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Seed Fairs, Seed Banks, and Mountain-to-Mountain Exchange

Conservation of agricultural biodiversity has become an important paradigm in efforts to promote sustainable development throughout the world. This is especially the case in Andean countries, where ex situ conservation of crops has been a focus of attention since the 1970s. In Peru in the early 1990s, researchers and development specialists also focused on in situ conservation and the participation of campesino communities in mountain development processes. They designed the Cajamarca model as a result of several years of experience in rural development projects. This model includes so-called seed fairs (Figure 1) and encourages the creation of local seed banks managed by a conservationist campesino association. The HimalAndes Project, which promotes technical cooperation to support exchange of seeds and local knowledge between mountain agriculture ecosystems, is another recent project with a partial focus on agrobiodiversity conservation in Andean and other countries.

FIGURE 1 Potato varieties displayed at a seed fair in Huancayo, Peru. (Photo by author)

Biodiversity conservation for sustainable agriculture

In the wake of the 1992 Rio Earth Summit, global and local food security have been redefined in terms of paradigms relating to sustainability and biodiversity conservation. In the past decades, many institutions and nongovernmental organizations (NGOs) have oriented their activities, with mixed results, toward improving the standard of living of over 300 million people who depend on mountain agriculture worldwide. Up to now, however, not enough attention has been given to promoting the use of native crops and locally domesticated livestock adapted to the specific requirements of each ecoregion, despite the potential of such resources to improve the quality of human nutrition and provide economic benefits. There is a growing awareness that rural economies in mountain regions in developing countries depend on the conservation of local genetic resources and natural environments, as well as the smallholder with mixed rainfed cropping systems that are the basis of a predominantly subsistence economy (Figure 2).

Ex situ conservation of Andean mountain agrobiodiversity

Various research and development projects since 1968 have concentrated on the conservation and use of several Andean crops (especially small grains such as quinoa, *qañiwa*, and amaranth), as well as on tubers and roots. During a workshop in 1981, researchers from six Andean countries reviewed the status of germplasm conservation for Andean crops. At that time, conclusions tended to favor the organization of botanical expeditions to collect the genetic resources of various crops threatened by genetic erosion. The main crops considered were potatoes and maize, but other native tubers and grains were also studied. Subsequently, Andean national agricultural research institutes and regional universities collected material and maintained most of the germplasm under ex situ conditions (see Table 1).

A more recent research initiative is the Andean root and tubers project (ART) run by the International Potato Centre

(CIP) in collaboration with the Swiss Agency for Development and Cooperation (SDC). ART is responsible for agrobiodiversity research and the promotion of 9 crops. It is coordinated by CIP personnel with the participation of several NGOs and focuses on the conservation of 5 different types of roots and 4 species of tubers apart from potatoes. Research results have greatly contributed to knowledge about in situ conservation throughout the central Andes (Ecuador, Peru, and Bolivia) in the last 5 years.

Indeed, institutions such as INIA (Instituto Nacional de Investigación Agraria) and NGOs in various Peruvian Andean regions have been increasingly concerned that ex situ conservation of germplasm is only one step in the conservation process. They have underlined the need to promote the conservation of genetic resources locally and under community management. One initiative for achieving this aim was the organization by INIA in 1989 of a seed fair (see below). But it was also recognized that the process of in situ conservation requires further development tools and an institutionalized framework.

The Cajamarca model of in situ conservation

The Cajamarca model is the result of a project that aims to support Andean biodiversity conservation. It was generated in turn by a project concerned with integrated management of an Andean microwatershed. The latter project was jointly executed by ASPADERUC (Association for Rural Development in Cajamarca), an NGO, and CIP. This integrated management project was located in the Encañada district of the Cajamarca Department in northern Peru and lasted for 8 years. With the support of the Consortium for the Sustainable Development of the Andean Ecoregion (CONDESAN), the methodology has since been applied to and evaluated in other parts of the Cajamarca Department as well as in other areas of the Peruvian Andes.

In situ conservation activities are integrated into comprehensive management of a watershed's natural resources. They are part of an entire process that begins with environmental management, the final aim of which is to improve food security and economic independence among producers. The methodology followed in the Cajamarca model consists of 6 steps:

FIGURE 2 Kallawaya area, Bolivia: a typical example of Andean subsistence farming that depends on mixed cropping and local genetic resources. (Photo by Martin Grosjean)

TABLE 1 State of ex situ conservation of main Andean crops in Peru (2000). (Accession: a plant sample, strain or population held in a genebank. Landrace: a primitive variety cultivated by local campesinos. Race: a group of individual plants that have morphological and genetic similarities).

Crop	Estimated number of collections	Institution responsible
Potatoes	4000 accessions, approximately 1000 landraces	International Potato Centre (CIP), Universities of Cusco and Huanuco
Maize	52 races	University of La Molina, Lima
Quinoa	1500 accessions	Universities of Puno, Ayacucho, Cajamarca, Huancayo
Oca	500–600 accessions	Universities of Cusco, Huancayo, Ayacucho; Instituto Nacional de Investigación Agraria, Peru (INIA)
Olluco	400–500 accessions	Universities of Cusco and Puno
Lupines	±1000 accessions	INIA, University of Cusco

soil conservation and water management, seed fairs, thematic workshops, creation of a conservationist *campesino* association, creation of *campesino* seed banks, and monitoring.

Step 1: Soil conservation and water management

Plant genetic resources cannot be conserved if environmental conditions are not maintained at a level adequate for their regeneration. From this perspective, rehabilitation and conservation of soil and water resources are basic requirements for creating a prosperous environment on plots where in situ conservation of agricultural diversity is planned.

FIGURE 3 *Campesina* at a seed fair in Cajamarca, Peru, exhibiting medicinal plants used locally. (Photo by author)

Step 2: Seed fairs in a biogeographical management context

Management of plant genetic resources by *campesinos* (local farmers) can be stimulated and evaluated periodically through the organization and promotion of seed fairs. In Peru, agricultural fairs initiated by the Ministry of Agriculture in the 1950s were one of the first efforts to recognize the value of traditional crop varieties. In addition to commercial varieties, farmers presented collections of local potatoes and other Andean tubers as well as other traditional crops such as medicinal plants (Figure 3). However, these events did not emphasize the need for conservation of plant genetic resources. As mentioned above, in 1989, the Experimental Station of INIA in Cajamarca initiated the organization of seed fairs in the area around Chota. In 1990, with the help of the Andean Ecosystems Pilot Project (AEPP) and the University of Cajamarca, the community of Chamis organized one of the first seed fairs based on a clear concept of in situ conservation.

Seed fairs are organized in the following way: *campesino*s, both women and men, are officially invited by village authorities to participate in the fair by displaying their genetic resources. They are encouraged to show not only the best varieties they have but also the greatest diversity of species they succeeded in cultivating. A contest takes place among participants from the villages belonging to a watershed. Prizes are awarded to farmers who bring not only the greatest number of varieties but who also prove to have the most complete knowledge about the production, storage, and use of their crops (Figure 4). The fairs appear to be an appropriate means of stimulating in situ conservation of plant genetic resources. They also have the social advantage of stimulating participation by the entire family in the conservation of genetic resources.

Seed fairs have become common as a result of the success of initial experiments. They are held in different parts of the Peruvian Sierra once a year, generally just after harvest time.

Step 3: Thematic workshops

Seed fairs are followed by periodic meetings or thematic workshops, where

*campesino*s discuss the restrictions they face in maintaining biodiversity (Figure 5), including such problems as plant diseases, postharvest difficulties, and marketing disadvantages that ultimately affect agrobiodiversity.

Step 4: Creation of a conservationist *campesino* association

The conservationist *campesino* association enables *campesinos* to obtain benefits and ensure the long-term maintenance of a minimum spectrum of varieties and crops on their farms. Within each village or district, some *campesino*s are known for their experience and eagerness to conserve seeds. In the case of seed loss due to pests or bad climate, for example, families will turn to these conservationists to recover certain seeds.

Step 5: Creation of *campesino* seed banks

Campesino seed banks are created by selecting farms where germplasm is maintained. This does not constitute the reproduction of an ex situ model in the field; it implies the maintenance of a basic collection on the plots under the care of the different members of the association.

Creation of the seed banks includes a previous morphological and molecular characterization of the germplasm, identifying those varieties that encompass the highest percentage of genetic variability for each crop. Different varieties are maintained on the farms of conservationist *campesino*s (under different ecological conditions and subject to various management strategies) while trying to preserve local knowledge about diversity conservation such as crop rotation, crop combinations, and seed exchanges. The members of the conservationist *campesino* association and the seed banks should become economically self-sustainable, producing native varieties for commercial purposes.

Step 6: Monitoring

As the process of on-farm conservation is inherently dynamic, maintenance of traditional native varieties requires periodic monitoring. The conservationist *campesino* association receives advice on and support for both technical and financial monitoring based on the results of the thematic workshops. The association is expected to become a recognized entity both inside and outside the community.

FIGURE 4 Native crop varieties are evaluated at a local contest in Huancayo, Peru. (Photo by author)

So far, the Cajamarca model has proven to be a suitable way of encouraging genetic conservation activities in the context of local rural development strategies. However, at a national level, different needed actions are still missing. For example, official recognition by the Ministry of Agriculture and PRONAMACHS (National Soil Conservation Program) would provide conservationist *campesinos* with an identification card and recognize them as members of a national association. On the other hand, as the association consoli-

FIGURE 5 Conservationist *campesinos* at a thematic workshop on genetic resources in Cajamarca, Peru. (Photo by author)

FIGURE 6 *Campesinas* preparing to market native varieties of olluco in La Encañada, Cajamarca. (Photo by author)

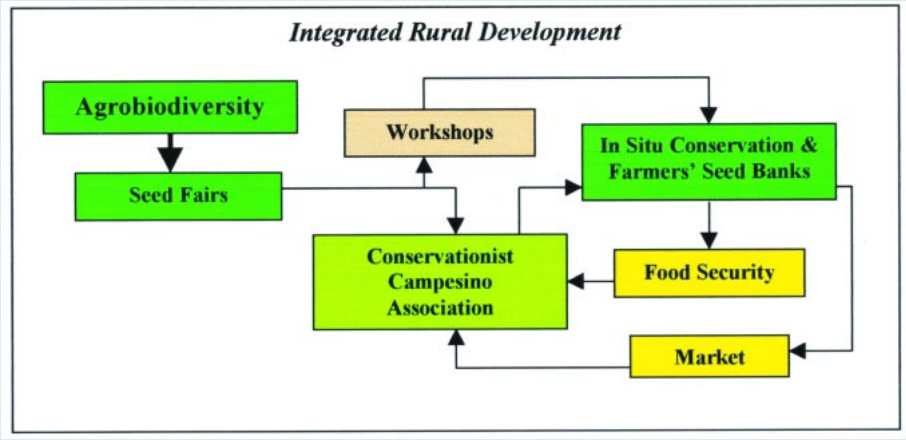
dates, it can be expected to assume more formal responsibilities related to conservation. In addition, it must be regarded as a pilot project to promote biodiversity on an economically sustainable basis by marketing native varieties through agroindustrial companies (purchase of native varieties of potato, tubers, grains, medicinal plants, etc; Figure 6). The ultimate aim of the model is integrated rural development (Figure 7).

Thus, integrated conservation of biodiversity at the national level should result in the registration of conservationist farms, existing varieties, new varieties, and varieties threatened by genetic erosion. In this specific case, activities should include exchange of seeds between isolated communities still likely to be rich in genetic resources and highly eroded and market-exposed areas, where few local varieties are likely to remain.

Marketing

Finally, the aim of conservation of genetic crop resources is not just to sell native varieties but to market biodiversity baskets. This consists of selling bags that include different varieties of native potatoes and other crops. In a test of this idea by CIP personnel, several varieties of native potatoes were marketed with excellent results because the farmers sold their own varieties at a special price while consumers tested new uses and discovered the flavor of native potatoes.

FIGURE 7 Cajamarca model of integrated rural development.



Further initiatives

Conservation of local biodiversity can also be of value to other countries. The possibility of exchanging economically and ecologically promising crops is currently being studied in various Andean and Himalayan countries.

Research on native Andean crops

Several native crops and numerous varieties are still under cultivation in the Andean countries. Research focusing on native crops was initiated in 1968, producing a wealth of information that is now proving useful in further projects. An initial international conference on Andean crops took place in 1977 in Ayacucho, Peru, and others followed at regular intervals in Bolivia, Ecuador, Colombia, Chile, and Peru, generating knowledge about germplasm collections, plant physiology, breeding techniques, nutritional value, industrial processing, etc. Research has also focused on native Andean crops that might be of economic value in other mountain areas. Table 2 offers an overview of the species that have been studied in detail.

The ecological adaptability of these crops and their nutritional value, combined with related traditional knowledge, make them suitable for agricultural development under mountain conditions in the Andean ranges. Experience has shown that they can also alleviate malnutrition in other highland environments. Potatoes and quinoa introduced in Tibet and other Andean tubers and roots introduced in the Himalayas have shown excellent promise in this respect.

Mountain-to-mountain interaction

In 1987, an international workshop on mountain genetic resources was organized in Nepal by the International Center for Integrated Mountain Development (ICIMOD) and the International Development Research Center (IDRC-Canada). Workshop conclusions revealed interest in and potential for continuous exchange of crop varieties of several different species among the world's mountain regions. Creation of a mountain-to-mountain project was suggested, including technology transfers and

TABLE 2 Native Andean crops and their altitudinal ranges.

Crop	Scientific name	Edible part	Altitudinal range (meters)
Lima bean	*Phaseolus lunatus*	Grain	0–1200
Sweet potato[a]	*Ipomea batata*	Root	0–2500
Bean[a]	*Phaseolus vulgaris*	Grain	0–2500
Yuca[a]	*Manihot esculenta*	Root	0–1200
Maize[a]	*Zea mays*	Grain	0–3000
Potato[a]	*Solanum tuberosum*	Tuber	0–3900
Amaranth	*Amaranthus caudatus*	Grain	0–3200
Quinoa, valley	*Chenopodium quinoa*	Grain	1500–3500
Arracacha	*Arracacia xanthorriza*	Root	1500–3200
Yacón	*Polymnia sonchifolia*	Root	1500–3200
Olluco	*Ullucus tuberosus*	Tuber	1500–3800
Aguaymanto	*Physalis peruviana*	Fruit	1500–3000
Tree tomato	*Cyphomandra betacea*	Fruit	1500–3000
***Tarwi*, chocho**	*Lupinus mutabilis*	Grain	2000–3500
Mashwa	*Tropaeolum tuberosum*	Tuber	3300–3900
Oca	*Oxalis tuberosa*	Tuber	3300–3800
Quinoa, altitude	*Chenopodium quinoa*	Grain	3800–3900
***Tarwi*, high plateau**	*Lupinus mutabilis*	Grain	3800–3900
Bitter potato[a]	*Solanum juzepczukii*	Tuber	3900–4200
Qañiwa	*Chenopodium pallidicaule*	Grain	3900–4300
Maca	*Lepidium meyenii*	Root	4100–4300

[a]Important staple crops.

TABLE 3 Mountain crops considered for mountain-to-mountain exchanges.

Crop type	Species
Andes	
Quinoa	*Chenopodium quinoa*
Amaranth	*Amaranthus caudatus*
Qañiwa	*Chenopodium pallidicaule*
Lupines	*Lupinus mutabilis*
Potatoes (frost-resistant varieties)	*S. juzepzcukii*
Maca	*Lepidium meyenii*
Fruit	
Chirimoya	*Annona cherimola*
Lucuma	*Bouteria* sp.
Himalayas	
Rice	High altitude varieties
Barley	High altitude varieties
Finger millet	*Eleusine coracana*
Buckwheat	*Fagopyrum esculentum*
Foxtail millet	*Setaria italica*
Pulses	
Chickpeas	*Cicer arietinum*
Peas	*Pisum sativum*
Lentils	*Lens sculentum*
African highlands	
Tef	*Eragrostis tef*
Chat	*Catha edulis*
Wheat	High-altitude varieties
Forage species	

exchanges involving crops and crop utilization in projects concerned with nutrition and development in mountain environments of the world. Some of the crops considered for such exchanges are presented in Table 3.

In 1999, ASHOKA, a global organization that promotes social entrepreneurship, organized a workshop under the HimalAndes Initiative, with the support of ICIMOD in the Himalayas and CIP in the Andes. Several projects, including exchanges of mountain crops and livestock technology as well as the use of medicinal plants, alternative energies, and agrotourism, are being developed as important components of mountain-to-mountain interaction.

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