Climbing to Zero Hunger with crop biodiversity

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Alliance

The Alliance of Bioversity International and the International Center for Tropical Agriculture (CIAT) delivers research-based solutions that harness agricultural biodiversity and sustainably transform food systems to improve people's lives.
Bioversity International and CIAT are CGIAR Research Centres.

Difficult terrain, inaccessibility, extreme vulnerability to climate change, poor infrastructures and distinctive gender and youth dimensions, are features of mountain agricultural systems. Global trends continue to emphasize commercial priorities that do not adequately capture the needs of mountain farmers. Through our partnerships with national researchers, educators and farming communities, we are improving the access to and use of the rich diversity still found in local crop varieties, increasing the productivity and resilience of mountain agroecosystems.

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The challenge

Mountain systems are particularly vulnerable to climate change: warming in mountain regions greatly exceeds the global average and weather patterns are becoming more unpredictable and extreme, with prolonged dry spells and very strong storm events. Difficult terrain, inaccessible habitation, extreme vulnerability to natural calamity, poor infrastructure and distinctive gender dimensions, are the key issues for mountain farmers and their communities.

Most crop varieties today are bred for large-scale, single-condition environments that assume constant levels of temperature and precipitation. However, since mountain agroecosystems are complex transitional systems consisting of a mix of subtropical and temperate environments, these cropping solutions do not respond to the needs of farmers who live there. Additionally, global trends favour commercial priority-setting mechanisms over ones that better suited to capturing the interests of rural producers and consumers. Increasingly, urban consumers are choosing crops that are not well adapted to the often hostile growing conditions in mountain environments. Farmers must have access to a broader, more diverse range of locally-adapted crop varieties to cope with these changes.

Our solution

For over 25 years, Bioversity International has been working with national researchers, educators and farming communities in Bhutan, Bolivia, China, Ecuador, India, Iran, Kyrgyzstan, Mexico, Morocco, Nepal, Peru, Tajikistan, Uganda, Uzbekistan and Vietnam to assess and improve the use of the wealth of diversity found within local crop varieties of mountain ecosystems, to reduce hunger for smallholder farmers. We draw on three complementary approaches to ensure mountain farmers can make the most of crop biodiversity in their agricultural production systems. The first is to develop tools to ensure that the key adaptive

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Swiss Agency for Development and Cooperation SDC

UN environment
United Nations Environment Programme

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Photo: Farmer in field in front of poplar and fruit trees and mountain lanscape, Tajikistan. Credit: Bioversity International/B.Vinceti

and socioeconomic traits of crops in fragile and marginal environments are varied enough to meet the needs of smallholder mountain farmers. The second is to ensure that high-quality, locally adapted planting materials with larger enough population sizes to adapt to change are available to farmers in mountain ecosystems. The third is to provide farmers and farming communities in these harsh environments with the knowledge, institutions and leadership capacity and the policy environment to benefit from this diversity.

Results

1. Amount and distribution of crop genetic diversity of mountain crops available to mountain farmers assessed. In partnership with national researchers and institutions in each host country, we have developed protocols to assess the amount and distribution of high-quality and productive crop varieties in mountain agroecosystems for different breeding systems and life history traits (annual, perennial):

- Major and minor staple crops (durum wheat, barley, rice, maize, buckwheat, amaranth, finger millet, foxtail millet, proso millet, banana, plantain, potato)
- Legumes (common beans, faba bean, mung bean, mung bean)
- Temperate fruit and nut trees (apple, pear, apricot, grapes, cherry plum, pomegranates, walnut, almond, pistachio)

Bioversity International has supported researchers and farmers to test the use of intraspecific diversity linked to good agronomic management practices for mountain agroecosystems on farm, on station and in laboratories. In Nepal, over 300 indigenous crop varieties of barley, rice, millets, amaranths and beans were evaluated for functional traits and overall agronomic performance and made available in Nepal's isolated mountain sites. In Central Asia, over 100 indigenous cultivated apple and apricot varieties and 132 promising forms of wild apple, walnut and pistachio adapted to mountain conditions were identified. Over 100 local varieties of maize, barley, high land rice, common bean, and faba bean were identified with high and medium resistance to major pests and diseases in the mountain environments of China, Ecuador, Morocco, Nepal and Uganda.

Analysis conducted with national partners revealed that increased diversity – specifically targeted to manage pests and diseases – reduced damage in 75% of the farmers' fields and was correlated to increased yields in low-input environments. Our national partners conducted over 600 field trials to compare the yield and biotic and biotic stress tolerance of mixture of varieties grown together against single varieties grown in monocultures. Results show that more than 50% of the mixtures outperformed the monoculture crops in terms of both yield and damage reduction.

2. High-quality, locally adapted planting materials with larger enough population sizes to adapt to change made available to farmers in mountain ecosystems. We worked with our national partners to make a broad range of plant materials available to mountain farmers through a series of diversity fairs, demonstration trials, the establishment of community seedbanks

and community nurseries, distribution of diversity kits, participatory variety selection, community meetings and knowledge products.

Tens of thousands of farmers (30%–60% of which were women) across participating countries have benefited from our training and technical assistance aimed at building their capacity to produce and store clean seeds. Farmers participating in our projects in China, Ecuador, Morocco, Nepal and Uganda increased the number of varieties used in their fields to manage pest and diseases by 50% on average. In Nepal, together with our partners, we were able to identify 60 superior varieties of 8 crops via on-farm evaluation, and subsequently made those superior varieties available to 16,000 farmers through dissemination of diversity kits/Informal Research Development packages and seed multiplication, reaching a further 20,000 farmers outside of the direct target area and including varieties not originally targeted by the project. In Central Asia, small-scale community nurseries are producing over 500,000 million saplings of traditional varieties of temperate fruit and nut trees that are specifically adapted to mountain environments.

3. Knowledge, capacity of people and institutions, leadership capacity, and policy frameworks strengthened. Bioversity International has worked with national researchers from all countries to train site-level personnel on the participatory approaches commonly used on farm and in laboratories to assess intraspecific diversity, its impact on abiotic and biotic stress management, and ability to meet social, cultural and economic needs.

We have worked with national partners to leverage policy support of ministries of agriculture and the environment, national agricultural research organizations and local governments in all countries who have allocated staff and students to work with farmer communities. Thanks to this programme, hundreds of BS, MSc, and PhD students (30%–50% of which are women) have completed their degrees in on-farm management, participatory varietal selection, mixture trials, and genetic diversity analyses. Over 30% of the technicians trained are women, and the overall percentage of women involved in project management is over 60%. In Nepal, our work is linked with the Department of Agriculture and Livestock's newly approved 'Indigenous Crop Promotion' programme, as well as its 58 Roadmaps. In Uzbekistan, the government has decreed that land allocated to cotton be allocated to fruit and vegetables.

We have developed innovative access and benefit-sharing mechanisms with community seedbanks, as well as created new value chain linkages with local and organic markets that are currently being tested in Nepal and Uzbekistan.

Impact

The planting of endemic varieties of economically and culturally important mountain crop species has increased across all project countries, and by 20% in Central Asia and Nepal. This is due to the recognition in all countries that the lack of locally adapted, high-quality planting materials within national seed systems is a severe hindrance to creating productive mountain agricultural systems. Under our initiatives, the development of community seedbanks and nurseries by local farmers have resulted in a thriving and growing provision – in each country – of hundreds

Photo: Nepali farmers. Credit: Bioversity International/D.Gauchan

of thousands of seeds, saplings and grafted plants of local endemic varieties to mountain farmers. The resilience of these endemic varieties, and their tolerance to drought and inclement weather, pests and diseases, has increased recognition within local and national development workers, research staff and educators that biodiversity is the key to successful, adaptive mountain production systems when it comes to fighting climate change and increasing resilience. Our work has generated hundreds of technical, scientific and information products including papers, leaflets, posters, videos etc. in English, Spanish, French, Chinese, Russian, Arabic, and many local languages, most of which are available online. Some are posted prominently on international websites including that of the Convention on Biological Diversity. Our approach to data collection and use – recognizing among other things the need for Free Prior and Informed Consent – was instrumental in securing high-quality participation by data providers. Another important impact was influencing the development of policies that benefit farmers and forest users, such as realizing Farmers' Rights, securing access and benefit sharing, and improving land use. These results have served to increase the appetite for, and interest in using diversity as a driver for development in mountain ecosystems.

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