µg/day
(More if breastfeeding)

Pandanus fruit
4 spp, >180 varieties
β-carotene 14-1000 µg/100 gm

ANNEX

Vitamin A

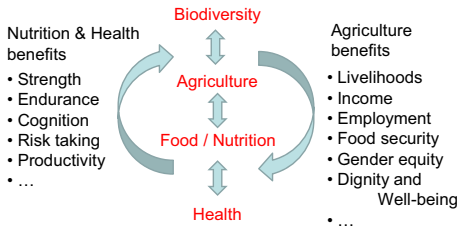
Banana >480 varieties in Pacific
β-carotene 1-8500 µg/100 gm
Fe'l in Pacific guiding research in Cameroon

West Africa

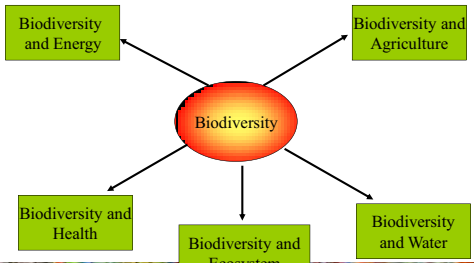
Pacific

Food Systems Approach

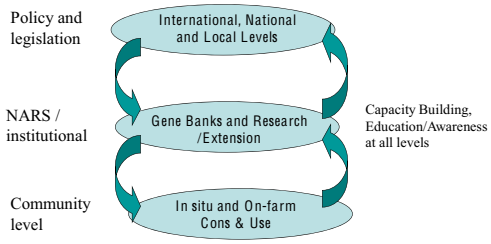
Multiple benefits



Biodiversity in the Wider context



Integration into overall Agriculture R&D



More than just Agriculture

- Agricultural biodiversity development requires:
  - Multi-sectoral engagement (Agriculture, Environment, Health, Finance, Education, etc)
  - Multi-stakeholder participation:
    - Researchers
    - Policy makers
    - Community groups
    - Development partners

ANNEX

CGIAR and Agricultural Biodiversity

A lot of investment and research

- Ex Situ: Over 650,000 samples are held by 11 CGIAR centre genebanks, 40% unique
- In situ conservation; CWR; on farm management and use
- Current CG Reform
  - CGIAR Research Programs (CRPs)
  - Scoping Study (Global research)

Conclusion

Agricultural Biodiversity:

- Vast and complicated area of work
- Vital resource for food security and nutrition
- Wider environmental benefits
- Diverse potential inadequately explored
- Awareness and Policy support essential
- APAARI providing support

Thank You

ANNEX

The Suwon Agrobiodiversity Framework

THE SUWON AGROBIODIVERSITY FRAMEWORK

The Way Forward for Managing Agrobiodiversity for Sustainable Agriculture in the Asia-Pacific Region

Rural Development Administration, Suwon, Republic of Korea
13-15 October, 2010

Photo Credits: Cover Page -from left to right: (a) Dr. B. Sthapit (Bioversity International), (b) Dr. B.M.C. Reddy (Bioversity International), (c) Dr. R.S. Paroda (APPARI)

THE SUWON AGROBIODIVERSITY FRAMEWORK

Rationale

The Asia-Pacific region is the center of diversity of many important species of crops and livestock. Resource poor farmers in the region are largely dependent on the agrobiodiversity of minor crops, their wild relatives and other species of plants and animals for their food security and livelihood. The rich mosaic of people and cultures found in the region have contributed to the enormous diversity of cultivated plants and domesticated animals. Population migration and the trade enabled introduction of new species and varieties. Additionally, the genetic diversity in both indigenous and introduced species has been enhanced through extensive exchange of germplasm within the region.

Agrobiodiversity is the foundation of sustainable agricultural development. Plant Genetic Resources for Food and Agriculture (PGRFA), that constitute a major part of current agrobiodiversity, are an essential resource to meet our food security. However, while the threats to these resources are growing, the efforts to conserve and use genetic diversity are still insufficient. This has been further confounded by the large scale adoption of few improved varieties resulting in displacing some of the landraces on farmers' fields. Also, the traditional knowledge, associated with the use of old varieties/landraces, has somehow remained undocumented and is rapidly disappearing. Reduction of agricultural biodiversity on the farm can significantly increase the vulnerability of farmers and existing agro-ecosystems. In recognition of the value of genetic diversity for the society, and also in view of the concerns of their loss, concerted efforts have been made by various international/regional organizations and national governments in the conservation and promotion of sustainable use of available crop and animal genetic resources. The sustainable conservation of agrobiodiversity can help in achieving the Millennium Development Goals (MDGs) since use of PGRFA is central to food security. However, this can only be possible through easy access and benefit sharing (ABS) of PGRFA and Animal Genetic Resources (AnGR).

The 9th session of the Commission on Genetic Resources for Food and Agriculture, held in 2002, emphasized "the importance of promoting the sustainable use of PGRFA and AnGR, through germplasm characterization, evaluation, genetic enhancement through plant breeding, seed production and distribution; and its contribution to food security". Promoting sustainable use of biodiversity is also one of the seven 2010 Biodiversity Targets of Convention on Biological Diversity (CBD) (Decision VII/30). Furthermore, the CBD at its 8th Conference of the Parties (COP 8) held in Curitiba, Brazil in 2006 adopted a 'Cross-cutting Initiative on Biodiversity for Food and Nutrition', to be developed under the leadership of the Food and Agriculture Organization of the United Nations (FAO) and Bioversity International. These priorities have also been endorsed by the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA)-Article 6: Sustainable Use of Plant Genetic Resources. "Genetic Resources Partnership" is also identified as one of the four areas for elaboration under the Global Partnership Initiative for Plant Breeding Capacity Building (GIPB), being implemented by FAO. It is now increasingly accepted that future crop productivity increases can only be achieved through an increased use of PGRFA, including wild relatives and exotic materials. It is for this reason, the United Nations General Assembly has declared 2010 as an International Year of Biodiversity (Resolution 61/204 dated 20 December 2006) to bring greater awareness and promote new initiatives that can reduce the current loss occurring globally and enhance activities aiming mainly at conservation through use.

APAARI, in collaboration with its stakeholders, especially Bioversity International and other CGIAR Centers, viz., CIMMYT, IRRI, ICRISAT, ICARDA, ILRI, ARIs, FAO, GFAR, CFF, AVRDC and other Regional Fora, and the National Agricultural Research Systems (NARS) continue to review the role and direction of agricultural R&D to efficiently address above challenges. Several stakeholders have also initiated programmes to promote conservation and use of agrobiodiversity for sustainable agricultural production in the Asia-Pacific region. Four sub-regional networks have been organized to promote regional collaboration for strengthening PGRFA conservation and use. These are: (i) South Asia Network on Plant Genetic Resources (SANPGR), (ii) the East Asia PGR Network (EA-PGR), (iii) Regional Cooperation for Plant Genetic Resources in Southeast Asia (RECSEA-PGR) and (iv) The Pacific Plant Genetic Resources Network (PAPGREN). In addition, there are also several commodity focused PGR networks like the Banana Asia Pacific Network (BAPNET), the International Coconut Genetic Resources Network (COGENT), Cereals and Legumes Asia Network (CLAN), and the International Network for the Genetic Evaluation of Rice (INGER). These sub-regional networks are operated mostly by the CGIAR Centers in close partnership with APAARI.

As a part of these ongoing efforts, and in recognition of 2010 as an International Year of Biodiversity, APAARI had organized an International Symposium on "Sustainable Agricultural Development and Use of Agrobiodiversity in the Asia-Pacific Region", in partnership with Rural Development Administration (RDA), Republic of Korea; Global Forum for Agricultural Research (GFAR); Bioversity International; FAO and other International Centers such as CIMMYT, ICARDA, ICRISAT, IRRI, ILRI and AVRDC during 13 - 15 October, 2010 in Suwon, Republic of Korea. The symposium provided an excellent opportunity to review, identify and redefine the role and directions of agricultural R&D, especially in the context of conservation through use of valuable agrobiodiversity for sustainable agricultural development. It also helped in agreeing on a 'Way Forward' for the access and benefit sharing of valuable genetic resources.

The agrobiodiversity research and development framework for the Asia-Pacific region, adopted during the Symposium aims to provide a strategic approach, towards both management and use through regional collaboration and partnerships among stakeholders.

Challenges and Opportunities

The attainment of MDGs, as reviewed recently by the world leaders (September, 2010) particularly on alleviating poverty, assuring food and nutrition security and environmental sustainability, against the background of declining natural resources, together with changing climate scenario, remains a daunting task.

Therefore, initiatives through conservation and use of agrobiodiversity must respond to these challenges. It is also evident that the contribution of agrobiodiversity in ensuring sustainable and productive agriculture remains vital to food security. The reservoir of genetic resources remains a main resource for food security, and equally important for improving nutrition, product quality, product diversification and food safety.

Responding to the emerging challenge of climate change, greater access to a range of varieties that can help farmers deal with drought or flood, will be required. Exploring the genetic resources available will require new tools (Genomics, GIS, ICT), technologies and innovative approaches for their conservation and use.

All these challenges are compounded by the continuing loss of genetic diversity of plants, livestock and aquatic resources. At the same time, available agrobiodiversity can contribute significantly towards addressing the concerns of food security, poverty, environmental degradation, urbanization, climate change, etc. Hence, effective conservation and sustainable use of available genetic resources becomes a major priority in the region.

Genetic Diversity in pearl millet

Integrated Approach

The proposed integrated approach seeks to ensure the continued availability of critical genetic resources not only for the improvement of agricultural productivity and resilience of the production systems but also to improve the quality of the supply chains through effective collaboration of different stakeholders working on a broad range of genetic resources for food and agriculture. It also builds on current partnerships and eco-regional experiences involving national and international organizations and for integrating partnerships across the different sectors of genetic resources.

The vision of the proposed approach draws lessons from existing collaboration between different CGIAR centres, NARS, Regional Fora and all the stakeholders in the region - a collaboration that now needs to be strengthened to a higher level of performance and accountability.

An integrated systems approach would intrinsically be more useful in the long run since it brings together work on microbes, crop plants, forest trees, livestock and fish genetic resources. It should also combine research on genetic, biological, agronomical, socio-cultural, market and economic aspects. It will encourage development of national plans that will focus not only on major commodities that are important for our food security but also on other crops, livestock and aquatic resources. Finally, it encourages the different organizations and local communities to work in partnership for collective actions. This approach will maximize the resources and opportunities to have an agile response to new, yet unforeseen developments in understanding diversity and promoting use through research, conservation, evaluation and documentation.

Focus of Research and Development

1. **Studies to enhance use of genetic resources through subset approaches:**
   There are many methods/approaches to sample germplasm collections to create subsets that are manageable in size by the researchers to quickly evaluate/characterize (phenotypic/genotypic) genetic resources to select useful accessions for use in pre-breeding. These approaches include core, mini core, Focus Identification of Germplasm Strategy (FIGS), composite and reference collections and trait-specific subsets. Enhancing research efforts on certain underutilized crops and their wild relatives may also be necessary to cover gaps in existing knowledge concerning their benefits to the society.

2. **Pre-breeding and participatory plant breeding to enhance utilization of genetic resources in crop improvement programmes:**
   There is a need to encourage the use of genetic resources [especially underutilized species, their relatives and other useful species such as non-timber forest products (NTFPs), medicinal plants, etc.] to exploit untapped genes, broaden the genetic base of existing cultivated varieties and develop the new ones. This will be essential for coping better with the challenges of increasing productivity, improving quality, managing new pests and diseases, and adapting to climate change and abiotic stresses. It will also be important to develop partnership with farmers and other stakeholders to explore alternative approaches for genetic improvement such as participatory plant breeding and community based conservation activities.

3. Strategies and technologies to enhance *in situ* and *ex situ* conservation through use:

The aim must be to generate and synthesize coherent messages with appropriate information and knowledge, evidence and tools which can contribute to the understanding of genetic diversity and its effective use, especially

- The incorporation of information/knowledge and new technologies (genomics) into integrated approaches can promote the understanding of the diversity distribution and identification of useful traits for adaptation to climate change, and other abiotic and biotic stresses.
- Research should explore the potential of consumer preferences, certification strategies, geographic indication, community and farmers' rights or payment systems for ecosystem services to secure agrobiodiversity for the future and exploit its direct values and uses. A market oriented approach is very important in enhancing the economic status of farmers involved in conservation and use of genetic resources.
- Efforts need to be made to empower traditional custodians of biodiversity in the region for *in situ* conservation on-farm to enhance conservation of landraces and wild relatives of cultivated crops and livestocks, both *in situ* and on-farm together with its associated knowledge.
- Apply proven modalities for community based biodiversity conservation with partners especially the civil societies, such as supporting communities to sustainably use local genetic diversity to reduce vulnerability and crop loss and to sustain the resilience and ecosystem services of their production systems.
- Promote cost-effective complementary *ex situ* and *in situ* strategies for conservation of genetic resources.

4. Assessment of the agrobiodiversity richness and the status relative to economic, social and cultural (traditional knowledge) factors:

- Support studies related to the assessment of genetic erosion and restoration of lost diversity across the region jointly with various national and international partners including advance research organizations (to access new methodologies).
- Assessing the relationship of poverty and other socio-economic factors that affect the genetic diversity for developing various livelihood options or for the payment for ecosystems services associated with conservation and use.
- Greater emphasis on documenting traditional knowledge (TK) and linking its use in both conservation and utilization of PGR in the context of benefit sharing as well as exchange of knowledge among communities.

5. Interdisciplinary studies on the invaluable ecosystem services for agriculture that agricultural landscapes, forests and other mainly wild ecosystems provide (following CBD-COP 5 Ecosystems Approach):

Degradation of wild ecosystems in the landscape has important implications to agriculture and food production. Compensating the lost ecosystem services with artificial irrigation systems, growth media, fertilizers or pesticides is potentially not only costly but probably not even viable in many resource-poor areas. There is a need to better understand the relationships between society and nature in the socio-ecological landscape (as those envisioned in the CBD-COP 10 Satoyama Initiative). It is, therefore, worth looking into the following aspects:

- The role of wild ecosystems in providing services for forest and other agricultural systems, the processes and interactions which maintain these services, and the threats that they are facing.
- Planning rehabilitation and maintenance of diverse landscape mosaics of agricultural lands and viable wild ecosystems including policies that support their creation and maintenance.
- Adaptation of wild ecosystems to changing environment as a prerequisite for the continued provision of the services as their demand increases.

6. Information systems and tools for data exchange:

The aim is to develop or adapt an information facility for online access to a wide range of datasets on genetic resources. The rapidly changing ICTs open up new opportunities to collect, store and analyze genetic resource information, and facilitate its exchange among researchers, local communities and countries. The integration of geo-references as the primary key for all forms of data, capitalizing on social media, data-interchange protocols, electronic germplasm catalogues and directories, GENESYS, GRIN Global and others. Common descriptors with guidelines for recording and reporting information should be extended to increase comparability and usability among datasets.

7. Supportive policies, laws and strategies to enable enhanced PGR exchange and use:

There is need to focus on assessing the impacts of international laws and policies on the use and conservation of genetic resources. Support is needed to assist countries that have signed the ITPGRFA to have the necessary regulatory/legislative mechanisms to implement the Treaty effectively. A well developed ABS framework must also be developed to provide legal mechanisms necessary to accelerate sharing of genetic resources.

ACRONYMS

ABS: Access and Benefit Sharing
AnGR: Animal Genetic Resources
APAARI: Asia Pacific Association of Agricultural Research Institutions
ARI: Agricultural Research Institute
AVRDC: The World Vegetable Center
BAPNET: Banana Asia Pacific Network
CAAS: Chinese Academy of Agricultural Sciences
CBD: Convention on Biological Diversity
CFF: Crops for the Future
CGIAR Consultative Group on International Agricultural Research
CIMMYT: International Maize and Wheat Improvement Center
CLAN: Cereals and Legumes Asia Network
COGENT: International Coconut Genetic Resources Network
COP: Conference of the Parties
CSOs: Civil Society Organizations
EA-PGR: East Asia Plant Genetic Resources Network
EURISCO: European Plant Genetic Resource Catalogue
FAO: Food and Agriculture Organization of the United Nations
FIGS: Focus Identification of Germplasm Strategy
GFAR: Global Forum for Agricultural Research
GIPB: Global Partnership Initiative for Plant Breeding Capacity Building
GPA: Global Plan of Action
GPA-NISM: Global Plan of Action-National Information Sharing Mechanism
ICARDA: International Center for Agricultural Research in the Dry Areas
ICRISAT: International Crops Research Institute for the Semi-Arid Tropics
ICTs: Information and Communication Technologies
ILRI: International Livestock Research Institute
INGER: International Network for the Genetic Evaluation of Rice
IRRI: International Rice Research Institute
ITPGRFA: International Treaty on Plant Genetic Resources for Food and Agriculture
MDGs: Millennium Development Goals
NARS: National Agricultural Research Systems
NBPGR: National Bureau of Plant Genetic Resources
NIAS: National Institute of Agrobiological Sciences
NTFPs: Non-Timber Forest Products
PAPGREN: Pacific Plant Genetic Resources Network
PGR: Plant Genetic Resources
PGRFA: Plant Genetic Resources for Food and Agriculture
PRA: Pest Risk Analysis
RDA: Rural Development Administration
RECSEA: Regional Cooperation for Plant Genetic Resources in Southeast Asia
SANPGR: South Asia Network on Plant Genetic Resources
SINGER: System-wide Information Network for Genetic Resources
SMTA: Standard Material Transfer Agreement
TK: Traditional Knowledge

Areas of Regional Collaboration

1. **Developing national agrobiodiversity plans and integrating them into regional and global collaborative frameworks:**
   The development of national plans and integrating them into regional collaborative frameworks are important to enhance both food security and sustainable agricultural development. In the absence of such national agrobiodiversity plans and regional collaborative frameworks, it is difficult to advocate the importance of agrobiodiversity to the policy makers and other stakeholders. This will require assessment of national and regional priorities for agrobiodiversity in view of the emerging challenges. To achieve this, the facilitation role of regional fora such as APAARI, CGIAR centres, FAO, etc. is necessary and must be promoted.

2. **Increasing R&D collaboration on agrobiodiversity conservation and use in the region:**
   Agrobiodiversity cuts across national boundaries and there are many common issues and concerns that need multi-country partnerships and sharing of experiences. Collaboration and support are very much needed in collecting, understanding and maintaining endangered crop, livestock and fisheries genetic resources. More R&D collaboration for underutilized crops in the region such as: small millets (finger millet, kodo millet, barnyard millet, foxtail millet, and little millet), minor but locally important legumes (black gram, rice bean, lablab bean, horsegram, etc.), cultivated minor and wild tropical fruits, and indigenous vegetables will ensure needed progress in improving these crops through plant breeding efforts.

3. **Increased sharing of information and data on genebank collections:**
   To further improve access and sharing of genetic resources in the region, the sharing of information on national genebank collections is a prerequisite. This could be on the model similar to that of CGIAR's SINGER or the European countries' EURISCO where data and information from different genebanks are available from a common searchable database. These databases are needed to accelerate the access to the collections held by the different genebanks. The national and international centers must ensure sharing of information being critical for enhanced use of genetic resources (i.e. GENESYS) following an open source system. The sustained use and maintenance of the GPA-NISM in many Asia-Pacific countries that have this database and its development in other countries should also be supported. The GPA-NISM provides the big picture of PGRFA in different countries beyond the genebanks.

4. **Strengthening agrobiodiversity capacity, education and public awareness:**
   Capacity development needs to be addressed at the individual, systemic and institutional levels. Continuing capacity development in national systems is needed since often well-trained staff are either promoted or transferred. This can be in the form of short-term as well as formal degree courses. The capacity of indigenous and local communities to assess, inventorize and monitor genetic resources and related TK will also have to be developed. At the institutional level, emphasis is needed for the administrative framework; funding and resource management; mechanisms for follow-up, monitoring and assessment; in addition to strengthening policy analysis and capacity. Public awareness and education on agrobiodiversity should start at an early age with focus on the basic appreciation of genetic resources from their own locations, knowing their value for food, nutrition, health and to humanity. Other points to consider are as follows:
   - Several universities in the region currently provide degree courses in plant and animal genetic resources but suffer from low enrolment. There is a need to make the curriculum more innovative and interesting (agrobiodiversity in food, nutrition, health and humanity) to young people and also make it relevant to supporting the extension workers. There is also a need to increase awareness and support through scholarship programs to these genetic resources related degrees and courses.
   - The more advanced organizations in the region are currently offering short-term courses on PGR and AnGR management (e.g. RDA, South Korea; Japan NIAS Genebank, Japan; NBPGR, India; CAAS, China) to enhance the capacity of different genebanks in the region. Such courses should be expanded and be made more specialized to cover new tools (e.g. DNA fingerprinting, information technology), approaches (complementary and integrated approach) and strategies. Specific courses that will improve the access of researcher to donors and grant information including better skills to grant writing and producing effective publications are also needed.
   - There is a need to lay greater emphasis on public awareness on agrobiodiversity targeting policy makers and consumers, especially in the context of importance of conservation. The importance of underutilized tropical fruit species, crops, vegetables, forages and medicinal plants for food security, nutrition and income generation also needs to be emphasized. The participation of rural communities, the private sector and CSOs in conservation can help in ensuring financial support for national genebanks.
   - There is also an urgent need for policy advocacy on agrobiodiversity for the officials involved in developing national policies and international treaties and conventions such as ITPGRFA and CBD.

5. Enhancing exchange and use of genetic resources:

- Through available options for the multilateral system for PGR exchange using SMTA, especially in those countries that have signed ITPGRFA.
- Empowering the farmers' organizations to participate in decision making related to implementation of farmers' rights as stipulated in the ITPGRFA.
- Enhanced cooperation on plant quarantine issues, including pest risk analysis (PRA) for safe movement and exchange of germplasm.
- Promoting the implementation of the GPA through specific actions at the national and regional levels through policy advocacy, strengthened R&D programmes and the use of NISM-GPA.
- More active facilitating role of APAARI on communications between the Treaty Secretariat and the NARS, and between NARS and policy makers.

6. Role of stakeholders in strengthening agrobiodiversity conservation and use:

In view of limited funding resources in the region, enhanced collaboration between international and regional agencies, CSOs, the private sector, and regional networks will help in promoting genetic resource conservation and use.

- The proposed emphasis on research relating to genetic resources in the different Consortium Research Programmes should ensure better integration with national plans and regional and global strategies/collaborative frameworks.
- The sub-regional networks on genetic resources will have better sustainability if linked with regional/global organizations such as APAARI, GFAR and FAO with adequate financial support and active facilitation roles of CGIAR centres.
- Regional PGR and crop networks should emphasize on strengthening partnerships for the exchange of genetic resources that benefit users and germplasm providers directly (including wild relatives, neglected and underutilized crops, forest trees and NTFPs).
- Pursue partnership with CSOs and the private sector for more effective public awareness, education and advocacy. Civil society and the private sector can contribute to the development of a more holistic perspective to support agrobiodiversity initiatives in the region. The private sector can also help in generating additional resources, keeping in view corporate social responsibility.

Conclusions

The vast agrobiodiversity in the Asia-Pacific region is a valuable resource to achieve the MDGs, especially food and nutrition security and agricultural sustainability. These resources are to be used and conserved to ensure productivity and quality, adaptation to climate change and sustainable agriculture development. Effective conservation and utilization of this capital would obviously require increased focus and investment both at the national and regional levels, through greater involvement of all stakeholders. Also there is need for greater public awareness and policy advocacy for enhanced support for AR4D efforts in the region. International and regional agencies, CSOs, private sector, and regional networks have a crucial role to play in strengthening agrobiodiversity conservation and use in the Asia-Pacific. Enhanced collaboration between national and international research institutions and civil society would help in the holistic understanding and importance of agrobiodiversity. The following actions will ensure optimal participation of different stakeholders and the building of new partnership opportunities:

- Benefitting from the new tools and technologies through new alliances among scientists working on plant and animal breeding, molecular biology, bioinformatics and biometrics that integrates genetic resources, genomics and genetic improvement programmes.
- Laying focus on genetic resources in different CGIAR research programmes should be analysed for better integration into national plans and regional and global collaborative frameworks, to avoid gaps and overlaps.
- Enhance regional and crop improvement programmes and PGR networks to ensure capacity development and improved exchange of materials and their use in the Asia-Pacific region. Such networks must be facilitated by the CGIAR centres to identify regional priorities and implement region- wide PGR-related activities. Network activities should also focus more on underutilized crops of the region. The different sub-regional networks will also be more sustainable if linked with regional or global initiatives, such as those of APAARI and GFAR.
- Strengthening partnerships with CSOs and the private sector to contribute more effectively towards public awareness, education and policy advocacy. CSOs and the private sectors can contribute significantly towards development of a more holistic perspective to support agrobiodiversity related initiatives in the region. Private sector can also help in this especially for resource mobilization and use of new tools and innovations in exploiting genetic resources.

Finally, there is a need to form new partnerships involving farmers and other stakeholders who ultimately guard the agrobiodiversity and its associated knowledge. Active collaboration with them will ensure recognition of farmers' needs and concerns, optimal planning and monitoring of activities, participation in plant and animal breeding activities, adoption of innovations, documentation and use of TK, and usefulness of research for the poor. All above initiatives will contribute to the holistic understanding of agrobiodiversity conservation and use for the settlement of humankind.

Acknowledgements

The APAARI Executive Committee endorses the Suwon Framework on Agrobiodiversity that was adopted by the participants of International Symposium on Sustainable Agricultural Development and Use of Agrobiodiversity in the Asia-Pacific Region held from 13-15 October 2010 in Suwon, Republic of Korea.

We thank all the participants of the symposium for adopting this framework in order to have a Road Map for a more effective management of agrobiodiversity for sustainable agriculture in the Asia Pacific region. We acknowledge all the member country representatives and NGO/CSO representatives for ensuring that the framework embodies not only their concerns but also the collective vision. We thank the symposium speakers, resources persons and experts for their contribution in the formulation of this framework.

We also acknowledge the support of our host-the Rural Development Administration (RDA), co-organizers – Bioversity International and Global Forum for Agriculture Research (GFAR), and the co-sponsors, namely, International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), International Rice Research Institute (IRRI), International Wheat and Maize Improvement Center (CIMMYT), International Center for Agricultural Research in Dry Areas (ICARDA), International Livestock Research Institute (ILRI), Food and Agriculture Organization of the United Nations (FAO), and AVRDC-The World Vegetable Center.

We also appreciate the excellent technical input provided by the working group consisting of Drs. Raj Paroda, Leocadio Sebastian and Prem Mathur for meticulously planning and guiding the process while ensuring that all the inputs of the participants were duly considered.

It is our expectation that this Framework will catalyze all the stakeholders in Asia-Pacific region to accelerate activities relating to conservation through use of valuable genetic resources.

APAARI Executive Committee

Technical Programme

Day 1: Wednesday, 13 October 2010

09.30 - 10.00			Registration of Participants
10.00 - 11.15			Inaugural Session
	Welcome Address	-	Abd Shukor bin Rahman (APAARI)
	Welcome Address	-	Seung-Kyu Min (RDA)
	About the Symposium	-	Raj Paroda (APAARI)
	Opening Speech	-	William Dar (ICRISAT)
	Keynote Lecture	-	Emile Frison (Bioversity International), Presented by Kwesi Atta-Krah
	Vote of thanks	-	Leocadio Sebastian (Bioversity-APO)
11.15 - 11.40	Group photo and Tea/Coffee break		
11.40 - 13.00	Technical Session I: Global and Regional Initiatives		
	Chair:		S. Ayyapan
	Co-chair:		Shui-Ho Cheng
	Rapporteur:		Ehsan Dulloo
	Role of networks in strengthening collaboration on conservation and use in Asia-Pacific		Leocadio Sebastian
	The global strategy for the *ex situ* conservation of rice genetic resources		Fiona R. Hay
	Conservation and use of agrobiodiversity in the SAT region		C.L. Laxmipathi Gowda
	ICARDA's efforts to promote *ex situ* and *in situ* conservation and sustainable use of dryland agrobiodiversity		Ashutosh Sarker
13.00 - 15.20	Lunch break		
	Monitoring maize and wheat genetic resources		Bonnie J. Furman
	Farm animal genetic resources-An overview of current knowledge on the molecular diversity		Han Jianlin
	Conservation and use of vegetable germplasm at AVRDC-The World Vegetable Center		Andreas Wilhelm Ebert
	Beyond conservation: Enriching diets and enhancing incomes with the genetic diversity of vegetables		Jacqueline d'Arros Hughes
15.20 - 15.40	General discussion		
15.40 - 16.00	Tea/Coffee break		
16.00 - 16.40	Technical Session II: Status of Global Plan of Action and the Treaty		

	Chair:	**Nicomedes P. Eleazar**
	Co-chair:	**Somchai Charnnarongkul**
	Rapporteur:	**Zongwen Zhang**

NISM-GPA-National Information Sharing Mechanism for the Global Plan of Action: A mechanism for monitoring progress in global PGRFA activities **Duncan Vaughan**

Global status of the Treaty implementation, regional cooperation, information gaps and capacity building **Lim Eng Siang**

16.40 - 17.00 General discussion

18.30 - 20.30 Dinner hosted by RDA

Day 2: Thursday, 14 October 2010

8.30 - 11.50 **Technical Session III: Agrobiodiversity Conservation for Use: Country Status Reports**

Chair:		**William Dar**
Co-chair:		**Thierry Mennesson**
Rapporteur:		**Paul Quek**
Australia	-	**Simon Hearn**
China	-	**Wang Shumin**
India	-	**D.C. Bhandari**
Republic of Korea	-	**Chung-Kon Kim**
Malaysia	-	**Mohd Yusoff Abdullah**

10.10 - 10.30 Tea/Coffee break

Pacific Sub-region	-	**Mary Taylor**
The Philippines	-	**Patricio Faylon**
Sri Lanka	-	**P.W. Ratnasiri**
Asia-Pacific region	-	**S.K. Sing**

11.50 - 12.10 General discussion

12.10 - 13.00 Lunch break

13.00 - 15.00 **Technical Session IV: Recent Advances for Managing**

Agrobiodiversity

Chair:	**Masami Yasunaka**
Co-chair:	**Bhartendu Mishra**
Rapporteur:	**Mary Taylor**

Trends, advances and research needs in *ex situ* and *in situ* conservation of agricultural biodiversity **Ehsan Dulloo**

Crop biodiversity and ecosystem resilience: Adaptive capacity within the agricultural production system **Devra Jarvis**

Climate change, agriculture and food security in Asia **Kwesi Atta-Krah**

Gene mining and other effective strategies in using plant genetic resources **Ruaraidh Sackville Hamilton**

	Germplasm enhancement and development of crop breeding materials **Yoshinobu Egawa**
	Exploring agrobiodiversity through the integration of ITC, GIS and other technologies **Michael C. Mackay**
15.00 - 15.20	**General discussion**
15.20 - 15.40	**Tea/Coffee break**
15.40 - 17.25	**Technical Session V: Promoting Agrobiodiversity in the Asia-Pacific Region**
	Chair: **Abd Shukor bin Rahman**
	Co-chair: **Ajit Maru**
	Rapporteur: **C.L.L. Gowda**
	Role of NGOs in the conservation and use of agrobiodiversity through sustainable agriculture **Fr. Francis Lucas**
	Contribution to sustainable agriculture and food systems through the enhanced use of underutilized species: The role of crops of the future, a new international organization **Michael Hermann**
	Understanding traditional knowledge in managing and enhancing agrobiodiversit **Paul Quek**
	Collective action for pro-poor specialty crops, species and products **Ralf Kwaschik**
	Crop simulation modeling: A catalyst for research collaboration **Sayed Azam Ali**
	Interface between the UPOV convention and other international treaties **Keun Jin Choi**
17.25 - 18:00	**General discussion**

Day 3: Friday, 15 October 2010

08.30 - 10.30	**Working group discussions**
	Working Group I : Areas of R&D collaboration on agrobiodiversity conservation and use for sustainable agricultural development **Chair: Raghunath Ghodake**
	Convenor: Sayed Azam-Ali
	Working Group II : Strengthening agrobiodiversity capacity, education and public awareness in the Asia-Pacific **Chair: Fr. Francis Lucas**
	Convenor: Michael Herman
	Working Group III : Enhancing exchange and use of genetic resources in the Asia-Pacific **Chair: Patricio S. Faylon**
	Convenor: Ruaraidh Sackville Hamilton
	Working Group IV : Role of international and regional organization and networks in strengthening agrobiodiversity conservation and use in Asia-Pacific **Chair: Ajit Maru**
	Convenor: Prem Mathur

10.30 - 11.00	**Tea/Coffee break**	
11.00 - 12.30	**Plenary Session: Presentation of Working Group Reports and Finalization of Recommendations**	
	Chair: **Raj Paroda**	
	Co-Chair: **Kwesi Atta-Krah**	
	Rapporteur: **Prem Mathur**	
	Presentation of report of Working Group I	**Sayed Azam-Ali**
	Presentation of report of Working Group II	**Michael Herman**
	Presentation of report of Working Group III	**Ruaraidh Sackville Hamilton**
	Presentation of report of Working Group IV	**Prem Mathur**
12.30 - 13.00	**Closing**	
13.00 - 14.00	**Lunch break**	
14.00 - 18.00	**Tour of RDA institutions, including the Genebank**	

List of Participants

Dr. Simon Hearn
Senior Adviser, Australian Centre for International Agricultural Research (ACIAR), PO Box 1571, Canberra ACT 2601,
Australia

Dr. Wais Kabir
Executive Chairman, Bangladesh Agricultural Research Council (BARC), New Airport Road, Tejgaon, Dhaka1215,
Bangladesh

Dr. Md. Rafiqul Islam Mondal
Director, SAARC Agriculture Centre (SAC), BARC Complex, Farm Gate, New Airport Road, Dhaka 1215,
Bangladesh

Dr. Tashi Samdup
Director, Council for RNR Research of Bhutan (CoRRB), Ministry of Agriculture and Forests, PB No. 119, Thimpu,
Bhutan

Dr. Ouk Makara
Director, Cambodian Agricultural Research and Development Institute, National Road No 3, Prateah Lang Commune, Dangkor District, Phnom Penh,
Kingdom of Cambodia

Dr. Shumin Wang
Deputy Director General, Institute of Crop Science, Chinese Academy of Agricultural Sciences, 12 Zhongguancun Nandajie, Beijing 100081,
China

Dr. Shui-Ho Cheng
Director, Taoyuan District Agricultural Research and Extension Station, Council of Agriculture, Executive Yuan, Nanhai Road,
Chinese Taipei 100

Ms. Ko Kathy Yi-Chia
Officer of the Department of International Organizations, Ministry of Foreign Affairs, Council of Agriculture, Executive Yuan, Nanhai Road,
Chinese Taipei 100

Mr. William Wigmore
Director of Research, Ministry of Agriculture, P.O. Box 96, Rarotonga,
Cook Islands

Dr. Jai Gawander
Chief Executive Officer Sugar Research Institute of Fiji, P.O.Box 3560, Lautuka,
Fiji

Mr. Mason Smith
Permanent Secretary for Agriculture, Department of Agriculture, Ministry of Primary Industries, Robinson Complex, Raiwaqa,
Fiji

Dr. S. Ayyappan
Director General, Indian Council of Agricultural Research (ICAR), Krishi Bhawan, New Delhi-110 001,
India

Dr. D.C. Bhandari
Director, NBPGR, Pusa Campus, New Delhi 110012,
India

Dr. Narsingh Narayan Singh
Vice Chancellor, Birsa Agricultural University, Kanke, Ranchi, Jharkhand - 834006,
India

Dr. R.P. Singh
Secretary General, Indian Agricultural Universities Association (IAUA), IG-2, CGIAR Block, NASC Complex, DPS Marg, New Delhi-110012,
India

Dr. S.K. Singh
Principal Scientist (AG&B),
Central Institute for Research on Goats.
(ICAR) Makhdoom, Farah,
Mathura 281122,
India

Mr. P. Narayanan Unny
Navara Eco Farm,
Karukamani Kalam, Chittur College
PO, Palakkad 678104, Kerala,
India

Dr. Sudiaty Silitonga
CABIOGRAD and Member,
RECSEA-PGR, Jalan Tentara Pelajar 3A,
Bogor 16111,
Indonesia

Dr. Mostafa Aghaei
Director General, Seed and Plant
Improvement Research Institute(SPII),
Agricultural Research, Education and
Extension Organization (AREEO),
Yemen Ave., Chamran Highway,
PO Box 19395-1113, Tehran,
Iran

Dr. Jahangir Pourhemmat
Deputy Minister and Head, Agricultural
Research, Education and Extension
Organization (AREEO), Yemen Ave.,
Chamran Highway,
PO Box 19395-1113, Tehran,
Iran

Dr. Yoshinobu Egawa
Directer of Tropical Agricultural Research
Front, Japan International Research
Centre for Agricultural Sciences
(JIRCAS), Ministry of Agriculture Forestry
& Fisheries, 1-1 Ohwashi, Tsukuba,
Ibasraki 305 8686,
Japan

Dr. Masami Yasunaka
Vice President, Japan International
Research Centre for Agricultural
Sciences (JIRCAS), Ministry of
Agriculture Forestry & Fisheries, 1-1
Ohwashi, Tsukuba,
Ibasraki 305 8686,
Japan

Dr. Hyung-Jin Baek
Senior Researcher, National
Agrobiodiversity Center
National Academy of Agricultural Science
Rural Development Administration (RDA)
88-20 Seodun-dong, Gwonseon-gu,
Suwon 441-853,
Republic of Korea

Dr. Chung-Kon Kim
Director, National Agrobiodiversity Center,
National Academy of Agricultural Science,
Rural Development Administration (RDA),
88-20 Seodundong Kweonseonku,
Suwon 441-853,
Republic of Korea

Dr. Ji-Hyuk Kim
Researcher, International Technical
Cooperation Center
Rural Development Administration (RDA)
150 Suinro, Gwonseon-gu,
Suwon 441-707,
Republic of Korea

Dr. Kang-Su Kwak
Researcher, International Technical
Cooperation Center
Rural Development Administration (RDA)
150 Suinro, Gwonseon-gu,
Suwon 441-707,
Republic of Korea

Dr. Seung-Kyu Min
Administrator
Rural Development Administration (RDA)
150 Suinro, Gwonseon-gu,
Suwon 441-707,
Republic of Korea

Dr. Hong-Kil Moon
Director, International Technical
Cooperation Center
Rural Development Administration (RDA)
150 Suinro, Gwonseon-gu,
Suwon 441-707,
Republic of Korea

Dr. Seung-Yeol Na
Director General, Technology Cooperation
Bureau, Rural Development Administration
(RDA), 150 Suinro, Gwonseon-gu,
Suwon 441-707,
Republic of Korea

Dr. Gihwan Yi
Senior Researcher, International Technical Cooperation Center
Rural Development Administration (RDA)
150 Suinro, Gwonseon-gu,
Suwon 441-707,
Republic of Korea

Dr. Bounthong Bouahom
Director General, National Agriculture and Forestry Research Institute,
Ministry of Agriculture and Forestry,
Nongviengkham, Xaythany District,
Vientiane,
Lao PDR

Dr. Mohd. Yusoff bin Abdullah
Director, Strategic Resource Research Centre, Malaysian Agricultural Research and Development Institute (MARDI),
P.O.Box No. 12301,
Kuala Lumpur 50774,
Malaysia

Dr. Abd Shukor bin Rahman
Director-General, Malaysian Agricultural Research and Development Institute (MARDI), P.O.Box No. 12301,
Kuala Lumpur 50774,
Malaysia

Dr. Myint Thein
President, Myanmar Academy of Agriculture, Forestry, Livestock and Fishery Sciences, Ministry of Agriculture and Irrigation, No. 40,
Kaba Aye Pagoda Road,
Bahan Township, Yangon,
Myanmar

Dr. Bhartendu Mishra
Executive Director, Nepal Agricultural Research Council (NARC),
Singha durbar Plaza, P.O.Box 5459,
Kathmandu,
Nepal

Mr. Netra Timsina
President, NGO Federation of Nepal,
P.O.Box 7768, New Baneshwor,
Buddhanagar, Kathmandu,
Nepal

Mr. Thierry Mennesson
Director General, Institut Agronomique Neo-Caledonien, Centre de Cooperation, Internationale en Recherche Agronomique Pour le developpement,
B.P. 35 Paita Nouvelle- Caledonie,
New Caledonia

Dr. Dilip Nandwani
Program Leader, Cooperative Research, Extension and Education Service (CREES), Northern Marianas College,
PO Box 501250, Saipan MP 96950,
Northern Mariana Islands

Dr. Ghulam Muhammad Ali
Chief Scientific Officer
Institute of Agri_Biotechnology and Genetic Resource (IABGR),
National Agriculture Research Centre (NARC)
Park Road, Islamabad 44000,
Pakistan

Mr. Thomas Solepa Arginasafa
C/o Mr. Jeffrey Waki, NARI, Momase Regional Centre, Bubia, PO Box 1639,
Lae 411, Morobe,
Papua New Guinea

Dr. R.D. Ghodake
Director General, National Agricultural Research Institute (NARI), 2nd Floor
Vele Rumana, Box 4415 Lae Morobe,
Province 411,
Papua New Guinea

Dr. Abdul Halim
Professor and Head, University of Technology, Department of Agriculture,
PMB, Lae 411, Morobe Province,
Papua New Guinea

Dr. Nicomedes P. Eleazar
Director, Bureau of Agricultural Research (BAR), Department of Agriculture,
3rd Floor, ATI Building,
Elliptical Road, Diliman,
Quezon City,
Philippines

Dr. Patricio S. Faylon
Executive Director, Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD), Los Banos, Laguna 4030,
Philippines

Mr. Anthony Obligado
Bureau of Agricultural Research,
RDMIC Bldg., Elliptical Rd.,
cor. Visayas Ave., Diliman,
Quezon City 1104,
Philippines

Ms. Emele Meleisea-Ainuu
Acting ACEO, Crops Division,
Ministry of Agriculture,
Forests, Fisheries and Meteorology
(MAFFM), 3rd Floor, ACB Building,
P.O. Box 1875, Apia,
Samoa

Mr. Prabath Wimal Kumara
Executive Director, Sri Lanka Council
for Agricultural Research Policy (CARP),
114/9, Wijerama Mawatha,
Colombo 07,
Sri Lanka

Mr. P.W. Ratnasiri
Deputy Director, Plant Genetic
Resources Center, Peradeniya,
Sri Lanka

Mr. Somchai Charnnarongkul
Director General, Department of
Agriculture, Paholyothin Road,
Chatuchak, Bangkok 10900,
Thailand

Dr. Bui Chi Buu
Vietnam Academy of Agricultural
Sciences, Ministry of Agriculture and
Rural Development (MARD),
No. 2 Ngoc Ha Street,
Ba Dinh, Hanoi,
Vietnam

Regional Organizations and International Research Centers

Dr. Zongwen Zhang
Coordinator for Office for East Asia,
Bioversity International c/o CAAS, 12
Zhongguancun Nandajie,
Beijing 100081,
China

Dr. Andreas Ebert
Genebank Head, Asian Vegetable
Research and Development Centre
(AVRDC), P.O. Box 42, Shanhua,
Tainan 74199,
Chinese Taipei

Mr. Hiva Levi
Board Executive Member, Pacific Islands
Association of NGOs (PIANGO),
30, Ratu Sukuna Road,
PO Box 17780, Nases Suva,
Fiji

Dr. Mary Taylor
Genetic Resources Coordinator,
Secretariat of the Pacific Community (SPC),
Private Mail Bag, Suva,
Fiji

Dr. Hannah Jaenicke
Consultant in Project Management and
Evaluation: Agrobiodiversity, Marketing
and Rural Development, ICUC, Burghof 26,
53501 Grafschaft-Gelsdorf,
Germany

Dr. Raj Paroda
Executive Secretary, APAARI,
C/o TAAS, Avenue II, IARI Campus,
New Delhi 110012,
India

Dr. Prem N. Mathur
Coordinator, South Asia Office,
Bioversity International, NASC Complex,
DPS Marg, New Delhi 110012,
India

Dr. Ashutosh Sarker
Coordinator
International Centre for Agricultural
Research in the Dry Areas (ICARDA) –
South Asia Office
NASC Complex, DPS Marg,
New Delhi 110012,
India

Dr. William D. Dar
Director General, International Crops
Research Institute for the Semi-Arid Tropics
(ICRISAT), Patancheru 502 324,
Andhra Pradesh,
India

Dr. C.L.L. Gowda
Global Theme Leader - Crop Improvement,
International Crops Research
Institute for the Semi-Arid Tropics (ICRISAT),
Patancheru 502 324,
Andhra Pradesh,
India

Dr. Ralf Kwaschik
Coordinator, Global NTFP Partnership
International Network for Bamboo and
Rattan (INBAR), South Asia Regional Office,
41, Second Floor Zamrudpur Community
Centre Kailash Colony Extn.
New Delhi 110 048,
India

Dr. Ajit Maru
Senior Knowledge Officer, GFAR, FAO
Headquarters, Viale delle Terme di
Caracalla, 00100, Rome,
Italy

Dr. Ehsan Dulloo
Project Coordinator,
Ex situ Conservation and Use,
Bioversity International,
Via dei Tre Denari, 472/a 00057
Maccarese, Rome,
Italy

Dr. Kwesi Atta-Krah
Deputy Director General, Bioversity
International, Via dei Tre Denari,
472/a 00057 Maccarese,
Rome,
Italy

Dr. Michael Mackay
Senior Scientist and Coordinator,
Biod. Inf. Proj., Bioversity International,
Via dei Tre Denari, 472/a 00057
Maccarese, Rome,
Italy

Dr. Ibrahim Hamdan
Executive Secretary,
AARINENA, P.O.Box 950764,
Amman 11195,
Jordan

Dr. Han Jianlin
International Livestock Research Institute
(ILRI), P.O. Box – 30709, Nairobi,
Kenya

Ms. Dorothy Chandrabalan
Scientific Assistant,
Bioversity International,
Regional Office for Asia,
Pacific and Oceania, Serdang,
Selangor,
Malaysia

Dr. Michael Hermann
Global Coordinator, Crops for the
Future, c/o Bioversity International,
Office for the Asia, Pacific and
Oceania, Serdang, Selangor,
Malaysia

Dr. Paul Quek
Scientist, Documentation/
Information, Bioversity International,
Regional Office for Asia,
Pacific and Oceania,
Serdang, Selangor,
Malaysia

Mr. Lim Eng Siang
Honorary Fellow, PU,
Bioversity International,
Regional Office for Asia,
Pacific and Oceania,
Serdang, Selangor,
Malaysia

Dr. Leocadio Sebastian
Regional Director,
Bioversity International,
Regional Office for Asia,
Pacific and Oceania
Serdang, Selangor,
Malaysia

Dr. Sayed Azam-Ali
Vice President (Research),
University of Nottingham,
Malaysia Campus. 43500
Semenyih, Selangor Darul Ehsan,
Malaysia

Dr. Bonnie J. Furman
Maize Curator, CIMMYT,
Lisboa-27, Apartado,
Postal 6-641 06600,
Mexico

Fr. Antonio Francisco B. Lucas
Chairman, ANGOC, 73-K Dr.
Lazcano Street, Barangay Laging
Handa, Quezon City, 1103,
Philippines

Mr. Raul Montemayor
International Federation of
Agricultural Producers (IFAP),
41 Highland Drive, Blue Ridge,
Quezon City 1109,
Philippines

Dr. Achim Dobermann
Deputy Director General (Res),
International Rice Research Institute
(IRRI), Box 933,
1099 Manila,
Philippines

Dr. Ruaraidh Sackville Hamilton
Head, Genetic Resource Center,
International Rice Research Institute
(IRRI), Box 933,
1099 Manila,
Philippines

Dr. Fiona Hay
Scientist, Genetics Resource Expert,
International Rice Research Institute
(IRRI),
Box 933, 1099 Manila,
Philippines

Dr. Hukmatullo Ahmadov
Chairman, CACAARI and President,
Tajik Academy of Agricultural Sciences
(TAAS), 44, Rudaki Ave.,
734025 Dushanbe,
Tajikistan

Mr. P.K. Saha
Liaison Officer, APAARI,
FAO-RAP, Maliwan Mansion,
39 Phra Atit Road,
Bangkok 10200,
Thailand

Dr. Attaluri Srinivasacharyulu
Coordinator- APARIS, APAARI,
FAO-RAP, Maliwan Mansion,
39 Phra Atit Road,
Bangkok 10200,
Thailand

Ms. Rujirek Urairat
APAARI, FAO-RAP,
Maliwan Mansion,
39 Phra Atit Road,
Bangkok 10200,
Thailand

Dr. Duncan Vaughan
FAO-RAP, Maliwan Mansion,
39 Phra Atit Road,
Bangkok 10200,
Thailand