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## AGRICULTURAL BIOLOGICAL DIVERSITY

***On-farm management of crop genetic diversity: paper submitted by the International Plant Genetic Resources Institute***

*Note by the Executive Secretary*

1. The Executive Secretary is circulating herewith, for the information of participants in the seventh meeting of the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA), a background paper prepared by the International Plant Genetic Resources Institute (IPGRI) on on-farm management of crop genetic diversity. This information note supplements the progress report by the Executive Secretary on the implementation of the programme of work on agrobiodiversity, including the development of the international pollinators initiative (UNEP/CBD/SBSTTA/7/9). As noted in paragraph 21 of that progress report, syntheses of case-studies and analysis of lessons learned are under preparation for various dimension of agricultural biodiversity. As recommended by the liaison group on agricultural biodiversity, which met in January 2001, the present information note has been prepared by the IPGRI to provide a synthesis of case-studies and lessons learned on on-farm management of crop genetic diversity.

2. The paper is being circulated in the form and language in which it was submitted to the Secretariat of the Convention on Biological Diversity.

* UNEP/CBD/SBSTTA/7/1.

# On Farm Management of Crop Genetic Diversity and the Convention on Biological Diversity's Programme of Work on Agricultural Biodiversity

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## SECTION 1. Introduction

### 1.1. The Convention on Biological Diversity and the development of a work programme on agricultural biodiversity

In May 2000, at its fifth meeting in Nairobi, the Conference of the Parties to the Convention on Biological Diversity (CBD), through Decision V/5, adopted a programme of work on agricultural biodiversity. The overall aim of the programme of work is to promote the objectives of the Convention in the area of agricultural biodiversity, in line with relevant decisions of the Conference of Parties, notably decisions II/15, III/11 and IV/6. The programme of work will also contribute to the implementation of chapter 14 of Agenda 21 (Sustainable agriculture and rural development). It takes account of, and complements, the programmes identified in the Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic resources for Food and Agriculture agreed by over 150 countries at FAO's International Conference held at Leipzig in 1996 (FAO, 1996). The four objectives of the CBD programme of work are:

<u>Objective 1: Assessment of agricultural biodiversity</u>
To provide a comprehensive analysis of status and trends of world's agricultural biodiversity and of their underlying causes, (including a focus on goods and services, agricultural biodiversity provides), as well as local knowledge of its management.

<u>Objective 2: Adaptive management</u>
To identify management practices, technologies and policies that promote the positive and mitigate the negative impacts of agriculture on biodiversity, and enhance productivity and the capacity to sustain livelihoods, by expanding knowledge, understanding and awareness of the multiple goods and services provided by the different levels and functions of agricultural biodiversity.

<u>Objective 3: Capacity Building</u>
To strengthen the capacities of farmers, indigenous and local communities, and their organizations and other stakeholders, to manage sustainably agricultural biodiversity so as to increase their benefits and to promote awareness and responsible action.

<u>Objective 4: Mainstreaming</u>
To support the development of national plans or strategies for the conservation and sustainable use of agricultural biodiversity and to promote their mainstreaming and integration in sectoral and cross-sectoral plans and programmes.

In order to facilitate the implementation of this work programme, the Executive Secretary of the CBD established a liaison group. At its meeting in Rome in January 2001, the liaison group reviewed current work on the conservation of agricultural biodiversity and identified areas where further studies were needed prior to the Seventh Meeting of the CBD's Subsidiary Body on Science Technology and Technical Advice (SBSTTA 7), November, 2001. The International Plant Genetic Resources Institute (IPGRI) was asked, in consultation with others, to prepare a synthesis paper on the ongoing practices and lessons learned with respect to on-farm management of crop genetic diversity.

This synthesis paper describes some of the major initiatives that have been undertaken by different countries, international collaborators and NGOs on the maintenance of crop genetic diversity[1] (see also Annex A). The ways in which this work contributes to the agricultural biodiversity programme of work are reviewed and the contributions to the agroecosystem approach adopted in the CBD work programme are identified. The relevance of the current work to cross cutting issues is also

[1] In this paper, crop genetic diversity is taken to refer to the genetic variation occurring within crops that is manifested as differences between cultivars and individuals within cultivars (i.e. allele, gene or genotype differences within and between populations of individual crops).

briefly considered. The information used to prepare this paper comes from published material and from information kindly provided by a number of organizations (listed in Annex B).

### 1.2. Historical perspective

Farmers have always maintained substantial amounts of crop genetic diversity. As long as 12 thousand years ago, farmers had successfully experimented with invading wild and weedy species in their settlement clearances and had domesticated the first crops (Harlan, 1975). Not only did prehistoric cultivators give humanity the major food crops and animals which nourish us today, but they simultaneously created their own specialized knowledge systems about food, fiber, and medicinal values of thousands of plant and animal species (Fowler and Mooney, 1990). Within each crop, a diversity of forms were maintained as mixed types within a single population and as separate cultivars[2] with different morphological and physiological characteristics, and different uses. This crop diversity present in agricultural systems, has been maintained through the joint action of natural and human selection.

Over the last 50 years, world food production has increased very substantially (over 2% p.a. during the last 30 years) through the combined effects of changed agricultural practices, characterized by increased use of chemical inputs, mechanization and water, and improved cultivars. The development of improved cultivars has, itself, depended very largely on the controlled exploitation of the crop genetic diversity maintained by farmers.

At the same time, many millions of farmers continue to depend on their traditional cultivars for food, fodder, and other economic, cultural and ecological activities (Brush, 1991; Zimmerer and Douches, 1991; Bellon, 1996). In many developing countries, farmers also rely largely on local seed sources for their staple crops. Over 95% of rice cultivated in Nepal, 85% of durum wheat and 98% of barley in Morocco, and 50% of maize seeds in Mexico still come from local farmer sources (Mellas, 2000; Upadhyay et al., 2001). In economic terms, crop genetic diversity has been described as an impure public good, meaning that it has both public (crop genetic diversity and ecosystem health) and private (farmer utility) attributes. The use of locally adapted cultivars is usually associated with limited chemical inputs and they can also serve to maintain ecosystem health and improve soil structure (Vandermeer 1995; Wood and Lenné, 1999). Cultivars adapted to particular microniches are often one of the few resources available to resource-poor farmers to maintain or increase production on his or her fields (Jarvis et al., 2000a).

Over the last century, increased human population pressure, continuing poverty, land degradation, environmental change and the introduction of modern cultivars have contributed to the erosion of crop genetic diversity in large areas of the world. The Green Revolution has had a very substantial impact on crop genetic diversity in areas of high production potential, and many thousands of local cultivars are believed to have been lost, especially of major crops such as rice and wheat (FAO, 1998). One response to this loss by the global agricultural science community has been the development of a world wide network of gene banks and botanical gardens for conserving the available useful genetic resources *ex situ.* While this has been a significant contribution, *ex situ* gene banks are unlikely to accommodate the full range of useful diversity in economically useful plant species. In addition, these facilities do not conserve the dynamic processes of crop evolution and farmers' knowledge of crop selection, management, and maintenance inherent in the development of local cultivars. Nor can they ensure the continued access to and use of ,these resources by farmers.

While *ex situ* conservation efforts provide an important resource for the development of improved cultivars, it is increasingly recognized that farmer management of crop genetic diversity based on

[2] The term cultivar is used throughout this paper to refer to a plant variety produced by selective breeding which has been especially improved for agriculture or horticulture and is grown in cultivated conditions. A number of different terms are used for local cultivars maintained within traditional farming systems including landrace, farmer's variety or cultivar, traditional variety or cultivar, or folk variety.

traditional cultivars continues to be of central importance in many production systems. Over the past 15 years, a growing movement of farmers, communities, NGOs, national institutions and international partners have become involved in efforts to identify, develop or strengthen the use of crop genetic diversity and traditional cultivars. Such on-farm or *in situ* initiatives have the potential to (1) conserve the processes of evolution and adaptation of crops to their environments, (2) conserve diversity at all levels the ecosystem, the species, and the genetic diversity within species, (3) improve the livelihood for resource-poor farmers, (4) maintain or increase control and access of farmers over their genetic resources, and (5) integrate farmers into the national plant genetic resource system for conservation. The CBD programme on agricultural biodiversity provides a timely contribution to this agenda.

## SECTION 2. Overview of Programmes which support the management of crop diversity in agroecosystems

Many programmes are now in progress throughout the world and it is probably impossible to provide a complete list of all the activities under way. While some of the work carried out in specific localities forms part of larger regional or global programmes, in this summary, the work has been organized by individual countries and regions. The following paragraphs seek primarily to indicate the range and scope of current work, while a more complete list of current and recent programmes is provided as Annex A.

### 2.1. Sub-Saharan Africa

In Ethiopia UNDP/GEF supported a project on "A Dynamic Farmer-based Approach to the Conservation of Plant Genetic Resources". After constructing 12 community gene banks, the project is now working to link these to locally used seed storage systems in order to strengthen the seed supply system and enhance its viability. This helps to conserve the traditional storage system and link it to national research stations, universities and ministries. One of the important gene banks in Sub-Saharan Africa is that at the Institute of Biodiversity Conservation and Research, Ethiopia (IBCR), which works to return farmers' cultivars to areas from which they had disappeared. This work includes the restitution of farmers' cultivars of durum wheat to areas south of Addis Abeba and support for Tigray's community seed bank that currently holds seeds of a wide range of traditional crops, selected by the local farmers on cultural, technological and ecological criteria. An Ethiopian Flora Project has developed capacity on plant taxonomy and includes specimens which represent intra-specific crop diversity to help assess the amount and distribution of crop diversity. Eritrea is undertaking a participatory barley breeding programme with the International Center for Agricultural Research in the Dry Areas (ICARDA). This involves working with farmers to improve barley landraces while keeping diversity on-farm.

A network of organizations participate in an on-going Community Biodiversity Development and Conservation (CBDC) Programme in which a range of activities are undertaken that aim to strengthen farmer community management of agricultural biodiversity. This programme supports farmer networks in Ethiopia, Kenya, Zimbabwe, and also Burkina Faso, Mali and Sierra Leone. The Sierra Leone Project, in Kambia District, recognizes that change is inevitable and addresses the issue of shifting agricultural practices. There are also several crop diversity management projects in Burkina Faso (supported by both IPGRI and CBDC): ecosystem components are used as indicators to manage crop diversity in production systems in three agro-ecological zones and six target villages. The work includes capacity building for the conservation and use of agricultural biodiversity, activities related to gender and on-farm management and a participatory plant breeding programme for sorghum.

Kenya also has gene bank facilities which, like Ethiopia, have held field grow-outs of local cultivars for farmers to select and use. Another on-going project in Kenya is the: "Curcurbitaceae: East. African Bottle Gourds and West African Egusi Melons". NGOs working in Zimbabwe on agro-biodiversity management include COMMUTEC and the Community Technology and Development Trust (CTDT), which have also facilitated community based crop genetic resources management in Zimbabwe and Kenya. In Burkina Faso and Zimbabwe, the Institut d'Etudes et de Recherches Agricoles, Burkina Faso (INERA) and CTDT respectively are working with farmers to promote community-based crop genetic resource management. In Mudzi and Mutoko in Zimbabwe, local agricultural extension agents actively encourage farmers to maintain on-farm crop biodiversity and farmers say this has significantly influenced their agricultural biodiversity decisions. Work has also been done in Botswana, Cameroon, Senegal and Zimbabwe on the biodiversity of leafy green vegetables.

Another initiative in the region is the INIBAP supported project on *in situ* conservation of banana and plantains in the Great Lakes area in Uganda and Tanzania. Also active in Uganda as well as in areas of Somalia, Sudan and Kenya, are development relief programmes, which provide emergency seed aid in times of crisis using local seed materials where possible.

In Mali, projects focus on farmer maintenance of pearl millet and sorghum cultivars and on production in environments subject to desertification. In the Democratic Republic of Congo and Rwanda work is in progress on farmer's management and decision-making strategies for bean cultivars from the perspectives of enhancing disease protection and food security. In Ghana crop genetic diversity is studied in a variety of landscapes and there is a project on the maintenance of diversity in home gardens.

### 2.2. The Americas

Cuba's National Biodiversity Strategy and Action Plan promotes the establishment of mechanisms to allow validation, use and dissemination of genetic material included in *ex situ* collections of plants of economic importance. In addition, there is an on-going project to understand (1) if home gardens retain varietal and species diversity that is undergoing genetic erosion in other production systems, (2) how commercialisation and crop introduction or improvement affect species and varietal diversity in home gardens and, (3) what targeted development interventions enhance home garden biodiversity and improve family nutrition and income. Similar projects are in progress in Venezuela, Guatemala, Ghana, Vietnam, and Nepal. The co-ordinating NGO for Latin America for the CBDC programme used to be CET based in Brazil, where significant work involving on-farm management of agricultural biodiversity is in progress. NGOs in Chile, Peru and Colombia are also participants in the CBDC programme.

In Mexico, there are several agricultural biodiversity initiatives. In San Felipe del Progresso, the Centro de Investigación en Ciencias Agropecuarias (CICA) of the Universidad Autonoma del Estado de Mexico (UAEM) has been conducting participatory research on campesino agrodiversity within a UNU/PLEC project since 1996, basing its work in two indigenous Mazahua campesino communities (San Pablo Tlalchichilpa and Mayorazgo). A national project, led by the Colegio de Postgraduados (CP), evaluates the improvement of local maize cultivars. Other on-going *in situ* projects include: a multi-partner project on conservation and improvement of crop production supported by the McKnight Foundation projects work by University of Guadalajara and by the Instituto IMECBIO: CIMMYT projects in Oaxaca Valley of Cuzalapa and the Sierra de Manantlan Biosphere Reserve; the Mexico Country component of the IPGRI global project "Strengthening the Scientific Basis of *In Situ* Conservation of Agricultural Biodiversity On-Farm" in the Yucatan, a project on shade coffee plantations and their associated biodiversity.

A large amount of agricultural biodiversity management work is going on with Andean roots and tubers through CONDESAN and national programmes in Colombia, Bolivia, Ecuador and Peru. The ethnic Amazon groups of Shipibo-Conibo and Ashaninca in Peru are working with the Consorcio para el Desarrollo Sostenible de Ucayali (CODESU) and IPGRI on the maintenance of their agricultural biodiversity. The Institute for Research and Development (IRD), France and the University of Montpellier, France are working with national institutes in Ecuador and French Guyana on the dynamics of farmer management in cassava diversity.

As noted above, in Venezuela, the Universidad de los Andes, the Fundación para la Agricultura Tropical Alternativa y el Desarrollo Integral (FUNDATAD), the Centro de Recursos Geneticos and the Banco de Germoplasma are involved in enhancing home garden biodiversity and improving family nutrition and income. The Insituto de Investigaciones Agronomicas and the Universidad San Carlos, in Guatemala are also undertaking work on home gardens and diversity maintenance.

### 2.3. Russia and the CIS countries

A new project has been initiated for On Farm Conservation of Agricultural Biodiversity in Central Asia funded by UNEP/GEF focused on horticultural crops and their wild relatives in the Republic of Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, and the Republic of Uzbekistan

### 2.4. North Africa and the Middle East

In Jordan, Lebanon, Palestine and Syria, ICARDA, IPGRI and ACSAD are involved with ministries and national institutions in a project on the conservation and sustainable use of agricultural biodiversity in the fertile crescent. Participatory barley breeding with farmers to enhance barley diversity and production is in progess in Egypt, Jordon, Morocco, and Tunisia. Work on participatory management of date palm project is in progress in Algeria, Tunisia and Morocco. In addition, Tunisia's Institut de Recherche Agronomique (IRA) is involved in the conservation and use of local fig and pomegranate. The Aegean Agricultural Research Institute (AARI) in Turkey is working on *in situ* conservation of lentil, chickpea and bean landraces grown in northwestern transitional zones.

### 2.5. Asia, the Pacific and Oceania

Yunnan, China offers several examples of work on developing good practices for community participation and management of agricultural biodiversity. UNU/PLEC is also working with national partners on the diversification of traditional and modern crop cultivars for pest control in Yunnan, China and the management of fallow succession in Thailand. An ethnobotanical project is looking at the genetic diversity of taro and at farmer's management of it. Another project on indigenous vegetables of yunnan combines genetic characterization and ethnobotanical field methods with nutritional analysis of important wild vegetables in Southwest China.

There is a great deal of work on maintaining crop diversity in Nepal and agricultural biodiversity is now being integrated into the Nepalese national biodiversity action plan. Many projects are in progress and a number of best practices are being established on capacity building between famers and national institutes, *in situ* conservation and use of agricultural biodiversity and participatory marketing systems research. In India, the Philippines and Vietnam, one project that finished in 2000 was the International Rice Research Institute (IRRI) on-farm conservation project that looked at the amount and distribution of rice cultivars under farmer management in these Countries. In the Philippines, the Southeast Asia Regional Institute for Community Education (SEARICE) is an important actor in the management of crop genetic diversity.

Several genetic diversity management projects are in progress in Vietnam, including the CBDC project in the Mekong Delta, supported by SEARICE, which is also working in Philippines and Thailand. A second regional project, the Biodiversity Use of Conservation Asia Programme (BUCAP) for the conservation and development of agrobidiveristy through farmer field schools in being implemented by national institutes and NGOs in Vietnam, Lao PDR, and Bhutan. Through collaboration between communities, national institutes and IPGRI, on farm conservation work is in progress in seven sites in Vietnam. IRRI has also worked with Vietnamese partners on rice conservation on farm. Work on home gardens is carried out in the Northern Highlands, Central Midlands and Southern Lowlands of Vietnam, and IDRC is working with Vietnamese policy makers on crop genetic resources issues.

The User's Perspective with Agricultural Research and Development (UPWARD) programme, focuses on farmer management of sweet potato through the Central Luzon State University in the Philippines and through the Cendrawasih University and the Central Research Institute for Food Crops (CRIFC) in Indonesia. The Seeds of Survival (SOS), programme composed of the Sultan Kudurat Project implemented by SEARICE and CONSERVE focuses on conservation and development though management of crop genetic resources. In Bangladesh, the NGO UBING is supporting the management of community seed banks. In India, projects on permaculture and agricultural biodiversity conservation, focusing on the elimination of chemical inputs and an increase of biodiversity in the fields. In addition, innovations were undertaken and revival of indigenous crops, in which biodiversity fairs resulted in an increase in discussions on the increased nutritive values of the foods they consumed, and the quality of fodder available for cattle. In India, the Beej Bacho Andolan (Save the Seeds Movement) has instigated a project in reviving traditional crops and practices, while the MS Swamanathan, Research Foundation has been instrumental in bring awareness of the use of local crop diversity through training programmes and strengthening of community conservation actions. Fiji and Vanuatu are member of TAROGEN, a group working on on-farm conservation of Taro.

### 2.6. Europe

In Europe, on farm conservation of fruits and fruit trees has been undertaken in a number of countries. In Belgium, DBCPGR is focusing on *in situ* conservation of apple cultivars and in Finland, Northern Heritage is involved in apple tree testing in local nurseries. Poland is also involved in on farm conservation of fruits trees. Groups in Italy are involved in the maintenance and improvement of local cultivars in Lombardia, Toscana, Abruzzo and Campania. Work on organic production of traditional cultivars is also undertaken by the Centre for Biodiversity (Biodiversitet) and the Seed Collectors (Frosamlerne) in Denmark, as well as in many other European countries.

Local cultivar identification, survival and sustainable use is of interest to the Agricultural Institute in Slovenia, as well as to the Institute of Agrobotany in Hungary. The United Kingdom's Henry Doubleday Research Association (HDRA) and Heritage Seed Library (HSL) are involved in the conservation of traditional vegetable cultivars. The Sesam Association in Sweden is involved in the growth and reproduction of cultivars in home gardens and small farms, the Transcarpathian Institute of Agroindustrial Production of Ukraine is also concerned with the maintenance of crop cultivars on-farm for traditional use, and Pro Specie Rara in Switzerland is involved both with the genetic variation and the cultural and historical conservation of plant and animal genetic resources.

Conservation work undertaken by Maatiainen, Finland, is aimed towards traditional ornamental and cultivated plant species, and Austria's focus, through Arch Noah, is based on conservation and development of fiber pharmaceutical crops, as well as cereals and vegetables. The national institute VERN in Germany is using -protected areas for dynamic management of old cultivars from gene banks. DIKA, Renovabis and Elkana in Georgia are working on the re-introduction of local cultivars on-farm. Greece's gene bank, has initiated identification of sites with local farming communities with an interest in re-introduction of local landraces for organic farming. Romania's Gene bank system and "zonal agricultural centres" are undertaking initiatives to identify agricultural biodiversity zones for major crops.

## SECTION 3. Crop genetic diversity programmes and the objectives of the CBD programme of work on agricultural biological diversity

In this section, the ways in which the different activities described in Section 2 contribute to the agricultural biodiversity programme of work are discussed. Emerging practices are described which seem particularly useful and have potential as "best practices". Gaps with respect to the programme of work are identified and policy implications are noted.

A primary task for those concerned with supporting maintenance of agricultural biodiversity in general, and of crop diversity in particular, is to understand when, where and how this will happen, who will maintain the material and how those maintaining the material can benefit. It is useful to identify four aspects where information is needed to support farmers and local communities in crop genetic diversity conservation, management and use on farm:

1. What is the extent and distribution of the genetic diversity maintained by farmers over space and over time?
2. What are the processes used to maintain the genetic diversity on farm?
3. Who maintains genetic diversity within farming communities (men, women, young, old, rich, poor, certain ethnic groups)?
4. What factors (market, non-market, social, environmental) influence farmer decisions on maintaining traditional cultivars?

Work relevant to the extent and distribution of diversity contributes to Objective 1 of the Work Programme, while work concerned with where, when, how and why crop genetic diversity is maintained contributes to the fulfillment of Objective 2. All the work undertaken contributes to Objective 3 and, as programmes mature and expand, increasingly to Objective 4.

### 3.1. Objective1: Assessment of agricultural biodiversity

#### *3.1.1 Status of crop genetic diversity*

Considerable information is now being collected on the amount and distribution of crop genetic diversity maintained by local communities in many different countries. This information is replacing the earlier vague estimations obtained which referred largely to loss of crop diversity (e.g. China reported a loss of 2000 rice cultivars since 1945, FAO, 1998). The data suggest that considerable numbers of local cultivars of many crops continue to be maintained in different farming systems (Box 1).

**Box 1. The numbers of traditional cultivars in some production systems**

In the Jayawijaya division of Irian Jaya, a wide range of sweet potato cultivars can be found in almost every garden. Field identification of sweet potato crops showed that the numbers of distinct cultivars planted in one garden ranges from 20 to over 100. Surveys conducted by Root and Tuber Research Center, Manokwari, Irian Jaya and CIP indicate that there are more than 600 cultivars distributed over the whole Division (48,000 sq. km.) (Achmady and Schneider, 1995).

Jajpur, India is located in the coastal plain of Orissa. The population consists of over 2,000 people living in about 300 households. A survey carried out in 1993 and 1994 showed that 87% of the area planted to rice in the kharif (rainy) season was planted to traditional cultivars and that over 30 traditional cultivars were grown on a total area of 66 ha. On average, each farmer grew 3-6 cultivars (Kshirsagar and Pandey, 1996).

In north Shewa and South Welo districts of Ethiopia, 60 sorghum varieties were identified by farmers in a survey of 260 farmers' fields. The numbers of cultivars found in a field ranged from 1 to 24 and were related to farmers' selection criteria, altitude, field size, soil pH and clay content. (Teshome et al., 1999).

While most of the information has been collected on the number of cultivars, there are also reports on the genetic variation found in different production systems, using agromorphological traits and biochemical and molecular markers. In some cases, genetic data have substantially confirmed information on cultivar numbers, but, in many cases, important new information has come from these genetic studies. In Jumla, Nepal (a high altitude site), over 20 rice cultivars were identified by farmers which were found to differ with respect to a small number of key morphological traits, while only limited molecular genetic diversity was detected (Bachracharya et al., 2001). In contrast, a single field of cassava in Brazil was found to contain almost as much molecular marker diversity as was found in 40 very distinct cultivars from the CIAT cassava collection (Second and Iglesias, 2001). This analysis also showed that there was almost no overlap between the two sets of materials.

There has been considerable debate about the use of farmer names as a basis for arriving at estimates of cultivar numbers. Do farmers use the same names for different cultivars or different names for the same cultivar? The work to date has shown that information from farmers on the traits that distinguish cultivar names is an important starting point for answering these questions. In Mexico and Morocco, the traits that male and female farmers used to distinguish different cultivars of maize and faba beans were more consistent than the cultivar names given by the farmers (Chavez-Servia et al., 2000; Arias et al. 2000; Sadiki et al., 2001). Work on rice cultivars in India and in the Cagayan Valley, Philippines showed that samples with the same name often had a quite different genetic constitution (Sebastian et al., 1999). This work has confirmed the importance of working with farmers to understand their cultivar identification and classification systems, and of exploring the diversity patterns of different types of characters, using both agromorphological and molecular genetic data.

Much of the work of recent years has been concerned with environments selected for their high diversity. Projects in areas where modern cultivars have substantially replaced traditional cultivars has been limited. For the most part, the scale of many projects has been small and often only 3-6 crops have been selected for study, over several villages in 3 to 4 agroecological zones. The Ethiopia Flora project provides an example of an attempt to work at a wider scale, possibly reflecting the major commitment of the UNDP GEF supported project in Ethiopia. The project has developed capacity on plant taxonomy and includes intra-specific crop diversity studies to help assess the amount and distribution of crop diversity. In general, however, much of the work has provided a "snapshot" rather than a good overall estimation that could be used for future monitoring. Relatively more information has been obtained on major crops than on minor crops or on neglected and underutilized crop species (NUS). NUS, together with and crops in home gardens present particular methodological problems. Distinct cultivars are often not formally recognized and, thus, agromorphological analysis is necessary for any crop diversity estimation. However, diversity studies in home gardens have shown that extensive amounts of genetic diversity are maintained in these micro-agroecosystems even though numbers of cultivars and population sizes in any individual garden are often small (Castineiras et al., 2001).

Information on diversity trends remains limited and that available is concerned very largely with local trends over rather short time scales. One exception is the work in Mali, which provides one of the best pictures of change over 20 years. This work shows 20% loss in number of local pearl millet cultivars over the last 20 years at desert margins and 70% loss in southern areas of the country, where pearl millet has been replaced by maize. Long term information on the loss of number of cultivars over a 30 to 40 year time span is also available for selected villages in Vietnam (Ha, 2000). In this case, war and changes in rice management policies have probably had a profound effect on the extent of loss. Recent work in Peru compared gene bank collections from 1980 to populations collected in the field in 1999 showing a loss of diversity both of numbers of cultivars and within individual cultivars for several Andean root and tuber crops (e.g. mashua, ullucos, oca; Tapia, 2001).

More information is becoming available on the number of seasons, years and human generations farmers keep their seeds. Studies in Nepal, Morocco, Mexico and Peru have shown that farmers may keep seeds for many years or generations and this information can be used as a proxy indicator of the agroecosystems' resilience to genetic erosion and to seed loss (Rana, 2000; Ortega-Paczka et al., 2000; Valdivia et al., 1995).

Information on short-term changes indicates that some production systems seem very dynamic from a genetic diversity perspective. Work in Mexico has shown that although farmers maintain the same named cultivars through the selection of true types from their maize populations, seed exchange between farmers can lead to a turn-over of up to 40% in their material over five years (Louette et al., 1997). In the analysis of trends, information based solely on numbers of cultivars needs to be treated with caution. Some local cultivars are often very diverse and the losses in numbers of cultivars may not be accompanied by an equivalent loss of genetic diversity.

*3.1.2 Lessons learned, best practice development, and policy implications*

Although not yet codified and made widely available, the many different country activities have provided considerable experience of how, through working with farmers using participatory methods, it is possible to estimate the number of, and area covered by, different crop cultivars. The on-going programmes have also provided an understanding of the ways in which multidisciplinary approaches can best be used to ensure that information on crop genetic diversity indicators takes account of the farming context and socio-economic and cultural features of the situations being evaluated.

A key element of the approach is likely to involve a clear and more general description of the farmers' unit of diversity management, as an analytical unit and quantifiable estimate of diversity. A major requirement for the future is the development of estimation procedures that can operate over larger scales than have so far been attempted.

### 3.2. Objective 2. Adaptive management

*3.2.1. Understanding and supporting farmer management of crop genetic diversity in production*

Central to achieving Objective 2 is a full acceptance by the international community, national organizations and local agencies of the importance of crop genetic diversity in many production systems throughout the world. This acceptance brings with it a need to understand and appreciate the different ways in which farmers use crop diversity to achieve their objectives and the production situations in which diversity is maintained. Such an understanding, based on multidisciplinary collaboration with farmers and farming communities creates the optimum environment in which to identify the actions most likely to promote the positive and mitigate the negative impacts of agriculture on biodiversity, and to enhance productivity and capacity to sustain livelihoods.

A number of initiatives over the past 5 – 10 years have adopted appropriate participatory and collaborative approaches based on a recognition of the importance that crop genetic diversity can have in many farming communities. This work is now bearing fruit and leading to a much fuller understanding of why crop diversity is important, of where, when and how it is maintained, and who is responsible for its maintenance and management. Some of the key findings from the different programmes are summarized in the following paragraphs.

In the first instance, substantial evidence is now accumulating on the way in which maintenance of high levels of crop genetic diversity, based largely on traditional cultivars, meets the needs of resource poor farmers. These include:

- Risk avoidance or management, for example, in respect of climatic uncertainties or pest and disease problems;
- Food security in respect of total food supplies and nutritional well being;
- Multiple uses for food, forage, construction materials, brewing etc.;
- Income generation providing products that can be sold in different markets or are of high value;

- Meeting cultural or religious needs through providing specific products for special ceremonies;
- Optimizing land use to ensure cultivars are available for difficult (stony, wet, cold) lands;
- Adaptation to changing conditions such as increasing drought.

High levels of crop genetic diversity occur most commonly in areas where production is particularly difficult such as desert margins or high altitudes, where the production environment itself is extremely variable (such as upland regions), and where access to resources and markets is difficult (Brush and Meng, 1998; see Box 2 for further examples). High levels of diversity are also characteristic of agroecosystems such as home gardens (Box 3) where production is optimized in small areas to meet multiple use needs and maximize use of all available ecological niches (Fernandes and Nair, 1986).

**Box 2. Factors found to affect the numbers of local cultivars maintained by farmers.**

In the Gaoligongshan area of Yunnan, China there is a positive relationship between agricultural biodiversity and household incomes (Guo Huijin pers. Comm.). In Begnas, Nepal, this is also the case and richer households grow more varieties of different crops than poorer households (Rana et al., 2000).

Expertise plays a key role in determining the numbers of different varieties grown by farmers. Work within the framework of the PLEC Project have found that expert farmers act as a key resource in the maintenance of diversity. In Mexico, age seems to play a significant role in determining how much diversity farmers maintain. Almost 50% of the farmers growing significant numbers of traditional cultivars were over 56 (Morales and Quinones, 2000).

In Malaysia work by the CBDC-Malaysia (2001) showed that the number of sweet potatoes and cassava varieties maintained was related to ethnic group.

Work by IRRI on rice showed that agricultural intensification played a role in the reduction of cultivar diversity and that adverse and heterogeneous biotic and abiotic conditions tended to increase diversity (IRRI, 2000; Pham et. al., 1999).

In Ethiopia, Deribe (2000) showed that sorghum diversity was related to distance from the homestead: the nearer to the homestead, the larger the number of varieties grown.

Not all farmers within a community play the same part in maintaining a diversity of crop cultivars. In different communities there can be marked differences by gender, age, income group and ethnicity. Thus, in parts of Nepal, farmers with higher incomes grow larger numbers of cultivars than farmers with lower incomes (Rana, 2000). In Mexico, age and gender are significant factors in determining both whether farmers grow traditional cultivars and which cultivars they grow (Morales and Quinones, 2000). In Bolivia, women are more likely to be the key decision makers on seed selection and storage, while men were more likely to decide where these varieties were to be deployed within the landscape (Iriarte et al., 2000). In Burkina Faso women and young unmarried men are responsible for managing different plots of land, deciding separately what to sow according to ceremonies and religious festivals in addition to, environmental and ecological needs (Belem, 200; Sawadogo et. al 2001).

In many communities one or two “expert” farmers in a community may play a key role in the maintenance and use of diversity, in addition to being especially knowledgeable in diversity management. In eastern China, expert farmers take modern varieties and trade them locally in exchange for greater amounts of unselected rice (Ellis and Wang, 1997). In Morocco, expert farmers act as alfalfa seed suppliers and multiply cultivar seeds for sale in local markets (Bouizgaren et al., 2001). Work in Yunnan, China, which forms part of the UNU/PLEC project, includes collaborating with expert farmers to develop agricultural biodiversity rich solutions to problems of production, land management and pest control (Guo et al., 2000)

Cultivar maintenance is crucial to the maintenance of diversity in production systems. The survival of certain cultivars can be linked to specific accompanying management practices (Bellon and Taylor, 1993; Jarvis et al., 2000). By altering environmental selection pressures that crops face, farmers' influence the maintenance of genetic diversity in their agroecosystems. At high elevations in Nepal, farmers re-route cold water from the main valley river to raise the water temperature before irrigation so as to induce earlier flowering and timely maturation of their rice cultivars (Rana et al., 2000b). Changes in agroecological conditions can change the balance between traditional and modern varieties. In the Casayan valley, the development of irrigation changed the balance between long duration high quality traditional cultivars and short duration modern cultivars (Pham et al., 1999).

The importance of the informal sector in meeting seed needs has been confirmed by most of the work on crop diversity management (Hardon and de Boef, 1993; Tripp, 2001; Gaifani, 1992). In Morocco, only 13% of durum wheat seed and 2.5% of food legume seed come from certified seeds, indicating that the majority of seeds used are from local crop diversity or from seed saved from earlier purchases (Mellas, 2000). Dynamic and complex local seed supply systems have also been described in Mexico (Louette et al., 1999), Nepal (Schrestha, 1998; Baniya, 2001a,b), Peru, (Valdivia et al., 1995; Gonzales, 2000; Ortega, 1997), Vietnam (CBDC-Vietnam, 2001), and Tanzania (Friss-Hansen, 2000). Improving on-farm seed storage was also found to be important in the maintenance of traditional cultivars in the Philippines (Morin et al., 1998). It is clear that these systems are essential elements of the security and sustainability of many farming systems.

Not all production systems have the same amounts of diversity or the same reliance on traditional cultivars. This has been especially well shown in work at three different sites in Nepal (Rana et al., 2000a, b). At the isolated high altitude site of Jumla only traditional cultivars of rice are grown whilst at Bara, on the fertile plains of Nepal, only about 20% of the cultivars grown are traditional and modern commercial cultivars predominate. Traditional cultivars are required at Jumla because of the difficult extremely production conditions. While at Bara, traditional cultivars continue to be used where they can fulfill special needs, or permit the use of difficult production environments (e.g. waterlogged soils).

Work on farmer management of tropical root and tuber crops (yam, sweet potato, cassava) has shown that these are extremely dynamic and characterized by very high levels of diversity (CBDC-Bohol, 2001) Often new crop cultivars seem to be obtained from wild or weedy materials. Thus, there is an active process of yam domestication in parts of Benin and other countries in W. Africa. New sweet potato materials are being more or less continually obtained from botanical seed in Indonesia (Widyastuti, 1995) and extremely high levels of plant to plant diversity are maintained in single fields of cassava in Brazil (Yaku et al., 2001; Second and Iglesias, 2001). In Burkina Faso, farmers use ecological indicators from the surrounding ecosystem such as the flowering of certain trees, the arrival of certain animals, to make decisions on which cultivar to plant and over what area (Sawadogo et al., 2001).

**Box 3 – The role of home gardens in sustainable production and biodiversity conservation**

Home gardens provide microenvironments that serve as refuges for crops and crop cultivars that were once more widespread in the larger agroecosystem. These microenvironments help to preserve the function and resilience of the larger agroecosystem. Studies have shown that niche differentiation through multi-story, multi-species microenvironments like home gardens can increase the overall productivity of the agroecosystem.

Farmers often use home gardens as a site for experimentation and introduction of new cultivars arising from exchange and interactions between cultures and communities, or as sites for domestication of wild species. These useful wild species are often moved into home gardens when their natural habitat is threatened, such as in the case of loroco (*Fernaldia pandurata*) threatened by deforestation in Guatemala (Leiva et al., 2001). While many studies have documented the contribution of home gardens to development, less is known about their potential contribution to maintaining diversity. Studies of the genetic diversity of key home garden species in Guatemala, Ghana, Vietnam, Venezuela, and Cuba have demonstrated that significant crop genetic diversity does exist in home gardens and that they can be a sustainable *in situ* conservation system.

As well as the essentially descriptive work aimed at understanding how diversity is managed, and how its maintenance can be strengthened, there have been a number of initiatives more directly focussed on the use of dversity to improve production and strengthen sustainability. A limited number of programmes are investigating the direct use of local crop diversity as a natural resource to improve crop production (Rijal et al., 2000; Ortega-Paczka et al., 2000b; Finckh and Wolfe, 1997). Countries are also working to identify local crop cultivars that have high adaptation to biotic and abiotic stress environments so this germplasm can be used in similar stress-environments. In Burkina Faso and Mexico, drought tolerant cultivars of sorghum and maize, respectively, are being identified and tested in similar environments (Kabore, 2000; Castillo et al., 2000). In the Maghreb, local Faba bean cultivars resistant to chocolate-spot are being identified for their potential use in breeding and for direct distribution in areas of high infestation (Sadiki et al., 2000). In Vietnam and Hungary, where ecosystem health is a concern, cultivars adapted to low fertilizer input are being identified and distributed for use in other similar environments (Mar, 2000).

An effective way of identifying valuable new materials adapted to farmers needs is participatory variety selection (PVS). This technique allows farmers to test new materials from other regions or from the formal sector in ways that allow them to play a full part in the selection (Soleri and Cleveland, 2000; 2001). The results have shown that this method is a valuable way of identifying useful new materials and enhancing diversity in production systems where traditional cultivars have been lost (CONSERVE, 2001a; Witcombe et al., 1996; Sthapit et al., 1996; Joshi et al. 1997; Joshi and Witcombe, 1998; Sperling et al. 1996).

Participatory plant breeding (PPB) programmes have been established by a number of agencies and the CGIAR has played an important role in supporting several programmes involving different crops and countries (Box 4). PPB allows farmers to select the materials that are most appropriate to their production environments and production needs and also seems likely to extend the amount of diversity present in some production system (Castillo et al., 2000; Ceccarelli, and Grando, 2000; Weltzien et al., 1998; Bellon et al., 1999).

**Box 4– Participatory plant breeding – the System Wide Programme of the CGIAR**

Participatory plant breeding (PPB) involves scientists, farmers, and others, such as consumers, extensionists, vendors, industry, and rural cooperatives in plant breeding research. Two main institutional types are often distinguished: one approach when farmers join in breeding experiments which have been initiated by formal breeding programs (which is termed 'Formal-led PPB'); and another when scientists seek to support farmers own systems of breeding, varietal selection and seed maintenance, (termed 'Farmer-led PPB'.) Among the 80 to 90 PPB projects which have been extensively inventoried, the approach to-date has been applied primarily as a crop improvement strategy in response to the need for impact in non-commercial crops and in very unpredictable, stressed production environments. However, a range of other goals have also been defined within PPB programes: for instance, enhancing biodiversity and germplasm conservation; developing adapted germplasm for especially disadvantaged user groups (eg. women, poor farmers); and making breeding programs more cost-efficient, particularly through decentralization of programs which target more niches. Currently about 20% of PPB projects combine both production objectives and inter- and intra-species conservation and enhancement. As methods for farmer-led PPB are further refined, the SWP-PRGA believes that initiatives will multiply which focus on strengthening local germplasm and local skill building (http://www.prgaprogram.org).

The working group on participatory plant breeding of the SWP includes many active practitioners involved in participatory plant breeding programes such as: Li-BIRD's (Local Initiatives for Biodiversity, Research and Development) work supporting farmer maize breeding in Nepal ; the Ecuadorian national program's innovative participatory selection approaches for potato; ICRISAT's (International Crops Research Institute for the Semi-Arid Tropics') collaborative work with Indian NGOs screening segregating pearl millet materials with poor farmers in Rajasthan; and the collaborative work of ICARDA on barley in Syria, Egypt, Morocco, Tunisia and Eritrea (Ceccarelli and Grando, 2000).

*3.2.2. Lessons learned and best practice development*

The work undertaken by farmers, communities, NGOs, and national and international research centres has provided clear evidence of the importance of the maintenance of crop genetic diversity in agroecosystems. This work has also established how complex and sophisticated the systems can be that enable farmers to maintain the diversity they desire. A wide variety of ways have been described in which ecological, agronomic, crop genetic, socio-economic and cultural factors can interact to create the different patterns of diversity observed within different production systems.

Much of the work has involved working with selected communities and production environments often involving no more than a few hundred farmers, or 3 or 4 communities in a region. As a result of this we have a detailed knowledge of a few situations (perhaps no more than 50 – 100 production environments worldwide). However, the work has been done over a wide range of countries and situations, and it is likely that the major findings are widely applicable and provide a framework for understanding the factors that can determine the maintenance of crop genetic diversity. In contrast, the needs of individual communities are often quite specific and not so easily generalized. Some key issues that need to be considered can be identified:

- Maintaining knowledge of the diversity available at community or farmer level is an essential element of effective diversity management. The value of community based knowledge needs to be recognized and procedures for its maintenance further developed.

- Seed supply systems are often one of the most vulnerable components of diversity management at local level. While they are often central to effective selection and distribution of diversity at local level, they are also especially subject to stochastic events. The development of local systems that enhance seed security is a priority and the role that might be played by community seed stores or community genes banks needs further attention to improve their sustainability (Almekinders et al., 1994).

- Knowledge that the informal farmer to farmer seed system may be supplying 80 to over 90 percent of a country's total seed supply has helped focus attention on the need to have appropriate policies in place that support the informal seed system.

- An understanding of marketing options and of multiple use possibilities is important to the development of sustainable diversity maintenance systems. Here, the information available is still limited because of the limited extent of economic studies to date (Smale et al., 1999).

- Substantial progress has been made in developing procedures that could support on farm conservation of crop diversity, but these are most adapted to programmes that wish to carry out detailed work involving selected communities. There needs to be further work to explore how the experiences obtained from recent work can be scaled up to allow for the development of effective regional or national initiatives.

- There are many local production practices that allow diversity to be maintained or used to optimize sustainable production. However, the information remains dispersed and largely inaccessible. The ways in which this knowledge can best be strengthened and used to support sustainability more widely needs to be further explored.

- The issue of the potential benefits of using crop diversity as a natural resource in farming system management, integrated pest management (IPM) and integrated soil nutrient management has not been systematically addressed or tested. Few IPM programmes make use of local crop diversity as part of their procedures.

- Identifying local cultivars that are better adapted to local abiotic and biotic conditions, and thus reducing the need for agricultural inputs, will be important in integrating local crop diversity management into agricultural development plans. There is a need for comprehensive assessment of the benefits that crop diversity can have on ecosystem health by maintaining ecosystem stability and resilience.

A number of practices have been tested in collaboration with farmers and are likely to constitute important elements of best practices in crop genetic diversity management programmes. These include:

- Maintenance by communities of a "Community Biodiversity Register" which records the cultivars (and areas of production) of the different crops grown by farmers in the community (Rijal et al., 2000).

- The organization of Diversity Fairs in an area. This allows farmers to see the kind of diversity available in a region and to exchange materials. Thus strengthening local knowledge and seed supply systems (Tapia and Rosas, 1993; Mushita, 1993; Rijal et al., 2000; De, 2000)

- The planting by some communities of "diversity blocks" which they use to grow and compare locally available materials and to evaluate strengths and weaknesses of the materials.

- The procedures for participatory variety selection and participatory plant breeding that are being established by the partners in the CGIAR programme (http://www.prgaprogram.org).

- The development of a set of approaches that can be used to understand the important characteristics of on farm diversity maintenance within an area or community. A preliminary manual on this has been prepared as, "A Training Guide for *In Situ* Conservation On-farm" (Jarvis et al., 2000b).

### 3.3 Objective 3: Capacity building

Most groups working on the maintenance of crop genetic diversity on farm have ensured that capacity building, the promotion of awareness and development of responsible actions are always part of the activities undertaken. Similarly, there is usually a genuine interest to involve, not only farmers and local communities, but also a wider range of concerned and interested stakeholders. Thus, many of the initiatives identified in Section 3.2 above also support fulfillment of this objective as described below.

#### *3.3.1 Activities supporting capacity building, responsible actions and public awareness*

Participatory approaches have been central to most of the work undertaken and this has resulted in development of local capacity for informal research and evaluation of diversity. This is especially the case with PVS and PPB programmes and with the participation of many communities in setting out and monitoring diversity plots of available local cultivars. In a number of communities, work on diversity has been linked to literacy campaigns that *inter alia* strengthen diversity management capabilities (Nassif, 2000). Training for farmers in Mexico has also included an introduction to crop plant reproductive systems.

Not all institutions are used to working in a multi-institutional, multidisciplinary way, and at many times, the framework for this type of collaboration is non-existent (Prain, 1993). In these instances, time and energy must be set aside to develop collaborative operating frameworks. To achieve a collaborative management framework, the partner institutes often have to formalize partnerships with other national and international institutions, e.g. through a formal Memorandum of Understanding (Jarvis and Ngund'u-Skilton, 2000; Balma, 1998). One approach to overcoming problems in meeting stakeholders' differing objectives and needs is to hold a series of consultative meetings among all partners prior to the start of a project (Salazar, 1992). These meetings help to provide a forum to establish the purpose of the project as well as each partner's responsibilities and commitments (De, 2000). Any outstanding concerns or issues can be addressed during these meetings, helping to avoid confusion and strife later. Equity needs to be promoted at all project levels, from farmer participation to research to project management and decision-making. Gender awareness is one important facet of national on-farm conservation projects, not only in the collection of gender-disaggregated data and the participation of women farmers in the project, but also in the involvement of women and men as members of research and management teams. Such multidisciplinary programmes have included linking gene banks with universities, agricultural extension workers, NGOs and farmer groups in Ethiopia (Worede 1992).

Farmer field schools (FFS) have been developed as effective ways of implementing IPM strategies over very wide areas. Several millions of farmers have been involved in FFS enabling IPM to move from the site specific investigative phase to large scale implementation (CONSERVE, 2001b). Generally, IPM and FFS approaches have not used local crop diversity as part of their programmes and this may be an area that needs future emphasis.

A number of community based actions have been identified which have important positive effects. Thus, many of the active groups have organized diversity fairs, which support both the involvement of communities and the availability of local materials. Local diversity plots also provide a framework for further development of these approaches (Upadhyay et al., 2001; Tapia and Roasas, 1993).

Community gene banks have been considered to be a way of building local capacity to maintain traditional cultivars and ensuring that these are available when needed (Feyissa, 2001). In

Bangladesh they seem to have been successful and have supported maintenance of diversity (Mazhar, 2000). In Tigray, Ethiopia, farmers have established a community seed bank for a wide range of traditional crops that currently holds seeds selected by local farmers using specific cultural, technological and ecological criteria (Teekens, 2000). However, in other areas, community gene banks have not been effective and farmers keep their own individual seed supplies (e.g. Nepal). In some of these instances, Community Biodiversity Registers have been established with farmers maintaining a record of who has what cultivar to encourage seed exchange and local diversity maintenance.

There has been a growing interest in farmer based conservation initiatives over the last few years and a number of news reports, videos and other public awareness materials have been successfully produced and disseminated. Many different kinds of public awareness activities seem to be desirable ranging from personal contact, group exchanges and demonstrations, to diversity fairs, poetry and drama events, folk song competitions, distribution of printed materials, and production of audio-visual aids. Many local groups have prepared extremely interesting public awareness materials. In Nepal, drama performances and poetry contests have occurred and in both Vietnam and Hungary there have been similar activities. Neglected and underutilized crops often seem to catch the imagination of the media and a number of TV programmes and other reports have been produced on specific crops.

*3.3.2 Lessons learned, best practice development*

The activities that have been undertaken are providing a good basis for the development of best practices which directly contribute to the fulfillment of this objective. Diversity Fairs are becoming established events for a number of communities and experience is being gained in the ways they should be organized and some of the problems that are likely to be encountered. The same is true of Community Biodiversity Registers and Community gene banks, although, in the case of the latter, some further thought is needed on the sustainability of the facilities, and the ways in which they can fit in with local seed storage practices. Activities such as the establishment of diversity blocks and involvement of farmers in selection and breeding work are also becoming established components of the work programmes of many groups. These will become more important as they provide the framework for linking long term maintenance of diversity to development needs.

As in the case of activities associated with Objectives 1 and 2, the work has been (correctly) focussed at local community level. There remains a need to develop work that operationalizes diversity maintenance on a regional or national scale (Visser and Jarvis, 2000). For this large scale training and sensitization will be needed of all agricultural extension workers and of many others working with local farming systems. Much larger numbers of farmers will need to be involved and FFS approaches might well be developed for diversity maintenance. In Mali, “Farmer Field Fora” are being organized to explore this idea. However, some Progress has also been made in respect of the involvement of national institutions in on-farm conservation, particularly in Burkina Faso, Morocco, Mexico, Vietnam and Nepal (Jarvis and Hodgkin, 2000). This has resulted in training in participatory approaches to the formal sector and a wider appreciation of the strengths and potentials of community based conservation.

### 3.4. Objective 4: Mainstreaming

In contrast to the procedures used to understand crop genetic diversity maintenance and use, which have widespread application, actual interventions to support improved management are often reported to be site specific. Therefore, a portfolio of options is needed based on a range of possible methods for increasing the benefits to farmers from local crop diversity to formulate national plans, strategies, and agricultural development activities. This includes methods for integrating locally adapted crop cultivars and farmer preferences into national and local development and extension projects and understanding of the role of the formal and informal seed system in the maintenance of crop genetic diversity.

*3.4.1 Activities supporting national plans and strategies and other mainstreaming actions*

While progress has been made by a number of countries in developing national plans or strategies that take account of on farm maintenance of crop genetic diversity, activities to implement the proposals that have been formulated remain patchy. Some countries, such as Cuba and Turkey, have developed national strategies which explicitly take account of the need to develop actions in support of on-farm conservation. In other countries, formulating plans to develop such strategies is still in progress.

Where they have been undertaken, mainstreaming activities have remained very largely the concern of agricultural ministries or agencies. There are bound to be limitations to this approach and other agencies and Ministries will need to be involved in many activities. Thus, the maintenance of traditional cultivars themselves will require appropriate actions to strengthen traditional resource rights and benefit sharing in most countries (Garg et al., 1998; Gauchan, 2000). The ways in which agricultural production is managed by a country (through subsidies, intervention and protection or lack of it) will need to be reviewed (Tripp, 2001). Some work has been undertaken by a number of groups on the marketing possibilities for traditional cultivars but these largely explore options within an existing status quo. This is unlikely to enable local communities to properly realize the value of their materials.

*3.4.2 Lessons learned, best practice development*

It is not yet possible to identify best practices for mainstreaming activities. However, coming out of the various actions in different countries are a number of elements which will need to be included in mainstreaming activities. These include:

*Strengthening the informal seed supply system.* Strong seed supply systems enable farmers to maintain a high level of crop genetic diversity over time, despite losses of seed stock, bottlenecks, and other regular or unanticipated losses of crops genetic diversity. Strengthening the informal seed supply system could serve to promote conservation of local cultivars and to supply a majority of farmer seed demand.

*Creating methodologies for integrating locally adapted crop cultivars and farmer preferences into development and extension projects.* This includes identifying locally adapted cultivars suited to particular marginal agricultural environments and including them in agricultural development packages, and supporting the use of crop diversity to manage risk and uncertainty to social and environmental change. In Mudzi and Mutoko, Zimbabwe, local agricultural extension agents now actively encourage farmers to maintain on-farm crop biodiversity and farmers say this has significantly influenced their agricultural biodiversity decisions. District Councils have also decided to include competitions for greatest number of crops and cultivars in the local agricultural show.

*Curriculum development in the formal sector (primary, secondary, extension workers, university) on the conservation and use of local crop diversity.* It will be necessary to transform perceptions of accepted agricultural practice and accepted development activities such that diversity maintenance becomes embedded as a normal expectation. This will require the development of new curricula at all levels and a different approach to development from agricultural scientists and extension workers. Already, the South Africa Government National Landcare Programme has a communication and information strategy geared primarily for farmers and secondarily for the broader land-user communities and young people. This seeks to promote a better understanding of factors that can lead to unsustainable use of resources in agriculture and of policies and institutions, which can address this.

## SECTION 4. Operational guidance and the 12 principles of the Ecosystem Approach

Because of the importance attached by the CBD to the ecosystem approach, the ways in which current work contributes to the 12 identified ecosystem principles is noted below and examples are noted of on-going work that exemplifies these principals. Most of the activities contribute to more than one ecosystem principle and the aim has been to provide a general analysis of the contributions. Most of the work so far undertaken also fits within the five points of operational guidance for the ecosystem approach: (1) focusing on the functional relationships and processes within ecosystems, (2) enhancing benefit-sharing, (3) using adaptive management practices, (4) carrying out management actions at the scale appropriate for the issue being addressed with decentralization to the lowest level, and (5) ensuring intersectoral cooperation.

1. *The objectives of management of land, water and living resources are a matter of societal choice.* On farm maintenance of crop genetic diversity depends on the crop production choices made by farmers and local communities. Farmers and communities decide what is to be planted and where it will be planted and societal choice is thus central to conservation in agroecosystems. This means that, when specific project activities are initiated, time needs to be devoted to building or creating rapport with those involved in the work, whose experiences and knowledge will provide the central component of the management of crop genetic resources.

2. *Management is decentralised to the lowest appropriate level.* There is a general recognition that the adoption of this principal is the only way in which on farm conservation can succeed. Local communities involved in the activities have often organized new grassroots societies or groups that can provide the operational framework to provide the required support. Thus, in India, the Deccan Development Society has been established and the women have organized themselves into *sanghas* that have initiated collective farming and a gene-fund programme. In Nepal, Community Biodiversity Registers provide a way whereby farmers maintain and use their knowledge of available local varieties and of the farmers who can supply these.

3. *Ecosystem managers consider the effects of their activities on adjacent and other ecosystems.* The potential is clearly here for substantial positive contributions to other ecosystems from improved agricultural biodiversity maintenance. Thus, the limited use of chemical inputs (herbicides, pesticides and fertilizers) characteristic of high diversity production systems can be expected to benefit biodiversity and other ecosystems substantially. Increasing the amounts of crop genetic diversity may also permit further reduction of chemical inputs in some production systems. Benefits can also be expected from improvements in agricultural biodiversity management that reduce wild harvesting (e.g. for fuel wood or of medicinal plants)**.**

4. *Recognition of potential gains from management through (a) reduced market distortions, (b) aligning incentives, (c) internalising costs and benefits.* There is rather little experience of the ways in which the desirable aims of this principal might be achieved within the framework of on farm conservation. Much will depend on successful mainstreaming of the approaches and a recognition by governments of different economic priorities and approaches. However, at the level of most of the projects described here, there are concerns to improve market value of traditional cultivars and to ensure that the development initiatives (such as PPB) realise their full economic potential.

5. *Conservation of ecosystem structure and functioning, in order to maintain ecosystem services.* Many of the initiatives undertaken to date have had a very positive concern with identifying farming system practices where the use of local crop diversity improves ecosystem health, reducing the use of pesticides, herbicides and fertilizer with better-adapted genetic resources. For example, the Beej Bachao Andolan (Save the Seeds Movement) are pursuing the revival of traditional farming methods, such as *baranaja*, in which about a dozen crop species grown together yield a variety of produce that fulfil many different domestic requirements, while maintaining soil fertility.

6. *Ecosystems managed within the limits of their functioning.* A number of studies have identified management practices that support crop production through various locally developed operations. These locally developed approaches meet the criteria set by this principal much more completely than modern high input farming methods. For example, the irrigation systems used at high elevation in Nepal, cipher water off the main rivers into small canals so that it has time to warm

before being used to irrigate local rice cultivars. This and the practice of letting seedlings sprout inside before planting allows rice cultivars to grow up to 3000 meters in Nepal (Rijal, 2000).

7. *Undertake work at the appropriate spatial and temporal scales.* The different sources and levels of information and activities in work to date include the local cultivar, the crop, the field parcel or plot, the household, the village or community, the landscape or region. There is a full appreciation of the need to work at all these different scales although, necessarily, the work so far has emphasized local levels. Determining the appropriate scale will be a key element in work on the role of seed supply systems since this affects the identification of the effective plant population size for conservation. Breeding system will also be a key factor. Self-pollinated crops may require more maintainers within a community than cross-pollinated ones to capture all diversity in the available local cultivars.

8. *Recognize the varying temporal scales and lag-effects that characterise ecosystem processes, and set objectives for ecosystem management for the long term.* The long term perspective (more than 5 years) has yet to be embedded in agricultural biodiversity work. This will need to involve development of work on how local crop diversity can continue to provide sustainable production over the long term. Better adapted cultivars identified by farmers need to be investigated in terms of sustainable long term management of the agroecosystem. As work in this area develops, the identification of clear long term objectives needs to be given greater emphasis.

9. *Management must recognize that change in inevitable.* On-farm conservation requires a recognition that farmers are controlling the decision making process and that conservation is concerned with the maintenance of the capacity of crop plants to change and adapt. Crop variety diversity provides an essential way in which farmers can meet their changing production circumstances. Best practices need to be explored that provide a buffering capacity in respect of the farmer's seed supply and storage system to adapt to changing environmental and economic conditions, and the capacity of the formal and informal sector to support farmers during times when individuals do not have the capacity to cope with random events (drought, hurricanes, abrupt market changes). Traditional cultivars can play a particularly important role in rural communities following major environmental disasters, civil disturbance or wars. In these situations, disruption and limitations of resource availability often increases the importance of local crop materials. This seems to have been the case in Ethiopia, Rwanda and Sudan and constitutes an important element of CBDC work in Sierra Leone (Richards and Ruivenkamp, 1997).

10. *Seek the appropriate balance between, and integration of, conservation and use of biological diversity.* This principal has been successfully embedded in all the work on agricultural biodiversity conservation currently being undertaken. As the State of the World Report noted (FAO, 1998) conservation through use is an essential component of maintaining crop genetic diversity. There are further opportunities to extend this approach as the work expands to take on a wider range of crops. This is likely to particularly benefit conservation of neglected and underutilized crop species where the formal sector will never have the resources to maintain enough genetic diversity *ex situ* and conservation through use must be a primary strategy.

11. *Consider all forms of information including scientific, indigenous, and local knowledge innovations and practices*. The work undertaken in this area has very largely adopted this approach and has shown that it is essential for effective implementation of the programmes. Thus, understanding farmer classification systems are an important part of quantifying number of cultivars and need to be complemented by at least some genetic studies to provide appropriate information on the richness and evenness of the diversity detected.

12. *The ecosystem principal of most relevance to the issue of mainstreaming is the recognition of the need to involve all relevant sectors of society and scientific disciplines.* The importance of this principal is widely recognized although it has often been rather difficult to implement the approach. A number of projects have noted the problems they have encountered with getting researchers from different disciplines to work together in a fully multidisciplinary manner. However there have

also been very successful collaborations. The Gaoligongoshan Farmers' Association for Biodiversity Conservation, established in 1995 is the first NGO for environmental protection in China. It opens the channels between government departments and farmers, as well as donor projects and farmers. In Vietnam, activities are decided collectively by all participating institutes and farmers, but management is done by local multi-disciplinary teams in the different regions.

**SECTION 5. Relevance to cross cutting elements identified by CBD**

**5.1. The effects of invasive alien species**

There may be some justification for suggesting that understanding farmer management practices of local crop diversity and the ways in which farmers control movement of new materials may be useful in developing innovative ways of limiting the expansion of invasive species. However, the work that has been done to date has not really linked to work on invasive alien species, despite the fact that many such species continue to create weed problems in agroecosystems.

In practice, pathogens, insect pests, and weeds are likely to be the “invasive species” of most concern to farmers. There are obviously opportunities to strengthen the integrated pest management approaches in ways that take account of the use of crop genetic diversity. Indeed the relatively limited use of crop variety diversity by IPM programmes is surprising. One exception is the use of intercropping with cultivars of rice in large scale trials by the Yunnan Agricultural University, Kunming, China. This has shown that proper diversification with traditional or modern crop cultivars can be an economically viable option for farmers who want to expand production, and can not afford to use commercial disease-resistant cultivars and pesticides for disease control. Weed management is another key issue where the use of local cereal crop cultivars with higher tillering have been used in Ethiopia to help to reduce weed population.

**5.2. Indicators of biological diversity and impacts on biological diversity**

Work on crop genetic diversity has addressed a specific aspect of the development of indicators of biological diversity – that of the estimation of diversity within cultivated species. Substantial progress has been made in understanding the issues involved in estimating the amount and distribution of this diversity over space and time. Concepts such as the “Farmer Unit of Diversity Management” and ways in which information on these can be collected and validated are likely to provide the basis for effective estimation in the future.

Further work is needed on how to scale up the estimates obtained so as to provide useful information on diversity at regional or country level. Current methods are imperfect in their capacity to provide realistic estimates of the amount of within species diversity within crop at e.g. country level. There is also a need to explore ways in which one can adequately estimate amounts of diversity within agroecosystems that adequately reflects the obvious fact that some systems contain much higher amounts of diversity, within and between species, than others (e.g. contrast home gardens with paddy rice production systems).

**5.3. Use of incentive measures**

The information collected from the work described can be used to start integrating local crop diversity into the agricultural development arena and providing incentive measures for maintenance of traditional cultivars. Important incentive measures could include: (1) creating methodologies for integrating locally adapted crop cultivars and farmer preferences into national and local development and extension projects, (2) improving access of materials to farmers through developing seed networks, diversity fairs and information systems, (3) market development for the maintenance of on-farm diversity including better processing, marketing and consumer awareness, (4) providing information on nutritional qualities of locally adapted cultivars that can provide low cost forms of improved nutrition, and, (5) Developing participatory breeding and selection programmes to overcome key constraints.

Even in relatively advanced economies, farmers have “incentives” to grow cultivars when they possess the traits and characteristics that satisfy their objectives, such as adaptation to specific environmental conditions (soil, disease, rainfall), as well as high quality product characteristics (for the preparation of special dishes and tastes, high nutritional value). These have been shown in the European Union and in Hungary and other European countries (Mar, 2001).

### 5.4. Impact assessment

While many of the programmes described have a substantial concern with measuring the impact of the activities undertaken, most of the work has not been carried out for long enough to permit good impact assessment of activities undertaken. The PPB programme of the CGIAR has developed clear procedures for impact assessment and for evaluating the effect of the work undertaken on agricultural production. However, protocols for impact assessment in other areas have still to be developed. These need to take into account not only the effect of interventions on agricultural production and human well being, but also their wider impact on diversity maintenance and ecosystem health. This type of assessment requires information collected over time and at appropriate scales.

### 5.5. Taxonomic concerns

Many of the individual actions have involved taxonomic work which is often an essential part of understanding crop genetic diversity. However, this has seldom been integrated into national taxonomic work programmes. One exception is in Ethiopia where the work has developed capacity on plant taxonomy and includes intra-specific crop diversity specimens to help assess the amount and distribution of crop diversity. In order to support farmers in the maintenance and management of crop diversity, it will also be necessary to integrate the results of local classification systems for crop cultivars into the national systems for biodiversity management.

### 5.6. Benefit sharing

A clear approach to benefit sharing is a central concern in work on maintenance of crop genetic diversity. At the international level there have been substantial efforts to explore various possible approaches (Correa, 1999). However, these are often oriented in favour of national governments and do not necessarily fully take account of the interest of the farmers and communities maintaining the materials. Benefit sharing means that the goods and services from crop diversity benefit the stakeholders responsible for their production and management. Work in Mexico, Brazil and Ethiopia have shown that it is possible for local communities to obtain increased value from local cultivars. Many other projects working in this area have developed benefit sharing protocols, which govern the partnerships involved between communities, NGOs and formal sector partners. It may be useful to explore the development of some more general guidelines in this regard under the auspices of the CBD. The renegotiation of the International Undertaking for Plant Genetic Resources has involved considerable discussions of the nature of farmer’s rights and of benefit sharing issues. However, how these might affect on farm maintenance of local varieties has yet to be determined.

### 5.7. Indigenous knowledge

Nearly all the work undertaken in recent years has a substantial component concerned with recognizing, validating and maintaining local knowledge. A number of initiatives have been developed which strengthen indigenous knowledge systems such as Community Biodiversity Registers in Nepal, Diversity Fairs in many countries and drama and poetry festivals. The ways in which indigenous knowledge can be kept in context and not merely secured using the more extractive approaches of traditional ethnobotanists is important and a number of groups are also working on this.

### 5.8 National biodiversity strategy action plans

The implementation of these different initiatives is leading to the inclusion of on-farm maintenance of diversity in the national biodiversity strategy and action plans of Nepal, Ethiopia, Burkina Faso, Cuba and a number of other countries. The initiatives have also supported the implementation of the biodiversity conservation strategies in Morocco, Mexico, and Vietnam.

This is a first step and it will be important for countries active in this area to exchange experiences on their approaches and procedures so as to identify key issues where sharing experiences and information might be beneficial. One of these areas might well be the need to link agricultural, development and environmental actors to provide greater coherence and effectiveness in the strategies. There is also a need to explore experiences of different countries on the implementation of the strategies and plans that have been developed.

## SECTION 6. Conclusions

This report has noted that there are substantial amounts of work on maintenance of local crop cultivars and of local genetic diversity in production systems in many countries. This work is demonstrating that diversity continues to be maintained and managed by farmers throughout the world as an integral part of their coping strategies. It is essential that development strategies integrate this knowledge effectively and that the importance of crop genetic diversity to agricultural resources management, sustainable production and the aims of the Convention on Biological Diversity is fully recognized. This includes designing a programme of work that addressed the issue of the potential benefits of using crop diversity in farming system management programmes, including IPM and integrated soil nutrient management initiatives.

The work undertaken over the last decade has involved a wide variety of partners including farmers, communities, NGOs, national organizations and international institutes. Often all of these have been involved in a single programme, and one of the most significant developments has been the clear recognition of the importance of collaboration between formal and informal sector partners. Another important element of the work undertaken has been the recognition that there must be a multidisciplinary approach and that genetic, agronomic, ecological, social, economic and other expertise are all required to develop the required understanding of farmer maintenance of diversity.

The best programmes have been drven by a clear appreciation of the central role of the farmer in managing crop genetic diversity and of the importance of adopting working practices that are fully participatory and start from a desire to reflect farmers' needs and concerns in diversity management. From this necessarily follows a conservation agenda that emphasizes the importance of dynamic management, based on the need to maintain adaptive capacity in crop materials linked to effective *ex situ* conservation actions.

The work has largely been concerned with local initiatives involving a few selected communities in one or two specific regions of a country. This has had the benefit of substantially deepening our experience of farmer management of diversity and of learning to work with farmers in ways which they find relevant and useful. The next challenge is to transfer these local experiences to wider scale activities that can cover areas, regions or countries. In this respect methods need to be developed to extend rapid survey procedures to identify areas of high crop diversity in a country and to expand work from selected villages or community foci to much larger areas.

Studies of diversity management have shown that local cultivars are complex and highly varied in their genetic structure and their relationships. Different communities and cultures approach the naming, management and distinguishing of local cultvars in different ways and no simple relationship exists between cultivar identity and genetic diversity or content. Research studies have found it useful to identify the farmers unit of diversity management as an analytical unit and this may become an important tool in work on diversity assessment. However, how this analytical element relates to meaningful management and conservation decisions and to community interests and seed supply systems has yet to be determined.

The work undertaken has often cited the possibility of benefits to the ecosystem from genetic crop diversity and to the provision of important ecosystem services. In practice, little information has been obtained on the scale and nature of these benefits or services. Cited benefits include improved nutrient cycling, reduced use of pesticides, herbicides and other chemical inputs, and improved soil properties. There is some evidence that diversity might improve management of pests and diseases (Zhu et al., 2000) but, in other areas, further studies are needed to determine both extent of these benefits and the ways in which they can be realized.

The central importance of maintaining local seed supply systems is becoming clear. Seed supply problems are often a very real constraint for resource poor farmers and lack of seed of local cultivars is often reported as a major problem for many communities. At the same time, informal seed supply systems are very dynamic and provide important elements in the maintenance of diversity and of adaptive capacity. We frequently seem to be dealing with complex meta-populations managed by farmers in ways that allow continual migration and selection to generate the qualities needed in local materials. Initiatives and policies that support local seed supply systems are likely to be important to future maintenance of diversity.

Much work is now needed to identify regional and national actions that will have a positive impact on diversity maintenance. While there have been many suggestions and several possibilities have been identified, the emphasis has been on local actions. National economic policies (and even global policies) may well have a much more substantial effect than any slight alteration in local circumstances.

There are a number of areas where the formal sector might usefully make additional contributions to maintenance of local crop genetic diversity. The first is an exploration of the ways in which national gene banks might be able to strengthen supplies of important local cultivars. Providing larger amounts of seed of key local materials may well be within the capability of national gene banks and would provide a way of linking *ex situ* and *in situ* conservation as well as strengthening the links between conservation and use. The knowledge gained on IPM is also likely to be extremely useful in developing ways in which the formal sector can support and strengthen diversity maintenance at local level.

In developing a strengthened programme of work on agricultural biodiversity, it will be essential to build on the effective and important local initiatives that have been developed over the last few years. The CBD programme provides a framework in which to validate and extend these initiatives. It must act in ways that recognize the work of farmers and communities over thousands of years in maintaining and passing on the crop diversity essential to sustainable production and meeting the needs of the world's growing population. The issue facing the work programme in this area is to develop new approaches that permit the development of countrywide actions and, yet, do not lose contact with the concerns of the farmers and communities responsible for managing and maintaining crop genetic diversity.

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**List of acronyms**

AARI - Aegean Agricultural Research Institute, Menemen, Izmir
ACSAD - Arab Center for the Study of Arid Zones and Dry Lands, Damascus, Syria
AMEXTRA- Asociación Mexicana para la Transformación Rural y Urbana, Mexico
ANSWER- Asian Network for Sweet Potato Genetic Resources, Philippines
ARC – Agricultural Research Center, South Africa
AREA – Agricultural Research and Extension Authority, Turkey
ARSIA – Agenzia Regionale per lo Sviluppo e l'Innovazione nel Settore Agricola-forestale, Toscana, Italy
ARSSA- Agenzia Regionale per lo Sviluppo e I Servizi in Agricoltura, Abruzzo, Italy
ASSAM- Agenzia Servizi Settore Agroalimentare delle Marche, Marche, Italy
ASPTA – Assessoruas e Servicios a Projetor de Tecnologia Alternativa, Brazil
AVDRC – Asian Vegetable Development Research Centre, Taiwan
BUCAP – Biodiversity Use of Conservation Asia Programme
CBAN – Community Biodiversity Action Network, Sierra Leone
CBDC- Community Biodiversity Development and Conservation Programme
CESA – Colegio de Estudios Superiores de Administración, Colombia
CET - Centro de Educacion y Tecnologia, Santiago, Chile
CIAT-Centro Internacional de Agricultura Tropical, Colombia
CICA - Centro de Investigación en Ciencias Agropecuarias, Mexico
CIKSAP - Centre for Indigenous Knowledge Systems & By-Products, Kenya
CIMMYT - Centro Internacional de Mejoramiento de Maíz y Trigo, Mexico
CINVESTAV- Centro de Investigaciones e Estudios Avanzados, Mexico
CIP - Centro Internacional de la Papa, Peru
CIRAD – Centre for International Research in Agriculture and Development, France
CIRES – Centre Ivoirien de Recherche Economique et Sociale, Cote d'Ivoire
CIRNMA - Centro de Investigación de Recursos Naturales y Medio Ambiente, Peru
CNRST- Centre National de Recherche Scientifique et Technologique, Mali
CODESU- Consorcio para el Desarrollo Sostenible de Ucayali, Peru
COLMEX – El Colegio de Mexico, Mexico
CONACYT- Consejo Nacional de Ciencia y Tecnología
CONDESAN- Consorcio para el Desarrollo de la Ecorregion Andina
CONSERVE – Community-Bases Nature Seeds Research Centre, Philippines
CP- Colegio de Posgraduados, México
CRIFC - Central Research Institute for Food Crops, Bogor, Indonesia/Malang
CTDT - Community Technology and Development Trust, Zimbabwe
CWANA – IPGRI's Regional Office - Central and West Africa and North Africa
DANIDA – Danish International Development Assistance, Denmark
DBCPGR- Department of Biological Control and Plant Genetic Resources, Belgium
DIKA – Agrobiodiversity Protection Society "Dika", Georgia
DR&SS - Department of Research and Specialist Services, Zimbabwe
ECP - European Cooperative Programme
ERSA - Ente Regionale per la Promozione e lo sviluppo dell'Agricoltura, Italy
FAO – Food and Agriculture Organization of the United Nations, Italy
FSA – Faculté des Sciences Agronomiques, Benin
FUGN – Fédération des Unions des Groupements NAAM, Burkina Faso
FUNDATADI - Fundación para la Agricultura Tropical Alternativa y el Desarrollo Integral, Venezuela
GEF - Global Environment Facility
GIRA - Grupo Interdisciplinario de Tecnología Rural Apropiada, Mexico
GTZ- Deutsche Gesellschaft Für Technische Zusammenarbeit, Germany
HDRA- Henry Doubleday Research Association, United Kingdom
HSL- Heritage Seed Library, United Kingdom
IAG – Institute of Agricultural Genetics, Vietnam

IAV Hassan II- Institut Agronomique et Vétérinaire Hassan II, Morocco
IER - Institut d'Economie Rurale, Bamako, Mali
IBCR-Institute of Biodiversity Conservation and Research, Ethiopia
ICARDA- International Center for Agricultural Research in the Dry Areas, Syrian Arab Republic
ICRAF- International Centre for Research in Agroforestry, Kenya
ICRISAT - International Crops Research Institute for the Semi-Arid Tropics, India
IDRC – Institute of Development Research, Canada
IFAD – International Fund for Agricultural Development, Italy
IGAU - Indira Gandhi Agricultural University, India
IIAP – Instituto de Investigaciones Ambientales del Pacífico, Colombia
IITA - International Instittue of Tropical Agriculture, Nigeria
IMECBIO- Instituto Manantlan de Ecología y Conservación de la Biodiversidad, Mexico
INERA - Institut d'Etudes et de Recherches Agricoles, Burkina Faso
INERA- Institut de L'Environnement et Recherches Agricoles, Burkina Faso
INIA - Instituto Nacional de Investigacion y Tecnologia Agraria y Alimentaria Peru
INIAP – Instituto Nacional de Investigación Agropecuarias, Quito, Equador
INIBAP–International Network for the Improvement of Banana and Plantain
INIFAT- Instituto de Investigaciones Fundamentales en Agricultura Tropical, Cuba
INIFAP - Instituto Nacional de Investigaciones Forestales y Agropecuarias. Veracruz, Mexico
INRA- Institut National de la Recherche Agronomique, Morocco
INRAN - Institut National des Agronomiques du Niger, Niger
INRAB – Institut National de Recherche Agricole du Bénin, Benin
IPAM - Instituto de Pesquisa Ambiental da Amazônia, Brazil
IPGRI- International Plant Genetic Resource Institute, Italy
IRA – Institut de Recherche Agronomique, Tunisia
IRAD – Institut pour la Recherche Agronomique et le Développement, Cameroon
IRD – Institute for Research and Development, France
IRESA – Institut National de la Recherche et de l'Enseignement Supérieur Agricole, Tunisia
IRRI - International Rice Research Institute, Philippines - CGIAR
ISRA - Institut Sénégalais de Recherches Agricole, Sénégal
ITDG – Intermediate Technology Development Group, Kenya
ITDG – Intermediate Technology Development Group , Southern Africa - Zimbabwe
KARI – Kenya Agricultural Research Institute, Kenya
KEFRI - Kenya Forestry Research Institute, Kenya
Li-Bird- Local Initiatives for Biodiversity and Development, Nepal
NARC – National Agricultural Research Centre, Nepal
NARO – National Agricultural Research Organization, Uganda
NBPGR – National Bureau of Plant Genetic Resources, India
NORAG – Agricultural University of Norway, Norway
NPGRC - National Plant Genetic Resources Centre, Malawi
NRI – National Resources Institute, United Kingdom
PGR – Plant Genetic Resources, Ghana
PGRU - Plant Genetic Resources Unit, Zambia
PHILRICE - Philippine Rice Research Institute, Philippines
PLEC – People, Land Management and Environmental Change Project, UN University
PRACTEC – Andean Project of Peasant Technologies
PROINPA - Programa de Investigación de la Papa/Instituto Boliviano de Tecnología Agropuecuaria, Bolivia
PUCE – Pontificia Universidad Católica del Ecuador, Equador
SADC - Southern African Development Community, Zimbabwe
SEARICE - Southeast Asia Regional Institute for Community Education, Philippines
Se. SIRCA - Servizio sperimentazione, informazione, ricerca, consulenza in agricoltura, Campania, Italy
SOS – Sultan Kudurat Project
TAROGEN,- Taro Genetic Resources, Fiji/Vanuatu
UACH – Universidad Autónoma de Chihuahua, Mexico

UAEM - Universidad Autonoma del Estado de Mexico
UAGM – Mexico
UBING/UDA – Policy Research for Development Alternative, Bangladesh
UDG – Universidad de Guadalajara, Mexico
UNDP- United Nations Development Programme
UNU – United Nations University
UPWARDS- User's Perspective with Agricultural Research and Development, Philippines
USC – Seeds for Survival, Canada
VASI- Vietnam Agricultural Science Institute, Vietnam
WARDA – West Africa Rice Development Asssociation, Côte d'Ivoire
YAAS – Yuman Agricultural Academy of Science, China

**ANNEX A:**

**Some current and recent programmes of work that support the management of crop diversity in Agroecosystems**

| **Sub-Saharan Africa** | | | | |
|---|---|---|---|---|
| **Country** | **Leading National Organisation/ Institute** | **Main activities or project title** | **International Partner if applicable** | **Crop** |
| Benin | University of Benin, INRAB | Dynamics of Yam Diversity and documentation | IRD, CIRAD, IPGRI, IITA | yam |
| Benin | INRAB | Dévelopment, conservation et utilisation de l'Agrobiodiversité au Bénin | Plant Research International, Wageningen | |
| Benin | FSA (Université Nationale de Benin), INRAB, MDR | Management of agro-biodiversity for the integrated fight against the principal organisms that are harmful to niébé (*Vigna unguiculata* L. Walp) in Bénin | Wageningen University | cowpea |
| Botswana | Thusano Lefatsheng | Biodiversity of Leafy green vegetables (phase 1) | IPGRI | African leafy vegetables |
| Burkina Faso | INERA, FUGN | Sorghum participatory plant breeding programme, both at the national level and with farmer organizations | CBDC | Sorghum, small grain cereals, indigenous vegetables |
| Burkina Faso | CNRST, INERA, FUGN, University of Ouagadougou | *In situ* conservation methods and capacity building between farmers and institutes for the conservation and use of ago-biodiversity | IPGRI | sorghum, pearl millet, cowpea, groundnuts, okra, *Solenstenum* |
| Cameroon | IRAD, University of Dschang | Germplasm management of African leafy vegetables for the nutritional and food security needs of women and children in sub-Saharan Africa | IPGRI, AVDRC, NRI | African leafy vegetables |
| Cote D'Ivoire | CIRES | Technological and Institutional Change for Rice-based Livelihoods | IITA, WARDA | rice |
| Democratic Republic of Congo | Not identified | Farmers' management and decision-making strategies for bean varieties | | beans |
| Democratic Republic of Congo | Mulungu research station | Enhancement of the genetic diversity of the common bean (*Phaseolus vulgaris* l.) At farmer's level with involvement of the farmers | Eastern and Central Africa Bean Research Network, CIAT | beans |
| Eritrea | Department of Agricultural Research and Human Resource Development, MoA | Participatory barley breeding in Eritrea | ICARDA, | barley |
| Ethiopia | IBCR, University of Addis Ababa, Seeds of Survival | A dynamic farmer based approach to the conservation of Ethiopia's plant genetic resources | | sorghum, barley, durum wheat |
| Ethiopia | University of Addis Ababa, Herbarium | Ethiopia Flora Project | | |
| Ethiopia | Tigray | Community gene banks | NORAG | |
| Ethiopia | IBCR, University of Addis Ababa, Herbarium | Spatio-temporal dynamics of crop genetic diversity and farmer selection on-farm, Ethiopia | IPGRI, University of Ottawa | sorghum |
| Ethiopia | Not identified | Study of formal and farmer breeding and seed systems for sorghum in Western Harerghe, Ethiopia | Technology and Agrarian Development, Wageningen University | sorghum |
| Ethiopia | National Seed Industry Agency (NSIA) | Farmer based seed production & marketing scheme | IDA | |
| Ethiopia | Africare | Humanitarian organisation | Africane | maize, sorghum |

| | | | | |
|---|---|---|---|---|
| | | distributing maize & sorghum seed to farmers in SE Ethiopia | | |
| Ethiopia | CARE | Humanitarian organisation involved in training farmers in seed production | CARE International | |
| Ethiopia | Christian Reformed World Relief Committee (CRWRC) | Humanitarian organisation involved in distribution of seed in South Gondor region | | maize, beans |
| Ethiopia | Mercy Corps International | Humanitarian organisation that supports a seeds and tools programme implemented by Concern Worldwide in Ethiopia | | wheat |
| Ghana | University of Ghana | Identification and promotion of profitable agrobiodiversity-rich management systems and techniques in five contrasted areas | UNU/PLEC | yam, cassava, rice, home garden |
| Ghana | PGR center, University of Ghana, Crops Research Institute | Home gardens project - Ghana | IPGRI | fruit trees, indigenous crops (e.g. sorghum, yam, plantain), medicinal plants, wild relatives of crops |
| Ghana | PGR center (Crops Research Institute) | Monitoring Genetic Diversity through Ethnobotanic and Genetic Erosion Studies for Effective Conservation Strategies of Crop Genetic Resources | IPGRI | bambara groundnut |
| Guinea | Not identified | Technological and Institutional Change for Rice-based Livelihoods | IITA, WARDA | rice |
| Guinea | Université de Conakry | Identification and promotion of profitable agrobiodiversity-rich management systems and techniques in the Fouta Djallon and upper Niger Plains | UNU/PLEC | rice, fruits, maize, tuberous crops, fonio, home gardens |
| Kenya | CBDC (CIKSAP) | Field grow -outs of local varieties for farmer selection and use | CBDC, Plant Research International, Wageningen | |
| Kenya | CIKSAP | Sustainable use and conservation of indigenous vegetable diversity. (Indigenous Knowledge Systems and By- Products) | CBDC Plant Research International, Wageningen | |
| Kenya | KARI | Participatory Plant Breeding for Drought Resistant Maize Varieties in Eastern Kenya | CIMMYT | maize |
| Kenya | KARI | 'Development Relief programme and seed fairs to ensure support in times of 'crisis' | IPGRI | |
| Kenya | KARI, KEFRI, Moi University | Participatory seed technology | Plant Research International (Wageningen UR) | grain legumes & pulses |
| Kenya | ITDG – East Africa | Agriculture & pastoralism programme projects on development of technologies for agro-biodiversity conservation e.g. community seed banks & diversity fairs | ITDG | |
| Kenya | KARI | Identification and promotion of profitable agrobiodiversity-rich management systems and techniques, Embu district | UNU/PLEC | |
| Kenya | CARE – Kenya, Catholic Relief Services, CRWRC | Humanitarian organisation involved in training farmers in seed production | CARE international | |
| Kenya | KARI (NGBK), National Museums of Kenya, | Germplasm management of African leafy vegetables for the nutritional and | IPGRI, AVDRC, NRI | African leafy vegetables |

| | | | | |
|---|---|---|---|---|
| | University of Nairobi | food security needs of women and children in sub-Saharan Africa | | |
| Madagascar | Not identified | *In-situ* Conservation of Crop Wild Relatives through Enhanced Information Management and Field Application | IPGRI | wild relatives of crops in Natural ecosystems |
| Mali | IER | Participatory plant breeding to introduce sorghum variability | ICRISAT | sorghum |
| Mali | IER | Development of strategies for *in situ* conservation and utilization of plant genetic resources in desert prone areas of Africa | FAO, IPGRI | sorghum |
| Mali | Seeds of Survival | Shifting agricultural practices to increase agroecosystem resilience | USC Canada, | |
| Malawi | Chitedze Research Station, Bunda College of Agriculture, Kasinthula Research Station | Participatory breeding and *in situ* & *ex situ* conservation of Sorghum and Cow pea in Malawi | Laurentian University, Sudbury, Ontario | sorghum and cowpea |
| Malawi | NPGRC | Monitoring Genetic Diversity through Ethnobotanic and Genetic Erosion Studies for Effective Conservation Strategies of Crop Genetic Resources | IPGRI | cassava, sweet potato |
| Mozambique | Not identified | The LinKS project: local knowledge to support biodiversity conservation and food security | FAO | |
| Namibia | Mahenene Research Station | Farmer-Participatory Plant Breeding: Experiences with pearl millet breeding in Southern Africa | ICRISAT | pearl millet |
| Niger | INRAN | Dynamics of pearl millet diversity | IRD, University of Paris | pearl millet |
| Nigeria | Not identified | Technological and Institutional Change for Rice-based Livelihoods | IITA, WARDA | rice |
| Rwanda | Not identified | Farmers' management and decision-making strategies for bean varieties | CIAT | beans |
| Senegal | ISRA, HORTI Consult | Germplasm management of African leafy vegetables for the nutritional and food security needs of women and children in sub-Saharan Africa | IPGRI, AVDRC, NRI | African leafy vegetables |
| Sierra Leone | CBAN | Shifting agricultural practices to increase agro-ecosystem resiliency, following war disasters | CBDC Plant Research International, Wageningen | groundnuts, roots and tubers |
| Sierra Leone | Rice Research Station, Rokupr | Project studies the farmers management and genetic background of local varieties | CBDC Plant Research International, Wageningen | rice |
| Somalia | Not obtained | 'Development Relief program' and seed fairs to ensure support in times of 'crisis' | IPGRI | |
| Somalia | CARE | Humanitarian organisation involved in training farmers in seed production | CARE International | |
| South Africa | ARC | Germplasm management of African leafy vegetables for the nutritional and food security needs of women and children in sub-Saharan Africa | IPGRI, AVDRC, NRI | African leafy vegetables |
| Sudan (Northern Kordofan state in western Sudan) | ARC | *In situ* conservation of PGR in Sudan (traditional ways of pearl millet landraces conservation & women's role) | Agricultural University of Norway | pearl millet |
| Sudan | Not identified | 'Development Relief program' and seed fairs to ensure support in times | IPGRI | |

| | | | | |
|---|---|---|---|---|
| | | of 'crisis' | | |
| Swaziland | Not obtained | The LinKS project: local knowledge to support biodiversity conservation and food security | FAO | |
| Tanzania | Agricultural Research Institute | Farmer management of Musa diversity | INIBAP | banana, plantain |
| Tanzania | Selian Agricultural Research and Training Institute Arusha, Ministry of Agriculture | *In-situ* conservation of agrobiodiversity: Beans in Southern Tanzania | CIAT, Horticulture Research International, UK | Beans |
| Tanzania | Tanzania Food and Nutrition Centre, Dar es Salaam | The LinKS project: local knowledge to support biodiversity conservation and food security | FAO | |
| Tanzania | Agricultural Research and Training Institute Ukiriguru | Identification and promotion of profitable agrobiodiversity-rich management systems and techniques in the humid and subhumid sites on Mr. Meru | UNU/PLEC | |
| Uganda | NARO (National Agricultural Research Organization) | Farmer management of Musa diversity | INIBAP, IPGRI | Banana, plantain |
| Uganda | | 'Development Relief program' and seed fairs to ensure support in times of 'crisis' | | |
| Uganda | Makerere University | Identification and promotion of profitable agrobiodiversity-rich management systems and techniques in the uplands of Ankole | UNU | |
| Uganda | NARO | Monitoring Genetic Diversity through Ethnobotanic and Genetic Erosion Studies for Effective Conservation Strategies of Crop Genetic Resources | IPGRI | Yam |
| Zambia | PGRU (Ministry of Agriculture Food & Fisheries) | Germplasm management of African leafy vegetables for the nutritional and food security needs of women and children in sub-Saharan Africa | IPGRI, AVDRC, NRI | African Leafy Vegetables |
| Zimbabwe | Southern African unit for Local Resource Development (SALRED Trust) | Community Seed Centres, Participation of farmers in on-farm, farmer managed trials | CIMMYT | |
| Zimbabwe | ITDG – Southern Africa | Food production programme supports projects on development of technologies for agro-biodiversity conservation e.g. promotion of community seed banks & diversity fairs | ITDG | |
| Zimbabwe | CTDT | Community based crop genetic resources management. Strong focus of the farmers seed supply system | CBDC Plant Research International, Wageningen | sorghum, millets, cowpea |
| Zimbabwe | CTDT | Development of strategies for *in situ* conservation and utilization of plant genetic resources in desert prone areas of Africa | FAO, IPGRI | sorghum |
| Zimbabwe | DR&SS | Biodiversity of Leafy green vegetables (phase 1) | IPGRI | African leafy vegetables |
| Zimbabwe | SADC Centre of Communications for Development, Harare | The LinKS project: local knowledge to support biodiversity conservation and food security | FAO | |

| **AMERICAS** | | | | |
|---|---|---|---|---|
| **Country** | **Leading National Organisation/ Institute** | **Main activities or project title** | **International Partner if applicable** | **Crop** |
| Bolivia | FUNDACION PROINPA | Agrobiodiversity management of local roots and tubers | CIP | root and tuber crops |
| Brazil | IPAM | Identification and promotion of profitable agrobiodiversity-rich management systems and techniques in the dynamic physical of the lower amazon basin | UNU/PLEC | home garden, banana, acai palm-fruit, field crops |
| Brazil | CENARGEN/ EMBRAPA, FUNAI | Agrobiodiversity managment of Indian crops | | maize, fruit, rice, beans |
| Brazil | ASPTA (Assessoruas e Servicios a Projetor de Tecnologia Alternativa) | Implementation of breeding and seed multiplication programmes to support local community structures and varietal diversity | CBDC | corns, beans |
| Chile | CET | Implementation of breeding and seed multiplication programmes to support local community structures and varietal diversity | CBDC | bean, quinoa, potatoes |
| Colombia | Proyecto Semillan (NGO) | Implementation of breeding and seed multiplication programmes to support local community structures and varietal diversity | CBDC | corn beans, aripacacha |
| Cuba | INIFAT | Enhancing homegarden biodiversity and improving family nutrition and income | IPGRI | home garden |
| Equador | INIAP | Agrobiodiversity management of local roots and tubers | CIP | root and tuber crops |
| Equador | PUCE | Dynamics of Cassava genetic diversity | IRD, University of Montpellier, France | cassava |
| French Guyana | Not identified | Dynamics of Cassava Genetic Diversity | IRD, University of Montpellier, France | cassava |
| Guatemala | Facultad de Ciencias Agronomicas, Universidad San Carlos | Enhancing home garden biodiversity and improving family nutrition and income | IPGRI | home garden |
| Mexico | INIFAP | Economic concepts for designing policies to conserve crop genetic resources in Oaxaca | CIMMYT | maize, wheat |
| Mexico | INIFAP, UACh | Agronomic Management of maize diversity in Oaxaca | | maize |
| Mexico | CP, UDG, COLMEX, INIFAP, UNAM, UacH | Conservation of Genetic Diversity and Improvement of Crop Production in Mexico: A farmer based approach | University of California, Davis, North Carolina State University, USA | maize, beans, chili, squash |
| Mexico | CICA, AMEXTRA, GIRA, UAGM | Reintroduction of the traditional agrobiodiverse Mesoamerican cropping patterns (the *milpa* system) | UNU / PLEC | Mesoamerican cropping systems, such as *milpa* |
| Mexico | CINVESTAV | *In situ* conservation methods and | IPGRI | maize, bean, chili, |

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| | | capacity building between farmers and institutes for the conservation and use of agobiodiversity | | squash |
| Mexico | CP, CONACYT | The improvement of local maize varieties in Mexico | | maize |
| Mexico | Colegio de Posgraduados Agricultural Minstitry of Agricultural | Conservation of Microhabitats for crop diversity | | |
| Mexico | University of Guadalajara, IMECBIO, CUCBA | *In situ* conservation and monitoring of seed systems | ORSTOM | maize |
| Peru | CODESU | Agro-biodiversity preserved *In Situ* by Shipibo-Conibo and Ashaninca ethnic groups in the Amazon | IPGRI | maize, beans, peanuts, chili pepper, and cassava |
| Peru | CIRNMA | Agrobiodiversity management of local roots and tubers | CIP | root and tuber crops |
| Peru | IIAP, CESA, INIA, PRACTEC | *In situ* Conservation of Native crops and their wild relatives | | |
| Peru | INIA, Biodiversidady Manejo Integrado de Cultivos | Managing native potato diversity for self sufficiency and sustainability | CIP | potatoes |
| Peru | Istituto de Investigaciones de la Amazonia Peruana | Identification and promotion of profitable agrobiodiversity-rich managment systems and techniques in the upper Amazon flood plain | UNU/PLEC | home garden, fruit trees, camu-camu, field crops |
| Peru | INCA, CIED | Implementation of breeding and seed multiplication programmes to support local community structures and varietal diversity | CBDC | potatoes, maize, quinoa, beans |
| Venezuela | Univerisdad de los Andes, FUNDATADI, and the Centro de Recursos Geneticos, Banco de Germoplasma, | Enhancing home garden biodiversity and improving family nutrition and income | | home garden |

| **RUSSIA AND THE CIS COUNTRIES** | | | | |
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| **Country** | **Leading National Organisation/ Institute** | **Main activities or project title** | **International Partner if applicable** | **Crop** |
| Republic of Uzbekisatn | Institute of Genetics and Plant Experimental Biology; Scientific and Production Agriculture Centre; Ministry of Agriculture; NGO "Ecoles | On-farm conservation of horticultural crops and their wild relatives. | IPGRI, UNEP | horticultural crops |
| Kazikstan | National Academic Centre of Agrarian Researches | On-farm conservation of horticultural crops and their wild relatives. | IPGRI, UNEP | horticultural crops |
| Kyrgyz Republic | Agrarian Academy; Ministry of Environmental Protection; State Forestry Agency; NGO ""Fauna and Flora International"; Research Institute on Forest and Nut | On-farm conservation of horticultural crops and their wild relatives. | IPGRI, UNEP | horticultural crops |
| Tajikistan | Academy of Agricultural Sciences; Production Association on Forestry "Tajikles" | On-farm conservation of horticultural crops and their wild relatives. | IPGRI, UNEP | horticultural crops |
| Turkmenistan | Ministry of Agriculture and Water Management; Ministry of Nature; Ecological Club "Caten" | On-farm conservation of horticultural crops and their wild relatives. | IPGRI, UNEP | horticultural crops |
| Ukraine | Transcarpathian Institute ofAgroindustrial Production | Maintenance of crop varieties on-farm for traditional use | | spring rye, maize, vegetables, spices and fruits |

| **NORTH AFRICA AND THE MIDDLE EAST** | | | | |
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| **Country** | **Leading National Organisation/ Institute** | **Main activities or project title** | **International Partner if applicable** | **Crop** |
| Algeria | Ministry of Agriculture | Participatory management of date palm in Oases of the Maghreb | IPGRI | dates |
| Egypt | Matrouh Resource Management Project | Participatory barley breeding | ICARDA | barley |
| Jordan | Ministry of Planning | Conservation and sustainable use of dryland agrobiodiversity of the Fertile Cresent | ICARDA, IPGRI, ACSAD | wheat, barley, lentil, vetch, olive, cherries, pistachio, fig |
| Jordan | Ministry of Agriculture, University of Jordon | From formal to participatory plant breedings | ICARDA | barley |
| Lebanon | Agricultural Research Institute, Ministry of Agriculture | Conservation and sustainable use of dryland agrobiodiversity of the Fertile Cresent | ICARDA, IPGRI, ACSAD | wheat, barley, lentil, vetch, pear, cherries, pistachio, fig |
| Morocco | IAV Hassan II/ INRA | *In situ* conservation methods and capacity building between farmers and institutes for the conservation and use of agobiodiversity | IPGRI | durum wheat, barley, faba bean, alfalfa |
| Morocco | INRA | Increasing the relevance of breeding to small farmers | ICARDA, | barley |
| Palestine | Ministry of Planning | Conservation and sustainable use of dryland agrobiodiversity of the Fertile Cresent | ICARDA, IPGRI, ACSAD | wheat, barley, lentil, vetch, pear, cherries, almond, pistachio, fig |
| Syria | Scientific Agricultural Research Directorate, Ministry of Agriculture and Agrarian Reform | Conservation and sustainable use of dryland agrobiodiversity of the Fertile Cresent | ICARDA, IPGRI, ACSAD | wheat, barley, lentil, vetch, pear, cherries, almond, pistachio, fig |
| Syria | Directorate of Agricultural and Scientific Research (DASR), MoA | Farmer participation and use of local knowledge in breeding barely for specific adaptation | ICARDA | barley |
| Tunisia | IRA | Conservation and use of local fig and pomegranate | | fig, pomegranate |
| Tunisia | Institut National de la Recherche et de l'Enseignement Superieur Agricole (IRESA) | Increasing the relevance of breeding to small farmers | ICARDA | barley |
| Tunisia | Ministry of Agriculture | Participatory management of date palm in Oases of the Maghreb | IPGRI | date agroecosystem |
| Turkey | AARI | In-situ conservation of lentil chickpea and bean landraces grown in northwestern transitional zones | | chickpea and bean landraces |
| Yemen | AREA (Agricultural Research and Extension Authority) | Village based participatory breeding in the mountain slopes | ICARDA | barley |

| **ASIA, THE PACIFIC AND OCEANIA** | | | | |
|---|---|---|---|---|
| **Country** | **Leading National Organisation/ Institute** | **Main activities or project title** | **International Partner ifapplicable** | **Crop** |
| Bangladesh | UBING/UDA | Reviving Traditional Crops and Practices and supporting community gene banks | IDRC | rice |
| Bhutan | National Biodiversity Center Renewable Natural Resources Center | Conservation and Development of Agrobiodiversity through farmer field schools | BUCAP | rice |
| China | Kunming Institute of Botany | Agroecosystem change and threats to agrobiodiversity ethnobotanical project | IPGRI | taro |
| China | YAAS | Participatory approaches to community biodiversity registration | IPGRI | field crops |
| China | Xishuangbanna Tropical Botanical Garden | Identificaiton and promotion of profitable agrobiodiversity-rich management systems and techniques, at sites in sub-tropical southern Yunnan and mountainous western Yunnan | UNU/PLEC | |
| China | Yunnan Agricultural University | Diversification with traditional and modern crop varities for pest control | IRRI | rice and other field crops |
| Fiji/Vanuatu | TAROGEN | On farm conservation of Taro | AusAid, IPGRI | taro |
| Lao PDR | Lao National Agricultural Research center | Conservation and Development of Agrobiodiversity through farmer field schools | BUCAP, CIDSE International, Oxfam, SEARICE, FAO IPM programme | |
| India | Beej Bachao Andolan (Save the Seeds Movement) | Reviving Traditional Crops and Practices in Jardhargaon | | N/A |
| India | MS Swamanatha Research Foundation | Strengthening Community Conservation of Agrobiodiversity | IPGRI | rice, millet |
| India | NBPGR, IGAU | Rice diversity and farmer management | IRRI | rice |
| Indonesia | CRIFC, Cendrawasih University | Farmer management of sweet potato diversity and PVS, documentation of sweet potato IK | CIP | sweet potato |
| Indonesia | CRIFC | Understanding farmer management of biodiversity | | sweet potato, X*anthosoma*, rice, sorghum, yam |
| Nepal | NARC/Li-Bird | *In situ* conservation methods and capacity building between farmers and institutes for the conservation and use of agobiodiversity | IPGRI | rice, finger millet, taro, barley, pigeon pea, squash |
| Nepal | Li-Bird | Participatory plant breeding and diversity conservation | IDRC, IPGRI | rice |
| Papa New Guinea | National Research Institute | Identification and promotion of profitable agrobiodiversity-rich management systems and techniques | UNU/PLEC | yam, sago, sweet potatoes |
| Philippines | SEARICE | Community innovation systems in relation to PGR diversity and the seed supply system | CBDC | rice |
| Philippines | Central State University of Luzon | Influence of changing livelihood on cultivar maintenance | UPWARD, CIP | sweet potato |
| Philippines | CONSERVE SEARICE | Conservation and development through management of crop genetic | SOS (Sultan Kudurat | |

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| | | resources | Project), SEARICE | |
| Philippines | UPWARD | Sustainable root crop agriculture through participatory user-focused research and development | CIP | root crops |
| Philippines | PHILRICE, Local government agencies | Rice diversity and farmer management | IRRI | rice |
| Philippines | ANSWER | Conservation and evaluation of sweetpotato genetic resources | CIP IPGRI | sweet potato |
| Thailand | Hat Muang Nan Foundation | Farmer participatory rice varietal selection and distribution | SEARICE, CBDC | rice, chili, luffa |
| Thailand | Chiang Mai University | Management of Fallow succession and edges by minority-group farmers in northernThailand | PLEC | rice, maize, cabbages, tuberous crops |
| Vietnam | Mekong Delta Farming Systems Institute, Cantho University | Community innovation systems in relation to plant genetic resource diversity and the seed supply system | CBDC | rice |
| Vietnam | Hue Univeristy of Forestry and Agriculture | Rice diversity and farmer management | IRRI | rice |
| Vietnam | IAG (Institute of Agricultural Genetics) | In-situ conservation of landraces and their wild relatives in Northern Vietnam | UNDP | |
| Vietnam | VASI, Hanoi Agricultural Unviersity, Hue Forestry and Agricultural University, Tay Nuyen Unviersity, Cantho University | *In situ* conservation methods and capacity building between farmers and institutes for the conservation and use of agobiodiversity | IPGRI | rice, taro, mung bean, cardommen |
| Vietnam | VASI, Cantho University, PGI | *In situ* conservation of home gardens | IPGRI | |
| Vietnam | Vietnamese National IPM programme-Plant protection department, VASI, National Institute for Plant protection | Conservation and Development of Agrobiodiversity through farmer field schools | BUCAP, SEARICE, FAO, IPM programme | rice |

| **EUROPE** | | | | |
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| **Country** | **Leading National Organisation/ Institute** | **Main activities or project title** | **International Partner if applicable** | **Crop** |
| Austria | Arche Noah | Conservation and development of crop biodiversity | | cereals, vegetables, fiber, pharmaceutical crops |
| Belgium | DBCPGR | In-situ conservation of old fruit cultivars | | apple orchards |
| Denmark | Center for biodiversitet | Local production and re-introduction of best varieties for organic production on-farm | IPGRI | cereals: barley, wheat, oat, rye |
| Finland | Maatiainen | Conservation of traditional ornamental and cultivated plant species | | ornamental and cultivated plant species |
| Finland | Northern Heritage | Apple tree testing in local nurseries | | apples |
| Georgia | DIKA, Renovabis and Elkana | Re-introduction of local varieties on-farm | | |
| Germany | SAVE | Coordiantion of activities for the conservation of cultivated plant varieties in the form of live populations | | |
| Greece | Greek Gene Bank | Re-introduction of local landraces for organic farming | | |
| Hungary | Institute for Agrobotany | Traditional knowledge and incentives for landrace survival and sustainable use | IPGRI | maize, beans |
| Ireland | Irish Seed Savers | Location and preservation of traditional varieties of furit, grain and vegetables | | |
| Italy | ERSA, Assessorato Agricoltora, ARSIA, ASSAM, ARSSA, SIRCA, Campania | Maintenance and improvement of local fruit species / varieties ex–situ, and reintroduction for on-farm cultivation | | fruit trees |
| Italy | Civiltà contadina, Emilia Romagna Region | Biological organic management | | potatoes |
| Italy | Provincia of Genoa Committee for safe guarding potatos | Promotion of old potato varieties | | potatoes |
| Italy | Region Toscana | Subsidy to the cultivation of local endangered varieties in the framework of the EU | | cereals, vegetables |
| Poland | National Centre for Plant Genetic Resources, IHAR | On-farm conservation of fruit trees | | fruit trees |
| Portugal | University of Tras-os-Montes and Alto OUro | Conservation of Barbela wheat landrace | | wheat |
| Romania | “zonal agricultural consulting centres” | Informative activities on introduction of new varieties, agricultural, disease and pest control techniques | | oat, barley, rye, wheat, potato, hemp, flax |
| Romania | Romanian Gene bank | Identification of agrobiodiversity | | oat, barley, rye, |

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| | | zones with crops of major importance | | wheat, potato, hemp, flax |
| Slovenia | Agricultural Institute of Slovenia | Identification of old landraces and cultivars | | |
| Sweden | Sesam Association | Growth and reproduction of cultivars in home gardens and small farms | Nordic Gene Bank | vegetables, agricultural plants, fruits, berries and herbs |
| Switzerland | Pro Specie Rara | Genetic variation, cultural diversity and history of conservation of plant genetic resources | | fruits, potatoes, tomatoes, grain crops and *leguminoseae* |
| United Kingdom | HDRA and HSL | Conservation of traditional vegetable varieties suitable for gardeners | | traditional vegetable varieties |

## ANNEX B

**List of organizations who provided information on their agricultural biodiversity work in response to requests from IPGRI.**

Centro Internacional de Mejoramiento de Maíz y Trigo (CIMMYT), Mexico.

Community Biodiversity Development and Conservation Programme (CBDC).

People, Land Management and Environmental Change Project, UN University (PLEC) Japan.
International Plant Genetic Resources Institute (IPGRI), Italy.

International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), India.

International Centre for Research in Agroforestry (ICRAF), Kenya.

Instituto de Investigaciones Fundamentales en Agricultura Tropical (INIFAT), Cuba

Centro Internacional de Agricultura Tropical, (CIAT), Colombia.

CGIAR Systemwide Programme on Participatory Research for Technology Development and Institutional Innovation.

Southeast Asia Regional Institute for Community Education (SEARICE), Philippines.

Centro Internacional de la Papa (CIP), Peru.