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Enhancing the *in situ* management of agricultural biodiversity

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CRP 1.1 Dryland Systems Proposal Sub-Component on Agrobiodiversity

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CRP on Dryland Systems

Enhancing the *in situ* management of agricultural biodiversity

A proposal for Strategic Research Theme 5 of CRP 1.1

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Introduction

The sustained conservation, management and use of agricultural biodiversity (see Box below) is critical to realizing the vision of the CGIAR Consortium. Improving conservation and increasing the availability of agricultural biodiversity will become more and more important, not only in the pursuit of improved crop performance, but also in the context of adaptation to climate change, greater resilience and improved nutrition, maintaining the socio-economic balance of farming communities and the rehabilitation of degraded ecosystems. The management and sustainable use of agricultural biodiversity is also important to sustain the livelihoods of poor communities who practice traditional farming systems and who live under harsh environments, which include biodiversity-rich areas. Many of these biodiversity-rich areas are within Vavilovian centres of diversity and contain unique material with great potential for adaptation to the effects of climate change.

Agricultural biodiversity, as a term, reflects the entire panoply of diversity that contributes directly and indirectly to food production, including livestock, pollinators, microbes etc. In this proposal we focus on the genetic diversity of farmer-maintained local livestock breeds, varieties or landraces of major crops (LR) and neglected and underutilized plant species (NUS) and their wild relatives (CWR), and the rangeland plant species so important to pastoralists and herders. Priority varieties, breeds and species will be selected with the full participation of all stakeholders, as detailed below. In this proposal, where appropriate we may refer to each of these classes separately, but more often we will refer to “target agrobiodiversity” to include selected priority plants and animal populations.

There are currently a number of activities in the portfolio of CRPs that are related to the conservation and availability of agricultural biodiversity, particularly with respect to *ex situ* conservation of commodity crops. However, the report of the Scoping Study on Genetic Resources commissioned by the Consortium Board recognized that these should be complemented by promoting *in situ* conservation and sustainable use and by working on cross-cutting issues of fundamental importance to global food security that are not addressed by the current portfolio of CRPs. The Consortium Board Chair requested that a component on agricultural biodiversity be developed to address three particular challenge areas identified by the Scoping Study: *in situ* conservation (including on-farm management of genetic diversity), knowledge and information about agricultural biodiversity, and policies to support conservation, availability and use of agrobiodiversity from local to global levels. This proposed Strategic Research Theme reflects the recommendations of the Scoping Study team and responds to the request from the Consortium Board Chair regarding these three interlinked areas (see section below on “Origin and positioning of the component in the CRP Portfolio” for details). It will promote *in situ* conservation, management and sustainable use of agricultural biodiversity to complement *ex situ* conservation efforts and to ensure the dynamic conservation of a broad genetic base in terms of both species richness and intraspecific genetic diversity. This is needed to enable adaptation to evolving biotic and abiotic challenges, to respond to nutritional requirements and to continue to provide various ecosystem services.

In addition to addressing the gaps in the CRP Portfolio identified by the Consortium Board, the proposed SRT also addresses areas of research that have been identified as priorities by GFAR (Global Forum on Agricultural Research) and would support and contribute to the implementation of regional agricultural biodiversity initiatives, such as the Agricultural Biodiversity Initiative for Africa (ABIA) coordinated by FARA, the Suwon Declaration on Agricultural Biodiversity coordinated by APAARI and the regional strategy for conservation and sustainable use of genetic resources in the Near East and North Africa region developed in collaboration with AARINENA. It will also contribute to implementing the regional and crop conservation strategies developed with support from the Global Crop Diversity Trust. The SRT additionally addresses the key research areas included in two binding agreements on biodiversity, the Convention on Biological Diversity (CBD, 1992) and the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA, 2004), and permits responses to the needs of the Global Plan of Action (GPA) and the State of the World on Genetic Resources for Food and Agriculture of the Commission on Genetic Resources for Food and Agriculture of the United Nations Agriculture of the Food and Agriculture Organization (CGRFA-FAO).

Although located administratively within CRP 1.1, which focuses on dryland ecosystems, this component is global in coverage and will work in collaboratively-identified priority ecosystems, not all of which will be in the dry lands.

Vision of Success

We envision a future in which the knowledge of how best to conserve and manage agricultural biodiversity on farm and *in-situ* is meshed with information about conserved material in a fully supportive policy environment to enable all interested parties, including farmers, breeders and other scientists, to make the fullest possible use of agricultural biodiversity to deliver the CGIAR System Level Outcomes of reducing rural poverty, improving food and nutrition security, and sustainable management of natural resources.

Justification

The CGIAR's Strategy and Results Framework recognizes the importance of agricultural biodiversity and many of the CRPs have included relevant research and conservation activities in their proposals to address the challenges agriculture faces. In many cases, the focus is on using existing agricultural biodiversity through breeding, as a source of traits for improved varieties and breeds that can deliver the productivity gains needed to cope with biotic and abiotic stress; such breeding is an historic forte of CGIAR research. Increasingly, however, breeding will require new traits sourced from a widening pool of genetic resources. Sustainability in agricultural production systems will also require more use of a wider range of agricultural biodiversity to contribute to system resilience and to reduce the need for economically and environmentally costly inputs. Ecosystem services, particularly regulating and supporting services, can be improved by increased use of agricultural biodiversity and will contribute to resilience and sustainability, and the genetic resources of local species will play a vital role in rehabilitating and restoring degraded ecosystems and farming systems. Additionally, and of direct relevance to rural farming communities, agricultural biodiversity can make vital contributions to nutrition security and continue to support the livelihoods of its custodians.

It is important to note that agricultural biodiversity, while it is an essential component of agricultural ecosystems, contributing to provisioning, regulating, supporting and cultural services, is also a product of these same agroecosystems. It is shaped by multiple anthropogenic and environmental processes.

In order to live up to its potential, agricultural biodiversity requires research to be carried out within five closely interwoven topics, each of which represents a series of outputs:

- Improved understanding of the status and trends of *in situ* conservation and diversity, especially on farm and for crop wild relatives, with a greater understanding of what is being conserved, where, how and why.[1]

- The development of *in situ* conservation approaches, tools and methodologies, including the demonstration of various options for promoting community-driven *in-situ* conservation.

- New approaches to facilitating the management, use and deployment of agricultural biodiversity conserved *in situ*.

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[1] The use of the term *in situ* is based on the definition in the Convention on Biological diversity (http://www.cbd.int/convention/articles/?a=cbd-02 accessed 21 November 2011). Thus:

> "In-situ conditions" means conditions where genetic resources exist within ecosystems and natural habitats, and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.
>
> "In-situ conservation" means the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

In this sense, "on farm" is equivalent to "*in situ*" and where we stress "on farm" is it in order to draw attention to the role of smallholder farmers in providing "the surroundings where they have developed their distinctive characteristics".

- Information about this material gathered and shared in ways that contribute to its management and use. Such research would complement the extensive work in *ex situ* conservation being done within commodity CRPs.
- A policy and legal environment that promotes and supports availability of agrobiodiversity to farmers and research and development organizations, linking users and conservers through practical mechanisms at local, national and international levels.

To ensure that results from these outputs drive forward sustainable improvements in conservation and use, it will also be necessary to improve the livelihoods of the main custodians of agricultural biodiversity, to engage in awareness-raising activities with specific audiences, and to help develop the capacities of national bodies, including their ability to devise sustainable and realistic policy strategies for the enhanced management of agricultural biodiversity.

A further important aspect of this SRT is that the activities in the research topics will to a large extent take place in the same geographical hotspots and will look largely at the same biological populations in each hotspot. These priority areas and priority varieties, breeds and species will be identified in close collaboration with national partners and other organizations, building on the experience of the centres, and will provide models for use in similar eco-systems and farming systems. It is anticipated that this deliberate overlap will strengthen the research outputs and add to both impact and global relevance.

Problem Statement

For the reasons given above, it is critically important to conserve agrobiodiversity, and to ensure its availability for use by researchers, breeders, farmers and pastoralists.

Unlike *ex situ* conservation, *in situ* conservation does not focus only on biological material. The interventions by which *in situ* conservation is achieved are all targeted at factors and processes that affect farmers' decision making concerning their use of agricultural biodiversity (e.g. policies, markets, consumer preferences, access to diversity, etc), the dynamics of genetic diversity (including farmers' seed and breed management and formal and informal seed and breeding systems), and the maintenance of CWR populations (land use, landscape fragmentation, protected areas, etc).The efficiency of these interventions depends on how they fit the values and practices of involved stakeholders. Research for *in situ* management and conservation has therefore to consider not only the genetic make-up of the target agricultural biodiversity, but also those additional factors and processes that shape its diversity within agroecosystems. Furthermore, the services provided by agrobiodiversity in many cases result from a combination of intraspecific and interspecific diversity.

Having this system-based approach in mind will permit the research to focus on the combination of an agreed set of agroecosystems selected to reflect various environmental and socio-economic conditions and changes, and an agreed set of priority varieties, breeds and species, selected on the basis of a variety of criteria for their importance within the agroecosystems. The target species will include: local breeds of livestock; landraces or farmer varieties of staple crops (LR); minor crops, which despite being labelled “neglected and underutilized species (NUS)” by many researchers are nevertheless very important locally; and their wild relatives (CWR). The SRT will furthermore work on designated rangeland plant communities of great importance to herders and pastoralists. All of these elements of agricultural biodiversity are threatened by over-exploitation, changes in land use, urbanization, accelerating rural emigration and in the longer term, by climate change (FAO, 2010b; FAO, 2011c). All also play multiple roles that contribute to the livelihoods of the poor and to the economies of developing countries ({Rege Anderson, 2003; Rege & Gibson, 2003). Despite their importance, however, they are currently under-represented in most conservation efforts. Furthermore, both because agricultural biodiversity is very frequently used in places other than where it occurs or is conserved and because lessons learned from specific crops in specific locations may have wider applicability, the problem of conservation and use assumes a global dimension and requires collaborative action.

Ex situ conservation and knowledge and information systems relevant and specific to commodity crops are included in other CRPs, and arrangements are being made to obtain the secure funding of *ex situ* collections. Working closely with other CGIAR centres and partners, this component specifically seeks to expand and improve on the knowledge and information systems related to *in situ* conservation, and to enable these to be linked to data from material conserved *ex situ*, in order to contribute to a more comprehensive global information system. The focus of SRT5 research in this area is on gathering and making use of information about the target agrobiodiversity conserved on farm and *in situ* in order to manage these natural resources more sustainably and ensure that the priority species are able to contribute to reducing rural poverty and improving food and nutrition security. The SRT also recognizes that the social contexts that surround *in situ* conservation are complex (Russell & Harshbarger, 2003; Knowler & Bradshaw, 2007; Quaye, Adofo, Madode, & Abizari, 2009) and that the development of effective policies must acknowledge and respond to social contexts, not least the crucial role of women in the management of agricultural biodiversity, in order for conservation goals to be fully met (Warriner & Moul, 1992; Louette, Charrier, & Berthaud, 1997; Badstue et al., 2006). The SRT5 proposal responds to concerns in these areas through research with a wide range of partners within and outside the CGIAR system.

The overarching objective of the SRT5 proposal, in addition to promoting enhanced management and on farm and *in situ* conservation of important agrobiodiversity within a supportive policy environment, is to ensure the enhanced flow of information and material in both directions, from farmers and natural environments to breeders and scientists and *vice versa*.

Lessons Learned

A number of broad generic lessons have been learned from the experience of the CGIAR and partners in research on agricultural biodiversity. Some of these lessons are given below:

The conservation of agricultural biodiversity as promoted by the CGIAR centres, the Global Crop Diversity Trust and other actors has tended to focus predominantly on *ex situ* genebank collections, with less attention paid to conservation on farm and *in situ* in natural habitats. Conservation *in situ* complements *ex situ* conservation in that it allows the continued evolution and, in the case of on farm conservation, selection of the diversity to adapt to changing environments (Vigouroux et al., 2011) and conserves a wider genetic base (Scarcelli et al., 2006). In the absence of continued evolution *in situ*, the so-called global system of conservation for use risks becoming static, without the built-in adaptability essential to respond to future challenges. Also, not all species, and especially not livestock and NUS, benefit from significant *ex situ* conservation efforts. The large number of those species and their importance suggests that *in situ* conservation approaches should be developed to target the agroecosystem level, in addition to the species level, and thus to encompass whole sets of domesticated and cultivated species and their wild relatives. For the farmers and communities whose efforts conserve the target agrobiodiversity, the management of these resources is an important element in their livelihoods and in their cultural identity and self-determination. Thus the sustainable management of agricultural biodiversity represents an important avenue for responding both to the challenges facing agriculture and to the needs of smallholder farmers.

Threats to existing agricultural biodiversity require the development of global tools and methodologies that will be widely applicable for assessing and monitoring levels of and threats to agricultural biodiversity, identifying priority areas for conservation and ensuring effective conservation. Although the Convention on Biological Diversity (CBD) recognizes genetic diversity as one of the fundamental levels of biodiversity, actions to protect agriculturally important genetic diversity *in situ* are limited, little is known about the global status of agricultural biodiversity and there is no established process for routine global-scale monitoring of genetic diversity over time (Dulloo, Hunter, & Borelli, 2010). Several efforts under the 2010 Biodiversity Indicators Partnership (http://www.twentyten.net) have been made to identify indicators useful to detect changes in species and ecosystem diversity, but there are only two initiatives that are explicitly working on developing indicators that deal with genetic variation for agricultural biodiversity. These include an indicator on *ex situ* crop collections (Thuillet et al., 2011) and the number of food production breeds of domestic animals, and both are still under development (Anon, 2007; Walpole et al., 2009). Indicators for on farm and *in situ* diversity are urgently needed (Brown 2008).

The only authoritative accounting of agricultural biodiversity status at the global level is represented by the First and Second reports on the *State of the World's Plant Genetic Resources for Food and Agriculture* and *The State of the World's Animal Genetic Resources for Food and Agriculture*, published by FAO (FAO, 1997; FAO, 2007, FAO, 2010b). The SoW reports are accompanied by a Global Plan of Action which now contains 18 priority areas. Indicators for monitoring progress in the implementation of the GPA have been developed with support from CGIAR centres and recently the Commission on Genetic Resources for Food and Agriculture (CGRFA) at its 13th Regular session called for a set of higher level indicators to be developed. The CGIAR is expected to provide leadership and do more in this critical area, especially in relation to the threat posed by climate change and the development of indicators.

With regard to information systems about agricultural biodiversity, there is an over-riding need to ensure that researchers of all kinds can find and interrogate data from disparate sources, including data derived from and concerning material conserved *in situ*. Ideally, this information can be used in conjunction with other sources, such as herbarium sheets and material conserved *ex situ*, to deliver more useful results. For example, geospatial information is essential to many kinds of data filtering. Such geospatial systems are being developed in other CRPs. The agroecosystem information system being developed in the "Information system for land, water and ecosystems" module of CRP5 represents a valuable source of geospatial data layers on which accession-level, variety-level and population-level information derived from material conserved *in situ* can be superimposed. CRP4 is collecting information about the nutritional qualities of local agricultural biodiversity. CRP7, too, is developing geospatial information systems, and this component will link closely with both of those CRPs and other partners. This component will gather and share information about target agricultural biodiversity, working closely with other CRPs to ensure that there is no duplication of effort and that the various sources and types of information can be brought together effectively.

Information systems to harvest and share data about agricultural biodiversity conserved *in situ* are also important to allow that information to be used in geographically distant locations, and for this to be effective the information, including traditional and indigenous knowledge, needs to be available and integrated with other sources of information. For example, a Bioversity project (Seeds for Needs) has worked with local communities and genebanks in two pilot countries (Ethiopia and Papua New Guinea) to identify suitable material conserved *ex situ* in local genebanks and to trial the selected material with communities in order to identify accessions that are pre-adapted for predicted future climates. The adoption and upscaling of research outcomes to other locations and ecosystems would deliver greater impact if information gathered from on-farm trials were to be easily integrated with other sources of information and if projects such as this had access to *in situ* information from other geographical localities.

Over the course of the past fifteen years, it has been increasingly difficult to access agrobiodiversity for use on farm and by formal sector research and development organizations. The combined high level of politicization of genetic resources issues, and low levels of certainty about the conditions under which they can be shared and used have contributed to a wide range of key actors being unwilling or unable to make agrobiodiversity available (Safrin, 2004). Farmers are unable to obtain adequate supplies of quality germplasm to make optimal use of agrobiodiversity on farm (Kuyek, 2002; Brush, 2007; Jarvis, Padoch, & Cooper, 2007); the CGIAR genebanks and breeders report unwillingness of some countries to allow joint collecting missions to introduce new diversity into the international collections they host (Halewood, López Noriega, & Louafi, In Press) and improved materials for inclusion in breeding programmes. While there have been a number efforts at the international levels to address this situation – most notably, the creation of the International Treaty on Plant Genetic Resources for Food and Agriculture – to date, the situation is not, overall, improving, and in some parts of the world, for some components of agrobiodiversity, it is getting worse. Very importantly, there is growing evidence that the Treaty's multilateral system is not actually functioning to support introduction of new diversity, from *in situ* conditions, into globally accessible *ex situ* collections, with the danger that those collections remain largely static (Halewood, López Noriega, & Louafi, In Press). There is a risk that *in situ* and *ex situ* conservation efforts will therefore continue to operate in isolation from one another. There is also very little experience of materials being sent from the genebanks directly to farmers, or farmers' organizations, although there are documented cases of using indigenous range species to help rehabilitate degraded rangelands (Peacock et al., 2003) and wild fruit tree species in afforestation efforts (Amri, pers. comm.).

Ironically, as more information about possible uses of agrobiodiversity is becoming available through genomics, proteomics, and international research consortia such as the Generation Challenge Programme (Glaszmann, Kilian, Upadhyaya, & Varshney, 2010; Varshney, Glaszmann, Leung, & Ribaut, 2010), the physical resources themselves are increasingly subject to restrictive controls. Divisions between agriculture and environment communities are among the factors contributing to this situation, with policies originally developed for the conservation and management of wild flora and fauna being foisted upon the agricultural sector (e.g., the access and benefit sharing policies under the Convention on Biological Diversity) (Singh, Fern, Harn, & Hui, 2009). In addition, there is a general lack of due attention to the conservation and use of agricultural biodiversity in many national biodiversity strategies and action plans under the Convention on Biological Diversity and the United Nations Framework on Climate Change.

Centres' Experience

Significant expertise exists in different CGIAR centres building on past and ongoing research.

ICARDA coordinated a UNDP-GEF funded project in Jordan, Lebanon, the Palestinian Authority and Syria on community-driven *in situ* conservation of landraces and wild relatives of cereals, legumes, Alliums, forages and dryland fruit trees, which allowed the development of a holistic approach to promote the conservation and sustainable use of dryland agrobiodiversity. Between 1999 and 2005 the project conducted monitoring and trend analysis the target crops and species in 75 monitoring areas in Jordan, Syria, Lebanon and Palestine (Amri et al., 2005). Surveys of farming systems were also conducted in 26 communities in 2000 and 2004 to analyze diversity in terms of farming systems, species and landraces, livelihoods strategies and value chains (Mazid, Shideed, & Amri, 2005). Results from these and additional ecogeographic surveys and other data could be incorporated into a database that has been developed by ICARDA, which would be improved further to enable researchers and policy makers to assess the trends of biodiversity and its threats and to define high-priority areas for the conservation of agricultural biodiversity, including systems for improving and monitoring conservation. This project introduced management plans for promoting *in situ* and on-farm conservation of agrobiodiversity, including low-cost technological packages, added-value technologies, alternatives sources of income, institutional arrangements and policy recommendations.

In the context of implementing the Global Plan of Action (GPA) for Animal Genetic Resources (FAO, 2007; Hoffmann & Schaal, 2010), FAO, through expert consultations that included ILRI, developed several guidelines ({FAO, FAO, 2009; FAO, 2010a; FAO, 2011a; FAO, 2011b) at regional, community and national levels. In this context, the results of ILRI's research on the genetic characterization of indigenous livestock (http://dagril.ilri.cgiar.org) has contributed to the identification of hotspots and mapped diversity to global livestock centres of domestication (Hanotte et al., 2000; Hanotte et al., 2002; Muigai, 2003; Ndumu et al., 2008; Gorbach et al., 2010; Kugonza, Nabasirye, Hanotte, Mpairwe, & Okeyo, 2011; Kugonza, Nabasirye, Mpairwe, Hanotte, & Okeyo, 2011).

Recently ILRI with partners has embarked on the development and application of methodologies for community-based and system-wide understanding of indigenous livestock diversity and options for their strategic and sustainable conservation and improvement (http://agtr.ilri.cgiar.org). ILRI is also developing mapping, characterization and assessment frameworks, databases, database management expertise, and analytical tools which will make an important contribution to SRT5 (www.progebe.net; www.fangrasia.org). ILRI's networks and capacity are also important in this context and include: the BecA-ILRI Hub (http://hub.africabiosciences.org), state-of-the-art laboratory facilities and platform for livestock and crop research and capacity building for the eastern and central African region hosted at ILRI.; and the joint ILRI-Chinese Academy of Agricultural Sciences molecular laboratory (http://agtr.ilri.cgiar.org) dedicated to molecular typing of animals and forages. These two facilities allow sharing of expertise and enable processing and genotyping of samples in a cost effective manner, besides providing unrivalled opportunities for capacity building for national partners (Ojango, Panandam, Bhuiyan, & Khan, 2010). ILRI has an extensive network of Advanced Research Institutions from Europe, Asia and the Americas, and not least, relevant national African institutions and individuals, to draw on in this particular research area.

CIP has a long track record of scientific research on *in-situ* conservation of sweetpotato in Asia and potato as well as minor roots and tubers in the Andes (Brush, Carney, & Huaman, 1981; Prain, G., 1993; Prain et al., 1995; de Haan, Núñez, Bonierbale, & Ghislain, 2010). CIP has been working closely with farming communities in the Peruvian Andes over the past 15 years to implement a dynamic conservation strategy for native potatoes by linking *ex situ* with on-farm conservation as a single comprehensive effort. The activities include research on farmer-driven conservation (de Haan, 2009), indigenous food systems (Burgos, Amoros, Morote, Stangoulis, & Bonierbale, 2007; Graham et al., 2007; Scurrah, Amoros, Burgos, Schafleitner, & Bonierbale, 2007), farmer seed systems (Thiele, 1999), indigenous knowledge (Prain, G., Schneider, & Widyastuti, 2000; de Haan, Bonierbale, Ghislain, Núñez, & Trujillo, 2007), support for biodiversity seed fairs (Scurrah, Fernandez-Baca, Ccanto, Nunez, & Zúñiga, 1999), publication of regional catalogues of *in-situ* collections (CIP-UPWARD, 2003), and the publication of methods and tools (CIP-UPWARD, 2003). The CIP genebank has also been active with the repatriation of virus-free native potato accessions collected 30-50 years ago to the original communities where the accessions were collected, the establishment of community genebanks, the implementation of clean seed production for annual crop production and dissemination to neighbouring communities, and commercialization of potato production and eco-tourism (Ordinola, Bernet, & Manrique, 2007). The community at San Jose de Aymara in Peru Central Highlands is so successful that each year they regenerate the "in trust" clean tuber collection for CIP (Huaman, 2002). Another success story is the Potato Park in Cusco region, where the six communities of the Park have voluntarily included some 600 accessions of their native potato varieties in the multilateral system of access and benefit sharing under the ITPGRFA, and in the process have deposited a safety duplicate set in the form of true seed at Svalbard in Norway. In November 2011 CIP's collaboration with the NGO Grupo Yanapai in the indigenous Chopcca communities of Huancavelica was recognized with a reward from the Peruvian Ministry of Environment.

These successes form the basis for extending the biological and social science research concerning *in situ* and on farm conservation and management, and linking it to *ex situ* conservation. CIP will include a network on long-term conservation sites where potato in the Andes co-exists with its 187 species of wild relatives; *in situ* conservation of these CWR with the farming communities is a target research topic. CIP also plans to extend this research approach into other root and tuber crops, such as sweet potato in the highlands of Papua New Guinea and Irian Jaya.

Bioversity, in collaboration with international (FAO, BGCI, IUCN and WCMC) and national partners (Armenia, Bolivia, Sri Lanka, Madagascar and Uzbekistan) has made considerable progress on *in situ* conservation of CWR in a UNEP/GEF-supported project (Hunter & Heywood, 2010). Aside from countries assessing more than 310 CWR species according to IUCN guidelines and Red List criteria, and Bolivia producing the first ever Red List of CWR (VMABCC-Bioversity, 2009), the project undertook what is one of the largest bodies of work on ecogeographic surveys of CWR and this has added substantially to the global knowledge base. The project offered potential solutions in relation to prioritization of species and areas, assessments of distributions, diversity and threat status, *in situ* management in protected areas, development of CWR national plans and strategies and raising awareness and understanding of the importance of CWR. The use of National Red Lists of cultivated plants and crop wild relatives is gaining ground as an important tool in the management of conservation efforts.

Starting in 1998 Bioversity International coordinated a global partnership involving 8 countries (Burkina Faso, Ethiopia, Hungary, Mexico, Morocco, Nepal, Peru, and Vietnam) and 27 crop species, aimed at measuring the amount and distribution of genetic diversity present in farmers' fields. This global on-farm project demonstrated that considerable crop genetic diversity is conserved on-farm and provided measures of crop diversity that offer a useful framework for the conservation of diversity on-farm and an appropriate basis for developing indicators of on-farm diversity (Jarvis et al., 2007; Jarvis et al., 2008).

These few *in situ* conservation projects have led the way to an important area of research, which will require multi-disciplinary inputs and the involvement of multiple stakeholders, including the empowerment of farmers, herders and women along the value-chain. The lessons learned can be shared and extended to other biodiversity-rich areas and to other species and the approaches developed can be further improved and tested in pilot areas within the different biodiversity-rich areas, mainly in the major centres of crop and livestock diversity.

The CGIAR centres have participated actively as observers in the international negotiations for and implementation of the International Treaty, the Nagoya Protocol to the CBD and the multi-year programme of work of the Commission on Genetic Resources for Food and Agriculture. The centres have made technical contributions highlighting the special nature of agrobiodiversity and the need to develop policies that support availability and use from farm to international levels (CGIAR & SGRP, 2009; Dedeurwaerdere, Iglesias, Weiland, & Halewood, 2009; Fujisaka, Williams, & Halewood, 2009; Beed et al., 2011). It is essential for the centres and national programmes to continue to fulfil their role.

Potential Impact Areas

While much of the outputs of this component will deliberately be of global relevance and significance, the on-the-ground monitoring of status and trends in agricultural biodiversity will be focused on specific, collaboratively identified priority geographical locations, such as the Vavilov centres of diversity. This is where we can expect most genetic diversity of interest to agriculture to exist and where it will be most important to monitor for long-term changes, especially across environments that differ in terms of pressures on agricultural biodiversity, as has been initiated by ICARDA in the Fertile Crescent and CIP in the Andes. Several of these target areas or hotspots will coincide with areas of work of CRP1.1, but as this component is global in coverage others will be outside the dryland ecosystems of that CRP and will be identified with the assistance of CRP1.2 and CRP1.3.

Theory of Change

While the potential benefits of agricultural biodiversity are many, failure to realise those benefits is often a reflection of difficulties in obtaining and using appropriate material. This may be the result of an inability to locate information about specific genetic resources within agricultural biodiversity; in some cases, the existence of the agricultural biodiversity itself may be threatened. Even when the required genetic resources are known and available, there may be difficulties in obtaining access due to institutional or geographic characteristics, or even preferences that reduce the ability or willingness of farmers, organizations, governments and other entities to manage and conserve. The global “system” covering the exchange of material and information may thus be considered to have seized up. We therefore anticipate that as the elements of *in situ* conservation and policies are addressed, they will contribute to the lubrication of the entire system, which will then begin to function more smoothly. As it does so the beneficial outcomes of making wider use of agricultural biodiversity will be recognised by smallholder farmers and by the scientific community and this will then feed back and further improve the functioning of the system as a whole.

Farmers and national systems will conserve more agricultural biodiversity *in situ*. Researchers, including scientists working with farmers, breeders and genebank managers, will make more characterisation and evaluation information from material conserved on farm and *in situ* available through enhanced information systems, and farmers will be empowered and become an integral part of this system, supplying information about the material they conserve and making use of information from others. Social scientists will help identify critical dimensions of the local and regional contexts that, if harnessed effectively, can catalyze conservation activities. Policy-makers will see the costs of conservation and sharing to be minimal compared to the potential benefits that would result from improvements in their own national systems. A virtuous circle will ensue, with the wider use of agricultural biodiversity helping agriculture to meet the challenges of population growth and climate change, to the ultimate benefit of poor smallholder farmers.

What's new

Until now, research activities across the CGIAR have focussed on questions related to the scientific basis of *in situ* conservation, discovering, documenting and describing the dynamics involved through biological and anthropological assessments. Furthermore, past research of the CGIAR centres related to *in situ* conservation and use has been scattered and poorly coordinated, lacking the requisite scale and coordination mechanisms to achieve appreciable impact beyond local project sites. The research proposed in SRT5 takes advantage of the tools and knowledge developed in the past to focus on management planning, with a conservation research agenda at its core.

This proposal breaks new ground by working on *in situ* conservation and management at a global level. As part of that effort, the proposal includes the following new activities and outputs:

- Monitoring systems will be established in different ecosystems worldwide, and will contribute new information on both the status and trends of *in situ* conservation.
- Contributions to the development of high level indicators to indicate the status of genetic diversity *in situ*.
- The capacity to provide synthesized information, drawing on research from globally distributed sites, on the state of agrobiodiversity *in situ.*
- Scaling up collective capacity to evaluate the contribution of protected areas to the conservation of crop wild relatives globally and identify opportunities for better management of CWR outside protected areas.

- Systematic characterization and evaluation of an agreed set of priority agrobiodiversity conserved on farm and *in situ*, including their wild relatives.

- Provision of key evidence towards a better understanding of adaptive ongoing evolution within *in-situ* conserved populations of target agrobiodiversity.

- A novel ecosystem-services approach to agricultural biodiversity that will strengthen the ability of the poor to use agrobiodiversity to improve livelihoods, nutrition and resilience.

- Development of information tools and methods concerning *in situ* management and management plans, including information from farmers, to enhance availability of knowledge, along with material, to users.

- Systematic analysis of how formal and informal seed and breeding systems, and *in situ* and *ex situ* conservation dynamics, can complement each other with a strategic research focus on how to improve functional links between formal research and development systems and informal mechanisms for technology generation and diffusion and update.

- Identification of institutional arrangements and policy mechanisms that will improve farmers' ability to adopt improved agrobiodiversity management practices, drawing on case studies and research sites from around the world.

- Scaling-up lessons learned and recommendations about *in situ* management through international policy fora.

The project will work in a coordinated way with a globally distributed array of partners that has not previously worked together on *in situ* agrobiodiversity management issues. The demand for the outputs of the proposed research is also new. Climate change and the need for sustainable intensification of agricultural production have resulted in more immediate and well defined needs for agricultural biodiversity to be managed and conserved *in-situ* and to have the material and information about it available for wider use

SRT5 includes several innovative elements that will enhance the conservation and use of agricultural biodiversity. Starting from an understanding of the selected priority systems, the SRT will focus on the systematic characterization and evaluation of an agreed set of priority breeds, varieties and species conserved on farm and *in situ*, including their wild relatives. Traits and qualities important to farmers as well as to breeders will be used, representing a new departure for information about genetic resources, and where appropriate such information will be linked to molecular data. In addition, the establishment of monitoring systems in different ecosystems worldwide will contribute new information on both the status and trends of biodiversity. This will add value to existing data already supplied from a few sites by the collaborating centres and in coordination with international bodies such as the CBD and the Commission on Genetic Resources for Food and Agriculture, will contribute in large measure to the establishment of high level indicators. Further value will be provided by the integration of research within specified target sites, and the availability of information gathered from the same sites by different disciplines will add to the richness of the observations from those sites. Richness of results will also be enhanced by working closely with experts in the management of natural resources in CRP 1.1 and other CRPs. A key element in realizing these benefits is SRT5's emphasis on the interoperability of information systems, ensuring that others can make full use of data gathered in SRT5 for their own purposes. Furthermore, we will use specifically adapted community-based tools for sharing local knowledge and information. Information and knowledge about the priority agricultural biodiversity will be linked to the services it provides in the agroecosystem.

Research Overview

We have separated out five research topics in this SRT, but we must reiterate that these areas are mutually supportive and to some extent inseparable. We also know that links with other CRPs will need to be made on a crop-by-crop basis and with regard to specifics of each of the three broad research areas.

Identifying priorities for conservation, at the levels of ecosystems, species, populations, varieties and sets of material, is vital in order to make optimal use of available and limited resources. Knowing what diversity is available where, and understanding the threats to that material, as well as its dynamics, are important first steps. In the end, the practical management and conservation of agricultural biodiversity on farm and *in situ* is a matter for national partners, which requires the development of tools and methods that internalise and reflect the global dimension of the conservation and management of genetic diversity. Directly and through regional groupings (for example through GFAR (Global Forum on Agricultural Research), the Agricultural Biodiversity Initiative for Africa (ABIA) coordinated by FARA, the Suwon Declaration on Agricultural Biodiversity coordinated by APAARI and the regional strategy for conservation and sustainable use of genetic resources in the Near East and North Africa region developed in collaboration with AARINENA, national partners have acknowledged the need for such tools and methods to help them identify priority species and geographical areas for such conservation efforts. This SRT will contribute to meeting these requests.

From the perspective of crop and breed improvement, it will be important to understand the different types of value associated with particular wild relatives, breeds and landraces, and the timeframe over which threats may be expected to materialise. Drawing on studies of biological conservation, we will need to research how fragmentation affects the survival prospects of threatened populations. This includes not only ecosystem fragmentation but also the role played by informal seed and breeding systems and their spatial scale that affects the distribution of target agrobiodiversity. SRT5 will also build on existing efforts in order to capture long-term trends in the status of agricultural biodiversity. Many CGIAR centres have records that go back several years and research could help to make use of these to identify long-term patterns and promote future monitoring.

Drawing on social science studies of the management and conservation of biological materials, we will research how institutional contexts can either facilitate or restrain conservation activities. It is expected that through the collection of some combination of interview, observation, transaction and survey data, it will be possible to understand how the CGIAR centres can most effectively promote and encourage *in situ* conservation through various diversity management options.

Priority setting

It is important to be clear that in order to be successful SRT5 will focus its activities on carefully and collaboratively selected agroecosystems that are rich in agricultural biodiversity of global or regional importance; some will be within the Vavilovian centres of diversity and others in areas with unique agricultural biodiversity. Benchmark sites will be selected to represent major traditional farming systems and to include targeted species, a total of approximately 30 plant and animal species and their wild relatives, and the rangeland plant communities that support the livestock of herders and pastoralists. The vast bulk of the research activities of SRT5 will concentrate on these priority species in order to take full advantage of the synergies that will accrue if interdisciplinary efforts can be focused on a small but representative group of targets, in the full expectation that the research results will find wider applicability elsewhere.

For location, a transparent and objective filtering mechanism, for example based on the prevalence of rainfed agriculture, poverty, and biological diversity will be used to select wide geographical zones in which to work, with the final selection of project agroecosystems, communities and sites to be agreed in full consultation with the other SRTs of CRP1.1 and with CRP1.2 and CRP1.3.

For priority crops and species, SRT5 will draw on the collective experience of the proposal partners. From its earliest days Bioversity worked closely with local stakeholders to establish priority lists in each region. Such consultations were frequently conducted through local networks (for example WANANET Network, EAPGREN, CACT-PGR Network, ECPGR, EUFORGEN, etc), which played an important role in assisting NARS to identify priority species. These priority setting exercises were carried out with the participation of stakeholders, including representatives of research agencies, NGOs, CBOs and policy makers. For example, a major exercise organized in 1998 jointly with ICARDA and the WANANET Network was the priority setting conference for NUS dedicated to the Mediterranean region (Padulosi, 1999c) which was subsequently used in the development of the FAO State of the World Report (Padulosi, 1999b) and the debate over the inclusion of NUS into the FAO's Treaty for PGRFA (Padulosi, 1999a). (See Annex 1 for some outputs of this exercise.)

Subsequent work has built on and strengthened these approaches to priority-setting, most recently in the framework of an EU-ACP Project through two national workshops held in West and Eastern and Southern Africa. The project -- to develop capacity for research on neglected and underutilized species in West Africa and Eastern/Southern Africa -- is coordinated by the Regional Universities Forum for Capacity Building in Agriculture (RUFORUM), a network based in Uganda, in partnership with Bioversity International and six other national and international partners. A priority setting exercise took place in 2010 in order to focus the project's activities on the most important crop species and the most urgent research issues. (See Annex 2.)

ILRI's past and on-going activities in Asia (Pakistan and Sri Lanka) and sub-Saharan Africa (Gambia, Mali, Guinea, Senegal, Ethiopia and Kenya) have focused on the conservation of indigenous chicken, goat and sheep populations, selected and implemented in partnership with the respective national and regional partners. The proposed research would begin by focusing on areas of existing work that represent strategic locations relative to hotspots and current levels of threats to livestock diversity (Rege, Marshall, Notenbaert, Ojango, & Okeyo, 2011).

As a result of these and many other similar exercises SRT5 can draw on extensive experience and expertise in establishing the criteria to be evaluated in the selection of priority species and several already agreed lists. We anticipate using these approaches during the inception workshops of CRP1.1, CRP1.2 and CRP1.3 to select priority target agrobiodiversity for each site. Wild relatives of species will be targeted not only within the selected sites, but also in other regions where they are distributed and are in need of research, conservation and management. Where they are important to community livelihoods, rangeland species will be a further subject for research.

Categories of agricultural biodiversity

Four categories of agricultural biodiversity are of particular concern to this SRT: local and indigenous breeds of livestock; minor crops (neglected and underutilised species, NUS); farmer varieties or landraces (LR) of more major crops, and the wild relatives (CWR) of the priority species (and CWR of other species that may occur in the same habitats and that could benefit from conservation research). In addition, and where appropriate, the research will focus on rangeland species that support livestock of herders and pastoralists. Despite their importance for crop improvement, nutrition, resilience of agro-ecosystems, and adaptation to climate change, these categories of agricultural biodiversity are increasingly threatened by direct replacement with modern, genetically-uniform breeds and varieties and by changes in land use, over exploitation and climate change. While many crop-improvement CRPs (3.1-3.6) have a direct need for wild relatives and should incorporate their conservation and use in their research, collaboration through this component to develop widely applicable tools, methodologies and protocols to identify high-priority *in situ* conservation areas is clearly beneficial. In this regard, the conservation of natural habitats within the major centres of diversity of crops of global importance will be highly rewarding. For examples, as many as 39 species of wild relatives of major crops can be found sympatrically in Africa (Ramirez et al., 2009) and in the *lomas* of Peruvian coastal deserts wild potatoes, tomatoes, other solanums, oca, mashua, amaranths, maca, begonias and others coexist (see, for example, http://botany.si.edu/projects/cpd/sa/sa42.htm); such regions would be worthwhile foci for the establishment by National partners of *in situ* conservation reserves as well as for multi-species collecting missions by CGIAR centres and concerned stakeholders. Similarly, the *in situ* conservation of dryland agrobiodiversity could continue to supply genes for adaptation to the adverse effects of climate change. Outside the classically understood centres of diversity, there are also areas that are geographically and culturally isolated, where levels of agricultural biodiversity might be expected to be both high and threatened, and we will undertake research to identify these and select some as target sites.

There will be a need to pay more attention to the conservation of wild relatives and rangeland species in natural habitats and this will require the development of new partnerships with environmental agencies to ensure proper conservation and monitoring of CWR. Collaboration with CRP 6 will provide an opportunity for synergies in the development of tools and methods in support of more comprehensive conservation management strategies that include important genetic diversity of useful tree species including wild relatives and varieties of important tree crops. There is also a need to ensure that populations of CWR are included in global *in situ* conservation priorities and to ensure that conservation strategies are flexible enough to be able to cope with climate change.

In this regard the proposal will complement the recently launched initiative to collect and enhance the use of endangered wild relatives of 26 species of food crop, being carried out by the Global Crop Diversity Trust in partnership with the Royal Botanic Gardens, Kew, CGIAR centres and NARS institutions. This initiative focuses on *ex situ* conservation activities, including identification of gaps, collection and conservation of CWR and pre-breeding to make them more readily available to breeders. SRT5 will add value to that initiative by focussing on *in situ* conservation activities, including research on characterizing the growing environment and habitat ecosystem of the CWR. Results from this research will enable better prediction and modelling of individual species values, which will assist future breeding efforts to locate and use CWR.

Similarly for neglected and underutilised species, which often represent important elements for nutrition, income generation and production buffering, a collaborative effort to research approaches that help to understand and manage on farm available biodiversity will be widely beneficial, as will efforts to work with wild species and introduce them into cultivation. Linkages with CRP 4, CRP 5 and CRP 7 will ensure that the research conducted under this SRT will be widely used for improved management of genetic resources. These activities will also contribute to filling information gaps on the state of biodiversity in the State of the World PGRFA and the Global Plan of Action PGRFA produced periodically by FAO, as well as contributing to the existing IUCN Red List for CWR and the development of a new Red List system for cultivated plants.

Landraces, like NUS, are important elements in the livelihood strategies of smallholder farmers in many parts of the world (Jarvis, Hodgkin, Sthapit, Fadda, & López Noriega, 2011). These varieties are used, among others reasons, to adapt to marginal or specific agricultural ecosystems (Barry et al., 2007), to cope with environmental heterogeneity and climatic variability (Duc et al., 2010; Bellon, Hodson, & Hellin, 2011), for pest and diseases management (Finckh, 2008), for climatic risk management (Bhandari, 2009), to satisfy cultural and religious needs (Rana, Garforth, & Sthapit, 2008), and for their nutritional properties (Johns & Sthapit, 2004). A better understanding of the trends and amount of diversity available to farmers in different agro-ecosystems and the management of this resource will lead to better conservation and management strategies, which will help to ensure that this diversity will continue to evolve and adapt to changing conditions. Linkages with CRP 3, CRP 4, CRP 5 and CRP 7 will ensure that the LR traits will be used and managed by farmers and scientists.

Conservation of the existing livestock diversity, particularly through links to improved use, has a role to play in securing the future (Gibson et al., 2006; Oldenbroek, 2007) and if well planned and implemented allows for immediate realization of benefits from these resources, as well as potential for integration in longer-term efforts to improve performance.

Research topics

Five research topics will form a coherent research strategy for *in situ* and on farm conservation and management:

1. **Status and trends of target agrobiodiversity**: Understanding the status and trends of genetic diversity of varieties, breeds and species in centres of diversity and the threats to its maintenance and diversity, developing long-term monitoring tools and identifying biodiversity-rich areas for *in situ* conservation.

2. **Target species in systems: Development of *in situ* and on farm management approaches, tools and methodologies**: Developing globally applicable methods, decision-support tools and intervention strategies for *in situ* management of agricultural biodiversity in identified biodiversity-rich areas. To include also the development and demonstration of technological, socio-economic, institutional and policy options for promoting community-driven *in situ* conservation.

3. **Facilitating use of target agrobiodiversity**: Characterising, evaluating and searching for useful traits and qualities in populations conserved *in situ* and on farm, of species important for diversification of farming systems and incomes

4. **Information and knowledge supporting *in situ* conservation and management**: Developing systems that gather and make available different kinds of information related to material conserved on farm and *in situ*, with a strong focus on indigenous knowledge and the involvement of farming communities as providers and users of information.

5. **Policy and strategies to support *in situ* management and availability of agricultural biodiversity**: The need to understand how policies and the legal framework affect the *in situ* management and availability of agricultural biodiversity is an essential element in fostering good conservation management and in making use of plant genetic resources.

Crucially, research topics 4 and 5 above are absolutely essential to achieving impact. We are not interested in conservation for its own sake, but only insofar as the conserved material, and information about it, can be managed and used, by farmers as well as by breeders and other scientists. For that reason these two topics will serve the needs of the others, and there will also be tight linkages between this agricultural biodiversity SRT and appropriate elements in CRPs 3, 4, 5, 6 and 7 and elsewhere.

For each research topic, we provide overall and specific objectives, research questions, methods and research approaches and research outputs.

Research Topic 1: Status and trends of target agrobiodiversity

Very little is known about the pattern of distribution of genetic diversity and how it is changing over time, despite the importance of this agricultural biodiversity for food security, nutrition and ecological and livelihood resilience. There is evidence that agrobiodiversity is globally under threat of genetic erosion and even extinction (Padulosi, Hodgkin, Williams, & Haq, 2002; Amri et al., 2005; Mazid et al., 2005; Maxted & Kell, 2009; Pilling, 2010). On the other hand, there are also well-documented cases where no erosion has been documented (Bezançon et al., 2008). Better information on the status and trends of *in situ* agricultural biodiversity is thus crucially necessary. This research topic will gather evidence on the status and trends of genetic diversity of target agrobiodiversity in priority ecosystems in a new global and collaborative effort. This approach will bring new information on the amount of functional and neutral genetic diversity and how it can be used to tackle the challenges facing agricultural production.

Research objectives

The overall objective of this research topic is to gain a better understanding of the extent and distribution of the genetic diversity of selected agricultural biodiversity, to assess the degree of genetic erosion within priority genepools and to identify priority areas of high diversity for *in situ* and on farm conservation and use. The selection of priority geographical hotspots and priority species will be undertaken in close collaboration with national programme partners, including national advanced research institutes, farmer organizations and civil society organizations.

Research under this topic will have the following specific objectives:

- To identify specific priority areas for conservation action in primary and secondary centres of diversity.
- To prioritise selected target agrobiodiversity for *in situ* and on farm management interventions using selected, agreed criteria.
- To investigate the extent, distribution and geographical location of genetic diversity of the target populations, using neutral and functional molecular markers and other technologies.
- To describe the dynamic behaviour of NUS and LR populations in their agroecosystems and the factors which affect it, including geneflow as a result of farmer selection and seed systems.
- To understand the dynamics of CWR populations in their natural environment, including threats and their impact on population genetics.

- To develop and test methodologies for benchmark establishment and strategies for periodic monitoring of the status of target agrobiodiversity globally.
- To train key stakeholders in the multidisciplinary analysis of target agrobiodiversity and its dynamics.

Key research questions

Key research questions to be addressed include:

- How do we prioritise specific areas in primary and secondary areas of diversity?
- How do we prioritise target populations for *in situ* and on farm conservation in those selected agroecosystems?
- What is the extent of genetic diversity (overall and functional) of collaboratively-identified target crops and species, what is its distribution, and where are the populations with highest diversity or traits of interest? Where are the priority centres of diversity for conservation of the selected species and where do they overlap with areas of high poverty?
- To what extent is genetic diversity being lost *in situ*, what are the causes of this loss and threats of future losses, and what measures are required to prevent further losses?
- What are the status and trends of genetic diversity in the priority species *in situ* and in their centres of diversity and what indicators can be developed to monitor *in situ* and on farm genetic diversity? Can sentinel species be identified on farm as indicators?
- How do farmers manage dynamic processes that govern the distribution and evolution of genetic resources in target areas?
- What are current and past coping mechanisms (intuitional and otherwise) by herders and pastoralists to the identified past and current threats, and how can these contribute to the sustainable management and use of livestock diversity?
- How are populations adapting to changing environments? What are the patterns of annual establishment of different species and populations in relation to rainfall, temperature and other factors across seasons? What effects do drift and inbreeding have on this process?
- How to design a long-term monitoring system? How many observatories should be chosen and where? What variables should be recorded, considering the plant material and farmer practices?

Methods and research approaches

A number of different approaches can be used to set priorities for conservation including ecogeographic procedures (Guarino, Rao, & Reid, 1995; Guarino, Rao, & Goldberg, 2011), use-criteria systematic conservation planning (Margules & Pressey, 2000), gap analysis (Maxted, Dulloo, Ford-Lloyd, Iriondo, & Jarvis, 2008), surveys of traditional farming systems (Mazid et al., 2005) and the use of GIS/RS tools (De Pauw, 2005). These approaches are all concerned with assessing the distribution of target materials, the distribution of their genetic diversity, determining the socioeconomic importance of the material and analysing risks and threats to the sustained availability of this diversity. The Status & Trends research topic will use the most relevant methods to define criteria for identification of about 30 priority crops, breeds and species and 8 priority geographical areas for *in situ* and on farm conservation in different ecosystems and regions in order to ensure global coverage. Such criteria may include degree of threats, the representation of the different taxa in *ex situ* collections (using gap analysis), presence in protected areas, information about on farm conservation and breeding systems, among others.

It should be noted that the criteria to select priority species are different for each category of target agrobiodiversity. While conservation status may be more important for CWR, importance to livelihoods and the cultural role played by the species in the selected sites is more relevant for NUS and LR. For prioritising sites, selection for areas exposed to higher threats, poverty and or malnutrition and those areas that contain genetic diversity of global importance will be considered. In addition, major centres of diversity (such as Vavilov centres of diversity or other secondary centres of diversity, often associated with geographical and cultural isolation) and areas with extreme environmental conditions (e.g. heat and cold, frequent droughts, salinity etc) will also be considered, because populations adapted to these conditions may be of particular value for breeding for current and future needs and for the rehabilitation of degraded systems. Although diversity might be low in extreme environments, these populations may possess adapted genes that are of global interest in view of climate change. Special attention will be given to southern and eastern Africa, given the recognition that Africa (except Ethiopia) has not been well sampled, and yet contains important centres of diversity for many of the target populations. The Status & Trends research topic will clearly need to have a global scope but will not cover species that are already covered in CRPs that contain elements of *in situ* conservation (e.g. CRP 1.1 for West Africa, CRP 6 for tree species).

The comparative advantages of the participating centres in given regions will also be a determining factor in site selection, with each centre taking the lead in a specific region, but all centres will participate in other regions where justified, using common methodologies. In this respect, similar research activities will be carried out in each identified region to allow global analysis.

Research under Status & Trends will produce a better understanding of the dynamics of loss of diversity and identify threats, making use of genetic erosion studies involving advanced molecular and innovative information tools as well as the use of historic information about collecting missions held by CGIAR and its partners. It is possible (with appropriate safeguards) to compare the molecular diversity in representative historical germplasm collections from a particular site with those still present in the sampled site (Vigouroux et al., 2011). In some cases, data on diversity and its dynamics can be linked to biotic, abiotic, social and economic factors. If significant correlations are found, these factors can form the basis for an early warning system to predict possible future losses of diversity. The research would also include the use of geographical information systems and remote sensing (GIS/RS) for assessing changes in land use and land cover and for monitoring diversity and its threats. Diversity indices will be developed using the results of eco-geographic surveys and the information from GIS/RS analysis.

Understanding better the reasons why farming communities maintain or discard intraspecific and interspecific agrobiodiversity and the practices that result in the evolutionary dynamics of diversity on-farm is needed to design and implement efficient *in situ* management and conservation strategies. Developing this understanding will require the use of multidisciplinary approaches combining social and biological sciences. These challenging approaches need further improvement but have been developed and used by CGIAR centres and their partners (Barnaud, Deu, Garine, McKey, & Joly, 2007; Rana, Garforth, Sthapit, & Jarvis, 2007; Bazile & Weltzien, 2008). Although this has rarely been done in the past, there will be a need, and an opportunity, to assess the diversity of the set of crop species grown by farming communities, reflecting the fact that the planting area and variety choice for a specific crop will surely be influenced by choices made for other crops. Links will be established with other CRPs that are developing system approaches, because other changes in agricultural systems (such as intensification, increased market-orientation, farm size, etc) are likely to impact diversity on-farm. The research will help to identify the variables that need to be recorded for long term monitoring of *in situ* diversity.

Understanding patterns of conservation and ongoing evolution from the standpoint of genetics and population dynamics, and at the landscape level, is essential to explain processes of adaptation and loss of genetic diversity in response to change and to predict the rate of future provision of ecosystem services originating from farmer-driven *in-situ* management of agrobiodiversity. Different components of ongoing evolution will be studied:

I. Evolution of animal and plant populations and native model species through sexual pathways (gene flow, hybridization, introgression) and farmer management (selection).

II. Influence of environmental stress and human management on the population dynamics and genetic integrity of species under domestication.

In depth genetic and ethnographic studies will be conducted with model species such as wild, semi-wild and cultivated potato species complexes in Bolivia and southern Peru. Baseline inventories of agrobiodiversity in key hotspots will be documented in catalogues and atlases, so as to facilitate long-term future monitoring of the status of key *in-situ* populations. Methods will include gene-flow studies, high-throughput-genotyping using COS, SNP and SSR genetic markers, morphological characterization, sexual compatibility studies, phenology, cytogenetics, seed stock surveys, seed regeneration and population structure trials, genetic gap analysis, participatory GIS, household and field surveys, population dynamics and ecology studies, among others. The development of a vulnerability index that accompanies baseline documentation along the network of long-term conservation monitoring sites will be essential.

Eco-geographic and botanic surveys will use transects and quadrats and other appropriate sampling methods with Corine[2] levels 2 and 3 will be used to assess land use and land cover. Sites and individual quadrats will be georeferenced to allow time-series data to be accumulated. GIS/RS will also be used to assess and visualize the threats to biodiversity and to determine areas with similar biodiversity by making use of environmental similarities. This work will be complemented with continuing analysis of existing protected and well-managed areas so that lessons learned can be applied more widely to contribute to the conservation of CWR and rangeland species. The information generated will be compiled in existing databases, for example the one developed by ICARDA (see above) and will be made available to other databases and knowledge systems, including those developed in CRP5 and CRP7. This work will also be complemented by the work done in CRP 6, specifically on the identification of the status of and threats to populations of priority tree species.

Research will also be carried out to determine whether the target populations are viable or threatened and to determine their levels of neutral and functional diversity. Overall genetic diversity will be measured through phenotypic and molecular characterization. Extensive use of neutral molecular markers such as microsatellites and single nucleotide polymorphisms (SNPs) is envisaged to answer this question. This will allow assessment of the impact of genetic drift on genetic variation, of the level of inbreeding within populations, and of the amount of gene flow between or within populations. Analysis of livestock, LR and NUS will differ from CWR and rangeland species in that the former

[2] Corine is a programme of the European Environment Agency; see http://www.eea.europa.eu/

are subject not only to natural selection but also to human selection made by farmers when they choose reproductive material.

All relevant CGIAR centres will work in partnership to develop common methodologies for assessing the extent and status of genetic diversity of priority crops and species, which will serve as model species. Standardized tools will be developed for aggregating data from different regions in order to develop global indicators that will facilitate monitoring status and trends, and these will serve as key inputs in models to predict future distribution. Easy-to-measure and scientifically-sound indicators of conservation status will be developed using methodologies reviewed by Brown (2008) and validated with data from molecular diversity studies in order to become part of a global set of agricultural indicators. A methodology for assessing the endangerment level of cultivated NUS species, analogous to the IUCN Red List system, will be developed and NUS in target countries will be evaluated to provide lists of threatened species. Similarly, the feasibility of using sentinel species to monitor the status of NUS will be investigated.

Finally, by focusing on both neutral and functional diversity in CWR and rangeland species, this research will contribute to shedding light on the role of processes such as environmental degradation, climate change and disruption of species and population interactions in species extinction, thus moving forward from a traditional perspective focused almost exclusively on the effects of drift and lack of geneflow associated with habitat fragmentation. The extent of the interaction between these non-genetic effects and genetic processes, summarized as genotype-by-environment (GxE) interactions, is as yet largely unknown. How populations adapt to a changing environment, and what effects drift and inbreeding have on this process, are also to a great extent unknown.

The research outputs of this topic will be relevant to CRP 5 and CRP 7, because a better understanding of the genetic diversity and the adaptive potential of varieties, breeds and species is important to enhance the resilience of agro-ecosystems and to use this diversity to adapt to and cope with climate change.

Research Outputs

- List of prioritized target agrobiodiversity and priority areas for *in situ* and on farm conservation of these varieties, breeds and species.
- A network of key sites (hotspots) for documentation and long-term monitoring of *in-situ* populations established.
- Methodologies and tools developed for spatial analysis of diversity, in close collaboration with the spatial analysis efforts in other CRPs. NARS trained in their application and priority conservation actions identified.

- Methods to prioritize the diversity of genetic resources maintained by poor farmers.
- Better understanding of the genetic structure, functional diversity and the adaptive potential of LR, CWR and NUS in crops with different breeding systems.
- Better understanding of the impact of farmer choices in breeding and seed systems in the amount and distribution of genetic diversity and the dynamics of its changes.
- Extent of genetic diversity loss *in situ* documented for at least 30 varietes, breeds and species in 8 hotspots.
- Scientifically-sound indicators developed for assessing levels of genetic diversity conserved *in situ* and associated threat levels.
- Set of monitoring sites for target agrobiodiversity established across Vavilov and secondary centres of diversity and monitoring methodologies established.
- Evidence of ongoing evolution in populations of target agrobiodiversity as a response to environmental change.
- Lists of threatened varieties, breeds and species developed

Research Topic 2: Target species in systems: Development of in situ and on farm management approaches, tools and methodologies

A variety of different approaches and tools are available to encourage the conservation and enhance the management of target agrobiodiversity *in situ*, and these need to be refined and better understood and disseminated to stakeholders who are enabled to use them. Management plans, to include low-cost technologies, added-value options, alternative sources of income, institutional arrangements and enabling policy options, will be included to allow the empowerment of local communities to enhance the conservation of local agrobiodiversity in selected areas. A better understanding of this genetic diversity will also be used to explore how it can be used for sustainable intensification.

Research objectives

The overall objective of the Tools & Methodologies research topic is to ensure that priority populations identified under the Status & Trends topic are sustainably managed *in situ* with support from farming and local communities, national park managers and national decision makers. This research will have the following specific objectives:

- To develop and test practical management and conservation procedures, mechanisms and approaches for *in situ* conservation of target agrobiodiversity.
- To investigate the role played by fragmentation of populations of CWR on their long-term survival.
- To promote *in situ* conservation of target agrobiodiversity with full involvement of local communities and other stakeholders, linking closely with research in CRP1.2, CRP1.3, CRP2 and CRP5 to produce an improved understanding of the private and public good values associated with such populations, as well as the development of incentive mechanisms necessary to ensure the continued provision of such values. This will include the development and testing of management plans in pilot areas to serve as models for replication and use in other biodiversity-rich areas.
- To understand how genetic diversity can be integrated into sustainable intensification programs.
- To train key stakeholders on approaches to *in situ* and on-farm conservation and on the development and implementation of management plans.

Key research questions

Key research questions to be addressed include:

- What management approaches can ensure that populations of target agricultural biodiversity are maintained in the wild and on farms, where they can continue to evolve and generate new diversity?
- To what extent do existing protected areas contribute to the conservation of targeted agrobiodiversity and what additional sites for natural reserves will target the conservation of target species?
- How do *in situ* conservation and on farm management complement *ex situ* conservation? How can cost-effective, diversity-maximising conservation programmes be identified and implemented?
- How can agricultural biodiversity be better integrated in research on the sustainable intensification of agricultural systems?
- What are the costs of alternative conservation interventions for agricultural biodiversity and what mechanisms can be used to minimise these? What are the related benefits, to whom do these accrue and what are the implications for social equity? Which economic methods and decision-support tools can be used to assess such costs and benefits?
- How are the priority target populations currently managed in the identified hotspots? How do the hotspots match the Myers biodiversity hotspots, and are there opportunities for synergies in their protection?
- What is the role of gender in conserving target agrobiodiversity on farm and *in situ*? How do the roles of women and men differ, and how can they be better understood to promote effective management.
- What low-technology options, alternatives sources of income, added-value technologies, institutional arrangements and policy recommendations (management plans) are needed to promote community-driven conservation of target agrobiodiversity and agro-ecosystems?

Methods and research approaches

The knowledge and results generated by the research topic on Status & Trends will inform the development of long-term strategies, as requested by national partners, for maintaining populations of targeted agrobiodiversity for dynamic conservation in the face of different environmental challenges and threats, such as climate change and other drivers. This research topic will focus on investigating optimal conservation and management strategies and will promote interventions that would ensure the maintenance of the evolutionary capacity of the resources (Maxted, Ford-Lloyd, Kell, Iriondo, Dulloo, & Turok, 2008; Jarvis et al., 2011). These strategies will take into account the effective population sizes needed for continued evolution and the impact of fragmentation of populations on their long term survival. It will target species having different life histories, distribution patterns and ecological niches. Methodologies will include ecogeographic studies for priority model species, surveys and establishing a network of genetic reserves that will be representative of a broad genetic range of target species. The research will build upon the methodologies developed in previous projects led by the four centres on *in situ* and on farm conservation, for example the assessment and trend analysis for several crops species in 75 monitoring areas in Jordan, Syria, Lebanon and Palestine for the period of 1999-2010 undertaken by ICARDA. This experience will be expanded to other target regions and priority species identified in the Status & Trends topic.

A second set of research questions relates to the design and implementation of conservation actions and management plans and strategies such that conservation interventions are effective and efficient. Based on previous experiences of the *in situ* conservation of CWR (Hunter & Heywood, 2010), common *in situ* methodologies will be developed in partnership with communities (including children and women), protected area managers and policy makers, national institutions, NGOs, and the private sector. Research will develop and test management plans and strategies, methods and interventions to accomplish this at national levels. To date, research on dynamic conservation has consisted of unrelated case studies that focus on one or two key species and that use *ad hoc* methodologies and locations. The proposed research, by contrast, will take into account the interactions of multiple species in the systems where they coexist, and will ensure cross-learning that results in a toolkit that will be widely applicable to other species and conditions beyond those for which it was developed.

It is also important to test and compare different management actions within and outside protected areas and investigate what is feasible. Management plans may include suitable technologies, added-value options, alternative sources of income, institutional options and enabling policies targeting the promotion of given species, an ecosystem, a landscape or a protected area. Proposed options could be implemented at any of several levels, from field or natural habitat through farm, community, national, regional to the global level. Such management plans need to be implemented at the community level, (with emphasis on the empowerment of women and local communities) and coordinated and harmonized at national and international levels. In some cases it may be more cost effective to conserve threatened populations *ex situ*, and links to *ex situ* conservation will be explored with the major crop CRPs in such cases. Linkages will be established with other CRPs (e.g. CRP 6) involved in developing best approaches for conservation of genetic diversity.

Particularly for plant species, where ex-situ conservation in genebanks is more advanced, it is widely suggested that *in situ* and *ex situ* conservation should be complementary although there is much less clarity on what this means (Engels, Ramanatha, Brown, & Jackson, 2002). It would seem obvious that complementarity of some kind is desirable to achieve the most efficient use of resources, the conservation of the optimum level of diversity and a balance between static conservation and dynamic evolution and adaptation. Research under this topic will develop the required collaboration with national programmes so as to explore what constitutes effective complementarity for the priority crops in different environments and socio-economic contexts. The research would explore whether there is a subset of populations or varieties that need to be conserved both *ex situ* and *in situ*, what genetic content and population sizes are appropriate for effective complementarity, what are the differing effects of selection *in situ* and through genebank management practices on neutral and functional diversity, what are the flows of material are needed between *in situ* and *ex situ* conservation, in both directions. In some cases, analyses of threats to *in situ* CWR or crop populations may conclude that effective *in situ* conservation is impossible to implement, making *ex situ* conservation the only option. In other cases, the absence of sustainable *ex situ* conservation systems for some crops will make *in situ* conservation absolutely necessary. Such a research programme could be conducted in an extremely cost effective way through collaboration between centres contributing to CRPs1, 3 and 5. It would also need to bring in national programmes and botanic garden partners who play an important role in *ex situ* conservation of crop wild relatives. For example, Kew's Millennium Seed Bank may now have one of the largest collections of crop wild relatives in the world at the species level. The research would help stakeholders to design an optimal balance of actions in each arena for a given species under given circumstances and could explore how the approach might vary at national as compared with regional or global levels for conservation of a taxon.

To promote on farm conservation of NUS, an analysis and understanding of the management of the target taxa in the selected sites is needed, bearing in mind the different roles of men and women (and other social stratifications). In particular, it will be important to understand the role these species play in farmers' livelihoods, what are the uses of those crops and how and when they are managed. This understanding will require collaboration with CRPs 4, 5 and 7. Some of the target species will require efforts to bring them to cultivation for the diversification of cropping systems and farmers' incomes and to reduce the over-exploitation of natural populations.

Alternative sources of income and payments for agrobiodiversity conservation may be appropriate when on farm conservation is considered of high priority and there are no other incentives to promote such conservation. In this respect, collaboration with the other CRPs will be very important to identify non-monetary incentives for conservation (e.g. nutritional value, pest and disease control, adaptation to climate change or to particularly unfavourable environmental conditions). For wild relatives it will be important to understand whether and how they are used by farmers as food, medicines or to improve the cultivated varieties and breeds, thus interacting with the production system. Landraces too play various important roles in livelihoods and farm systems. The experiences of on-farm conservation conducted by ICARDA and CIP (see Lessons Learned section above) can be used to expand this methodology to other priority areas and to other priority agrobiodiversity and can be integrated with experiences from other centres (e.g. the global on-farm conservation initiative coordinated by Bioversity, which resulted in a heuristic framework for supporting the conservation of traditional crop varieties on farm developed by Jarvis et al. (2011)) and the economic and policy incentive mechanisms being researched in CRP2 and CRP5.

In situ conservation requires an effective team to implement the activities and this research topic will also ensure that national stakeholders are trained effectively to manage the *in situ* populations of the targeted agrobiodiversity and in the development and implementation of management plans.

Research outputs

- Priority populations of wild relatives of genetic resources conserved *in situ* through the development of networks of genetic reserves across 8 hotspot areas and the development and testing of management plants in pilot areas.

- Catalogues with up-to-date indicators of conservation status and vulnerability of target agrobiodiversity in key hotspots published and maintained.

- Improved understanding of the link between poverty and genetic resource diversity and clarification of the dynamics and drivers of this link.

- Improved understanding of the role of women in the management of agricultural biodiversity *in situ*.

- Tool kit for *in situ* and on farm conservation of target agrobiodiversity produced, based on a thorough systematization of different R&D experiences during the past two decades in the Vavilov centres.

- Incentive strategies for dynamically maintaining genetic resource diversity targeted to the local communities tested and assessed in at least 8 hotspots.

- Decision support tools for deciding on the balance of *ex situ* and *in situ* conservation strategies

- The role of genetic diversity in sustainable intensification better understood.

- Economic methods, decision-support tools and incentive mechanisms tested and developed for supporting the valuation of genetic resources and the design of cost-effective, diversity-maximising conservation strategies.

- NARs scientists and other stakeholders trained on *in situ* conservation techniques.

Research Topic 3: Facilitating use of target agrobiodiversity

The conservation of agricultural biodiversity *in situ* is not a goal in itself and must be complemented with the sustainable use of these resources for improved production systems and livelihoods as well as crop and livestock enhancement through breeding. Making available information about conserved resources is vitally important, for farmers and breeders and scientists, and is a key element in this proposal, while making the material itself available is an element in this proposal's research topic on Policies and Strategies. This topic aims to help farmers, breeders and other scientists to make use of material conserved on farm and *in situ*.

A key goal will be to research the interdependency of different kinds of ecosystem service derived from biodiversity. The conservation and evolution of existing and new genetic resources (i.e., cultivars and breeds, genes, and alleles) represent an essential supporting service with long-term global implications for crop and livestock improvement, bioprospecting, and gene mining, and for future generations to be able to confront unforeseen food security, medical, and (bio)technological challenges. Other ecosystem support services derived from biodiversity include the provision of habitats for endemic CWRs, wild food plants, and natural enemies of crop pests. However, these habitats are frequently under severe pressure and there is a need to scientifically demonstrate the evolutionary and economic value of their conservation. Furthermore, agrobiodiversity within patchy mountain and complex multi-strata forest agro-ecosystems provides numerous regulating services, ranging from conscious risk management by smallholders through the employment of varietal mixtures and field scattering to integrated pest and disease management (Power, 2010). Cultural services derived from wild and cultivated diversity, including the immanence of cosmovision or traditional environmental knowledge, are important drivers for on-farm conservation (Posey, 1999; Prain, G. et al., 2000). These services underpin the provisioning contribution of agrobiodiversity, the production of nutritious food (Hassan, Scholes, & Ash, 2005), including essential micronutrients, and economic benefits, which may potentially be derived from niche and novel food value chains (Ordinola et al., 2007; Brondizio, 2008).

The social welfare and ecosystems implications of food systems are interconnected, especially when food systems prioritize the provisioning services of ecosystems (i.e., the production, processing, and marketing of goods at the expense of other services which in the longer term support that provisioning). This issue will be explored through proposed research on resilience. However, we also propose looking at tradeoffs between ecosystem benefits and the development of value chains. In particular, we will examine the potential of novel, niche-market and inclusive value chains based on agrobiodiversity to enhance rural income and at the same time improve the conservation and sustainable use of ecosystems. Successful cases are known for the Andes and Amazon (e.g., Brondizio 2008, Ordinola et al. 2007).

Lessons and principles can be drawn from these experiences to enhance value chains of other biodiversity-based high-value products such as fruits, essential oils and nuts.

Research objectives

The overall objective of this research topic is to evaluate the potential of the *in situ* and on farm populations of target agrobiodiversity in providing goods and services. It will have the following specific objectives:

- To document local knowledge on uses and adaptive traits of target crops and species.
- To understand the operations of and constraints on informal seed systems and associated traditional knowledge, and interactions with the formal seed sector, and to make use of that understanding to improve the informal systems to support the use of agricultural biodiversity. The role of women in these systems will be of particular concern.
- To provide characterization and evaluation information of the target agrobiodiversity conserved *in situ*.
- To research adaptive traits present in selected target varieties, breeds and species to different biotic and abiotic stresses.
- To contribute to determining the relationships between the agrobiodiversity complexes in key agroecosystems and the capacity of associated food and livelihood systems to reduce poverty and food and nutrition insecurity.

Key research questions

- How can valuable indigenous knowledge about target agrobiodiversity be captured and integrated with classical descriptors?
- Based on their adaptive potential, which wild relatives of crops and which landraces are most valuable from the perspective of crop enhancement by farmers and breeders?
- What adaptive traits are present in the target livestock and how do they correlate with the other key productive and reproductive traits? This will inform how best can they be use in selective breeding programmes.
- Can ecosystem services provided through the *in-situ* conservation, management and evolution of local agrobiodiversity be enhanced as a pathway out of poverty?
- How do changes in food systems and their different components affect the three key outcomes of food systems: nutrition security,

social welfare, and linked ecosystem functioning and services (Ericksen, 2008)?

- How can useful qualities be identified?

Methods and research approaches

Research under the Status & Trends topic examines the full range of genetic diversity of *in situ* populations of target agrobiodiversity through phenotypic and molecular characterization as well as the environmental and geographic characteristics of their sites. This information will be used in this research topic first to identify populations for initial work and to develop a catalogue for prioritization, making use of surveys of farmers, breeders and NARs. From this catalogue, partners will work to identify traits with adaptive potential for breeding, crop improvement and the rehabilitation of degraded ecosystems. It is proposed to use the Focussed Identification of Germplasm Strategy (FIGS) approach (Mackay, Street, Mitrofanova, Konopka, & Berger, 2004) to identify plant populations likely to contain traits of value to user communities. Promising material will be characterized and evaluated for morphological and agronomic traits, using existing genebank descriptor sets and new descriptors and assessment tools to be developed, noting that GIS/RS information collected under the other research topics is an essential component of this evaluation. Once tested, information about the most promising varieties will be made available to CGIAR centres for crop improvement and breeding and directly to farmer groups to use in adapting their farming systems. Information on useful traits will be collated in a database and made available to all interested stakeholders (see Research Topic 4 Information & Knowledge).

A further element in this research topic will be to develop platforms to allow the exchange of information from historical assessments and incoming streams of data derived from molecular biology and other advanced technologies. This area will require close collaboration with other CRPs and advanced research partners, bringing in scientists and information managers to contribute to a range of tools that will enhance the flow of information back and forth between farmers, conservation managers, breeders and other scientists.

That on-farm conserved genetic contributes to creating greater ecosystem and socio-ecological resilience (its “insurance value”) is generally not valued from an economic perspective nor is it visible to policy-makers. Quantitative interdisciplinary scientific evidence needs to be generated to demonstrate the resilience provided by agrobiodiversity. Three dimensions of ecosystem and socio-ecological resilience will be researched using integrated and interdisciplinary approaches:

I. Stability of flow of goods contributed by intra- and infraspecific diversity of specific cultivar and species complexes under conditions of increased environmental stress.

II. Ability of contrasting household economies (diversified *vs* non-diversified) and variable types of social networks in agrobiodiversity hotspots to overcome and recover from environmental stresses or shocks.

III. Ability of endemic CWRs to cope with and adapt to conditions of environmental change (including climate change and habitat modification).

Specific methods used will include time-series comparisons based on satellite images, modelling of probabilistic scenarios of environmental change, participatory GIS, intentional exposure trials, yield stability trials and assessments, seed flow surveys, social network mapping, EcoCrop modelling, multi-year studies of genetics and population dynamics, inventories of drivers of local change and mitigation plans, and development of CWR management plans.

Research will include studies focusing on the food systems of different types of beneficiary groups: indigenous peoples and migrant populations. We will examine the cultural and nutritional contributions of diets high in locally acquired foodstuffs compared with diets based on exotic products. In the highlands of Peru and Bolivia these studies will also be undertaken in food systems based on root and tuber crops (linking with CRP3.3), especially comparing populations exposed to extensive migration and external influences.

Value-chain methods will be used to compare the marketing of animal products and NUS and LR and to understand variability in economic and environmental costs and benefits. Participatory market chain assessment involves the assessment of the different actors involved in the market chain, from production to consumption, in a social and economic characterization of the linkages and identification of opportunities. The market opportunity appraisal assesses which fresh or processed products offer the best economic opportunities for producers and processors (Ostertag Gálvez et al., 2005). Market readiness analysis assesses assets and connectedness to markets and service providers, and levels of innovation as a predictive method for supporting value-chain engagement (Best, Lundy, & Ferris, 2009). Enterprise design involves development of mini-business plans as well as the establishment of market and service provider linkages. We will pay particular attention to the identification of iconic target populations, both for fair trade and in what we call "eco-trade"; that is, where the species makes a particular contribution to conserving ecosystems and their services. Expected outcomes of this research include the establishment of an incentive structure that favours the development of value chains that conserve genetic diversity and a wide range of ecosystem services. It is also expected that the public and private sectors will use the knowledge generated about value-chain actors and relationships, market opportunities, and the requirements for entering the market to establish enterprises that capture niche markets whilst conserving biodiversity.

The mechanisms by which farmers acquire and exchange seeds and animals are key processes in the maintenance of and changes in agrobiodiversity (Badstue et al., 2007; Hodgkin et al., 2007; Aleman, Thomet, Bazile, & Pham, 2010). Informal seed systems and their connections to the conventional seed sector will be studied, as will the exchange of breeding animals. Projects that combine modelling and participatory approaches are under development (IMAS for example (Belem, Bousquet, Müller, Bazile, & H, 2011)) and the proposed SRT will make use of these.

Linkages with other CRPs will be essential in ensuring that the conserved material is managed and also made more widely available to breeders and scientists for production improvement (CRP 3) and to farmers for nutritional traits (CRP 4), enhancing resilience (CRP 5) and adaptation to climate change (CRP 7).

Research outputs

- Innovative methodologies to collect farmers' knowledge in order to integrate it into more classical descriptors.
- Characterization and evaluation data and information on specific adaptive traits are made available for inclusion in information systems.
- Evidence to show that the ongoing evolution of plant genetic resources in ecosystems contributes essential supporting, regulating, cultural, and provisioning services that so far have been inadequately understood by science.
- The varied contributions of agrobiodiversity to livelihoods of different beneficiary groups in contrasting ecologies analyzed and strengthened.
- Environmental, social, and economic trade-offs between value chains based on wild and cultivated diversity are modelled and sustainable value-chain scenarios developed.
- Knowledge of seed and breeding systems can be used to foster the *in situ* conservation of agrobiodiversity through participatory approaches.

To repeat, the conservation of agricultural biodiversity *in situ* and on farm is not a goal in itself and must be complemented with the sustainable use of these resources.

Research Topic 4: Information and knowledge supporting in situ conservation and management

The knowledge accumulated over several generations by farmers, no less than the information gathered over decades by researchers in agricultural biodiversity, is essential to improving conservation management and use in the future. This research topic processes and makes the information gathered by SRT5 widely available at the same time as providing essential support to the other activities in this component. A crucial element in the activities is to ensure that this information and knowledge is available to, and can be re-used by, other information systems, including the Knowledge Sharing Centres of CRP1.1 and by other information systems developed by other CRPs (e.g. CRP3, CRP5, CRP7) to support breeding strategies, identification of ecosystem services, early warning tools, etc. The role of communities in supplying their own indigenous knowledge and in being given access to the indigenous knowledge of other communities will also be central to this research topic. Documenting traditional knowledge in databases and registries of various kinds provides the potential to protect TK, avoid erosion and enable transfer and further innovation. To this end, some degree of codification of TK will be necessary. TK holders have announced a series of claims, for example to be identified as authors or inventors of their knowledge, to be able to control access to their knowledge, to be compensated for its use, to preserve national identity, and to preserve the organizational structure that enables the continuous production and use of their knowledge. As a result, public access to and use of this knowledge will necessitate the prior agreement of the communities involved and recognition of their authorship (Brahy, 2006). The harvesting, curation and distribution of a wide range of different kinds of information and knowledge from a wide variety of sources efficiently and conveniently, will improve the conservation, management and use of target crops and species not only by scientists but, equally importantly, by farmers and pastoralists and development practitioners. Traditional knowledge will be collected and made available respecting norms associated with farmers' rights, access and benefit sharing, and the protection of traditional knowledge. This research in this topic will be linked to the methodology applied in Research Topics 1, 3 and 5.

Characterization and evaluation, already a key element in database systems for material conserved in genebanks, is an essential area in which the provision of information needs to be expanded. A crucial area for future research is how best to present formal characterisation and evaluation data for what might be termed "farmers' traits" for material conserved on farm and *in situ*, along with environmental and other variables associated with a particular set of material, in such a way as to maximise its usefulness. This will support the identification of functional roles of the target varieties, breeds and species within agroecosystems and will contribute to the upscaling of the research results. There is also a need to formalise and incorporate information that captures the conservation and cultural practices applied by communities to the agricultural biodiversity they work with, and the ways communities interact with informal and formal seed and breeding systems. Partnership with the crop CRPs will be crucial to expand the knowledge base and give access to data on the performance of CWR and NUS that have not been characterised through a classic breeders' evaluation process. In gathering such information, we will ensure that the key role of women as traditional knowledge holders is recognized and reflected in research designs, along with the definite role of women in management decisions and planting practices relevant to the use and conservation of agricultural biodiversity on their farms (Feder, Just, & Zilberman, 1985; Knowler & Bradshaw, 2007).

Objectives

The overall objective of the Information and Knowledge research topic is to research and develop tools and systems that will allow the other research topics to present their work in ways that enhance the management and use of material conserved *in situ*. The topic will therefore be guided to a large extent by the needs of other scientists in the component. However, there are additional objectives, such as curating and making available different kinds of knowledge, making sure that the tools suit end users, ensuring interoperability with other information systems and adapting other protocols for use with *in situ* and on farm material, that have applications in all the research topics and beyond.

Among tools and methodologies that need further development are:

- Support for recording and making available the data collected in SRT5 and ensuring the provision of fit-for-use data that support the methods for monitoring different approaches to *in situ* conservation, taking into account various kinds and levels of threat, and training for national partners.

- Tools to support characterization and evaluation of target agrobiodiversity to be performed in research topic 3 (Facilitating use), making use of farmers' and herders' criteria, including the uses and the functional roles of the species, and to link these with climatic and other environmental data.

- Information on the status of agrobiodiversity conservation *in situ*, including indigenous and traditional knowledge obtained from communities, for example as maintained in Community Biodiversity Registers, and data about causes of erosion. Enhanced socio-economic data collected through available sources.

- In support of research topic 5 (Policy and strategies) attention will be given to documentation and knowledge about existing systems to facilitate the dissemination and adoption of selected varieties, breeds and species. Enhanced information regarding the status and distribution of wild relatives and, where appropriate, characterization and evaluation data, which will support gap analyses for conservation.

The value of this work will continue to increase along with the power of the information systems, the amount of information available (including, for example, molecular, geographic and environmental data) and the expanding ways in which they can be combined. To these must be added increasingly powerful information systems, making use of citizen-science tools and gathering additional knowledge and information. Improving access and usability of information on *in situ* and on farm agricultural biodiversity, and making it available to other sources of information about material in *ex situ* collections world-wide, will provide a powerful tool to enable researchers and farmers to make full use of the total diversity available. As they struggle to adapt to climate change and find income opportunities, farmers will need more and better information about the diversity available to them. This component will research the kinds of information farmers need and can use, ways of enabling them to request such information and material, especially from other farming communities, and novel approaches to the capture and delivery of information to farmers, including channels such as remote sensing, citizen science tools and mobile telephony. Information systems also need to be able to inform policies to encourage benefit sharing with conservator communities.

Key research questions

- How can data on taxononomy, genetics, phenotypic expression, environmental data and community knowledge on target agrobiodiversity be brought together and made available in a meaningful way to farming and herding communities and scientists (including linkages with CRP 5 and CRP 7), while respecting norms for TK?
- How can the traits farmers use for the characterisation and evaluation of material important to them be gathered, documented, verified, linked to formal assessments, and shared?
- How can characterization and evaluation data be processed to contribute to the identification of functional traits or services that species bring to agroecosystems?
- Can the list of priority species be used as a model to develop methods for online connections among the various kinds of information and relate them to specific populations of target crops and species?
- How can historical records be used to assess distribution, erosion, threats and vulnerabilities of the target agrobiodiversity?
- Can citizen science tools be developed to be used by target communities to enhance the ability of farmers, field workers and

communities to contribute knowledge and information on key aspects of target agrobiodiversity?

Methods and research approaches

Valuable and accessible sources of relevant data and knowledge will be identified for the priority species in order to assess gaps and the feasibility of filling them in order to build an adequate information system. Sources will be categorized and documented for their coverage, their accessibility and the role they can play in the information and knowledge system of this SRT. A process to capture and publish the new data will be implemented in collaboration with farmers' communities and scientists. Surveys conducted together by scientists and communities to collect the information on farmers traits and traditional practices will have to be developed in collaboration with research topic 4 to guarantee seamless insertion into the databases, registries and knowledge base. These activities will extend to characterization and evaluation data from *in situ* and *ex situ* sources, including legacy data. Existing standards and tools for collecting and sharing data on *in situ* conservation will be assessed and applied where appropriate. The adaptation of descriptor lists, trait ontologies and other *ex situ* information management standards and principles will be performed in order to standardize access to the information and make it comparable with breeders' data. The existing crop ontology (Shrestha et al., 2010) will be assessed as a model for an expanded trait knowledge base. The selected and adapted standards will then be tested with a selection of citizen science tools with the objective of up-scaling data collection and sharing across communities. Norms concerning the protection of traditional knowledge have been evolving relatively rapidly at local, national and international levels. One of the challenges, and important outputs, of the research will be to work with representatives of communities to develop mutually acceptable mechanisms for sharing, documenting, and publishing traditional knowledge into the public domain. These issues are also reflected in research topic 5.

In addition capacity development activities will be undertaken with partners and stakeholders to ensure that in future they are better placed to provide high-quality data and knowledge to this information system and elsewhere.

Research on *in situ* conservation and use will require combining data captured at several scales -- individuals, populations, species, communities, and ecosystems – using time series and geo-referenced data where available. Quality improvement of geo-references and access to historical records will therefore be an important pursuit. Traditional knowledge concerning the value or management of target agrobiodiversity varies from place to place, and the value of a plant or animal for a particular purpose may, for example, be realized only in a small part of its geographic range even though such knowledge may be important elsewhere. This supports the importance of making documentation on local use available globally. To this end, public domain data on community use and management practices will be mapped, with the support of experts in traditional knowledge GIS, in order to help identify places where the species could be possibly useful for other communities. This would provide a toolset for use in cultural preservation, natural resource management, and economic development. To avoid any charges of misappropriation of TK, knowledge that can be disclosed and considered public with correct and agreed citation of the community will be identified in collaboration with research topic 5. Protocols governing access to the databases and information tools will be clearly stated and agreed with the TK holders and users. Information tools will include advisory notes stating the recognition of the rights of TK holders as recommended in a report from UNU-IAS (Bhaati, Hardison, & Neumann, 2003). Multidisciplinary approaches will be required, bringing together many different sets of expertise. This research topic will therefore explore strategic partnerships with projects such as 'Sud Experts Plantes,' Pl@ntNet and regional networks to gain local expertise on local diversity, to acquire the critical mass of human resources needed to translate collected knowledge and to gain access to national knowledge inventories.

The Status and Trends and Tools and Methodologies research topics will produce several outputs in the form of assessment applications, which will need to be made widely available for use by others. This research topic will provide the support needed to ensure that these applications can be easily found and that they are linked to the species and to the potential uses to which they may be put. In relation to this and other outputs, it could prove fruitful to research the production of an online reference list of traits and characteristics and link it to population identifiers to enable the annotation of data relevant to the priority varieties, breeds and species, thus promoting the integration of scattered information. Such a tool will enable communities to access the reference lists for data annotation and also to contribute content.

Research outputs

- Expanded knowledge system with additional functionality, including a trait knowledge base, is developed to contain and make available information and knowledge on priority species to support *in situ* conservation and management of agrobiodiversity.

- Relevant additional data (including molecular data) sourced and made available to other appropriate information systems contributing essential components of the International Treaty's Article 17 global information system.

- Enhanced access to identified genetic variation by all potential beneficiaries – including smallholder farmers, seed networks, breeders and research communities, development practitioners etc.

- Tools and utilities to allow users to begin to analyze data across information systems to create their own subsets of target trait accessions.

- Tested tools for contributions from citizen scientists in communities made available to be deployed on other problems.

Research Topic 5: Policy and strategies to support in situ management and availability of agricultural biodiversity

This Research Topic addresses two very closely related issues: policy support for *in situ* conservation of agrobiodiversity, and policy support for increased availability of agrobiodiversity to be used by a range of actors, including farmers, and extending to agricultural research and development organizations and genebanks. Farmer management of agrobiodiversity depends on their ability to access and use diversity from numerous sources. Similarly, agricultural researchers and genebanks depend upon access to materials that are continually evolving in farmer-managed areas. So while the main point of entry for work in the Research Topic is *in situ* management, it necessarily requires engagement with a broader range of issues related to the question of availability.

Policies directly and indirectly affect how national governments, research organizations, companies and farmers make agricultural biodiversity available, and how they conserve and use it once obtained. Ultimately, policies affect the extent to which agrobiodiversity is allowed to continue to evolve in agricultural ecosystems by influencing management decisions at various scales. National policies on variety registration, seed certification, subsidies for seed production and distribution and for inputs such as fertilizers and machinery can have significant impacts on what materials are effectively available to farmers, and the choices farmers make in their management and use of agricultural biodiversity in production systems. Agricultural research policies have a direct impact on which crops receive priority treatment in terms of use and conservation. Policies concerning genebanks are gaining increased attention. Better functioning links between farmers and community genebanks on one hand, and national and international genebanks on the other, have the potential to positively affect the diversity of materials and information flowing in both directions, making more diversity available to farmers from *ex situ* collections, and more new materials for *ex situ* collections (and breeders) from farmers. To date, the actors that need to be proactively engaged in such coordinated activities, including policy makers, have shied-away from committing themselves, their organizations and their countries to the dynamic functioning of such systems of access and exchange. Administrative and policy restrictions have been allowed to evolve that ossify disincentives for proactive engagement. Research on the positive and negative effect of institutions and policies in this domain is essential to identify mechanisms to ‘unblock’ germplasm and information flows.

Given the widely different socio-economic, legal, political and geographic environments in which farmers around the world operate, a major challenge is to identify which policies affect the ability of farmers to manage and make use of biological diversity, and how. Some work has already been undertaken (Vernooy, Jingsong, & Li, 2010), but a more systematic approach to analysing the impacts of different policies on farmers’ decision-making is necessary in order to propose sound options (Jarvis et al., 2011). It is important to note that this work is not limited to formal sector actors, but extends to how policies impact on the viability and development potential of informal seed systems which continue to play an important role in many developing countries. In this context, it is important to investigate which policies and laws could further strengthen and improve functioning informal system systems, recognizing that different approaches will be necessary depending upon the crops, agroecosystems and capacities of actors involved. Examples of such research would include identifying options for making national seed control and certification schemes as well as variety release regulations more amenable to farmers' seed production and marketing. Formal and informal seed systems should not be seen as necessarily separate and mutually exclusive; research efforts will include consideration of how farmers and research organization are embedded in both formal and informal seed systems. As stated in Research Topic 2 (Tools and methodologies), gender, age, ethnic identity and economic status can be important variables influencing the ways farmers manage agrobiodiversity. It is important to identify ways in which policy options can be 'scaled down' to respond to these factors in situations where their influence is manifest across large numbers of people, or significant geographic scales.

There is a growing body of anecdotal evidence that intellectual property and access and benefit-sharing policies (and the problems that arise when these policies are not clearly defined) are having significant negative impacts on agricultural research organizations' ability to obtain and use agrobiodiversity (Atkinson, Beachy, Conway, & Cordova, 2003; Ruiz & Vernooy, 2011) but the extent of that problem has not been well documented. Scientists working with plant genetic resources are well aware of the fact that the International Treaty on Plant Genetic Resources for Food and Agriculture leaves a wide range of questions unanswered, which has given rise to a whole new set of policy questions that the centres need to address in their daily work. So far, the Treaty's multilateral system does not appear to be overcoming the traditionally 'siloed' approaches to *ex situ* and *in situ* conservation; since it has come into force, there has been very little new material introduced into internationally available *ex situ* collections from new collecting missions (Halewood, Sood, Sackville-Hamilton, & Amri, In Press). These same policies also restrict farmers' and local communities' capacities to access agrobiodiversity, for example, when newly developed materials are being protected through intellectual property claims, or when materials housed in genebanks around the world are inaccessible to them. Considering the importance of the CGIAR as a central player in the global genetic resources landscape, the CGIAR is expected to play a leadership role in informing international policies that affect the availability of genetic resources, as can be seen from the inputs provided by the Secretariats of the International Treaty, the CBD and the FAO CGRFA in Annex 3.

Research objectives

The first objective is to understand how policies influence the availability of agrobiodiversity for use and conservation from local level management by farmers to internationally coordinated initiatives. The second objective is to identify and pilot options for policies to support the *in situ* conservation, management and use of agrobiodiversity. A third objective is to develop the capacity of national partners to identify and implement strategic policy options to conserve agrobiodiversity and to enhance its availability.

Research questions

- What policies have had significant impacts on the availability of agrobiodiversity to be conserved and used by farmers individually and collectively? What combinations of policies support the continued evolution of agrobiodiversity *in situ* (on farm and in the wild)? What factors contribute to the differential impacts of these policies across the diversity of environmental, social and political situations in which farmers live and work?

- How to create a better fit between the formal institutional arrangements (at national and international level) and the normative practices and needs of farmer communities with regard to agrobiodiversity use and conservation?

- Who are the most important actors influencing and setting national level agrobiodiversity-related policies? How do they harmonize national and international policies? What are their roles and how do they interact? What sources of information do they rely upon?

- What policies are having the most significant impact on the ability of agricultural research organizations (and the CGIAR centres and their partners in particular) to obtain, conserve and use agrobiodiversity and to disseminate their research products, ultimately to farm level?

- In light of the research conducted with respect to the first four bullet points above, what policy options exist to support sharing and exchange of agrobiodiversity at multiple levels (farm, national, international) between actors conserving and using agrobiodiversity? In particular, how can dynamic movement of materials from *in situ* and *ex situ* conditions, and from formal and informal systems, be encouraged?

- How can international legal obligations concerning environment, trade and food and agriculture be implemented at national and local levels in ways that that support agricultural biodiversity being made available, used and conserved?

- What are the best practices and policies the CGIAR centres and other research organizations can adopt with respect to their acquisition, use and distribution of agrobiodiversity in light of the evolving international legal framework?

Research methodology

Research will be organized in sites where it is possible to simultaneously investigate farmer household decision-making and national policy mechanisms and institutional arrangements and CGIAR centres' (and their partners') experiences obtaining, using and distributing agrobiodiversity. This will be done through a combination of knowledge systems' and social actor approaches (Vernooy & Song, 2004). The former focuses on the institutional and organizational structures and mechanisms through which knowledge is generated and divulgated from higher to lower levels of society. It analyzes management rules, responsibilities and roles, decision-making, and division of labour in relation to knowledge generation and dissemination. The latter focuses on how social actors, including women and men small farmers, entrepreneurs, local authorities, staff of nongovernmental organizations (NGOs), researchers and policymakers actively take part in and make decisions about the use, management, and conservation of agricultural biodiversity. Such a combined approach allows for a deeper understanding of how policy processes are being shaped by the both macro and micro level political and socio-economic forces and how policy processes in turn influence social change.

Regarding farm-level decision making in particular, new information gathering activities will be integrated into the research activities associated with the other SRT5 research topics, where possible in the same sites, and with many of the same partners. The research may also involve revisiting sites where ICARDA, CIP and Bioversity and partners have previously engaged in *in situ* conservation projects to take advantage of previously collected data for time series comparisons. The scope of this investigation will include the extent to which policies have supported cooperation of conservation and use related activities between farmers at local levels and other relevant actors with roles to play in conservation.

Regarding the impact of policies on availability of agrobiodiversity to research and development organizations, information will be gathered from:

- CGIAR centre scientists directly engaged in conservation (*ex situ* and *in situ*) and breeders.
- Centres' research partners who are collaborating in relevant activities.
- A representative sample of national agricultural and private-sector organizations that are not linked to the CGIAR centres. Their feed-back will be used to compare to centres' own accounts of how policies are affecting activities related to the conservation and use of agricultural biodiversity. It will also provide insights into how

germplasm and related information moves in streams parallel to those in which the Centres are directly involved. The information gathered will also be used to identify possible means by which the centres could align themselves with a broader constituency of actors in attempting to influence policies that would have a positive impact on all actors.

Research and supportive capacity development concerning the harmonized implementation of international agreements will involve, when appropriate, partners from NAROs in countries where other SRT5 activities are taking place. Research in this area will involve identifying the networks of actors involved in policy making at national levels (taking into consideration the links of national actors to international processes) and assessing the relative strength and importance of links between key actors and stakeholder groups. Research and related capacity-building activities will be designed to involve participation of a range of representatives from NARS, from technical experts in conservation science to policy makers; it will build upon the strength of existing connections between some actors, and increase the strength of strategic linkages between others. Centres' policy experts will work with competent national authorities, national universities, representatives of affected stakeholder groups, secretariats of international conventions and international development agencies to identify mechanisms to implement international environmental conservation, and agriculture and food security-related obligations in mutually supportive ways that emphasize the important contributions of agrobiodiversity. One example of this work is the development of options and models to simultaneously implement the access and benefit sharing provisions of the International Treaty on Plant Genetic Resources for Food and Agriculture and the Convention on Biological Diversity/Nagoya Protocol in mutually supportive ways. Another example concerns integrating agricultural biodiversity conservation and use into National Biodiversity Strategic Action Plans (NBSAPs) under the CBD, and in National Action Programmes for Adaptation (NAPAs) under UNFCCC. Priority will be given to developing model approaches (with flexibilities and options to adapt to individuating circumstances), monitoring their implementation in test cases, and raising awareness among centres' partners in NARS and international policy-making fora with respect to the precedents developed. The CGIAR centres are natural research partners with NARS in this research area, given the fact that the centres are the source of benefits associated with participation in the Treaty, including germplasm, information, capacity-building, technology transfer, and so on.

All of the forgoing work will contribute to identifying policy options for centres' own best practices and policies when it comes to implementing their obligations under international laws. Over the next 3-5 years, primary focus in this area will be on how centres should be implementing their responsibilities subject to their agreements with the Governing Body of the International Treaty, and policies for how they should most appropriately address grey areas associated with the Treaty. Examples of issues that will be addressed in this context are the conditions under which centres may distribute material from genebanks for non-food and non-feed purposes, or under what circumstances they may distribute materials for direct use in cultivation. Other areas of practice and policy that will be addressed in this context will be options and best practices for accessing, managing and distributing genetic resources that are not among the 64 crops and forages included under the International Treaty's framework, and which fall instead under the auspices of the Convention on Biological Diversity. Another important area will be developing research agreements with national partners, farming communities and farmers to promote transparency, trust, equitable benefit sharing and the ability to use and share the resources and information (including traditional knowledge) obtained from those sources in conservation, research and breeding. This work will build upon centres' own efforts with project partners to develop agreements on the exchange of reproductive materials and information in the context of *in situ* conservation projects (Lapena, López Noriega, & Turdieva, In Press). It will also build upon the very successful track record of the Inter-Centre Working Group—Genetic Resources as a mechanism for sharing information about centres' genetic resources policy-related challenges, and for consulting with respect to the development of policy responses. However, the focus of issues engaged in this component extends beyond genebank-related challenges to conservation *in situ* and on farm. As a result, the range of specialists to be involved in consultation would need to be expanded to include policy and technical experts engaged in relevant activities both from within the CGIAR and from organizations involved in project activities under this component.

Many of the research results generated will be directly relevant to international policy making fora, such as the conferences of the parties to the CBD/Nagoya Protocol and the UNFCC, the Governing Body of the International Treaty and the CGRFA and the CFS, and to several of the ad hoc open-ended working groups that those bodies create. Research results and policy recommendations will be 'ratcheted up' through submissions to those bodies.

Research Outputs

- Institutional arrangements and policy mechanisms identified that affect farmers' ability to adopt improved agrobiodiversity management practices.
- Factors identified that influence the dynamic transfer of agrobiodiversity between in situ and ex situ sources, at local, national, regional and international levels.
- Actor networks and their dynamics identified that shape the development and implementation of polices affecting the *in situ* management of agrobiodiversity.

- Policy mechanisms and institutional arrangements to support the availability of agrobiodiversity for conservation and use in the form of:
    - National level policy initiatives and institutional arrangements to support:
        - effective availability of agrobiodiversity to be used by farmers
        - *in situ* conservation and use of agrobiodiversity on farm and in the wild
        - effective flows between formal and informal seed systems
    - Models for integration of agrobiodiversity conservation and use in national plans to implement the CBD/Nagoya Protocol, the International Treaty, and the UNFCCC
    - Technical contributions to the international-level processes dedicated to further policy development and implementation of the International Treaty, CBD/Nagoya Protocol, the CGRFA's multi-year programme of work and the UNFCCC.
- Constraints and opportunities for the practical application of benefit-sharing arrangements in relation to agrobiodiversity conservation identified and options piloted.
- Best practices, policy options, draft instruments and guidelines for consideration by the Consortium office, CGIAR centres, CRPs
- Strengthened capacity of NARS to develop and implement policies and institutional arrangements supporting increased availability, conservation and use of agrobiodiversity.

Origin and Positioning of the Agrobiodiversity Component (SRT5 of CRP1.1) in the CRP Portfolio

Upon analysis of the Portfolio of concept notes for CRPs in May 2010, the Consortium Board decided to commission a Scoping Study on Genetic Resources to analyse which elements of this topic were included in the different CRPs, where there might be gaps in the Portfolio, and to make recommendations to address these gaps.

The Scoping Study Report, which was submitted to the Consortium Board in February 2011, recognized that there were significant gaps in important areas and that these should be addressed in the CRP Portfolio. The Consortium Board analysed the report in May 2011 and recommended that some elements should be taken up in existing CRPs. In particular, the Consortium Board Chair wrote a letter to the Lead Centre of CRP5 (Water, Land and Ecosystems) recommending that the Centres develop an Agrobiodiversity Component to be added to CRP5 to address three important area that were missing in the CRP portfolio: 1) *in situ* conservation, 2) information and knowledge, and 3) policy aspects, from local to international.

Following discussions among the Lead Centre, the Consortium Office and Bioversity, it was agreed that Bioversity would take the lead in developing such a component. Subsequently, a letter was sent to all Centre DGs asking for expressions of interest in contributing to the proposed component. As a result, four Centres collaborated in the development of the Agrobiodiversity Component: CIP, ICARDA, ILRI and Bioversity.

In the course of the development of the component and discussion of its links to the different CRPs, it was recognized that the content formed a coherent whole, but did not easily fit in CRP5. While agrobiodiversity is an important contributor to ecosystem functions addressed in CRP5, the themes identified by the Consortium Board go well beyond this and are global in nature. The conclusion of the analysis of the current portfolio was that in order to integrate this component, it would be necessary to make a pragmatic decision and choose the CRP where there is most affinity, recognizing that there will not be a 100% fit. As an alternative to CRP5, it was felt most logical to integrate the agrobiodiversity component into one of the elements of CRP1 (integrated systems for dry areas, humid tropics and aquatic systems). Indeed, the agrobiodiversity component is relevant to all three, but it would not make sense from a management point of view to divide this global component into three parts. It is therefore suggested that a decision be made to incorporate the agrobiodiversity component into one of them, recognizing that it is global in nature and therefore not be limited to the ecosystems included in that particular CRP. The Lead Centre of CRP1.1 on Integrated agricultural production systems for the dry areas welcomed the inclusion of the Agrobiodiversity component, recognizing its global nature.

It is therefore proposed that, after review and approval, the revised Agrobiodiversity Component, which addresses the changes most recently recommended by the Consortium Board, be integrated in CRP1.1 as an additional Strategic Research Theme.

<table>
<tr><th colspan="5">CRP1.1 Strategic Research Themes</th></tr>
<tr><th>SRT5:

Enhancing the in situ management of agricultural biodiversity</th><th>SRT1:

Approaches and models for strengthening innovation systems, building capacity and linking knowledge to policy actions</th><th>SRT2:

Reducing vulnerability and managing risk, leading to resilient dryland agroecosystems</th><th>SRT3:

Sustainable intensification for more productive, profitable and diversified dryland agriculture</th><th>SRT4:

Measuring impact and cross-regional synthesis</th></tr>
<tr><td>Research Topic 1

Status and Trends</td><td rowspan="5">Capacity development cuts across all 5 topics of SRT5.

Capacity Development activities in SRT5, as in the other SRTs of CRP1.1m will be designed to involve the participation of a range of stakeholders, including NARs, technical experts in Conservation science, and policy makers.

Specific capacity-development activities for dry areas will be directly linked with SRT1.</td><td>Information and knowledge on status and trends of target crops and species will be essential for enhancing system resilience.</td><td>Monitoring the impact of SRT3's activities on status and trends of in situ material.</td><td rowspan="5">Monitoring and evaluation and impact assessment mechanisms are embedded in SRT5. Those aspects of SRT5 M&E that target the dry areas will be undertaken with the framework of SRT4. Analysis in other agroecosystems and at a global level will incorporate other mechanisms.</td></tr>
<tr><td>Research Topic 2

Management and Conservation Tools and Methodologies</td><td>Reducing vulnerability and managing risk will be a key element in the development of in situ management plans.</td><td></td></tr>
<tr><td>Research Topic 3

Facilitating Use</td><td>The proper management and use of SRT5 target crops and species will ensure their conservation and also reduce vulnerability and risk.</td><td>Use of in situ conserved and managed material in improvement and domestication feeds into sustainable intensification, participatory breeding etc.</td></tr>
<tr><td>Research Topic 4

Information and Knowledge</td><td>Information and knowledge on insitu material will be essential for SRT2 systems.</td><td>Information and knowledge on in situ material will be essential for SRT3 systems.</td></tr>
<tr><td>Research Topic 5

Policy and Strategies</td><td colspan="2">Policy research in SRT5 will enhance the conservation and use of agricultural biodiversity, including its use to improve the stability of production systems, reducing vulnerability, enabling sustainable intensification and enhancing livelihoods.</td></tr>
</table>

Cross linkages among the Strategic Research Themes of CRP1.1

Integration of SRT5 within CRP1.1

The Agrobiodiversity Component will be added to CRP1.1 as a fifth strategic research theme (SRT5) under the overall management and governance of CRP 1.1, with appropriate recognition of the global nature of SRT5. We will take part in the CRP1.1 inception workshops planned in each region in order to work closely with partners to identify priority crops and geographic areas for *in situ* conservation and management research as outlined in the proposal, working within CRP1.1's selected areas of focus. Staff working in SRT5 in a particular dry area focus region will join the respective interdisciplinary team. For work outside the target dry areas of CRP 1.1 the same priority setting process will be used to select priority species for implementation in the areas of focus of CRP1.2 and CRP1.3. Capacity development activities will be carried out in the context of SRT1 and impact assessment activities as part of SRT4. Monitoring and Evaluation activities will be fully integrated in the CRP1.1 M&E framework. (See table above.)

Linkages with other CRPs

Throughout the description of this agrobiodiversity component, some linkages with other CRPs have already been mentioned. Here we recapitulate some of the most important ones, recognizing that as we move into the more detailed planning process, after approval, further linkages are likely to be identified.

Because of the global nature of the work proposed, strong linkages will be established with CRPs 1.2 and 1.3.

We reiterate that *in situ* management and conservation is not an end on its own and that the use value of these resources is a key element in prioritizing the target agrobiodiversty. The use of conserved material is an important element of the research in SRT5, results from which will provide (and make available) relevant information on the priority target genetic material. However, it is important to note that there are other uses for genetic diversity, and that these that are to be investigated in other CRPs. Therefore, it is important for SRT5 to establish linkages with CRPs in which a use value for the genetic diversity is envisaged, i.e.:

- CRP 3 for crop improvement based on the specific traits of landraces and CWR,
- CRP 4 for the importance of agricultural biodiversity to improve health and nutrition
- CRP 5 for the importance of agricultural biodiversity in providing ecosystem services, and
- CRP 7 for using agricultural biodiversity to adapt to climate changes.

Collaboration with CRP 6 is envisaged to address methodological issues related to questions of complementarity among on farm, *in situ* and *ex situ* conservation.

For each of these potential linkages there is a need to develop collaboration along three major lines: how the other CRPs can benefit from the results of this research agenda on agrobiodiversity; how this agenda can benefit from outputs in other CRPs; and what research can be done together.

Regarding conservation, research on *ex situ* conservation is already included in some of the crop specific CRPs and should be included in those where it is not yet included in order to ensure that this research is adequately covered in the portfolio. Research on the Status and Trends of diversity research topic will provide valuable information to the crop-specific CRPs regarding areas for priority collection for *ex situ* conservation. The identification of important adaptive traits in landraces of major crops will be another important contribution from SRT5 to the crop-specific CRPs for those crops and species that are not already targeted within the CRPs.

CRP4 aims at improving nutrition and health, one of the system-level objectives of the CGIAR. One of the proposed ways to improve nutrition and health is through agricultural diversification for nutrition, focusing on the contribution of local biodiversity to diets (CRP 4 component 1). SRT5 will provide useful information on the potential relevance of biodiversity, in particular NUS and LR, for health and nutrition. This information will need to be validated by CRP4 in order to properly assess its relevance for health and nutrition, and working with CRP4 in the same geographical areas and communities will help to fully exploit this potential.

CRP5 aims at sustaining the environment and natural resource base in different environments. The ecosystem component of CRP5 in particular aims to ensure that agricultural intensification makes use of and enhances ecosystem services. There is a clear linkage in determining which elements of agrobiodiversity can contribute to the CRP5 goals. SRT5 will provide relevant information on the diversity available and its characteristics that could be important to enhance ecosystem services. While CRP5 focuses on the ecosystem level, SRT5 focuses on elements of biodiversity within the ecosystems.

CRP6 is about forest, trees and agroforestry, and its component 2 has a significant element on biodiversity, in particular on tree diversity. There are opportunities to collaborate to develop the tools to assess status and threats of priority species and to develop and share some of the GIS/RS tools required for the conservation action envisaged by this proposal for SRT5. This should also include the conservation of wild relatives of important tree crops (coffee, cocoa, coconut and dryland fruit trees).

CRP7 on climate change addresses one of the big challenges farmers face in their production system. CRP7 aims to develop practices to adapt agricultural systems to these changes and to reduce the risks associated to climate changes. While the actions will be different in different ecoregions, depending on the specific threats, one common element recognised by CRP7 is the role played by genetic diversity to reduce vulnerability to new biotic and abiotic stresses. There is a clear role for the SRT5 in linking to CRP7 to provide important information on the adaptive traits required to adapt to climate change. More detailed information on the required genetic diversity to increase system resilience will benefit the practices developed by CRP7 to help farmers to adapt to climate changes.

There will be strong collaboration with other Strategic Research Themes of CRP1.1. In particular, CRP1.1 envisages an important role for agricultural biodiversity in order to increase the resilience and productivity of agriculture in dry areas. In order to achieve this goal, collaboration with its agrobiodiversity SRT will be relevant in order to gain knowledge about the required genetic diversity. The same considerations of the importance of agrobiodiversity for resilience and productivity apply in the humid tropics (CRP1.2),

For the policy research, linkages will be established with all relevant CRPs as well as with all CGIAR centres to gather baseline information and to share experiences. The policy research activities included in CRP7 will be closely linked to the work in this component, as they will be complementary to each other, with CRP7 focussing on the climate change dimensions, while this component takes on a broader global dimension.

Potential Collaboration and Linkages between the agricultural biodiversity component (SRT5 of CRP1.1) and other CRPs

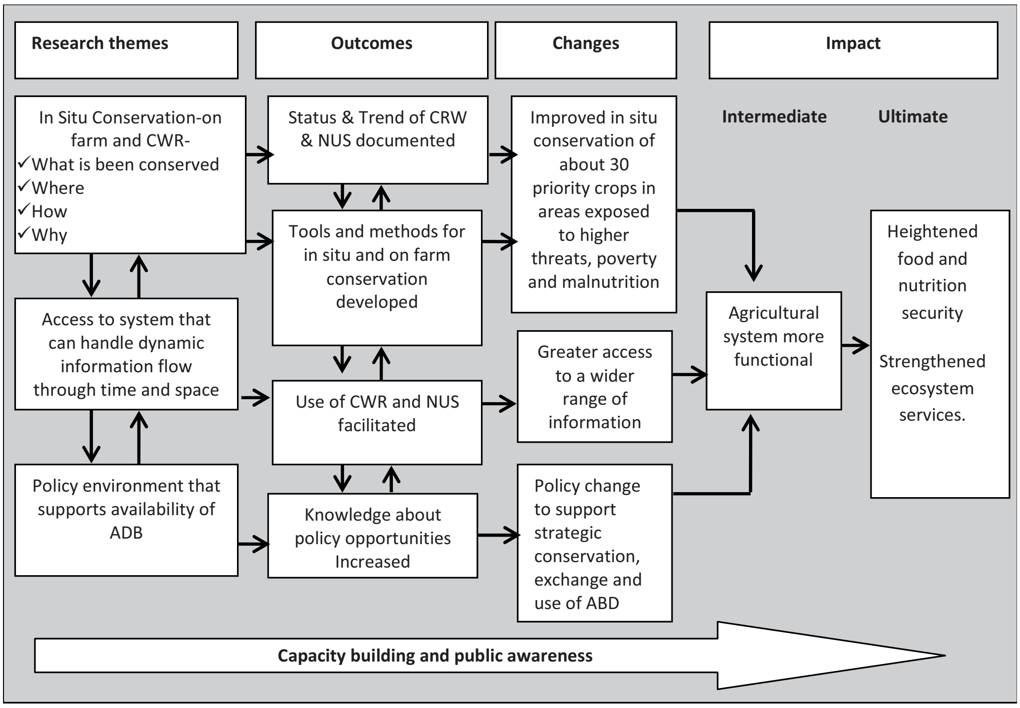
Other CRPs	Scope for Collaboration and Research Linkages	Mechanisms for Achieving Integration
CRP1.1	SRT5 will be integrated into CRP1.1. It will therefore be part of the overall CRP1.1, even though it will have a global reach in its activities, and will therefore operate outside the mandate zones of CRP1.1. The scope of research collaborations and linkages will be intense for SRT5 activities in the dry areas, as indicated in the table above.	SRT5 will be fully involved in planning meetings, M&E activities and capacity-development activities of CROP1.1. The component will participate in the planned inception workshops to be organized in each of the 5 target regions of CRP1.1. The inception workshops will be used to gain deeper understanding and involvement of all CRP1.1 partners in SRT5. The workshops will provide a locus for participatory priority setting of geographical areas and target crops and species.
CRP1.2 and CRP1.3	Although the agricultural biodiversity component (SRT5) is housed within CRP1.1, it is equally relevant to the other CRP1 themes, Humid Tropics and Aquatic Systems. CRP1.2 and CRP)1.3 will therefore have a strong programmatic relationship with SRT5 of CRP1.1. For example, the on-farm management of agricultural biodiversity towards improved livelihoods, especially for coconut, banana and fruit trees are expected inputs into CRP1.2. The effectiveness of different management interventions for agricultural biodiversity in AAS will be tested in the selected sites of CRP1.3 and similar work with respect to the humid tropics will be undertaken with CRP1.2	SRT5 will participate in the panning meetings and inception workshops organized in the framework of CRP1.2 and CRP1.3, for the same purposes as described for CRP1.1, above. The focal countries and sites of CRP1.2 and CRP1.3 could provide a base to assess the effectiveness of different management interventions for agricultural biodiversity developed through SRT5.
CRP2	Priority crops and species could be linked into CRP2 for value chain analysis and development. Information from the agricultural biodiversity component on potential and priority crops and species could provide a useful basis for CRP2 work on value chains.	

Other CRPs	Scope for Collaboration and Research Linkages	Mechanisms for Achieving Integration
CRP3 (all)	It will be important for the agricultural biodiversity component to establish linkages with all the CRPs in thematic area 3, to enable crop improvement based on specific traits in target crops and species of SRT5. Information on status and trends from SRT5 of CRP1.1 could also guide the collection by CRP3 of threatened material for *ex situ* conservation. Information and policies developed through the agricultural biodiversity component will be of direct benefit to the overall work of CRP3 on a crop by crop basis.	
CRP4	CRP4 aims to improve nutrition and health, one of the system-level objectives of the CGIAR. Obne of the proposed ways to do so is through agricultural diversification for nutrition, focusing on the contribution of local biodiversity to diets (Component 1 of CRP4). The agricultural biodiversity component can provide useful information on the potential relevance of target crops and species for health and nutrition. These would be validated and assessed for nutritional value through CRP4.	SRT5 of CRP1.1 will need to interact regularly with CRP4 in order to identify common areas of focus and to link activities in relevant areas. Working in the same geographical areas and communities as CRP4 will help to fully exploit this potential. Involvement of the agricultural biodiversity component in CRP4 planning meetings will strengthen synergy development.
CRP5	The agricultural biodiversity component will provide relevant information of the diversity available and its characteristics that could be important to enhance ecosystem services. While CRP5 focuses on the ecosystem level, SRT5 of CRP1.1 focuses on elements of biodiversity within agroecosystems. The two programmes are thus mutually supportive.	Regular consultations across the two programmes. CRP5 will be invited to participate in relevant activities of the agricultural biodiversity component.

Other CRPs	Scope for Collaboration and Research Linkages	Mechanisms for Achieving Integration
CRP6	There are opportunities to collaborate on the development of tools to assess status and threats, and to develop and share some of the GIS/RS tools that will be needed for the management and conservation actions envisaged by the agricultural biodiversity component. This will include the conservation of wild relatives of important tree crops, such as coffee, coconut and cocoa.	Regular consultations across the two programmes. Participation in relevant activities such as planning events and project development.
CRP7	There is a clear role for SRT5 of CRP1.1 to link to CRP7 in respect to the use of agricultural biodiversity to adapt to climate change. The agricultural biodiversity component will also provide important information on the traits required to adapt to climate change.	Regular consultations across the two programmes. The agricultural biodiversity component will be a party in the implemention of CRP7. This will include participation in planning events and project development and analysis.

Impact Pathways

A monitoring and evaluation (M&E) mechanism is embedded in the proposal in order to assess what changes will occur as a result of the interventions of enhanced *in situ* conservation and use, effective information support, and conducive policies, to guide how research outputs may achieve research and development outcomes and eventual contributions to impact. This will provide process information to assist research managers in managing the component. M&E of impact will thus be an integral element of the research agenda within the component



Through a participatory process that involves all research partners at all levels (farmers, breeders, other scientists, policy makers) we expect to understand how the planned research activities will lead to the expected impact. Network mapping analysis, including all research partners and beneficiaries, will be conducted to understand how research outputs, once adopted and used by the beneficiaries can also be "institutionalized" by policy makers at different levels.

Specific, measurable, attributable, realistic and timebound indicators, as well as baseline data will be required in order to be able to measure changes occurred as a result of the adoption and use of outputs generated by the component. Coordinated research aiming at providing globally applicable methods, decision support tools and methodologies, intervention strategies for *in situ* and on farm conservation of rangeland species, landraces, CWR and NUS, as well as greater access to a wider range of information about existing agricultural biodiversity and a policy environment at all levels from international to local, that permits and encourages the strategic conservation, exchange and use of agricultural biodiversity will lead to more functional systems that can contribute to reducing rural poverty, improving food and nutrition security and sustainable management of natural resources.

Capacity development

Capacity development has a dual purpose under this SRT. It will equip research teams, in particular national partners, with specific competences and opportunities to carry out multi-disciplinary and multi-stakeholder research on the key topics of this SRT: *in situ* conservation, information on plant genetic resources, and policies that support availability and use of agricultural biodiversity. Secondly, it will facilitate and enhance impacts of the SRT and contribute to mainstreaming the specific research results into local, national, and regional institutions and programmes.

Although agricultural biodiversity has become an accepted and well-known concept among policy makers and specialists over the past 15-odd years, the awareness among the broader range of stakeholders of the specific topics relating to this SRT is generally weak. Raising awareness and capacity in areas such as *in situ* conservation of crop wild relatives, on-farm conservation of landraces and NUS, and policy processes on plant genetic resources are central to achieving the expected outcomes and contribute to anticipated impacts of this SRT.

Very few universities offer courses or programmes in the core areas of this SRT (Rudebjer et al., 2011). This, in turn results in graduates with limited experiences in research methods such as participatory biodiversity management or the assessment of status and trends of agricultural biodiversity. The slow implementation at the national level of the ITPGRFA is partly attributed to capacity limitations regarding plant genetic resources policy. Similarly, biodiversity conservation specialists have had limited exposure to the conservation of agricultural biodiversity in production landscapes. The integration of *in-situ* conservation of crop wild relatives into national biodiversity conservation strategies is therefore lagging behind. Often, the scaling-up of results of agricultural biodiversity research requires new collaboration across disciplines and sectors.

The capacity development activities under this SRT will therefore enhance individual capacities for R&D, and influence institutional capacities for mainstreaming research results from local to regional levels. The SRT will also strengthen individual research capacity, especially among young scientists, for multidisciplinary approaches that combine biological and social sciences in agricultural biodiversity, by providing opportunities such as thesis research, research fellowships and visiting scientist schemes. These will allow young scientists to work under the mentorship of senior scientists within the SRT. Co-publishing jointly with international scientists will boost their scientific records.

Bringing research into use to achieve impact on peoples' livelihoods and on the environmental services of agroecosystems requires partnership with a range of intermediary organizations. These include, among others, conservation organizations, universities and university networks, regional and national research organizations, including networks, as further detailed in the Partners section. Working jointly with a distinct, selected set of such partners, this SRT will develop strategies and capacities for mainstreaming agricultural biodiversity into policies and programmes, such as university curricula, and national or regional agrobiodiversity conservation strategies, including for example the Suwon Agrobiodiversity Strategy and the Agrobiodiversity Initiative for Africa mentioned above.

The continued monitoring and evaluation of the global status and needs for capacity development in the field of agricultural biodiversity will also be an important activity.

Gender

The role of women as custodians of agricultural biodiversity and as a key element in food security is now well recognised. In sub-Saharan Africa, for example, women are responsible for roughly 80% of farm production, and around the globe among rural people their contribution generally outweighs that of men. In particular, women do most of the work of producing, gathering, processing and marketing of the food plants essential for family nutrition and livelihoods. Women are most likely to take action to diversify food supplies in their plots and family diets and to cope with market shocks and food shortages (Raney, 2011).

Of particular interest to this SRT, women play a vital, and often unrecognised, role in the management of agricultural biodiversity. The traits and qualities they value in crop varieties differ from those preferred by men, and often encompass aspects such as cooking qualities, taste and nutrition (Eyzaguirre & Linares, 2004). Within their communities, women tend to be the experts on edible plant diversity on their farms and in the wild. They are the innovators, selecting new varieties and developing new foods. The experience they accumulate as managers of local biodiversity for food security, family nutrition and livelihoods constitutes a body of knowledge that is essential for future conservation and use. The proposed research will help to gather and share this knowledge, which also offers the opportunity for women in communities to add new appropriate information from other communities that have faced similar challenges.

Furthermore, women often have a responsibility in their families and their communities for selecting and storing seed and in decisions of what to grow. For these reasons, and others, all of the research in this SRT will place importance on gender in design and implementation and will seek to understand the complexity of gender roles as they affect the conservation and use of crop and species diversity. Each research topic will reflect an awareness of the links between gender and the management, conservation and use of agricultural biodiversity. The capacity development activities that are embedded in each topic will use gender as a criterion in selection for participation in order to empower women at all levels, from farming families to collaborating scientists

Partners

Partnerships in this component will consist of four key types: relevant CGIAR centres; national agriculture research systems in developing countries, which are especially important for the implementation of *in situ* and on farm conservation; Advanced Research Institutions; and global agencies, NGOs and international organizations working on agricultural biodiversity.

The four participant CGIAR Centres will all be involved in most aspects of SRT5 research. Other CGIAR centres that collect and manage information about agricultural biodiversity will be vital partners in the Information and the Policy research topics.

Agropolis (Cirad, IRd, Inra, Montpellier "SupAgro"), EMBRAPA, NBPGR and CAAS, who have each expressed an interest in contributing to a component on agricultural biodiversity, will be important partners. The French institutions have expressed an interest in both research and capacity development activities.

Partnerships with FAO, CBD, IUCN and national conservation authorities will strengthen *in-situ* conservation both in terms of policies and with reserves in the field, such as through the Satoyama Initiative. Such partnerships will help to extend the range of conservation options for farmers' varieties and for crop wild relatives. Advocacy will be required to widen the purview of conservation organizations to include species and landscapes of direct economic importance.

The expertise of other scientific organisations, such as Birmingham University, Royal Botanic Gardens, Kew, Missouri Botanic Gardens, New York Botanic Gardens, USDA National Herbarium and other national herbaria will be important in identifying crop wild relatives and helping to designate potential areas for *in-situ* conservation.

NGOs such as LI-BIRD, MSSRF, PROINPA, CIRMM and others will be very important for working in the field with farming communities. International Organizations such as Conservation International and The Nature Conservancy are also expected to show an interest.

GFAR, FARA and APAARI have already expressed their strong support for the proposed Agrobiodiversity Component and will facilitate the participation of NARS in the research agenda. It is expected that similar engagement will emerge from other regional fora.

In the course of developing the ideas that have resulted in this proposal, we have consulted with several organizations, among them Agropolis, USDA, NBPGR, EMBRAPA, CAAS, universities, national partners and others. We have given undertakings to continue to involve them in the implementation of the SRT.

Bibliography

Aleman, J., Thomet, M., Bazile, D., & Pham, J. L. (2010). Central role of nodal farmers in seed exchanges for biodiversity dynamics: example of "curadoras" for the quinoa conservation in Mapuche communities in south Chile. In E. Coudel, H. Devautour, C. Soulard, & B. Hubert (Eds.), *International symposium ISDA 2010. Innovation and sustainable development in agriculture and food : Abstracts and papers* (p. 14). Montpellier: CIRAD.

Amri, A., Monzer, M., Al-Oqla, A., Atawneh, N., Shehahdeh, A., & Konopka, J. (2005). *Status and threats to crop wild relatives in selected natural habitats in west Asia region*. Paper presented at the Promoting Community-driven Conservation and Sustainable Use of Dryland Agrobiodiversity, Aleppo.

Anderson, S. (2003). Animal genetic resources and sustainable livelihoods. *Ecological Economics*, *45*(3), 331–339.

Anon. (2007). *Halting the loss of biodiversity by 2010: proposal for a first set of indicators to monitor progress in Europe.* Copenhagen: European Environment Agency.

Atkinson, R. C., Beachy, R. N., Conway, G., & Cordova, F. A. (2003). Public sector collaboration for agricultural IP management. *Science*, *301*(July), 174-176.

Badstue, L., Bellon, M., Berthaud, J., Ramirez, A., Flores, D., & Juarez, X. (2007). The Dynamics of Farmers' Maize Seed Supply Practices in the Central Valleys of Oaxaca, Mexico. *World Development*, *35*(9), 1579–1593.

Badstue, L. B., Bellon, M. R., Berthaud, J., Juárez, X., Rosas, I. M., Solano, A. M. et al. (2006). Examining the Role of Collective Action in an Informal Seed System: A Case Study from the Central Valleys of Oaxaca, Mexico. *Human Ecology*, *34*(2), 249-273.

Barnaud, A., Deu, M., Garine, E., McKey, D., & Joly, H. (2007). Local genetic diversity of sorghum in a village in northern Cameroon: structure and dynamics of landraces. *Theoretical and Applied Genetics*, *114*, 237-248.

Barry, M. B., Pham, J.-L., Noyer, J. L., Courtois, B., Billot, C., & Ahmadi, N. (2007). Implications for in situ genetic resource conservation from the ecogeographical distribution of rice genetic diversity in Maritime Guinea. *Plant Genetic Resources*, *5*(01), 45-45.

Bazile, D., & Weltzien, E. (2008). Agrobiodiversités : numéro spécial. *Cahiers agriculture*, *17*(2).

Beed, F., Benedetti, A., Cardinali, G., Chakraborty, S., Dubois, T., Garrett, K. et al. (2011). *Climate Change and Micro-Organism Genetic Resources for Food and Agriculture: State of Knowledge, Risks and Opportunities. Background Study Paper No. 57. CGRFA13.* Rome: FAO.

Belem, M., Bousquet, F., Müller, J. P., Bazile, D., & H, C. (2011). *A participatory modeling method for multi-points of view description of a system from scientist's perceptions : application in seed systems modeling in Mali and Chile*. Paper presented at the *7th European Social Simulation Association Conference (ESSA 2011), Montpellier, France, September 19-23, 2011*, Montpellier.

Bellon, M. R., Hodson, D., & Hellin, J. (2011). Assessing the vulnerability of

traditional maize seed systems in Mexico to climate change. *Proc Natl Acad Sci U S A*, *108*(33), 13432-13437.
Best, R., Lundy, M., & Ferris, S. (2009). *Getting to market. From agriculture to agroenterprise.* Baltimore: Catholic Relief Services.
Bezançon, G., Pham, J.-L., Deu, M., Vigouroux, Y., Sagnard, F., Mariac, C. et al. (2008). Changes in the diversity and geographic distribution of cultivated millet (Pennisetum glaucum (L.) R. Br.) and sorghum (Sorghum bicolor (L.) Moench) varieties in Niger between 1976 and 2003. *Genetic Resources and Crop Evolution*, *56*(2), 223-236.
Bhaati, S., Hardison, P., & Neumann, K. (2003). *The Role of Registers and Databases in the Protection of Traditional Knowledge.* Tokyo: United Nations University Institute of Advanced Study.
Bhandari, B. (2009). *Summer rainfall variability and the use of rice (Oryza sativa L.) varietal diversity for adaptation: farmers' perceptions and responses in Nepal.* SLU, Swedish Biodiversity Centre.
Brahy, N. (2006). The contribution of databases and customary law to the protection of traditional knowledge. *International Social Science Journal*, *58*(188), 259–282.
Brondizio, E. S. (2008). *The Amazonian Caboclo and the Açaí Palm (Advances in Economic Botany 16).* New York: New York Botanical Garden Press.
Brown, A. H. D. (2008). *Indicators of Genetic Diversity, Genetic Erosion and Genetic Vulnerability for Plant Genetic Resources for Food and Agriculture.* Rome: Food and Agriculture Organization of the United Nations.
Brush, S. B., Carney, H. J., & Huaman, Z. (1981). Dynamics of Andean potato agriculture. *Economic Botany*, *35*(1), 70-88.
Brush, S. B. (2007). Farmers' rights and protection of traditional agricultural knowledge. *World Development*, *35*(9), 1499-1514.
Burgos, G., Amoros, W., Morote, M., Stangoulis, J., & Bonierbale, M. (2007). Iron and zinc concentration of native Andean potato cultivars from a human nutrition perspective. *Journal of the Science of Food and Agriculture*, *87*(4), 668–675.
CGIAR, SGRP. (2009). *Experience of the International Agricultural Research Centres of the Consultative Group on International Agricultural Research (CGIAR) with the implementation of the Agreements with the Governing Body, with particular reference to the use of the Standard.* Rome: SGRP.
CIP-UPWARD (Ed.). (2003). *Conservation and Sustainable Use of Agricultural Biodiversity: a sourcebook.* Los Baños: CIP-Users' Perspectives with Agricultural Research and Development.
de Haan, S. (2009). *Potato Diversity at Height: multiple dimensions of farmer-driven in-situ conservation in the Andes.* Wageningen Agricultural University, Wageningen.
de Haan, S., Núñez, J., Bonierbale, M., & Ghislain, M. (2010). Multilevel Agrobiodiversity and Conservation of Andean Potatoes in Central Peru. *Mountain Research and Development*, *30*(3).
de Haan, S., Bonierbale, M., Ghislain, M., Núñez, J., & Trujillo, G. (2007). Indigenous biosystematics of Andean potatoes: folk taxonomy, descriptors, and nomenclature. *Acta Hort (ISHS)*, *745*, 89-134.
De Pauw, E. (2005). *Applying Geographical Information Systems (GIS),*

Remote Sensing, and Agro-Ecological Characterization in Agro-Biodiversity Assessments. Paper presented at the Proceedings of the International Conference on: Promoting Community-driven Conservation and Sustainable Use of Dryland Agrobiodiversity, Aleppo.
Dedeurwaerdere, T., Iglesias, M., Weiland, S., & Halewood, M. (2009). *The use and exchange of microbial genetic resources for food and agriculture. Background Study Paper No. 46. CGRFA, October 2009.* Rome: FAO.
Duc, G., Bao, S., Baum, M., Redden, B., Sadiki, M., Suso, M. J. et al. (2010). Diversity maintenance and use of Vicia faba L. genetic resources. *Field Crops Research*, *115*(3), 270-278.
Dulloo, M. E., Hunter, D., & Borelli, T. (2010). *Ex Situ* and I*n Situ* Conservation of Agricultural Biodiversity: Major Advances and Research Needs. *Not. Bot. Hort. Agrobot. Cluj*, *38*(2), 123-135.
Engels, J. M. M., V.R., R., Brown, A. H. D., & Jackson, M. T. (Eds.). (2002). *Managing Plant Genetic Diversity.* Rome, Wallingford: IPGRI, CABI Publishing.
Ericksen, P. J. (2008). Conceptualizing food systems for global environmental change research. *Global Environmental Change*, *18*(1), 234 - 245.
Eyzaguirre, P. B., & Linares, O. F. (2004). *Home gardens and agrobiodiversity.* Washington D.C.: Smithsonian Books.
FAO. (1997). *The State of the World's Plant Genetic Resources for Food and Agriculture.* Rome: Food and Agriculture Organization of the United Nations.
FAO. (2007). *The Global Plan of Action for Animal Genetic Resources and the Interlaken Declaration on Animal Genetic Resources.* Rome: FAO.
FAO. (2009). *Livestock Keepers: Guardians of biodiversity.* Rome: FAO.
FAO. (2010a). *Breeding strategies for sustainable management of animal genetic resources.* Rome: FAO.
FAO. (2010b). *The Second Report on The State of the World's Plant Genetic Resources for Food and Agriculture.* Rome: Food and Agriculture Organization of the United Nations.
FAO. (2011a). *Developing the institutional framework for the management of animal genetic resources.* Rome: FAO.
FAO. (2011b). *Surveying and monitoring of animal genetic resources.* Rome: FAO.
FAO. (2011c). *World Livestock 2011: Livestock in food security.* Rome: FAO.
Feder, G., Just, R. E., & Zilberman, D. (1985). Adoption of Agricultural Innovations in Developing Countries: A Survey. *Economic Development and Cultural Change*, *33*(2), 255-298.
Finckh, M. R. (2008). Integration of breeding and technology into diversification strategies for disease control in modern agriculture. *European Journal of Plant Pathology,* 399-409.
Fujisaka, S., Williams, D., & Halewood, M. (2009). *The impact of climate change on countries' interdependence on genetic resources for food and agriculture. Background study paper no. 48. CGRFA.* Rome: FAO.
Gibson, J., Gamage, S., Hanotte, O., Iñiguez, L., Maillard, J. C., Rischkowsky, B. et al. (2006). *Options and Strategies for the Conservation of Farm Animal Genetic Resources. Report of an International Workshop AGROPOLIS, Montpellier, France 7–10 November 2005.* Rome: CGIAR

System-wide Genetic Resources Programme (SGRP)/Bioversity International.
Glaszmann, J. C., Kilian, B., Upadhyaya, H. D., & Varshney, R. K. (2010). Accessing genetic diversity for crop improvement. *Curr Opin Plant Biol*, *13*(2), 167-173.
Gorbach, D. M., Makgahlela, M. L., Reecy, J. M., Kemp, S. J., Baltenweck, I., Ouma, R. et al. (2010). Use of SNP genotyping to determine pedigree and breed composition of dairy cattle in Kenya. *Journal of animal breeding and genetics*, *127*(5), 348–351.
Graham, R. D., Welch, R. M., Saunders, D. A., Ortiz-Monasterio, I., Bouis, H. E., Bonierbale, M. et al. (2007). Nutritious subsistence food systems. *Advances in Agronomy*, *92*, 1-74.
Guarino, L., Rao, V. R., & Reid, R. (Eds.). (1995). *Collecting Plant Genetic Diversity: Technical Guidelines.* Wallingford: CAB International.
Guarino, L., Rao, V. R., & Goldberg, E. (Eds.). (2011). *Collecting Plant Diversity Technical Guidelines - 2011 update.* Rome: Bioversity International.
Halewood, M., Sood, R., Sackville-Hamilton, R., & Amri, A. (In Press). Declining Rates of Acquisitions by International Genebanks: a pre-Treaty Baseline Study. In M. Halewood, I. López Noriega, & S. Louafi (Eds.), *Crop Genetic Resources as Global Commons: Challenges in International Law and Governance.* London: Earthscan.
Halewood, M., López Noriega, I., & Louafi, S. (Eds.). (In Press). *Crop Genetic Resources as Global Commons: Challenges in International Law and Governance.* London: Earthscan.
Hanotte, O., Tawah, C. L., Bradley, D. G., Okomo, M., Verjee, Y., Ochieng, J. et al. (2000). Geographic distribution and frequency of a taurine *Bos taurus* and an indicine *Bos indicus* Y specific allele amongst sub-saharan African cattle breeds. *Molecular Ecology*, *9*(4), 387–396.
Hanotte, O., Bradley, D. G., Ochieng, J. W., Verjee, Y., Hill, E. W., & Rege, J. E. O. (2002). African pastoralism: genetic imprints of origins and migrations. *Science*, *296*(5566), 336–339.
Hassan, R., Scholes, R., & Ash, N. (Eds.). (2005). *Ecosystems and Human Well-Being: current state and trends: Findings of the Condition and Trends Working Group.* New York: Island Press.
Hodgkin, T., Rana, R., Tuxill, J., Didier, B., Subedi, A., Mar, I. et al. (2007). Seed systems and crop genetic diversity in agroecosystems. In D. I. Jarvis, C. Padoch, & D. Cooper (Eds.), *Managing biodiversity in agricultural ecosystems.* New York: Columbia University Press.
Hoffmann, I., & Schaal, B. A. (2010). Implementing the Global Plan of Action for Animal Genetic Resources. *Animal Genetic Resources*, *47*, 1-10.
Huaman, Z. (2002). Tecnología Disponible para Reforzar La conservación “in situ” de los Cultivares de Papa Tradicionales de los Andes. *Revista Electrónica Red Mundial de CientíficosPhilos Tr*, *1*, 1-10.
Hunter, D., & Heywood, V. (Eds.). (2010). *Crop Wild Relatives: A Manual of In Situ Conservation.* London: Earthscan.
Jarvis, D. I., Brown, A. H. D., Cuong, P. H., Collado-Panduro, L., Latournerie-Moreno, L., Gyawali, S. et al. (2008). A global perspective of the richness and evenness of traditional crop-variety diversity maintained by farming communities. *Proceedings of the National Academy of Sciences of the*

United States of America, *105*(14), 5326-5331.
Jarvis, D. I., Hodgkin, T., Sthapit, B. R., Fadda, C., & López Noriega, I. (2011). An Heuristic Framework for Identifying Multiple Ways of Supporting the Conservation and Use of Traditional Crop Varieties within the Agricultural Production System. *Critical Reviews in Plant Sciences*, *30*(1), 125-176.
Jarvis, D. I., Padoch, C., & Cooper, D. (Eds.). (2007). *Managing biodiversity in agricultural ecosystems.* New York: Columbia University Press.
Johns, T., & Sthapit, B. R. (2004). Biocultural diversity in the sustainability of developing-country food systems. *Food Nutr Bull*, *25*(2), 143-155.
Knowler, D., & Bradshaw, B. (2007). Farmers' adoption of conservation agriculture: A review and synthesis of recent research. *Food Policy*, *32*(1), 25-48.
Kugonza, D., Nabasirye, M., Hanotte, O., Mpairwe, D., & Okeyo, A. (2011). Pastoralists' indigenous selection criteria and other breeding practices of the long-horned Ankole cattle in Uganda. *Tropical Animal Health and Production,* 1-9.
Kugonza, D., Nabasirye, M., Mpairwe, D., Hanotte, O., & Okeyo, A. M. (2011). Productivity and morphology of Ankole cattle in three livestock production systems in Uganda. *Animal Genetic Resources*, *48*, 13-22.
Kuyek, D. (2002). *Intellectual Property Rights in African Agriculture : Implications for Small Farmers.* Barcelona: GRAIN.
Lapena, I., López Noriega, I., & Turdieva, M. (In Press). *Guidelines: Access and benefit sharing in the research projects.* Rome: Bioversity International.
Louette, D., Charrier, A., & Berthaud, J. (1997). In situ conservation of maize in Mexico: genetic diversity and maize seed management in a traditional community. *Economic Botany*, *51*(1), 20-38.
Mackay, M. C., Street, K. A., Mitrofanova, O. P., Konopka, J., & Berger, J. (2004). *The Role of Registers and Databases in the Protection of Traditional Knowledge*. Paper presented at the Cereals 2004, Proceedings of the 54th Australian Cereal Chemistry Conference and the 11th Wheat Breeders Assembly, Melbourne.
Margules, C. R., & Pressey, R. L. (2000). Systematic conservation planning. *Nature*, *405*(6783), 243-253.
Maxted, N., Dulloo, E., Ford-Lloyd, B. V., Iriondo, J. M., & Jarvis, A. (2008). Gap analysis: a tool for complementary genetic conservation assessment. *Diversity and Distributions*, *14*(6), 1018-1030.
Maxted, N., Ford-Lloyd, B., Kell, S. P., Iriondo, J., Dulloo, E., & Turok, J. (Eds.). (2008). *Crop wild relative conservation and use.* Wallingford: CABI.
Maxted, N., & Kell, S. (2009). *Establishment of a global network for the in situ conservation of crop wild relatives: status and needs.* Rome: FAO Commission on Genetic Resources for Food and Agriculture.
Mazid, A., Shideed, K., & Amri, A. (2005). *Assessing the Impact of Agrobiodiversity Conservation on Rural Livelihoods in the Dry Areas*. Paper presented at the Proceedings of the International Conference on Promoting Community-driven Conservation and Sustainable Use of Dryland Agrobiodiversity, Aleppo.
Muigai, M. W. (2003). *Characterization and conservation of indigenous animal*

genetic resources: Genetic diversity and relationships of fat-tailed and thin-tailed sheep of Africa. Jomo Kenyatta University of Agriculture and Technology, Kenya.
Ndumu, D. B., Baumung, R., Hanotte, O., Wurzinger, M., Okeyo, M. A., Jianlin, H. et al. (2008). Genetic and morphological characterisation of the Ankole Longhorn cattle in the African Great Lakes region. *Genetics selection evolution*, *40*(5), 467–490.
Ojango, J. M., Panandam, J. M., Bhuiyan, A. K. F. H., & Khan, M. S. (2010). *Higher Education In Animal Breeding In Developing Countries -- Challenges And Opportunities*. Paper presented at the 9th World Congress on Genetics Applied to Livestock Production, Lepizig, Germany.
Oldenbroek, K. (Ed.). (2007). *Utilisation and Conservation of Farm Animal Genetic Resources.* Wageningen: Wageningen Academic Publishers.
Ordinola, M., Bernet, T., & Manrique, K. (2007). *T'ikapapa: Linking Urban Consumers and Small-scale Andean Producers with Potato Diversity.* Lima: CIP.
Ostertag Gálvez, C. F., Lundy, M., Gottret, M. V., Best, R., Peters, D., & Ferris, S. (2005). *Identifying market opportunities for small-scale rural producers.* Cali: CIAT.
Padulosi, S. (1999b). A comprehensive vs. limited list of crops: the role of underutilized crops and opportunities for international centres, donor communities and recipient countries. In M. Broggio (Ed.), *International Workshop: Inter-dependence and food security: which list of PGRFA for the future multilateral system?* Florence: Istituto Agronomico per l'Oltremare.
Padulosi, S. (1999a). *Criteria for priority setting in initiatives dealing with underutilized crops in Europe*. Paper presented at the Implementation of the Global Plan of Action in Europe – Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture. Proceedings of the European Symposium, 30 June-3 July 1998, Braunschweig, German, Rome.
Padulosi, S. (Ed.). (1999). *Priority Setting for underutilized and neglected plant species of the Mediterranean region. Report of the IPGRI Conference, 9-11 February 1998, ICARDA, Aleppo. Syria.* Rome: International Plant Genetic Resources Institute.
Padulosi, S., Hodgkin, T., Williams, J. T., & Haq, N. (2002). Underutilised crops: trends, challenges and opportunities in the 21st Century. In J. M. M. Engels, V. R. Rao, A. H. D. Brown, & M. T. Jackson (Eds.), *Managing Plant Genetic Diversity* (pp. 323-338). Wallingford: CAB International.
Peacock, J. M., Ferguson, M. E., Alhadrami, G. A., McCann, I. R., Hajoj, A. A., Saleh, A. et al. (2003). Conservation through utilization: a case study of the indigenous forage grasses of the Arabian Peninsula. *Journal of Arid Environments*, *54*(1), 15-28.
Posey, D. A. (Ed.). (1999). *Cultural and spiritual values of biodiversity: a complementary contribution to the Global Biodiversity Assessment.* London: Intermediate Technology Publications.
Power, A. G. (2010). Ecosystem services and agriculture: tradeoffs and synergies. *Philos Trans R Soc Lond B Biol Sci*, *365*(1554), 2959-2971.
Prain, G., Il Gin Mok, Sawor, T., Chadikun, P., Atmodjo, E., & Relwaty

Sitmorang, E. (1995). Interdisciplinary collecting of *Ipomoea batatas* germplasm and associated indigenous knowledge in Irian Jaya. In L. Guarino, R. V.R, & R. Reid (Eds.), *Collecting Plant Genetic Diversity: technical guidelines.* Wallingford: CAB International.
Prain, G. (1993). Mobilizing Local Expertise in Plant Genetic Resources Research. In W. de Boef, K. Amanor, & K. Wellard (Eds.), *Cultivating Knowledge: genetic diversity, farmer experimentation and crop research* (pp. 102-110). London: Intermediate Technology Publications.
Prain, G., Schneider, J., & Widyastuti, C. (2000). Farmers' maintenance of sweetpotato diversity in Irian Jaya. In W. de Boef & C. Almekinders (Eds.), *Encouraging Diversity.* London: Intermediate Technology Publications.
Quaye, W., Adofo, K., Madode, Y. E., & Abizari, A. (2009). Exploratory and multidisciplinary survey of the cowpea network in Tolon-Kumbungu district of Ghana: A food sovereignty perspective. *Journal of Agricultural Research*, *4*(4), 311-320.
Rana, R. B., Garforth, C. J., & Sthapit, B. R. (2008). Farmers' management of rice varietal diversity in the mid-hills of Nepal: implications for on-farm conservation and crop improvement. *Plant Genetic Resources*, *7*(01), 50-50.
Rana, R., Garforth, C., Sthapit, B., & Jarvis, D. (2007). Influence of socio-economic and cultural factors in rice varietal diversity management on-farm in Nepal. *Agriculture and Human Values*, *24*, 461-472.
Raney, T. (Ed.). (2011). *Women in Agriculture: Closing the gender gap for development.* Rome: FAO, IFAD.
Rege, J. E. O., & Gibson, J. P. (2003). Animal genetic resources and economic development: issues in relation to economic valuation. *Ecological Economics*, *45*(3), 319–330.
Rege, J. E. O., Marshall, K., Notenbaert, A., Ojango, J. M. K., & Okeyo, A. M. (2011). Pro-poor animal improvement and breeding -- What can science do? *Livestock Science*, *136*(1), 15 - 28.
Rudebjer, P., van, S., B., Chakeredza, S., Njoroge, K., Kamau, H., & Baena, M. (2011). *Teaching agrobiodiversity: a curriculum guide for higher education.* Rome (Italy): Bioversity International.
Ruiz, M., & Vernooy, R. (Eds.). (2011). *The Custodians of Biodiversity: Sharing Access to and Benefits of Genetic Resources.* London: Taylor & Francis and IDRC.
Russell, D., & Harshbarger, C. (2003). *Groundwork for community-based conservation: strategies for social research.* Walnut Creek, CA: AltaMira Press.
Safrin, S. (2004). Hyperownership in a time of biotechnological promise: the international conflict to control the building blocks of life. *American Journal of International Law*, *98*(4-October), 645-685.
Scarcelli, N., Tostain, S., Vigouroux, Y., Agbangla, C., Daïnou, O., & Pham, J.-L. (2006). Farmers' use of wild relative and sexual reproduction in a vegetatively propagated crop. The case of yam in Benin. *Molecular ecology*, *15*(9), 2421-2431.
Scurrah, M., Amoros, W., Burgos, G., Schafleitner, R., & Bonierbale, M. (2007). Back to the future: millennium traits in native varieties. *Acta Hort (ISHS)*, *745*, 369-378.

Scurrah, M., Fernandez-Baca, E., Ccanto, R., Nunez, E., & Zúñiga, N. (1999). Learning about biodiversity in Peru. *ILEIA Newsletter*, *15*, 26-28.
Shrestha, R., Arnaud, E., Mauleon, R., Senger, M., Davenport, G. F., Hancock, D. et al. (2010). Multifunctional crop trait ontology for breeders' data: field book, annotation, data discovery and semantic enrichment of the literature. *AoB Plants*, *2010*.
Singh, N., Gurdial, Fern, G. P., Harn, L. Y., & Hui, Y., Chan. (2009). *Framework study on food security and access and benefit-sharing for genetic resources for food and agriculture. Background Study Paper No. 42. CGRFA, September 2009.* Rome: FAO.
Thiele, G. (1999). Informal potato seed systems in the Andes: Why are they important and what should we do with them? *World Development*, *27*(1), 83-99.
Thuillet, A.-C., Pham, J.-L., Dulloo, E., Hodgkin, T., Mayet, P., Diulgheroff, S. et al. (2011). A summary indicator to describe biodiversity in ex-situ collections of genetic resources.
Varshney, R. K., Glaszmann, J. C., Leung, H., & Ribaut, J. M. (2010). More genomic resources for less-studied crops. *Trends Biotechnol*, *28*(9), 452-460.
Vernooy, R., Jingsong, L., & Li, Z. (2010). The Impact of National, Regional and Global Agricultural Policies and Agreements on Conservation and Use of Plant Genetic Resources for Food and Agriculture. In *Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture.* Rome: FAO.
Vernooy, R., & Song, Y. (2004). New Approaches to Supporting the Agricultural Biodiversity Important for Sustainable Rural Livelihoods. *International Journal of Agricultural Sustainability*, *2*(1), 55-66.
Vigouroux, Y., Mariac, C., De, M., Stéphane, Pham, J.-L., Gérard, B., Kapran, I. et al. (2011). Selection for Earlier Flowering Crop Associated with Climatic Variations in the Sahel. *PLoS ONE*, *6*(5), 9-9.
VMABCC-Bioversity. (2009). *Libro Rojo de Parientes Silvestres de Cultivos de Bolivia.* La Paz: Plural Editores.
Walpole, M., Almond, R. E. A., Besançon, C., Butchart, S. H. M., Campbell-Lendrum, D., Carr, G. M. et al. (2009). Tracking Progress Toward the 2010 Biodiversity Target and Beyond. *Science*, *325*(5947), 1503-1504.
Warriner, G. K., & Moul, T. M. (1992). Kinship and personal communication network influences on the adoption of agriculture conservation technology. *Journal of Rural Studies*, *8*(3), 279-291.

Annex 1: Budgets

Budget

Program costs 2012-2014

The proposed three year budget (2012–2014) for the program is estimated at $49.7 million. Five research topics are represented in the investment of US$ 49.665 million. The annual budget figures presented are based on current best assessment of the activities required to implement the program according to the timeline specified in the proposal. These figures will need to be adjusted on a pro rata basis according to the precise start date of the program.

Table 1: Projected expenditure by natural classification.

CONSOLIDATED	Year 1	Year 2	Year 3	Total
Personnel Costs	5,369	7,645	7,931	**20,945**
Travel	619	586	594	**1,799**
Operating Expenses	3,264	3,904	3,994	**11,162**
Training & Workshop	308	578	604	**1,490**
Collaborators/Partnership Costs	2,056	2,183	2,357	**6,596**
Capital and other equipment	269	320	300	**889**
Contingency	33	80	89	**202**
Subtotal	11,918	15,296	15,869	**43,083**
Institutional Overhead (% of direct cost)	1,720	2,373	2,489	**6,582**
TOTAL	13,638	17,669	18,358	49,665

Cost categories

The main cost categories used in preparing the budget are described below.

Personnel includes all CGIAR personnel that will be involved directly in delivering the program.

Travel includes all international and local travel for CGIAR staff.

Operating Expenses include non-equipment items or services purchased specifically to carry out the projects. It includes the costs of websites & publications.

Training & Workshops include major workshops and training events, including those to be used for scoping, planning and review of program implementation. It includes costs (travel, per diems, etc) of participants and presenters. It excludes costs of time of CGIAR and partner personnel.

Collaborators/Partnership Costs includes all of the costs of engagement by institutional partners in the research dimensions of the program for which funding will be channeled through the program's management structure. This will include costs of partners' staff, their travel, and other operating costs. It does not include these costs in those instances where they are covered by matching funds that the partners bring to our partnership. It also does not include any consultancy costs.

Capital and other equipment includes large specific capital items including cars, motorbikes, and other equipment required for research.

Contingency is included to cover unforeseen extra costs.

Institutional overhead covers the institutional costs that are not directly attributable to this program. They include the costs for each Center of the Director General's office, Board of Trustees, Corporate Finance and HR and other costs of a general nature.

Personnel, operating and partnerships costs account for 42%, 22% and 13% respectively. This program will engage many partners outside of the CGIAR. Bioversity has a long history of engaging with partners outside of the CGIAR and has both the management capacity and corporate structure to manage such partnerships.

Table 2: Projected funding sources

CONSOLIDATED	Year 1	Year 2	Year 3	Total
CGIAR CRP Funding	4,103	4,222	4,449	**12,774**
Restricted Funding	4,853	7,104	6,984	**18,941**
Funding gap	4,682	6,343	6,925	**17,950**
Total CRP Funding	**13,638**	**17,669**	**18,358**	**49,665**

As can be seen from Table 2 the program has an identified funding gap of $17.950 million. This includes funding for new activities that are foreseen in the SRT, but for which funding has not yet been identified or projects that are under negotiation but that are not yet concluded.

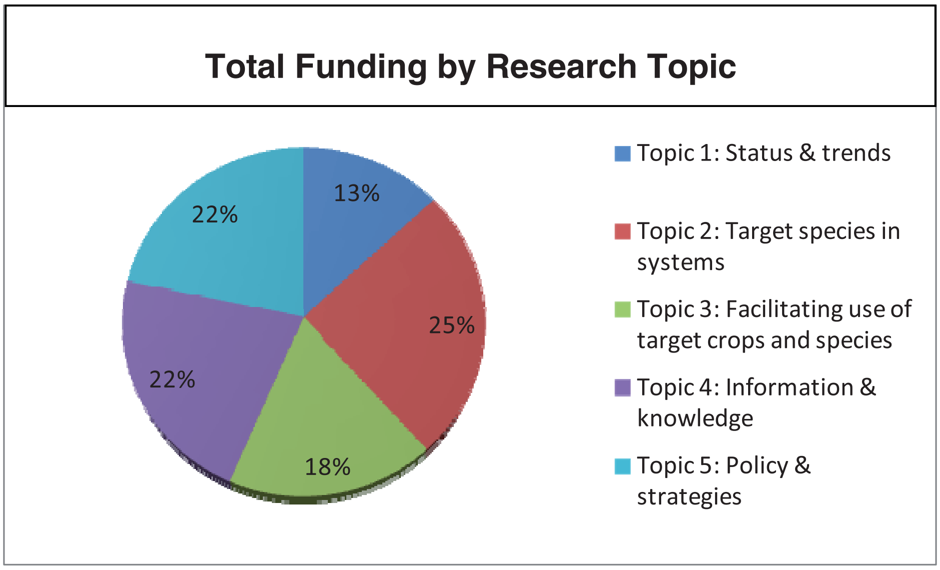
Table 3: Funding by center

CONSOLIDATED	Year 1	Year 2	Year 3	Total
Bioversity International	6,734	8,972	9,294	**25,000**
CIP	2,511	2,424	2,564	**7,499**
ICARDA	1,103	2,983	3,210	**7,296**
ILRI	3,290	3,290	3,290	**9,870**
	13,638	**17,669**	**18,358**	**49,665**

Funding by Research Topic:

The total funding by research topic is contained in Chart 1.

Chart 1: Total funding by Research Topic.



Budget Tables

(USD/000)

Projected expenditures by cost categories & funding sources

BIOVERSITY INTERNATIONAL

Additional budget for the Agrobiodiversity component

BIOVERSITY INTERNATIONAL	*Year 1*	*Year 2*	*Year 3*	*Total*
Personnel Costs	*2,828*	*4,019*	*4,187*	***11,034***
Travel	*317*	*272*	*263*	***852***
Operating Expenses	*1,169*	*1,717*	*1,792*	***4,678***
Training & Workshop	*258*	*458*	*454*	***1,170***
Collaborators/Partnership Costs	*1,060*	*1,073*	*1,112*	***3,245***
Capital and other equipment	*26*	-	-	***26***
Contingency	-	-	-	**-**
Subtotal	*5,658*	*7,539*	*7,808*	***21,005***
Institutional Overhead (% of direct cost)	*1,076*	*1,433*	*1,486*	***3,995***
TOTAL	***6,734***	***8,972***	***9,294***	***25,000***

Projected Funding Sources

BIOVERSITY INTERNATIONAL	*Year 1*	*Year 2*	*Year 3*	*Total*
CGIAR CRP Funding	*3,560*	*3,641*	*3,826*	***11,027***
Restricted Funding	*2,815*	*4,876*	*4,991*	***12,682***
Funding gap	*359*	*455*	*477*	***1,291***
Total CRP Funding	***6,734***	***8,972***	***9,294***	***25,000***

Partners Contribution

BIOVERSITY INTERNATIONAL	*Year 1*	*Year 2*	*Year 3*	*Total*
France	*2,214*	*2,214*	*2,214*	***6,642***
Total Partners contribution	***2,214***	***2,214***	***2,214***	***6,642***

Budget Tables

(USD/000)

Projected expenditures by cost categories & funding sources

CIP

Additional budget for the Agrobiodiversity component

CIP	Year 1	Year 2	Year 3	Total
Personnel Costs	728	764	803	**2,295**
Travel	152	154	161	**467**
Operating Expenses	82	83	87	**252**
Training & Workshop				**-**
Collaborators/Partnership Costs	846	860	945	**2,651**
Capital and other equipment	243	120	100	**463**
Contingency				**-**
Subtotal	2,051	1,981	2,096	**6,128**
Institutional Overhead (% of direct cost)	460	443	468	**1,371**
TOTAL	**2,511**	**2,424**	**2,564**	**7,499**

Projected Funding Sources

CIP	Year 1	Year 2	Year 3	Total
CGIAR CRP Funding	-	-	-	**-**
Restricted Funding	-	-	-	**-**
Funding gap	2,511	2,424	2,564	**7,499**
Total CRP Funding	**2,511**	**2,424**	**2,564**	**7,499**

Partners Contribution

CIP	Year 1	Year 2	Year 3	Total
				-
Total Partners contribution	**-**	**-**	**-**	**-**

Budget Tables

(USD/000)

Projected expenditures by cost categories & funding sources

ICARDA

Additional budget for the Agrobiodiversity component

ICARDA	*Year 1*	*Year 2*	*Year 3*	*Total*
Personnel Costs	*523*	*1,572*	*1,651*	***3,746***
Travel	*30*	*40*	*50*	***120***
Operating Expenses	*133*	*224*	*235*	***592***
Training & Workshop	*50*	*120*	*150*	***320***
Collaborators/Partnership Costs	*150*	*250*	*300*	***700***
Capital and other equipment	-	*200*	*200*	***400***
Contingency	*33*	*80*	*89*	***202***
Subtotal	*919*	*2,486*	*2,675*	***6,080***
Institutional Overhead (% of direct cost)	*184*	*497*	*535*	***1,216***
TOTAL	***1,103***	***2,983***	***3,210***	***7,296***

Projected Funding Sources

ICARDA	*Year 1*	*Year 2*	*Year 3*	*Total*
CGIAR CRP Funding	*379*	*417*	*459*	***1,255***
Restricted Funding	*557*	*747*	*512*	***1,816***
Funding gap	*167*	*1,819*	*2,239*	***4,225***
Total CRP Funding	***1,103***	***2,983***	***3,210***	***7,296***

Partners Contribution

ICARDA	*Year 1*	*Year 2*	*Year 3*	*Total*
NARS	*760*	*1,000*	*327*	***2,087***
Total Partners contribution	***760***	***1,000***	***327***	***2,087***

Budget Tables

(USD/000)

Projected expenditures by cost categories & funding sources

ILRI

Additional budget for the Agrobiodiversity component

ILRI	Year 1	Year 2	Year 3	Total
Personnel Costs	*1,290*	*1,290*	*1,290*	***3,870***
Travel	*120*	*120*	*120*	***360***
Operating Expenses	*1,880*	*1,880*	*1,880*	***5,640***
Training & Workshop	-	-	-	-
Collaborators/Partnership Costs	-	-	-	-
Capital and other equipment	-	-	-	-
Contingency	-	-	-	-
Subtotal	*3,290*	*3,290*	*3,290*	***9,870***
Institutional Overhead (% of direct cost)	-	-	-	-
TOTAL	***3,290***	***3,290***	***3,290***	***9,870***

Projected Funding Sources

ILRI	Year 1	Year 2	Year 3	Total
CGIAR CRP Funding	*164*	*164*	*164*	***492***
Restricted Funding	*1,481*	*1,481*	*1,481*	***4,443***
Funding gap	*1,645*	*1,645*	*1,645*	***4,935***
Total CRP Funding	***3,290***	***3,290***	***3,290***	***9,870***

Partners Contribution

ILRI	Year 1	Year 2	Year 3	Total
				-
Total Partners contribution	-	-	-	-

Annex 2: Priority Species, Example 1

Outputs from the 1998 CWANA conference on Priority Setting for underutilized and neglected plant species of the Mediterranean region.

In the course of the conference participants identified the limiting factors that prevent the full exploitation of the region's most important neglected and underutilized species, along with a list of priority actions needed for their sustainable promotion. In addition, participants identified those species that were particularly valuable for the whole region and were thus recommended as priority species for future initiatives.

Recommended species selected by the participants attending the conference on neglected and underutilized crop species. Species were selected on the basis of their contribution to: 1. Food security, 2. Ecosystem conservation and 3. Poverty alleviation in the central and west Asia and north Africa region.

Species Group	Recommended species
Cereals	*Secale cereale*; hulled wheat (einkorn, emmer, spelt); *Stipa lagascae*
Forages & browses	*Atriplex halymus*; *Salsola* spp.; *Lathyrus* spp; *Hedisarum* spp.; *Dactylis glomerata*
Forest trees	*Juniper* spp.; *Pistacia* spp.; *Quercus* spp.; *Acacia* spp.; *Abies* spp.
Fruit trees & nuts	*Pistacia vera*; *Ceratonia siliqua*; *Cydonia oblonga*; *Ziziphus* spp.; *Prunus* spp. (wild relatives of fruit species)
Industrial	*Catharmus* spp.; *Rhus* spp.; *Crocus* spp.; *Laurus nobilis; Stipa tenacissima*
Medicinal & aromatic	*Origanum* spp*; Artemisia* spp.; *Thymus* spp.; *Rosmarinus* spp.; *Coriander* spp.
Ornamental	*Tulipa* spp.; *Nerium* spp.; *Iris* spp.; *Limonium* spp.; *Cercis siliquastrum*
Pulses	*Trigonella foenum-graceum; Lupinus* spp.
Vegetables	*Cichorium* spp.; *Capparis* spp.; *Brassica* spp.; *Malva* spp.; *Scolymus* spp.

Annex 3: Priority Species, Example 2

Priority species, with justifications, agreed by 31 participants from Ethiopia, Kenya, Malawi, Mozambique and Uganda at a regional stakeholder workshop for Eastern and Southern Africa held in Nairobi, Kenya on 26-28 July 2010

Fruits	**Scientific name**	**Justification**
Guava	Psidium guavaja	• Neglected in research • Use is limited • Common in many diverse ecologies • Occurring in many countries • Enjoys wide acceptability • Has high market potential with several value-addition options
Prickly pear	Opuntia spp	• Adaptable to dryland conditions • Has options for high value products (jams etc) • Has medicinal qualities • Leaf can be used as a vegetable
Mexican wild apple	Uapaca	• Unique to mid to high rainfall options • Has options for value additions… (wine, fodder, etc) • Offers high potential for research, especially breeding • Other uses include medicine
Roots and tubers	**Scientific name**	**Justification**
Arrow roots	Colocasia spp	• Common in all countries • Underutilized • Has cultural importance in some areas • The leaf can be used as a vegetable
Wild/Livingstone potato	Plectranthus spp	• Common in all countries • Neglected in research • Highly nutritious • Has medicinal value • Multiple uses
Yams	Dioscorea Spp	• Occurs in several countries • Neglected in research • Limited in promotion

Cereals	Scientific name	Justification
Grain Amaranth	Amaranthus spp	• Cited by 3 countries • Drought resistant • Pest resistant • Drought escaper • Multiple harvesting • Nutritional & medicinal properties • LONG shelf life (flour & seeds) • Multiple uses (vegetable, forage & grain) • Multiple by-products
Finger millet	Eleusine coracana	• Cited by 5 countries • Drought resistant • High acceptability • Different recipes • Storability – pest resistant
Sesame	Sesamum indicum	• High commercial value • High oil content • Possible to produce at a large scale, with mechanization
Pearl millet	Pennisetum glaucum	• Cited by 4 countries • Drought resistant • Different recipes • Storability – pest resistant • High commercial value
Legumes and pulses	**Scientific name**	**Justification**
Cowpea	Vigna unguiculata	• Leaves eaten fresh & dried • Drought tolerant
Bambara	Vigna subterranea	
Lablab	Dolichos lablab	• Leaves as vegetables • medicinal (diabetes)

Leafy vegetables	Scientific name	Justification
Vegetable amaranth	Amaranthus spp	• Common in all countries, • Highly nutritious but little known about the anti-nutrients and other phytochemicals, • Getting popular in main markets and the main constraints needs to addressed
African nightshades	Solanum spp	• Common in all countries, • Highly nutritious but little known about the anti-nutrients and other phytochemicals, • Getting popular in main markets and the main constraints needs to be addressed
Spider plant	Cleome gynandra	• Highly nutritious but little known about the anti-nutrients and other phytochemicals, • Getting popular in main markets and the main constraints needs to be addressed
Undomesticated species	**Scientific name**	**Justification**
Drumstick tree	Moringa species	• Multi-purpose use, easy to grow and thrives on wide range of ecological zones • Claim of high nutritional and health benefits • Potential for commercialization
Vine spinach	Basella alba	• Claim of high nutritional and health benefits • Potential for commercialization
Baobab fruits and shoots	Adansonia digitata	• Potential for commercialization • Claim of high nutritional and health benefits

Annex 4: Letters of Support

Viale delle Terme di Caracalla, 00153 Rome, Italy Fax: +39 0657053057 Tel: +39 0657053554 www.fao.org

Our Ref.: PL 40/31

Your Ref.:

Rome, 29 November 2011

TO WHOM IT MAY CONCERN

The International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), which entered into force in 2004, represents a major achievement in ensuring that farmers and breeders will have access to the diversity they need to meet the challenge of feeding the growing world population.

The CGIAR, through IPGRI and later Bioversity International, has been actively involved as observers in the process of negotiation of the ITPGRFA from the very beginning. This has involved many studies and the production of policy briefs that have been important inputs for the member countries negotiating the Treaty. For instance, the first paper conceptualizing a Multilateral System of Access and Benefit-sharing was published in 1994 by IPGRI. Furthermore, the active participation as technical experts in the negotiation sessions has contributed significantly to their successful outcome.

The agreements signed between the CGIAR Centers and the Governing Body of the Treaty in 2006 were drafted in close consultation with the CGIAR and settled once and for all the overall legal status of these important collections. Indeed, the CGIAR collections provide the bulk of the material that is currently made available for research and breeding throughout the world through the Multilateral System of Access and Benefit-sharing created by the Treaty. As a result, the Centres are among the first organizations to encounter grey areas associated with the implementation of the Multilateral System and in the use of the use of the Standard Material Transfer Agreement (about which they have published a very useful guide). The Treaty secretariat has very much appreciated the inputs that the CGIAR centres have collectively made in bringing attention to these issues, and in working with the secretariat and others to identify best practices in response. The implementation of the Treaty at the national level will be essential to ensure the future access to the diversity needed both by the CGIAR and national breeding programmes. The Treaty secretariat is therefore very much counting on the technical contributions of the CGIAR genetic resources policy experts to assist countries with the implementation. To this end, the Treaty secretariat, along with FAO and Bioversity International have created a Joint Programme to assist countries to address policy and legal challenges associated with the implementation of the Multilateral System. Under the auspices of the Joint Programme, in relation to a grant Bioversity recently received from the Dutch government, Bioversity and the Treaty Secretariat issued a call, in July 2011, for expressions of interest for support for research and capacity building on policy issues associated with the Multilateral System. Bioversity received 27 proposals from over 20 countries. The Treaty secretariat very much appreciates the research and capacity building expertise that Bioversity and the centres can contribute to this crucially important area of Treaty implementation.

.../...

It should also be noted that the consolidated reports to the Governing Body prepared by the CGIAR Centres concerning their experiences working under the Treaty framework (which include information on centres acquisitions and transfers of genetic resources under the Treaty) are not only much appreciated by the member countries, but also represent a major contribution to demonstrating the importance of the treaty. The Secretariat very much hopes that the centres will be able to continue providing such critically important technical inputs to the Governing Body in the future. It is worth noting that at its last session earlier this year, the Governing Body created an inter-sessional working group to consider policies to support the sustainable use of PGRFA. It is certainly our hope that the CGIAR will make collective scientific contributions to the Governing Body to assist it in this important area of work.

For all these reasons, it is important that the CGIAR maintains and strengthens its genetic resources policy research capacity, as an important contribution to the successful implementation of the Treaty.

With best regards,

Dr. Shakeel Bhatti
Secretary
International Treaty on Plant Genetic Resources
for Food and Agriculture

Viale delle Terme di Caracalla, 00153 Rome, Italy Fax: +39 0657053152 Tel: +39 0657051 www.fao.org

Our Ref.: Your Ref.:

To whom it may concern

The FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) offers a permanent forum where members work to raise international awareness of the erosion of genetic resources and to spur policy efforts related to biodiversity for food and agriculture. With its more than 170 governments as Members, the Commission is the only intergovernmental body specifically dealing with biodiversity for food and agriculture. The CGIAR is making important contributions to the work of the CGRFA. The scientific expertise and practical experience in the conservation and use of genetic resources, combined with its political neutrality, position the CGIAR to play a unique role in support of the work of the CGRFA and its Working Groups.

The Commission negotiated the International Treaty on Plant Genetic Resources for Food and Agriculture, which was adopted in 2001. The CGIAR made important contributions to the negotiating process and provided highly relevant information on crops being proposed by various regions for inclusion in the Treaty's Multilateral System. The Commission developed a Multi-Year Programme of Work (MYPOW) that recognizes the inter-relatedness of all components of biodiversity for food and agriculture – plant, animal, aquatic, forest, invertebrate and micro-organism genetic resources. The Commission has overseen the preparation of global assessments of the world's plant and animal genetic resources for food and agriculture and the elaboration of global plans of action and other instruments for their conservation and sustainable use, and for access and benefit sharing. Over the years, many policy-related technical studies as well as other contributions to the global assessments have been contributed by the CGIAR that have informed the discussions and decisions of the CGRFA. For examples, the centres have contributed useful research results in the form of a number of background papers on patterns of use and exchange of plant, microbial, and forest genetic resources used in food and agriculture, and the impact of climate change on countries interdependence on genetic resources. These have helped provide a scientific basis for the Commission to consider options with respect to access and benefit sharing. At its last session, the Commission adopted an intersessional set of activities related to access and benefit sharing. We are depending on the centres to continue making collective contributions in this area, and in many others.

This MYPOW includes steps toward the preparation of an inclusive strategic assessment: The State of the World's Biodiversity for Food and Agriculture. FAO considers that further inputs from the CGIAR will be essential to the successful preparation of this assessment as well as to the broader agenda of the Commission and hopes that the CGIAR will maintain the necessary genetic resources policy research capacity to make those contributions.

Alexander Müller
Assistant Director-General
Natural Resources Management and Environment Department

United Nations Decade on Biodiversity

Ref.: SCBD/ABS/VN/SG/78098

04 November 2011

To whom it may concern,

One of the milestones of the 1992 Rio Conference has been the adoption of the Convention on Biological Diversity (CBD). The objectives of this Convention are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies.

The CGIAR, through the policy Unit of Bioversity International, has contributed to the work of the CBD, particularly in recent years, providing the perspectives of the agricultural sector to the discussion of the Conference of the Parties and its subsidiary bodies. This has been an important and appreciated contribution as most of the delegates attending the CBD meeting come from an environment background, and are not necessarily very familiar with the specificities of agricultural biodiversity and its specific needs.

In particular, the CGIAR usefully contributed to the negotiation process of the Nagoya Protocol on access and benefit-sharing, by informing the negotiation process with respect to the particular needs of different components of agricultural biodiversity, in particular through policy briefs and the organization of side-events.

The next step will be the entry into force of the Nagoya Protocol and its implementation at the national level. This should be done in harmony with the steps to implement the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA). This will require collaboration between different sectors, including the environment and agriculture. At COP 10, the Secretariats of the CBD and the International Treaty signed a Memorandum of Understanding to further enhance collaboration in areas of mutual interest within their mandates, including access and benefit-sharing. The CGIAR Centres can play a useful role in supporting countries with the implementation of both the Protocol and the Treaty in a mutually supportive manner, given their experience with genetic resources for food and agriculture. In this context, the expertise provided by the CGIAR through the Policy Unit of Bioversity International in particular has been and will continue to be very much appreciated.

Yours sincerely,

Ahmed Djoghlaf
Executive Secretary

Convention on Biological Diversity

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Life in harmony, into the future
いのちの共生を、未来へ
COP 10 / MOP 5