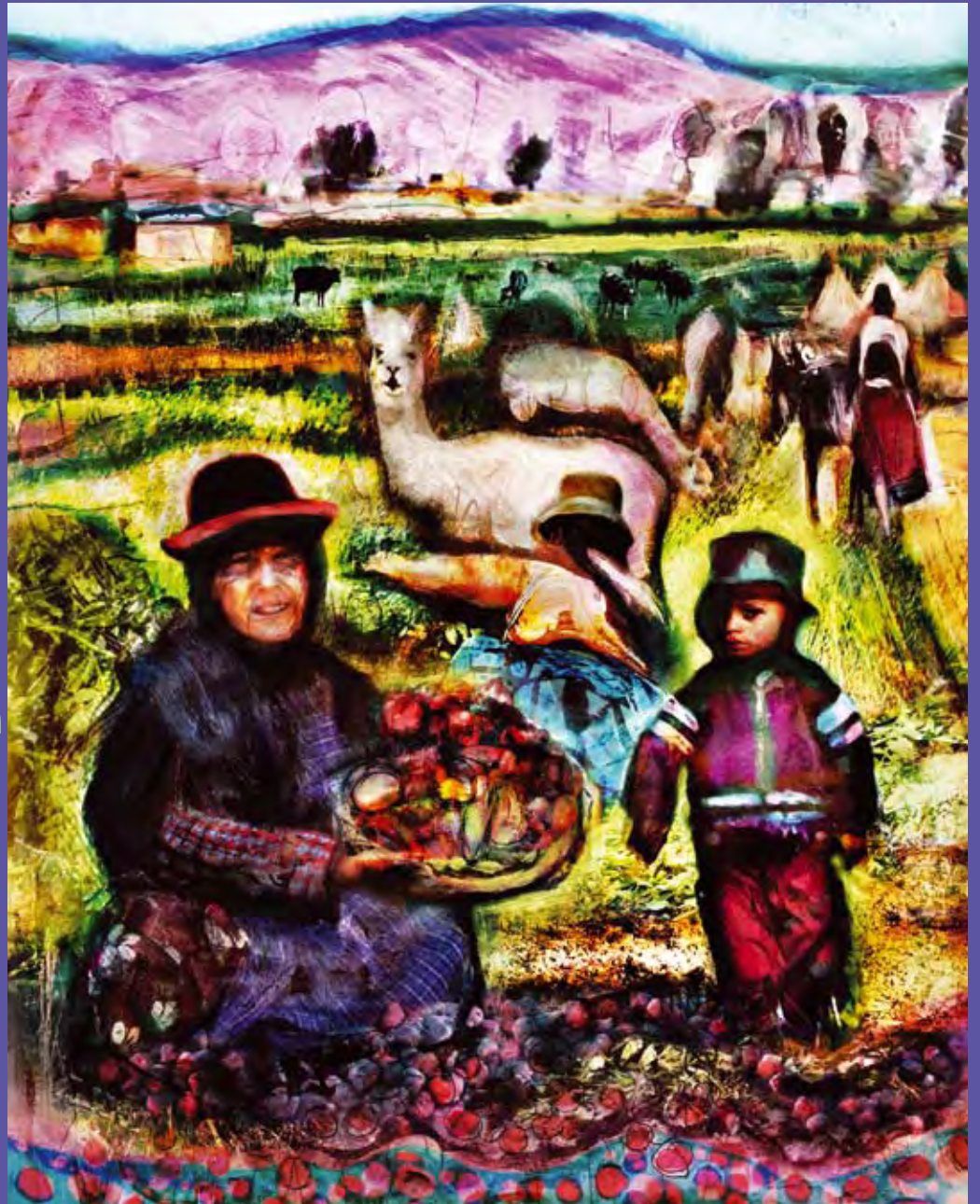


Annual Report

Bioversity International

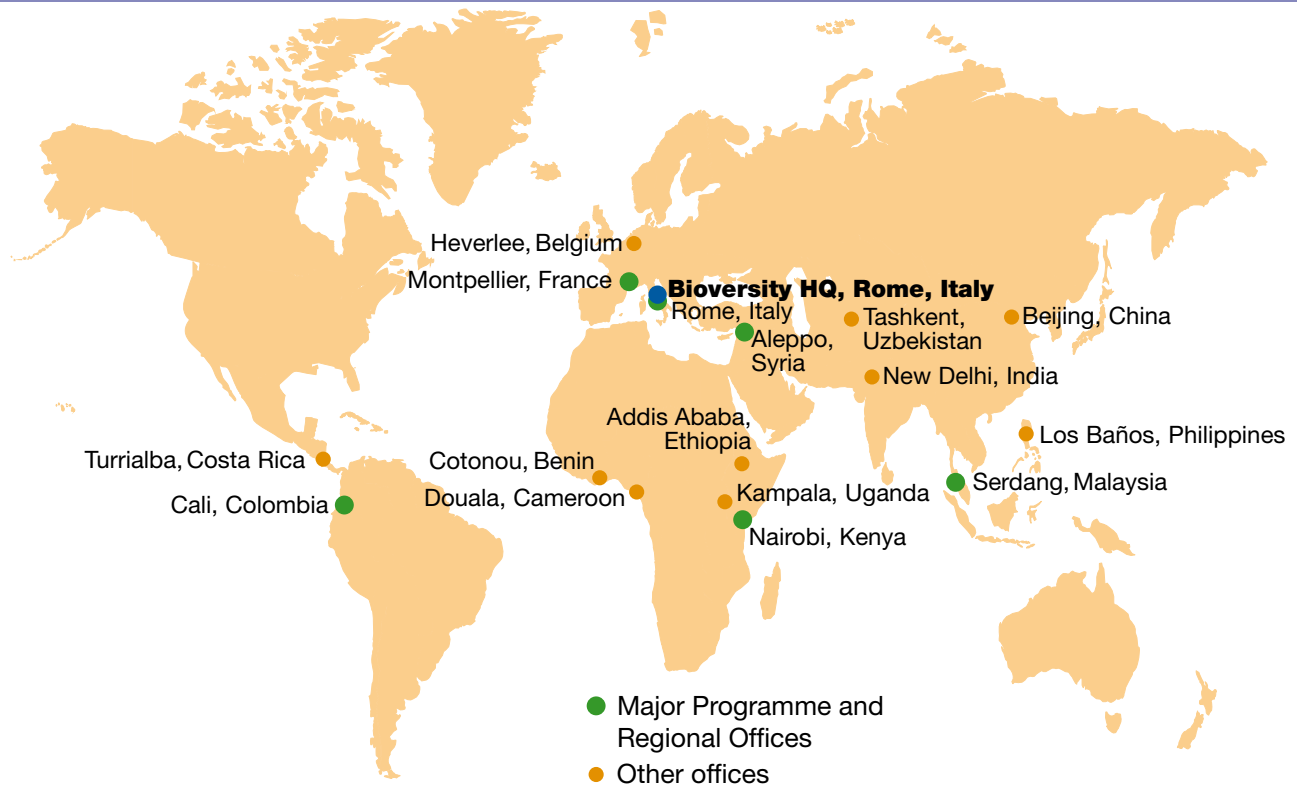


Contents

Bioversity's *modus operandi* is based firmly on working with others, leveraging our funds and abilities so that we not only achieve results, but also help to build capacity in those we work with and for. So strong and plentiful are these links, however, that to list them all in every case would make for a very long and dry document. In the following stories some of our partners have been mentioned by name while others have not, but we would like to take this opportunity to thank them all. Bioversity depends on partnership and partners to get the job done. We also acknowledge the support of all our donors, especially those that contribute unrestricted funds.

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Bioversity office locations



Foreword

Bioversity went into 2007 in a less-than-optimal financial position. A combination of unforeseen circumstances, which reduced our expected income, left us below the recommended level of reserves. But the organization was well prepared, and we are very pleased to be able to report that we ended the year in an even better position than anticipated. This was no accident. It was the result of careful planning, support from the Board, sympathetic yet firm management, and the willingness of all staff to make sacrifices and contribute to the greater good. The organization as a whole is stronger for their efforts; we would like here to acknowledge their contributions, which make Bioversity what it is.

Despite the difficulties, 2007 was as productive a year as any in Bioversity's history, as can be seen from the achievements and stories in this annual report. Long-standing areas of work continued to deliver important outcomes. In policy, for example, Bioversity represented the CGIAR through the System-wide Genetic Resources Programme and helped the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture to see the wisdom of allowing the CGIAR centres to use the Standard Material Transfer Agreement for all material distributed from centre genebanks, not just crops on Annex 1 of the Treaty. And projects that came to a close, for example on leafy vegetables and on seed systems in the Sahel, were judged to have had beneficial impacts. These impact studies will help to secure further support to extend the projects.

Our research on climate change and agricultural biodiversity and on policy-oriented work on the importance of home gardens in Europe to conservation efforts attracted considerable interest from the press. We hope that this will help to influence global and regional priorities.

The sharpened focus areas of our work, adopted in 2006, have started to show through in the project portfolio. The past year saw the launch of many new projects; we report on one that is measuring nutritional quality at the level of varieties, and another that makes use of biodiversity to combat pests and diseases. We now have fewer, larger projects, with wider impact, just as foreseen when we adopted our new strategy.

The past few years have been a period of change and adaptation, and the organization is now poised to move forward. As we do so, we note that the world faces considerable challenges. Malnutrition remains a huge problem. Climate change influences many aspects of farming systems and their adaptability and sustainability. Other challenges include emerging pests and diseases, the survival of crop wild relatives, water use and the use of biofuels. Bioversity will work to ensure that agricultural biodiversity plays a role in meeting these challenges and also to ensure that other well-meaning efforts to cope with changing circumstances do not needlessly threaten the agricultural biodiversity on which a sustainable future depends.

Emile Frison
Director General

Tony Gregson
Board Chair

Climate change will greatly affect what we grow and where we grow it. Bioversity research shows that farmers in Europe and North America stand to gain, whereas farmers in sub-Saharan Africa will lose. Solutions may come from existing diversity, but the wild relatives of crops are also threatened by climate change.

Adapting agriculture to climate change



Wine growers in the UK may well look forward to the new opportunities that a warmer climate will bring, but in other parts of the world the impact of climate change on local growing conditions will have serious consequences for food security and poverty.

Andy Jarvis and Annie Lane, scientists at Bioversity, working with Robert Hijmans at the International Rice Research Institute (IRRI), used sophisticated computer modelling to examine the impact that climate change will have on the cultivation of the world's most important staple and cash crops.

The predictions are bleak: by 2055, more than half of the 23 crops studied—including cereals such as wheat, rye and oats—will lose land suitable for their cultivation. This loss will fall disproportionately on sub-Saharan Africa and the Caribbean, regions of the world that have the least capacity to cope. On the other hand Europe and North America—regions

best equipped to manage the impacts of climate change—are predicted to experience the largest gain in land suitable for cultivation (see map).

These results are based on the 'business-as-usual' climate model of the Intergovernmental Panel on Climate Change (IPCC), which assumes that economic growth and greenhouse gas emissions will continue as they are at present. The study focused on crops listed in Annex 1 of the International Treaty on Plant Genetic Resources for Food and Agriculture as well as other staple and cash crops important for food security.

Overall, the area suitable for crop cultivation is projected to increase. For example, the model predicts increases in the area of land suited to pearl millet (31%), sunflower (18%), common millet (16%), chickpea (15%) and soya bean (14%). The problem is that many of the gains occur in regions where these crops are not important for food security. "We predict an increase of

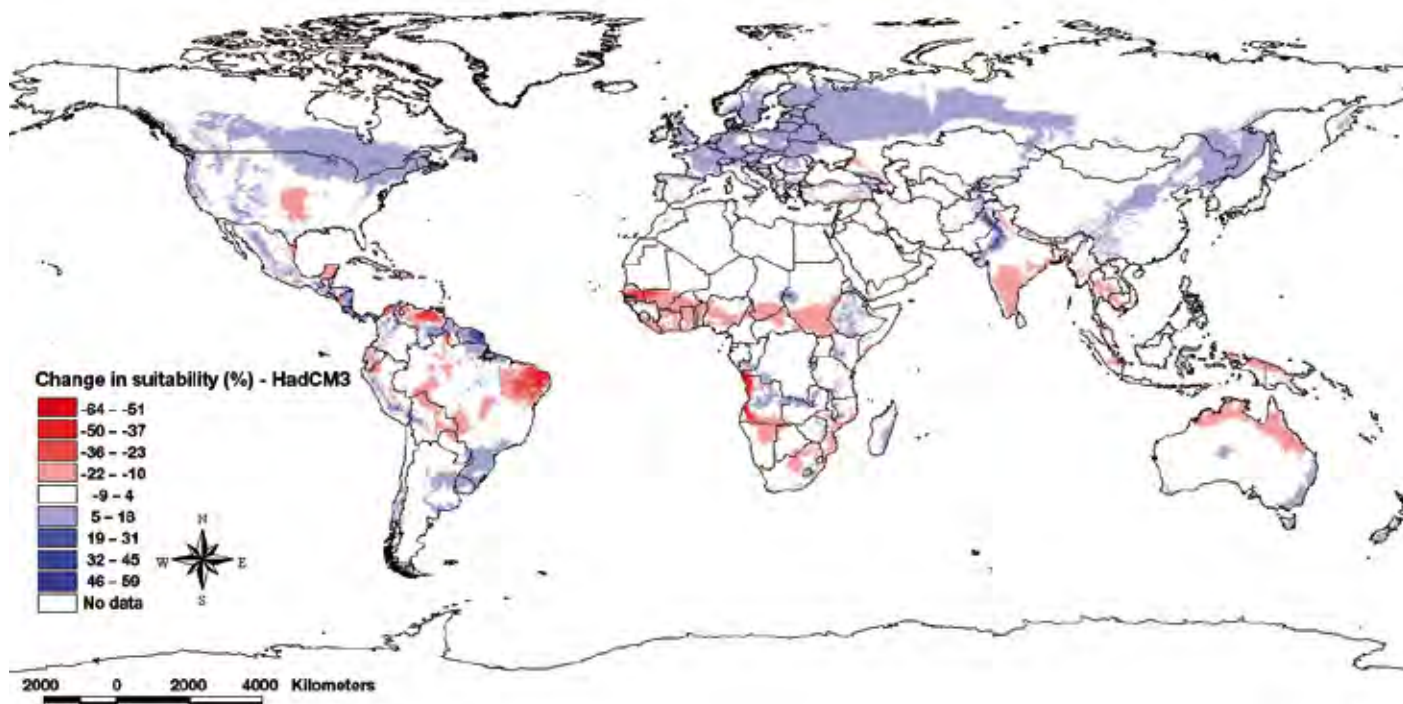
Wild groundnut, like this one from Bolivia, may be a source of pest and disease resistance for breeding cultivated varieties. Models predict that some 60% of the 51 groundnut species analyzed could become extinct within 50 years as a result of climate change.

A. Lane/Bioversity International



Changes in suitability averaged over all crops predicted by the HadCM3 climate change model.

Places shown red become less suitable, while those in blue become more suitable.



Source: Lane A and Jarvis A. 2007. Changes in climate will modify the geography of crop suitability: Agricultural biodiversity can help with adaptation. *Journal of SAT Agricultural Research* 4(1).

more than 10% in the area suitable for pearl millet in Europe and the Caribbean, where hardly anyone eats the crop, but not for Africa, where pearl millet is currently widely cultivated. That's the problem," Jarvis explained.

The impact of climate change on production depends mainly on the region, the growing season and the temperature thresholds of the crops in question. Thus, the growing period for crops that mature at a given cumulative temperature ('growing degree days') may be shortened as temperatures increase. A shorter growing period may reduce yields. This, combined with major losses predicted in land suitable for the cultivation of staple crops, is why regions such as sub-Saharan Africa will become increasingly vulnerable to food shortages.

The results of the study support the recent call by the IPCC to invest in solutions that will allow countries to

A selection of crops and the predicted areas they will lose or gain under HadCM3 and CCCma, two of the most comprehensive models of climate change.

Most of the losers, for which suitable areas shrink, are cold-weather crops: strawberry, wheat, rye, apple and oats. Among the winners are pearl millet, sunflower, common millet, chickpea and soya bean.

Crop	Species	Change in suitable area, HadCM3 (%)	Change in suitable area, CCCma (%)
Apple	<i>Malus domestica</i>	-21.38	-3.42
Chickpea	<i>Cicer arietinum</i>	13.91	16.95
Common millet	<i>Panicum miliaceum</i>	18.19	14.17
Oat	<i>Avena sativa</i>	-21.46	-2.79
Pearl millet	<i>Pennisetum glaucum</i>	31.28	31.46
Rye	<i>Secale cereale</i>	-25.72	-6.22
Soya bean	<i>Glycine max</i>	13.31	13.99
Strawberry	<i>Fragaria × ananassa</i>	-39.25	-24.33
Sunflower	<i>Helianthus annuus</i>	16.20	19.02
Wheat	<i>Triticum aestivum</i>	-30.86	-4.48

adapt to the impacts of climate change. It will be crucial to breed new varieties of crops with improved resistance to abiotic and biotic stresses to minimize the impacts of these climate and other environmental changes, according to Jarvis and Lane. Such new varieties would allow cultivation to continue in areas that would otherwise become unsuitable for the crop, as well as allowing the crop to be grown in new and previously unsuitable areas. The traits that will be needed to develop those new varieties are likely to come from traditional varieties and wild relatives. But another modelling study by Lane and Jarvis in collaboration with colleagues at the International Center for Tropical Agriculture (CIAT) shows that these very genetic resources may themselves be under threat of extinction.

Models of the impact of climate change on wild groundnut, potato and cowpea found that up to 61% of the 51 groundnut species analyzed and 12% of the 108 potato species studied could become extinct within 50 years. Wild cowpea was less affected, with only 4% of the 48 species studied expected to go extinct. It seems certain that, unless protective steps are taken, the impact of climate change on crops and their wild relatives will pose a major threat to the world's food supply. As Lane noted, "Relatively modest climatic changes over the past century have already had a significant impact on the distribution, abundance, phenology and physiology of a wide range of species."

In the case of crop wild relatives, the impact of climate change depends largely on their capacity to adapt to changing conditions or to migrate when their native regions become unsuitable. Wild groundnuts, for example, are particularly vulnerable to climate change because they grow in flat lands and would have to migrate a long way to reach cooler climates. Furthermore, because they bury their seed at the end of an extended flower stem, they can move only about 1 metre per year. On the other hand, species that grow in mountainous regions may be able to migrate to a slightly cooler climate by moving only a short distance up the slope.

The results of these studies point to the urgent need to collect and conserve crop wild relatives in genebanks, on farms and in protected areas, in order to ensure that this precious resource remains available for breeding new varieties of climate-tolerant crops. At the moment crop wild relatives account for only a small portion of the material stored in genebanks worldwide. Lane and Jarvis stress the need for further research into the ability of different wild species to adapt to climate change. This type of information could then be used to identify priority species for conservation.

But the studies also underline another urgent need: to invest in breeding programmes that will improve the tolerance and resistance of major crops to the effects of climate change, another area where developing countries fare worst. Support for plant breeding is inadequate in most countries and especially in countries that need it most. Increased financial support is a necessity but the focus of breeding programmes also has to change. Until recently breeders have concentrated on developing varieties of crops with higher yield and improved resistance to pests and diseases. And yet, according to Jarvis and Lane, abiotic stresses are now the main causes of declining yields. The focus of future breeding efforts will therefore need to be on drought- and heat-resistant varieties to help farmers reduce the losses caused by climate change. "Plant breeders now need to focus on the future as well as the present," conclude Lane and Jarvis.

The answer to global agricultural challenges such as climate change will most likely be found in the rich diversity of crop wild relatives and landraces. Ensuring that these resources remain available to all is the most important thing we can do.

Further information
a.jarvis@cgiar.org

A group of bananas bypassed by modern times offers a glimpse of what the ancestors of the export banana might have looked like. A Bioversity project, supported by the Gatsby Charitable Foundation, has been working with partners to understand the banana diversity of the Comoro Islands and to conserve it before it is too late.

A banana time machine on the Comoro Islands



French banana breeder Frederic Bakry pores over a plant portrait photographed by Mohamed Said Mzeouigni. He is searching for visual clues that will allow him to put the plant in its correct place among the known diversity of bananas and plantains. The fruit looks like a plantain but the colour of the male bud is all wrong. The inescapable conclusion is that this plant belongs to a type found only where the photo was taken, the Comoro Islands, a group of islands tucked away off the coast of Africa between Mozambique and Madagascar.

Thanks to the pioneering work done by his colleagues at the French Agricultural Research Centre for International Development (CIRAD), Bakry had known for some time that farmers in the Comoro Islands had been nurturing several unique types of banana. In the 1970s and 1980s French scientists visiting the islands noted the unusually high levels of banana diversity and collected samples for conservation in genebanks. This diversity took on additional significance in 2005, when CIRAD scientists probing the genetic make-up of the Comorian material conserved in the centre's banana collection in Guadeloupe announced that some of the varieties were the closest living relatives of the Cavendish banana that currently dominates the export market and of its predecessor, Gros Michel. It is by no means obvious to the naked eye that these Comorian bananas are of the same stock as the two export bananas, but the discovery of a genetic link has reawakened the dream, thwarted by repeated failures, of one day creating a commercial banana that would taste and perform like Cavendish (or better yet Gros Michel) while also being much more resistant to pests and diseases.



Mohamed Said Mzeouigni

'Padji', a local variety that is resistant to black leaf streak disease (black Sigatoka), might help efforts to breed a better dessert banana.

Bakry and his colleague, Christophe Jenny from the Guadeloupe station, were keen to continue documenting this diversity and securing it against threats such as disease, competition from introduced varieties and agricultural intensification. They approached Bioversity's Commodities for Livelihoods Programme in Montpellier, France, with a project to survey the islands' *Musa* diversity. Richard Markham, the programme director, immediately proposed integrating their survey into a Bioversity

project on conserving banana biodiversity for Africa, funded by the Gatsby Charitable Foundation.

One of the objectives of this project, which ended in 2007, was to assess the gaps in existing collections in relation to known or postulated centres of diversity. Collecting missions were targeted on Tanzania and Kenya for East African highland bananas, an indigenous group of dessert and cooking bananas, and the Congo basin of the Democratic Republic of Congo for plantains. The Comoro Islands survey presented a perfect opportunity to check on a third group of distinctly African bananas.

Nobody knows when the ancestors of today's African bananas reached the continent or how they arrived there. Bananas originated in the tropical rainforests of Asia. Recent archaeological evidence suggests that cultivated varieties may have arrived on the east coast of Africa as far back as 4000 years ago, although it is impossible to say whether they included the ancestors of today's highland bananas and African plantains. While Africa was becoming a secondary centre of diversity for these two groups, domestication was also proceeding in Asia, where more productive triploid varieties were replacing the ancestral diploid ones (see box, Wild beginnings).

The Comoro Islands, in contrast, became a refuge for diploid bananas derived from *Musa acuminata*. Bakry and his colleagues speculate that this happened because the islands are small and for most of their history have been off the beaten track of human migration and trade. Nearby Madagascar, for example, is much larger and has more biodiversity—as the theory of island biogeography predicts—but its banana diversity doesn't come close to that of its smaller neighbours (the islands of Pemba and Zanzibar also harbour rare diploids).

Bakry had no difficulty persuading Mohamed Said Mzeouigni, a Master's student at the Université Pierre et Marie Curie in Paris, to survey the banana diversity of the three main Comorian islands. Funding from CIRAD, the French government and

Wild beginnings

Botanists have identified some 70 species of wild bananas. Many bananas trace their origin entirely to *Musa acuminata*, which donated the so-called A genome. However, many cultivars, especially plantains, also include in their lineage *M. balbisiana*, which donated the B genome. Wild bananas are diploid; that is they have two sets of chromosomes, one from each parent. Typically full of seeds, wild bananas became edible when some of their offspring started producing fruits that had more flesh than seeds, prompting farmers to propagate them by using the offshoots (known as suckers) that grow at the base of the plants. But since these edible diploids were still fertile, they could also receive pollen from wild bananas.

Domestication went into high gear when one of the parents 'accidentally' contributed a double set of its chromosomes (instead of a single set, as sexually reproducing organisms normally do). These triploids very seldom set seeds, but what they lost in fertility they made up for in productivity, making them very attractive to farmers. From that point on, cultivated bananas relied entirely on vegetative reproduction; diversity was created by farmers selecting and multiplying any favourable mutations that arose. The most well-known triploid bananas, at least in banana-importing countries, belong to the Cavendish group, which dominates international trade.

Bioversity's Gatsby-funded project allowed Mzeouigni to spend two months in the Comoro Islands. His mission: to describe the plants based on established descriptors and to take photos and leaf samples from every unusual banana plant he was able to find with the help of a local agronomist. (All the information will be included in Bioversity's *Musa* Germplasm Information System.)

So far, some 48 plants have been tentatively classified into almost as



T. Lescot/CIRAD

many varieties based on Mzeouigni's photos and notes. Most of the leaf samples were analysed using a technology called flow cytometry, which revealed 9 diploids and 28 triploids (the ploidy of some samples could not be determined because they had deteriorated). The triploids tend to belong to groups that are common elsewhere but Bakry points to a few unique specimens. 'Padji' is a dessert banana that CIRAD scientists have shown is resistant to black leaf streak disease, the fungal disease commonly known as black Sigatoka that is forcing most commercial growers to use an increasingly heavy regime of fungicides. Unfortunately, 'Padji' doesn't have the post-harvest qualities that would allow it to break into the export market.

A woman carries a bunch of Cavendish bananas from her plot. The diversity of bananas on the Comoro Islands is threatened by the spread of Cavendish.

The diploids are more unusual. With one exception, Bakry reckons that they belong to a rare group of bananas that French scientists call 'mlali'. Some of those varieties, 'Samba' and 'Chicamé' for instance, are unique to the Comoro Islands while 'Mjenga' is also grown in Tanzania. Another, 'Chimwali kananbobwa', is unusual because it is a diploid that looks like a triploid. The great drawback of these diploids, however, is that they are very susceptible to diseases.

Pests and diseases, especially the black weevil, are one of the reasons why banana yields in the Comoro Islands are low, confirms Thierry Lescot, a banana production specialist at CIRAD. He adds that farmers do not use fertilisers and the scarcity of water on the islands precludes irrigation to make up for the lack of rain during the six-month dry season. Comorians traditionally grow bananas on small plots in low-input, mixed cropping systems. Yields have not been keeping up with growth in the islands' population and as a result farmers are under pressure to use pest- and disease-resistant varieties to boost productivity. Improved hybrids, however, are not popular with the islands' farmers or consumers. Modern varieties are mostly bred to solve disease problems, especially those found on large-scale plantations, and often lack the characteristics that would make them appealing to smallholder farmers with a long tradition of eating a large diversity of bananas.

Comorian bananas have become a traded commodity only in the past 40 years. Before that they were grown communally and belonged to everybody. Bakry thinks that the cultural value associated with bananas might have helped the rarer varieties survive to this day, but he is worried about the future. He thinks the islanders should be helped to conserve their unique banana diversity, and suggests setting up a field collection on each of the islands and even establishing a breeding centre that would help Comorians to create their own varieties. Bakry stresses the urgency. About three-quarters of the bananas produced in the archipelago are already the ubiquitous Cavendish. Time is not on the side of the edible

DArT targets molecular information

Descriptors for Banana, developed by Bioversity and CIRAD, lists 121 morphological characters that can be used to identify a banana plant. To make the job a little easier it also points to the 30 most discriminating descriptors that are stable across different environments. This reduced set of descriptors is being tested on 718 *Musa* accessions from Bioversity's International Transit Centre (ITC) that are being grown in the field to verify their identity (see *Rejuvenated bananas justify genebank confidence*, Annual Report 2005, p. 26). A reliable set of descriptors eases the process of identifying an unknown banana somewhat, but for more-precise identification at the cultivar level the latest strategy has been to look in detail at the DNA.

Various types of molecular marker have been tested to see if their results agree with those obtained with morphological characterization. The most useful approach for processing a large number of diverse samples at the same time is a recently-developed method known as DArT, for Diversity Arrays Technology. The great benefit of DArT is that it does not require any knowledge of the DNA sequence. It works by taking DNA from a large sample of individuals and from this 'metagenome' identifying fragments that are present in only some of the individuals. These are the so-called DArT markers. Once they have been identified, it is reasonably easy to develop a molecular profile for individual samples based on which of the DArT markers their DNA contains. As with other molecular markers, from these profiles it is possible to assemble a family tree that indicates relationships among the samples.

As part of a Gatsby-funded project studying *Musa* diversity, Bioversity has been working with Andrzej Kilian, the inventor of DArT technology, to investigate the same 718 *Musa* accessions from ITC that are being characterized using morphological descriptors. The results should help to confirm the identity of accessions that the morphological descriptors suggest are mislabelled. They will also be interesting for the light they might shed on the banana's phylogenetic tree and the places of the various African branches.

DArT analysis confirms that some of the Comorian diploid AA bananas are closely related to Cavendish and Gros Michel, which are triploid AAA. The East African highland bananas, on the other hand, cluster among the AA bananas from Papua New Guinea, even though they too are AAA. Finally, as predicted from morphological studies, the African plantains are closely related to the Pacific ones, which together share a common ancestor with AAB bananas from India.

diploids and there is still work to be done before scientists have a comprehensive picture of the islands' unique banana diversity.

The conservation of *Musa* diversity is one of Bioversity's goals, and the Commodities for Livelihoods Programme has developed a strategy for *ex situ* conservation with the Global Crop Diversity Trust. Sorting out diversity—which includes getting names right and establishing

relationships among varieties—is a vital prelude to effective conservation. This is a painstaking activity that requires a strong commitment, if only because we have a tendency to appreciate the importance of diversity only after it has disappeared. Making sure that the Comorian bananas escape that fate is a demanding but important activity.

Further information
n.roux@cgiar.org

Much of modern European agriculture favours homogeneity over diversity. And yet in the back gardens of Europe, a few farmers continue to grow a rich variety of crops to suit their needs. A study by Bioversity sheds light on the potential of home gardens as havens for the conservation of Europe's crop diversity.

Hope flourishes in home gardens



In the vicinity of Lake Trasimeno in Umbria, Italy, the Pelosi brothers are credited with bringing the cowpea (*Vigna unguiculata*) back into the lives of their neighbours. A hardy crop, cowpea used to be an important staple in Italy until after the second world war, when it was largely forgotten. The Pelosi family stubbornly held on to their seeds and now, thanks to the brothers' efforts, cowpea is enjoying something of a renaissance in the region. Ask the Pelosi brothers why they continue to grow this and other traditional crops and varieties in their back gardens and their answers will invariably turn to 'the old days' and stories of memorable meals with family and friends. They may not realize it, but conservation efforts such as theirs play a vital role in keeping alive Europe's crop diversity and the knowledge associated with it.

The Pelosi brothers with their nephew and some of the cowpea seeds they have kept going in their garden in Umbria, Italy.



V. Negri

The Pelosi's was just one of many stories about the conservation efforts of Europe's farmers that were exchanged at a meeting on the conservation of crop landraces in European home gardens, held in Ljubljana, Slovenia, in October 2007. Bioversity organized the conference under the auspices of the European Cooperative Programme for Plant Genetic Resources (ECPGR), for which Bioversity provides the secretariat. Experts from non-governmental agencies, universities, seed-saver networks and gardeners' associations drawn from 30 European countries participated.

"The aim was to launch a new research agenda that will help formalize the critical role that Europe's home gardens play in conserving the region's crop diversity," explained Lorenzo Maggioni, Bioversity scientist and coordinator of the ECPGR.



L. Maggioni/Bioversity International

Near Zagarolo, a small town on the outskirts of Rome, Italy, Raffaele Passari, an 83-year-old Italian farmer, continues to grow a landrace of leafy kale cultivated by his grandfather.

To help develop that new research agenda, Bioversity commissioned a review of current policies and research on home garden conservation across Europe. The review revealed that some farmers and gardeners do continue to grow traditional varieties and landraces of some of Europe's most important horticultural crops, legumes and grains in their home gardens and concluded that home gardens could play a strategic role in conserving Europe's crop diversity.

“Everyone was surprised to learn that, despite the large-scale commercialization of agriculture in Europe, there are still many dedicated farmers and gardeners who continue to grow and conserve traditional varieties in small plots around the home,” noted Pablo Eyzaguirre, Senior Scientist and anthropologist at Bioversity.

But the good news came with a note of urgency: “These efforts are still few and far between and they are often carried out by elderly farmers,” warned Gea Galluzzi, author of the review. “We need to ensure that these efforts are given the political and financial support they need to continue, and that awareness of their value is raised among younger generations.”

In many other regions of the world, traditional varieties and landraces represent the majority of crops planted. In Europe, however, commercial agriculture has relegated traditional varieties to small patches and gardens around the home. And yet, these varieties could prove vital in meeting the region’s needs in the face of climate change and other major agricultural challenges (see *Adapting agriculture to climate change*, page 2). But landraces and traditional varieties are not well represented in genebanks, making up only a third of material stored in collections worldwide.

Fortunately, a few farmers still continue to grow traditional varieties, despite their lack of commercial value. The reasons behind this can be personal or cultural. For example, a landrace might be grown because it suits a specific need or taste. In the province of Tuscany in Viterbo, Lazio, for example, some Italian farmers continue to grow a particular type of tomato because they consider it to be the most suitable for preparing a local dish of stuffed tomatoes.

Conservation in home gardens offers advantages that complement the benefits of conserving material in genebanks. Maintaining varieties in a home garden allows evolutionary processes to continue, thus enabling potentially valuable traits to develop. Conserving material in a genebank, on the other hand, freezes these processes, providing a snapshot of the material at the time it was collected.

“In home gardens, evolution still goes on, offering a living example of flexible on-farm management on a small scale,” explained Galluzzi. Conservation in home gardens is also about conserving the traditional knowledge that keeps these systems alive.

“The people who grow these varieties are as important as the varieties themselves,” explained Eyzaguirre. “They are treasure troves of knowledge on the properties, uses and history of these crops.” Without that knowledge, conservation loses much of its value. The study recommends further research into these traditional knowledge systems and how this knowledge is imparted from one generation to the next.

The study also identifies opportunities for making the conservation of traditional varieties in home gardens a more lucrative affair for farmers. Incentives such as appellations of origin and other regulations and policies concerning *terroir*, cultural practices and cultural history could put these farmers in touch with new markets.

Ageing farmers and lack of financial support are two of the threats facing home garden conservation. But maybe the most pressing threat that the study identified is the increasingly complex policy environment that engulfs such small-scale conservation efforts.

The European Community provides no formal recognition of home gardens and their contribution to the conservation of plant genetic resources. To make matters worse, European legislation exacerbates this already discouraging situation by creating a complex regulatory environment around the sale of seed. European farmers and gardeners are forbidden to market seeds of varieties that have not been registered in the European Common Catalogue. Registering a variety is both expensive and complicated. In April 2007, a new draft directive was published, setting the conditions for commercializing so-called conservation varieties. This draft is still in discussion and more study will be needed to understand exactly how it might affect the exchange and conservation of diversity in home gardens.



G. Galluzzi

A home garden near the Parco dell'Uccellina, a nature reserve in southern Tuscany, Italy. Home gardens are often rich in diversity, harbouring important landraces and traditional varieties that modern agriculture has cast aside.

“The significant role of seed exchange must not be underestimated,” noted Galluzzi. Seed exchange—getting and giving interesting crops and varieties—is one of the key elements for people who grow diversity in their home gardens. Supportive policies that take into account the special nature of these small-scale conservation activities and the need for exchange will help ensure the continuation of home garden conservation efforts. “Growing public interest in biodiversity, organic farming and the benefits of home gardens in agro-ecosystems make this a propitious time to begin a Europe-wide research initiative on this topic,” said Maggioni.

Participants at the meeting in Slovenia resolved to develop a five-year agenda to address some of these pressing issues. “There is still time to save this precious bio-cultural resource but the pace of change is also accelerating,” concluded Eyzaguirre. “As our research gets underway, we resolve to increase our efforts to communicate about this important issue to policy-makers and the public.”

Further information
l.maggioni@cgiar.org

More than ten years ago, scientists at Bioversity's regional office in Kenya noticed an alarming development. The traditional African leafy vegetables they had eaten as children were rapidly disappearing from farmers' fields and people's tables. Bioversity and its partners set out to reverse this trend.

Back by popular demand



Mary Wangari is fresh produce assistant at a Tusker supermarket in Nairobi, Kenya. Over the past few years, Mary has noticed a real change in the leafy vegetable corner of the fresh produce section. Since the supermarket began stocking traditional African leafy vegetables about four years ago, demand has increased to such an extent that, despite daily deliveries, by the time the afternoon arrives there is often not enough left to meet shoppers' needs. Demand for leafy vegetables now outweighs supply, with an astonishing increase in sales of 1100% in just two years (see *What's on the menu*, Annual Report 2005, p. 6). But things haven't always been this good.

Until recently, traditional African leafy vegetables were considered by many to be inferior to and less fashionable than introduced vegetables such as cabbage and kale. The conditions in which the indigenous leafy vegetables were grown and sold did little to improve their image, with consumers fearing that they were dirty and unhygienic. Faced with a lack of demand, farmers stopped growing them.

Two major projects led by Bioversity International set out to change this situation. They worked with farmers, NGOs, universities, hospitals, national research institutes and others across sub-Saharan Africa to improve livelihoods and nutrition by increasing production and consumption of leafy vegetables. This would also serve to ensure the conservation of the crops. The projects came to a close three years ago and although there was evidence of their success (see *Assessing the impact of our work*, Annual Report 2006, p. 24), no formal impact assessment had been carried out.



S. Mann/Bioversity International

Mary Wangari at work at a Tusker supermarket in Nairobi, Kenya.

Elisabetta Gotor, an Italian Associate Expert at Bioversity, recently carried out a study to assess the impact and sustainability of the projects' efforts in Kenya. "Ten years have passed since these efforts first began and we wanted to know what the impact had been on people's lives," explained Gotor. But the impact study went further. "We also wanted to find out exactly what Bioversity's contribution was and whether this role could have been played by anyone else," Gotor continued.

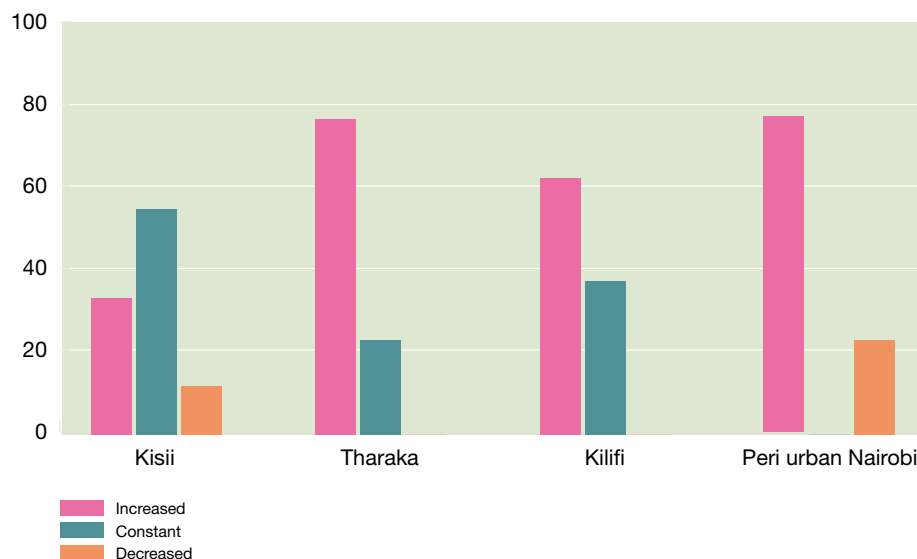
In addition to interviews with partners, the study sampled a total of 211 households from four regions involved in the project: Kisii in western Kenya, Tharaka-Nithi in the eastern province, Kilifi on the coast and peri-urban Nairobi, including the Kiambu and Thika districts. A combination of quantitative and qualitative methods, including focus groups, interviews and surveys, was used to ensure accuracy. Where possible, data collected at the beginning of the projects were used to provide a baseline for the impact study.

Results confirmed that the project's efforts were successful. Production of leafy vegetables in peri-urban Nairobi, for example, has increased more than tenfold since 1997. Incomes have increased too, particularly where farmers have been successfully linked to markets (see figure). And women, the main producers of leafy vegetables, were the main beneficiaries. In almost 80% of the households it was the women exclusively who kept the cash from sales of leafy vegetables and who decided what it would be spent on—mostly on more and better food and paying for schooling for their children. (This mirrors the impact of research on informal seed systems in Mali; see *Saving seeds in the Sahel*, page 13.)

"Some of these developments need to be monitored," warned Gotor, noting that as commercialization increases, gender issues may come into play. "There is a real danger that men will take over as leafy vegetables become more profitable," she said. It will be important

Farmers believe their incomes have risen from 1997 to 2007.

In three of the four districts studied, the majority of farmers believed their incomes had increased.¹



¹ The data refer to the perception of the respondents, when asked to compare the incomes they earned from ALVs in 1997 and 2007. This does not take into account the actual income value but the perceived percentage increase or decrease.

to ensure that women continue to be the main producers and marketers of traditional leafy vegetables, and in charge of cashing in the returns.

Things have clearly improved on the production side of things. But the study also found that people are buying and eating more leafy vegetables too. More than 80% of the households surveyed reported that they had eaten leafy vegetables over the past couple of days. Many households (37.5%) reported improvements in their health since they started eating leafy vegetables, saying

that they fell ill less often and were less anaemic. The study underlined the need for more research into the nutritional properties of traditional leafy vegetables and their impact on health so as to be able to build on this anecdotal evidence.

Among partners, more than 70% said that Bioversity had played a positive role in bringing traditional leafy vegetables to where they are now. More than 90% said that general efforts to promote leafy vegetables in the country had increased as a result of



E. Gotor/Bioversity International

In the village of Mariakani, Kenya, women study a pamphlet showing the nutritional value of various leafy vegetables. Public awareness like this was an area in which Bioversity played a significant role, informing consumers and farmers of the nutritional benefits of leafy vegetables.

project interventions. Further evidence of Bioversity's leading role and the effectiveness of its modus operandi emerged strongly from the study. The success of the project resulted in the launch of several other efforts by project partners, further evidence of impact.

Partners viewed Bioversity as the single most important organization with respect to initiatives to promote African leafy vegetables, with more than 60% of respondents rating collaboration with Bioversity as 'very beneficial'. Respondents saw Bioversity as a catalyst and an enabler, facilitating and driving work on African leafy vegetables in Kenya. One collaborator said that Bioversity was like the director of a big orchestra, directing and guiding all the players in the same direction in order to maximize the efficacy of results.

Respondents rated public awareness as one of the areas where Bioversity had played the most significant role. The study identified increased awareness of the nutritional value of traditional leafy vegetables as one of the key drivers of growth in consumption and demand. Much of the awareness-raising work took place in urban Nairobi and the study highlighted the need for more efforts to increase awareness in rural areas.

Public awareness can help increase demand, but the study also identified the need for more work at the supply end of the market chain. Increased production of leafy vegetables has brought with it the need for more research into storage methods and technologies that will help farmers reduce losses in periods when supply outweighs demand, such as the rainy season.

"There is no doubt that Bioversity played a unique role in bringing leafy vegetables back into the lives of Kenyans," says Gotor. "Efforts now need to focus on keeping them there."

Further information
e.gotor@cgiar.org



E. Gotor/Bioversity International

A woman selling leafy vegetables in a street market near Embu, South Tharaka, a very dry and poor rural area in central Kenya. Indigenous leafy vegetables grow well in marginal environments like that of Embu.

Who does the work? Gender roles in farming African leafy vegetables

Women are generally responsible for carrying out most of the farming activities relating to African leafy vegetables. Some activities are carried out jointly by husband and wife.

Farming activity	Household member performing activity			
	Wife	Husband	Both	% women
Land preparation	94	19	36	75
Planting	110	13	35	81
Manuring	92	16	31	78
Weeding	104	12	35	81
Crop protection	63	30	22	64
Irrigation	21	7	7	71
Harvesting	113	10	30	83
Marketing	62	12	15	79
Total	659	119	211	

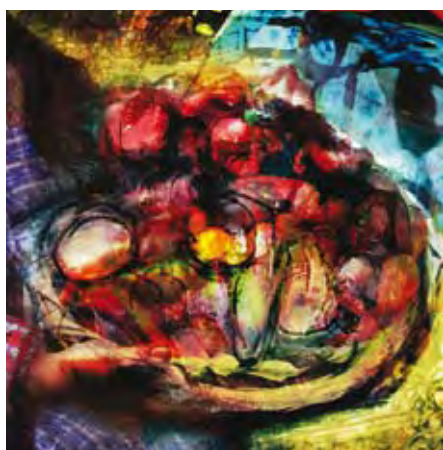
Who makes the decisions? Gender roles in decision-making for African leafy vegetables

Women are also responsible for much of the decision-making, although the figures also suggest that men are more involved in decision-making processes than they are in the farming itself.

Farming activity	Household member making decision on the activity			
	Wife	Husband	Both	% women
Land preparation	97	59	23	61
Planting	110	50	20	67
Manuring	98	47	20	65
Weeding	119	38	23	73
Crop protection	66	54	18	54
Irrigation	28	16	6	62
Harvesting	121	35	23	74
Marketing	57	25	16	66
Total	696	324	149	

An IFAD-funded project to help farmers in the Sahel make better use of agricultural biodiversity has opened new doors for women in Mali, improving their access to markets and strengthening their role in the local seed system.

Saving seeds in the Sahel



In the Sahel, producing a good harvest that will meet a family's needs for food and income is not an easy task. Harsh climate, poor soil and outbreaks of pests and diseases make this a difficult environment in which only a few crops can thrive. In such tough conditions, having access to a stock of high-quality seed of varieties that are adapted to local conditions becomes indispensable.

IFAD (the International Fund for Agricultural Development) funded a project entitled Empowering Sahelian Farmers to Leverage their Crop Diversity Assets for Enhanced Livelihood Strategies that worked with farmers in three countries—Burkina Faso, Mali and Niger—to improve their access to local crop diversity and to build their capacity to manage this resource to improve their livelihoods.

The project came to a close in 2007, and efforts in Mali were studied to assess their impact.

In Mali, the project focused on millet and sorghum, the two most important cereal crops for food security, as well as cowpea and bambara groundnut. More than half of Mali's land is desert or semi-desert, subject to droughts and with poor soils. Farmers not only have to cope with drought and other climate-related stresses, they also have to grapple with locusts and other pests that frequently threaten their harvests.

“One of the main things the project did was to improve farmers' access to quality seed of local varieties of staple crops and to strengthen the social links that drive the local seed system,” explained Raymond Vodouhe, who coordinated the project from Bioversity's

Women farmers note the characteristics of millet varieties growing in their diversity field. They will share this information with the rest of the village at the end of the day.



R. Vodouhe/Bioversity International

office in Benin. The project also looked at the role of markets in the local seed system and at ways of strengthening the links between farmers and seed markets.

Much of Mali's seed system for local cereal crops is informal, meaning that seed exchange occurs between farmers without the intervention of government institutions. Seed of local varieties is rarely bought or sold on the market; when it is, it is only in small quantities and in local village markets. One reason for this is that the process for registering varieties is difficult and selling uncertified seed was, until recently, forbidden. The other reason is social; in some villages buying seed, especially from a neighbour, is frowned upon because the practice goes against traditional values of sharing seed. Together these factors make it difficult for farmers to acquire seed through market channels.

A study by the socioeconomic team of the IFAD project confirmed that no certified seed was available in local markets in the project area. In more arid, risky environments farmers can sometimes buy uncertified seed at weekly village markets, especially after a poor harvest; small vendors sell grain from the stores on their farms, and this can be used for seed. But farmers generally exchange seeds among themselves and with farmers from neighbouring villages, thus ensuring that varieties are locally adapted and will suit their needs. With no certification system in place, this exchange is based on trust and relies on an intricate social network. Most seed of local landraces of staple cereals like sorghum and millet is

acquired through this kind of informal exchange. In times of difficulty—for example strife, migration or simply a succession of poor harvests—this social network can fall apart, which greatly limits farmers' access to seed.

Even locally, however, it may be difficult to turn to markets because of the social stigma attached to buying seed. People believe that every family should have its own stock of seed; if you need to buy seed, you are failing socially.

"To be without seed is to be destitute," noted Melinda Smale of the International Food Policy Research Institute, lead author of the market study. Nevertheless, local markets could be an important mechanism for reducing the vulnerability of farmers when seed is hard to find. The project therefore focused on strengthening the market-based informal seed system and the traditional knowledge on which it is based, working closely with farmers in the process. One of the ways it did this was by introducing 'diversity fields' into the villages of Boumboro, Pétaka and Tassiga in Mali.



R. Vodouhe/Bioversity International

After a morning's work in the diversity fields, farmers gather to share experiences and to record their findings.



R. Vodouhe/Bioversity International

These diversity fields are plots of land managed by the community in collaboration with researchers and agricultural extension workers. A chosen field is planted with traditional and improved crop varieties jointly selected by farmers and researchers. Groups of farmers from the village take turns to manage the field each day, recording their observations and experiences and sharing these with researchers and the rest of the village. Together, researchers and farmers select the varieties that best suit local needs for taste, yield and resistance to pests and diseases. Farmers from neighbouring villages are encouraged to visit the diversity field and to participate in the discussions, strengthening social links between villages in the process. There is also a continuous process of training that includes selection of seed stocks and preparation of the seed for marketing.

Diversity fields help each village to build up its own stock of high-quality seed and its capacity for managing crops and varieties. Farmers can fall back on their own seed stock when



Participants at a diversity fair showcase the local varieties grown in their diversity fields. By making farmers from different villages aware of the range of varieties that are available, such fairs help strengthen the informal seed system.

R. Vodouhe/Biodiversity International

supplies are short and any surplus can be sold on the market to earn some extra income. Diversity fields also help increase the diversity available for sale in markets, by improving farmers' access to a wide range of varieties adapted to their local growing conditions and tastes. Diversity fields are particularly important for developing the capacity of women farmers to harvest and market their seed. "Women farmers benefit greatly from diversity fields because they are often the ones in charge of managing the food crops and of selling any surplus seed on the market," explained Vodouhe.

There is some evidence that women from villages that participated in the project sold more seed in local markets than those from villages that hadn't participated. "Word soon got out about the high-quality seed being sold," said Vodouhe. That, combined with knowledge of their provenance, made the seed more attractive to buyers.

Money earned from selling seed also played an important role in ensuring the nutrition and health of households. The market study revealed that women typically used the money they earned to buy condiments and vegetables to accompany their staple foods. "The

condiments contain nutrients that are important for the family's nutrition and health," noted Smale.

The market study concludes by stressing the need for more supportive policies that promote markets as a complementary way of acquiring seeds when the village-based seed exchange system fails. Buying in markets means farmers can make impersonal transactions in times of need, without fearing social stigma attached to buying from a neighbour. On the production side, diversity fields will help ensure that seed sold through market channels is of high quality, reliable and suited to farmers' needs.

According to Vodouhe, "Future efforts will need to focus on ensuring that the diversity fields continue to operate with support from the formal sector". Strengthening market links and providing farmers with a seed system they can tap into when times are difficult will be another key area for future work.

Further information
r.vodouhe@cgiar.org

In 2006, the Conference of the Parties to the Convention on Biological Diversity tasked Bioversity and the UN's Food and Agriculture Organization (FAO) with leading a global cross-cutting initiative on biodiversity and nutrition. One year later and much progress has been made.

The missing link: biodiversity and nutrition



Around the world, a trend is emerging that alarms nutritionists, health specialists and agricultural development workers alike. According to the International Journal of Obesity, in countries as diverse as Brazil, China, Indonesia, the USA and Vietnam between 22 and 66% of households are now considered dual burden households—families that include both overweight and underweight people. What is happening at the household level is symptomatic of a much larger, global trend.

At the heart of this trend is a simplification of people's diets. As the West increasingly looks to traditional diets for clues to better nutrition and health, developing countries are abandoning their local foods in favour of processed foods rich in sugar and fats. The consequences of this shift are now being felt in the developing world, with malnutrition and obesity existing side by side and diseases normally associated with the affluent West, such as heart disease, diabetes and cancer, on the rise.

"These problems can be seen in West Africa, where people are gradually abandoning their nutritious traditional foods," said Pablo Eyzaguirre, Senior Scientist and anthropologist at Bioversity International. "This is a problem that concerns the agriculture, health and trade sectors alike and that requires a multi-sectoral approach to solve."

It was to facilitate such a multi-sectoral approach that Bioversity and the West African Health Organization (WAHO)—a specialized agency of the Economic Community of West African States (ECOWAS)—organized a two-day workshop in Burkina Faso.



E. Achigan Dako/Bioversity International

In northern Benin, Solange Avondo serves a plate of Man-unsunu, a local dish made with ackee, a traditional fruit native to West Africa. Ackee is rich in protein, fibre and potassium.

For the first time, the workshop brought together the health and agriculture sectors to discuss issues of mutual concern: nutrition and the gradual abandonment of local traditional foods. The meeting took place in September 2007, with support from the Canadian International Development Agency, the International Development Research Centre, Canada, the Global Facilitation Unit for Underutilized Species, hosted at Bioversity, and the West African Economic and Monetary Union.

More than 40 representatives from national, regional and international institutions participated, including people from farmers' groups and internation-

ally renowned charitable organizations such as Helen Keller International. Participants shared experiences about the growing incidence of diet-related chronic diseases, malnutrition and food insecurity in the region and discussed the role that traditional foods could play in improving nutrition and health.

“Nutrition interventions often focus on supplementation and food fortification,” said Francisca Smith, nutritionist and Honorary Research Fellow at Bioversity. Boosting the micronutrient content of staple foods such as rice and bananas is certainly a valid and medically effective approach to malnutrition, but it is expensive and normally a short-term solution to target a specific nutritional deficiency. In poorer rural areas a long-term, more cost-effective approach is needed. “Supplements can help address specific deficiencies in essential nutrients, but a diet that is diverse offers a more holistic approach to nutrition and health,” said Smith.

“We don’t know the full range of causes for the rise of diet-related diseases in West Africa,” Eyzaguirre said. “But we do know that people have gradually moved away from their traditional food systems and that these foods were highly nutritious.” A diverse diet based on traditional foods that are rich in micronutrients could offer a solution to malnutrition that is sustainable in the long-term, cost-effective and beneficial to the environment.

Chilli mix for sale at a market stall in Kunming, China. Condiments are an important element of people’s diets but they have rarely been studied for their nutritional contribution.



Participants identified several priority issues that need to be addressed jointly by the health and agricultural sectors. Foremost among these is the need to conduct an inventory of all the traditional and indigenous foods available in the region and to map their use. Research can then be carried out to identify how these can best be used to improve nutrition and health.

Participants made a strong plea for funds to carry out further research on the links between traditional foods, nutrition and health. “Collating existing information and evidence of the links between the consumption of traditional foods and better nutrition will help us to identify gaps and priority areas for further study,” said Smith. Information about the nutritional benefits of these foods will also provide a powerful tool for raising awareness of and increasing demand for nutritious traditional crops (see *Back by popular demand*, page 10).

The workshop concluded with the adoption of national and regional advocacy action plans. Such was the impact of the meeting that shortly after, Benin convened a national stakeholder meeting involving representatives from agriculture, health and other development sectors with the aim of starting addressing some of the issues raised during the workshop. “Benin has already begun to implement its own national plan to improve the nutrition and health of the country through the use of agricultural biodiversity,” said Raymond Vodouhe, regional coordinator of Bioversity’s office in Benin, adding that Bioversity stands ready to help.

At the policy level, bringing a multi-sectoral approach to bear on the problem of malnutrition will help boost countries’ efforts to use agricultural biodiversity for improving nutrition and health. On a technical level, however, more research is needed to solidify the links between biodiversity, nutrition and health. An important part of this involves broadening the scope of food composition data to include biodiversity. “By developing an indicator that can capture the nutritional differences of a diet rich in diversity, we can begin to assess the true value and contribution of diversity to human nutrition and health,” said Eyzaguirre.

To address these and other issues relating to food composition and biodiversity, Bioversity and FAO organized an international food data conference in Brazil in October 2007. Researchers, nutritionists and health professionals gathered from all over the world to develop indicators for biodiversity in the diet and guidelines for activities relating to the study of food composition and biodiversity worldwide.

The indicators that nutritionists and health workers currently use to collect information about what people eat do not allow them to capture the diversity inherent in people’s diets. “Ask a person what they eat in a day in the rural Andean region of Peru, for example, and you will most likely find that they consume at least two different varieties of potato in the same day, sometimes in the same meal,” said Eyzaguirre. Different varieties may have different nutritional properties and yet, for most of the world’s food crops, this kind of information does not exist at the varietal level. Similarly, condiments and spices are key elements of people’s diets but the nutritional contributions of these too have only rarely been assessed, despite some evidence of their importance.

“Dietary assessment instruments have been developed to capture the usual or habitual intakes of foods as reported by people,” explained Barbara Burlingame, nutritionist at FAO and keynote speaker at the workshop. “Until recently there was little demand to provide compositional data at the species or sub-species level.” There was also a widely-held but erroneous belief that people were not able to identify the foods they were eating at the species or sub-species levels.

The new biodiversity indicators now under development as a result of the workshop will provide nutritionists with the tools they need to begin capturing information about diversity. “The workshop was an important first step that will help us gather the initial data we need to assess the contribution of biodiversity to nutrition and health,” said Smith.

Further information
p.eyzaguirre@cgiar.org

A six-year project is setting out to help resource-poor farmers make the most of local crop diversity to control pests and diseases. The first step will be to talk to farmers to find out more about how they currently use crop diversity to protect their harvests from pests and diseases.

Diversity to manage pests and diseases



Every year, around 30% of the world's harvest is lost to pests and diseases and the people worst affected are resource-poor farmers in the developing world. A number of measures could be taken to help limit losses. Pesticides and fungicides are one solution, but they can damage the environment and harm people's health and are often too costly for poor farmers to afford. Modern varieties bred to resist pests and diseases offer another possible solution, but planting large areas with genetically uniform resistant varieties could provide ideal conditions for new strains of pests and diseases to evolve. Hence the resistance of the variety may fail after only a few cropping seasons. Smallholder farmers are in any case often unable to get hold of the latest modern varieties, and most of the time they are too poor to buy them. Furthermore, modern varieties often do not perform well in marginal areas with low inputs.

"Farmers in the developing world need sustainable solutions that are low input, affordable and environmentally-friendly," explained Devra Jarvis, Senior Scientist at Bioversity and one of the lead scientists of the project, which is funded by UNEP-GEF (United Nations Environment Programme–Global Environment Facility) and the Swiss Agency for Development and Cooperation. These more sustainable, cost-effective solutions, she believes, could lie in the diversity of traditional crops and varieties, a resource that smallholder farmers can easily access and make use of.

In November 2007, the first phase of the project—Conservation and Use of Crop Genetic Diversity to Control Pests and Disease in Support of Sustainable Agriculture—was formally launched at



Bioversity International

Researchers for the project are trained in the use of participatory diagnostic protocols. Here they are pretending to be farmers and have labelled their different varieties based on the traits farmers would use to distinguish between varieties.

a global meeting of partners in China. The project will work with small-scale farmers in four countries—China, Ecuador, Morocco and Uganda—and aims to help them to make use of the local diversity of key staple crops to minimize the damage caused by pests and diseases.

The project focuses on banana (*Musa* spp.), barley (*Hordeum vulgare*), common bean (*Phaseolus vulgaris*), faba bean (*Vicia faba*), maize (*Zea mays*)

and rice (*Oryza sativa*). Bioversity will collaborate with a range of national and international partners, including CIP-UPWARD (International Potato Center—Users’ Perspectives with Agricultural Research and Development), FAO (Food and Agriculture Organization of the United Nations), IFPRI (International Food Policy Research Institute), IRRI (International Rice Research Institute), local non-governmental organizations and universities.

Considerable evidence exists to support the project’s approach to pest and disease management. Studies of advanced agricultural systems have shown that crop mixtures and rotations can reduce the damage caused by pests and diseases. Research has also revealed that many farmers already use the diversity of traditional varieties and mixtures of modern and traditional varieties in this way. The benefits of such an approach are clear: not only is it affordable and environmentally sustainable, it also protects the diversity of the local agricultural ecosystem.

“We are working to identify systems where farmers can reduce the vulnerability of their systems and limit their losses by planting a diversity of varieties in their fields,” noted Jarvis. This diversity acts as a buffer, improving stability of a system even under stress.



T. Johns /Bioversity International

A farmer in Uganda tells a Bioversity researcher about the varieties of common bean she grows and their diseases.

A farmer in Morocco tells project partners from China, Ecuador and Uganda about the diseases that have been affecting his field of faba beans.

A key starting point for the project has been the development of a set of participatory tools to capture and understand farmers’ knowledge and practices for managing pests and diseases using local crop varieties. “Tapping into farmer knowledge is important for us to be able to find solutions that suit local needs and the local environment,” said Jarvis.

This adds a new dimension to work on pest and disease management, which has commonly focused on only three components: host, pathogen and environment. “The project will ensure that the fourth, critical component—the farmer—is also included,” says Jarvis.

The participatory diagnostic tools the project will employ include detailed guide questions that help to acquire such information as when and where intra-specific diversity can help to manage pests and diseases and to identify the ‘genetic choices’ farmers make to minimize losses caused by pests and diseases. The tools are now available in Chinese, Spanish and French, as well as English, and plans to translate them into Arabic are well advanced. Many of the tools build on successful participatory techniques developed during a global project on the *in situ* conservation of agricultural biodiversity run by Bioversity (see *An improved tool to assess local crop diversity*, Annual Report 2005, p. 10).

The next challenge will be to develop guidelines for laboratory and field assessments that build on this knowledge. Trials in farmers’ fields will be organized to assess the disease and pest resistance of traditional varieties and trials in experimental stations will allow researchers to follow epidemics over time and to observe impacts on yields.

“Integrating the knowledge, beliefs and practices of farmers with advances in the analysis of crop and pest and disease interactions will help increase farmers’ options for fighting pests and diseases in a sustainable way,” concluded Jarvis.

Further information
d.jarvis@cgiar.org



Bioversity International

A project to look in detail at the chemical composition of different varieties of some fruits and potatoes offers the opportunity to enhance our basic understanding of their nutritional properties, paving the way to improved crops and better nutrition.

Berry good nutrition



The N.I. Vavilov Research Institute of Plant Industry in Russia maintains an extensive collection of plants that produce small fruits—such as currants and blackberries—that are known, in general, to be extremely rich in nutritional components that contribute to good health. These include antioxidants, which help to mop up free radicals—highly reactive molecules that can damage cells and that are associated with many different diseases. A single cup of red currants, for example, can provide an adult with their entire daily requirement for antioxidants. However, scientists know little about the nutritional composition of different berry species and even less of the differences among varieties within each species.

One of the many samples of potato supplied by the N.I. Vavilov Research Institute of Plant Industry for analysis in Luxembourg.



A new Bioversity project launched in 2007 and funded by the government of Luxembourg aims to fill this knowledge gap. The project brings together the analytical expertise of the Centre de Recherche Public – Gabriel Lippmann in Luxembourg and the collections of the Vavilov Institute to evaluate accessions of *Ribes* (currants), *Rubus* (blackberries), *Lonicera* (honey berry), *Sorbus* (rowan or mountain ash), *Vitis* (grape) and, for good measure, potato (*Solanum tuberosum*).

A preliminary meeting of the partners at Bioversity headquarters in Rome set out the directions the work will take. The main thrust of the project will be to measure the nutritional components of the species and varieties. These will include carotenoids such as lycopene and lutein that are known to be beneficial to human health. In addition, because all the species are usually propagated vegetatively, the project also aims to develop better techniques for long-term conservation.



Centre de Recherche Public – Gabriel Lippmann

A scientist operates a rotating evaporator, used to prepare samples for biochemical analysis.

Many of the fruit varieties are now maintained only in field genebanks that are threatened by pests and diseases and abiotic stresses such as drought or frost. The project partners will work together to improve techniques to store the varieties as *in vitro* test-tube plantlets and ultimately to develop cryopreservation protocols that allow the material to be stored long-term in liquid nitrogen without damage.

In addition to the scientific community, project partners intend to make their results available to the wider public, especially to policy-makers. This will start with links to policy-makers in Russia and later in the European Union. In both, the goal is to encourage development of policies that will enhance the economic opportunities for growers of the crops and that will deliver health and nutrition benefits to consumers.

Further information
p.eyzaguirre@cgiar.org

Bioversity, working through the System-wide Genetic Resources Programme, helped to secure a global system for the conservation and exchange of crop diversity. An impact study completed in 2007 confirms a pivotal role for Bioversity and the SGRP in setting the stage for multilateral exchange of plant genetic resources and for sharing the benefits from them.

Policy paves the way to a global system



At its second meeting, in November 2007, the Governing Body of the International Treaty on Plant Genetic Resources for Food and Agriculture took several decisions that will help the world community to fight poverty and hunger. One of the most important was to extend the range of crops that the CGIAR (Consultative Group on International Agricultural Research) centres will distribute under the Standard Material Transfer Agreement (SMTA)—the legal instrument that governs exchange of material and information under the Treaty.

“This is a major step that bodes well for the future of the Treaty and the multilateral system it supports,” said Michael Halewood, Head of the Policy Unit at Bioversity International. “Distributing crop diversity under the SMTA ensures that material and information remain freely available and subject to the benefit-sharing provisions of the Treaty.”

The CGIAR centres have been using the SMTA for transfers of Annex 1 crops—a

list of important food and forage crops that are covered by the terms of the International Treaty—since 1 January 2007. Now, they are using it also for the transfer of plant genetic resources that are not in Annex 1 of the Treaty but that are nevertheless important to countless small farmers in the developing world and that are conserved in the CGIAR collections. This makes those species available on the same terms as the crops within the scope of the multilateral system of the International Treaty, at least so far as transfers from the centres are concerned.

The CGIAR collections are among the largest in the world, containing more than 650 000 samples of crops vital for food security, including species of such globally important staples as wheat, rice and maize. The collections are also home to samples of crop wild relatives and traditional varieties, valuable resources for helping farmers and breeders to develop new varieties that are able to withstand the effects of climate change (see *Adapting agriculture to climate change*, page 2).

Michael Halewood (right), Head of Bioversity’s policy unit, and Gerald Moore, Honorary Fellow at Bioversity, confer during the second meeting of the Governing Body of the International Treaty.



Photo courtesy of IISD/Earth Negotiations Bulletin

Delegates took the decision to extend the use of the SMTA to non-Annex 1 crops following discussion of a report that described the centres' experiences with distributing material under the SMTA. The centres distributed almost 100 000 samples of crops to farmers and breeders around the world in the first seven months of 2007 (see table). In the same period, they received 3988 samples of new genetic material from collections around the world to safeguard in-trust for the global community. The report was prepared by the SGRP, which is hosted by Bioversity and which coordinates the work of the centres in this area. The Centres were unanimous in asking the Governing Body to allow them to use the SMTA when transferring non-Annex 1 materials.

A look at figures from 2004, the most recent full year for which data are available, underlines the significance of the report. In the whole of that year, the centres sent out 90 504 samples and received 5033 new accessions. "The figures for the first seven months of 2007 show a clear increase in distributions," noted Gerald Moore, Honorary Fellow at Bioversity and one of the authors of the report.

The report also showed that a high proportion of the samples distributed by the CGIAR genebanks were of improved lines that centre breeders are releasing for further work and assessment by others; access to such lines is vitally important for the further improvement of crop varieties. Using the SMTA to do this ties the material and any products derived from it to the access and benefit-sharing system of the Treaty and means that these lines will always be available for others to make use of.

Following the report, delegates approved the centres' proposal to use the SMTA for distributing material that falls outside the crops listed in Annex 1 of the International Treaty. Bioversity is now leading an effort to develop guidelines that will help the centres implement this decision. "Footnotes will be included in the SMTA for those provisions that refer to Annex 1 materials or the multilateral system, indicating that these should not be interpreted as precluding the

Experience of the CGIAR centres with the SMTA

The table covers material distributed and acquired during the first seven months of 2007, when the SMTA came into use. Some centres reported only total transfers without distinguishing normal PGRFA¹ from PGRFA under development.

Centre	Acquisitions	Transfers of normal PGRFA1	Transfers of PGRFA under development	Total transfers
Bioversity	36	85	0	85
CIAT	0			747
CIMMYT	1890 ²	5 585	20 957	26 542
CIP	23 ³	1 324	63	1 387
ICARDA	0	6 554	- ⁴	6 554
ICRAF	No Annex 1 material			
ICRISAT	0	1 178	15 662	16 840
IITA	0			5 423
ILRI	0			406
IRRI	2039	23 484	12 166	35 650
WARDA	0			4 035
TOTAL				97 669

¹ Plant genetic resources for food and agriculture.

² Samples developed by CIMMYT's breeding programmes and acquired by the genebank.

³ SMTA not yet signed.

⁴ 14 442 samples were transferred using the old Material Transfer Agreement, since the material was not designated material in the in-trust collection. ICARDA will now be using the SMTA for transfers of improved material.

use of the SMTA for transfers of non-Annex 1 materials," Moore explained. The issue will be reviewed by the Governing Body at its next session.

Although the centres' experiences with distributing material under the SMTA were mostly positive, the report also identified areas where the operation of the system could be eased. One of the most important was the need to educate potential users about the Treaty. "The lack of awareness and understanding seems almost universal," commented one centre. "We receive frequent requests for specific information or for training courses." In this regard, many delegations at the second meeting of the Governing Body welcomed news of a joint programme being set up by Bioversity and FAO to provide technical assistance to developing countries to help them implement the Treaty and its multilateral system.

"Overall, the meeting was a great success," commented Halewood, adding that the number of countries that had ratified the Treaty had grown from 104 to 116 in just over a year. "Positive messages have been coming from the USA regarding the process of their ratification," he said. If the USA, which has not signed the Convention on Biological Diversity, were to ratify the Treaty this would send a strong signal to other countries that have not yet ratified.

The session also approved requests from the International Cocoa Genebank of Trinidad and Tobago and the Secretariat of the Pacific Community to enter into agreements with the Governing Body, placing their collections within the purview of the Treaty. The next step will be to work with the Pacific Community to help it implement its new commitments under the

Treaty. "Bioversity will continue working together with the Treaty Secretariat to help countries implement the Treaty and the multilateral system it supports," said Moore.

Helping countries implement the Treaty will be a key responsibility for Bioversity in the future, but a look at past efforts demonstrates the organization's long-standing commitment to building a multilateral system for the exchange of crop diversity.

An impact assessment conducted by Bioversity in collaboration with the University of Reading in the UK and the University of Naples in Italy looked at the impact of the in-trust agreements, adopted by the CGIAR centres in 1994, on the multilateral exchange of plant genetic resources. Under these agreements, the material conserved in the CGIAR genebanks is held in trust for humanity under the auspices of FAO. The study also looked at the role of Bioversity in developing these agreements, in particular through its policy-oriented research work.

To fully understand the significance of the in-trust agreements and their impact, it is necessary to take a step back in time. Since the beginning of agriculture, people have been exchanging plant genetic resources to develop crops that better meet their needs. By combining and selecting from the best performers in their harvests, farmers and breeders created

a vast range of crop diversity. For a long time, these plant genetic resources were considered to be a common heritage of humanity.

In 1992 the Convention on Biological Diversity enshrined a different concept: sovereign rights over plant genetic resources. Under this system the use of plant genetic resources was to be regulated by agreements between the country owning the resources and the people who wished to use them. This system was developed in a climate of distrust, at a time when allegations of biopiracy were becoming more strident. It was in this context that questions of ownership regarding the material conserved in the CGIAR collections began to surface. Bioversity collaborated with a wide range of stakeholders to develop a common understanding of the special nature of plant genetic resources for food and agriculture and contributed to policy negotiations that succeeded in keeping this material easily accessible for the benefit of all.

"Bioversity played a central role in the negotiations that led to the adoption of the in-trust agreements," explained Elisabetta Gotor, an Italian Associate Expert at Bioversity and one of the authors of the impact study.

Results of the study indicated that Bioversity had provided a bridge between the CGIAR and the member countries of FAO, helping to bring

together different stakeholders and to build a common understanding of the key issues. Through its policy research work, the organization helped to develop the idea of trusteeship and to establish mechanisms for applying the concept to the CGIAR collections, including placing them under the auspices of FAO.

According to the impact study, the key contribution of the in-trust agreements is that they paved the way for an internationally recognized accord for the multilateral exchange of plant genetic resources. "In this sense, Bioversity played a vital role in shaping the concept of a 'multilateral system', which in turn helped hasten negotiations for major legal instruments like the International Treaty, promoting the multilateral exchange of crop diversity," concluded Gotor.

Further information

m.halewood@cgiar.org and
e.gotor@cgiar.org



The Governing Body of the International Treaty took several important steps during its second session, including approving the use of the SMTA by the CGIAR centres to distribute material not included in Annex 1 of the Treaty.

FAO/G. Napolitano

In financial terms 2007 was an excellent year for Bioversity, with revenues up by US\$5.6 million on 2006 and the centre's reserves rebuilt having been drawn down in 2006.

Finance report 2007

Bioversity started 2007 with its reserves below the CGIAR's minimum recommended range of 75–90 days. However, as a result of increased support from some of our key donors, careful budgeting and management of expenditures, and the willingness of staff to make sacrifices, we finished the year with an operating surplus of US\$1.7 million. This enabled us to rebuild our reserves to 82 days, which is back within the CGIAR range. Total revenues for the year were US\$38.2 million, an increase of US\$5.9 million on 2006 revenues of US\$32.3 million. Expenditures were US\$36.5 million.

Beginning in 2007, the CGIAR is using five financial indicators to monitor the financial health of centres. These are the 'Long Term Financial Stability' ratio, a measure of the adequacy of an organization's reserves; the 'Short Term Solvency' ratio, which monitors the liquidity of a centre and its ability to operate in the short term; the 'Indirect Cost' ratio, which measures the efficiency of a centre's support functions; the 'Management of Donor Receivable/Payable' ratio, which measures cash flow from donors; and the external audit opinion.

Bioversity continues to be in a healthy financial position and meets the standard for all of these financial indicators. Bioversity has 82 days of reserves, against the minimum recommended range of 75–90 days. Its Short Term Solvency was at 123 days of liquidity at the end of 2007 against the recommended range of 90–120 days. Bioversity's Indirect Cost ratio, at 19.3%, is one of the lowest in the CGIAR system. The Donor Receivable/Payable ratio is 0.49,

against a benchmark of less than one. The organization again also received a clean audit opinion from its external auditors, Deloitte. The financial indicators confirm that Bioversity is in a strong financial position and will continue to remain fiscally healthy for the foreseeable future.

The finance department also underwent a Centre Commissioned External Review (CCER) of its operations in June 2007. The review noted the strong internal control environment; the comprehensiveness of the risk management framework; the high quality of finance staff and in particular their responsiveness to the needs of their customers; and in general the high-quality financial framework existing at Bioversity.

Gerard O'Donoghue
Director, Corporate Services

Risk management

Financial indicators

		2007	2006	2005
Total income	US\$ 000s	38 244	32 337	35 377
Total expenditures	US\$ 000s	36 525	34 811	34 725
Year-end results	US\$ 000s	1 719	-2 474	652
Short-term liquidity	Days	123	104	122
Long-term reserves	Days	82	67	91
Indirect cost ratio	%	19.3	18.4	19.4
Cash management on restricted operations		0.49	0.61	1.79

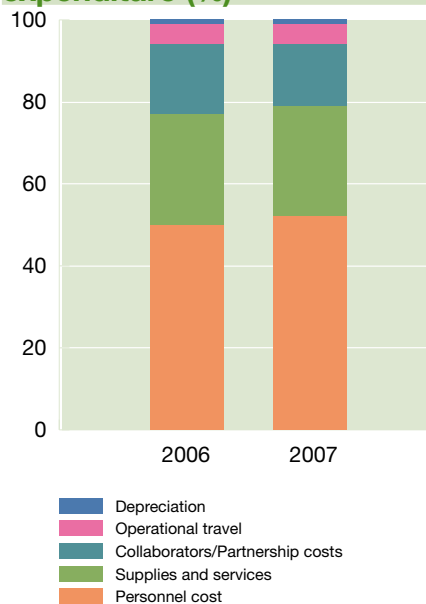
Bioversity's Board of Trustees has responsibility for ensuring that an appropriate risk management system is in place which enables management to identify and take steps to mitigate significant risks to the achievement of the centre's objectives.

Risk mitigation strategies have been ongoing at the centre and include the implementation of systems of internal control which, by their nature, are designed to manage rather than eliminate the risk. The institute also endeavours to manage risk by ensuring that the appropriate infrastructure, controls, systems and people are in place throughout the organization.

Top 20 donors to Bioversity in 2007

	2007 US\$ 000
European Union	4384
Netherlands	3736
Italy	3608
World Bank	3478
UNEP/GEF ¹	2845
Belgium	2081
United Kingdom	1955
Switzerland	1291
Canada	1283
IFAD	1145
Germany	994
Sweden	871
Norway	809
Austria	705
CFC ²	698
Generation CP	654
Ireland	541
Luxembourg	393
France	351
USAID	325

Breakdown of total expenditure (%)



The Board has adopted a risk management policy that has been communicated to all staff together with a detailed management guideline. The policy includes a framework by which the institute's management identifies, evaluates and prioritizes risks and opportunities across the organization; develops risk mitigation strategies that balance benefits with costs; monitors the implementation of these strategies; and reports, in conjunction with finance and administration staff and internal audit, semi-annually to a Task Group of the Board and annually to the full Board, on results.

The Board is satisfied that Bioversity has adopted and implements a comprehensive risk management system.

¹ United Nations Environment Programme/ Global Environment Facility

² Common Fund for Commodities

**For the Year Ended December 31, 2007
(US dollar 000s)**

Restricted grants 2007

AAS/AFORNET

Use and conservation of indigenous fruit tree diversity for improved livelihoods in Eastern Africa 11

ACIAR

Mitigating the threat of banana *Fusarium* wilt: understanding the agroecological distribution of pathogenic forms and developing disease management strategies 132

Alliance of the CGIAR Centres

Central Advisory Service on Intellectual Property—CAS-IP 302

Chief Alliance Officer 386

Subtotal 688

Austria

Developing training capacity and human resources management 247

Sustainable futures for indigenous smallholders in Nicaragua: harnessing the high-value potential of native cacao diversity 190

Development of strategies for the conservation and sustainable use of *Prunus africana* to improve the livelihood of small-scale farmers 268

Subtotal 705

AVRDC – The World Vegetable Center

Central Advisory Service on Intellectual Property—CAS-IP 17

Belgium

Improving livelihoods in *Musa*-based systems in Central Africa 1201

Brazil

Information system on genetic resources 20

Catholic Relief Service

Strengthening the capacity of the regional NARS to sustainably manage the outbreak of BXW in East and Central Africa (Crop Crisis Control) 81

CFC

Cocoa productivity and quality improvement: a participatory approach 646

Promotion of exports of organic bananas in Ethiopia and Sudan 33

Farmer participatory evaluation and dissemination of improved *Musa* germplasm 19

Subtotal 698

Christensen Fund

Reviving biocultural heritage: strengthening the socio-economic and cultural basis of agrobiodiversity management for development in Tajikistan and Kyrgyzstan 80

CIDA

Global Plan of Action implementation in selected sub-Saharan African countries 181

CGIAR–Canada linkage fund: understanding and managing the genetic diversity of noug (*Guizotia abyssinica*) for its improvement 61

System-wide Genetic Resources Programme (SGRP) 55

Subtotal 297

CORAF/WECARD

Sustainable use of biodiversity: deepening the methodological basis of participatory plant breeding 10

CTA

Co-publication of a self-learning manual on seed handling in genebanks phase I 18

European Countries

ECPGR—Phase VII 633

EUFORGEN—Phase III 385

Subtotal 1018

European Commission

Community management of agricultural biodiversity 1581

Conservation and management of agricultural biodiversity 1581

Conserving, understanding and improving *Musa* biodiversity 789

Establishment of a European Information System on Forest Genetic Resources (EUFGIS) 85

Networking on conservation and use of plant genetic resources in Europe and Asia (DIVERSEEDS) 36

EvoTREE network of excellence 123

Support to BARNESA 189

Subtotal 4384

FAO

Conservation and sustainable management of globally important agricultural heritage systems 8

Publication of the Plant Genetic Resources Newsletter (Nos. 149, 150) 75

Publication of the Plant Genetic Resources Newsletter (Nos. 151, 152)	75	Genetic Resources Policy Initiative—GRPI	65
Impact of the in-trust agreements between FAO and CGIAR	15	Global Facilitation Unit for Underutilized Species	405
International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA)	124	Postdoctoral project: assessing the contribution of diversified <i>Musa</i> genetic resources to poverty reduction, environmental sustainability and gender equality in rural communities	15
Occurrence and importance of genetic vulnerability studies	4	Promotion of neglected indigenous vegetable crops for nutritional health in Eastern and Southern Africa—Phase II	5
Subtotal	300	Subtotal	597
Finland		IDRC	
Associate Expert—Malaysia	94	Adaptive management of seed systems and gene flow (Mexico, Cuba and Peru)	84
FONTAGRO		Regional consultative workshop on genetic engineering/GMOs for development in East and Southern Africa	4
Development of biological pest control products	4	Subtotal	88
Soil quality and health of bananas in Latin America and the Caribbean	52	IFAD	
Subtotal	56	Programme empowering Sahelian farmers to leverage their crop diversity assets for enhanced livelihood strategies	299
The Ford Foundation		Programme for strengthening the income opportunities and nutritional security of the rural poor through neglected and underutilized species (NUS II)	544
Conservation and use of crop genetic diversity to control pests and diseases in support of sustainable agriculture	2	Programme for overcoming poverty in coconut-growing communities: coconut genetic resources for sustainable livelihoods	229
Gatsby Foundation		Technical support to IFAD's Technical Advisory Division—second contract	48
Improving the management of banana and plantain genetic resources for Africa	33	Technical support to IFAD's Technical Advisory Division—third contract	25
GFAR		Subtotal	1145
Associate Scientist—Montpellier, France	130	IFAR	
Global Crop Diversity Trust		Measuring the impact of IARC and NARS development projects for clean seed multiplication and new cultivars of banana and plantain: improving impact pathways for global public goods	11
Crop-specific regeneration guidelines	4	IRD	
Regeneration of accessions in the International Coconut Genebank for Africa and the Indian Ocean	38	Publication on coffee, CATIE	5
Finalization of the regional conservation strategy for the Americas and a consultation with the PGR network in the Caribbean, CAPGERNET	15	Italy	
Organization of a workshop to develop the <i>ex situ</i> conservation and utilization strategy for Central Asia and Caucasus (CAC) in Tashkent, Uzbekistan, 18–20 January 2007	4	Associate Expert—Institutional learning and change	96
Subtotal	61		
GRDC			
Vavilov-Frankel fellowships	22		
GTZ/BMZ			
An international information system for the genetic resources of crop wild relatives	86		
Gene flow risk assessment of genetically engineered crops	21		

1. The following provided support for the Genetic Resources Policy Initiative (GRPI): IDRC, The Netherlands and Rockefeller Foundation.
2. The following provided support for CGIAR-ICT/KM Coordination: Alliance of the CGIAR Centres and World Bank.
3. The following provided support for CacaoNet: Biscuit, Cake, Chocolate and Confectionery Association, World Cocoa Foundation and Mars, Inc.

Restricted grants 2007

Japan		Associate Expert—Economics of agrobiodiversity	5
Community plant genetic resources use and conservation in East Africa	176	Associate Expert—Management of forest genetic resources in sub-Saharan Africa	75
Japan CGIAR Fellowship Program 2007–2008 (JIRCAS)—Traditional food crop/animal diversity and use assessment in a model community, Kenya	3	Associate Expert—Supporting research on agricultural biodiversity	87
Subtotal	179	Associate Expert—Conservation and use of tropical fruit biodiversity	93
Korea, Republic of		Associate Expert—Conservation and use of crop diversity for pest and disease management	101
Associate Scientist	90	Associate Expert—Management of forest genetic resources	91
Associate Scientist—operational fund	58	Associate Expert—Nutrition	97
Molecular characterization of collections of some underutilized crops of diverse origins	23	Associate Expert—Economic and social aspects of agrobiodiversity	53
Workshop on development of database and e-descriptors of medicinal plants in 12 Asian countries	5	Associate Expert—Assessing the potential contribution of banana-based production systems to improved nutrition	43
Subtotal	176	Associate Expert—Communicating agrobiodiversity science for problem-based learning	46
Luxembourg		Central Advisory Service on Intellectual Property—CAS-IP	72
Conservation and maintenance of grapevine (<i>Vitis</i> L.) genetic resources in the Caucasus and Northern Black Sea region	136	Central Advisory Service on Intellectual Property—CAS-IP	407
Conservation, characterization and evaluation for nutrition and health of vegetatively propagated crop collections at the Vavilov Institute	257	Institutional learning and change	37
Subtotal	393	Innovating for sustainable poverty reduction	358
Malaysia		Subtotal	1571
Conservation and use of rare tropical fruit species diversity with potential for enhanced use in Malaysia	30	Nordic Genebank	
Conservation of rare and endemic dipterocarps in Malaysia	48	PhD—Student	59
Subtotal	78	Norway	
Morocco		Policy unit	88
Managing agrobiodiversity for better livelihood in Morocco	17	NZAID	
Multi-Donors to Genetic Resources Policy Initiative—GRPI¹		Pacific Agricultural Plant Genetic Resources Network (PAPGREN)—Phase II	224
Genetic Resources Policy Initiative expenditure	369	Philippines	
Multi-Donors to CGIAR-ICT/KM Coordination²		Coconut-based diversification to reduce poverty in coconut growing communities	13
Chief Information Officer expenditure	300	Introduction, evaluation and adoption of new banana materials in the Philippines	33
Multi-Donors to CacaoNet³		Support to the banana development programme in the Philippines	9
Support to CacaoNet expenditure	18	Subtotal	55
Netherlands		Pioneer	
Associate Expert—Agricultural economist	6	Vavilov-Frankel Fellowship	10

Rockefeller Foundation			
Develop common approaches to exchange genetic resources with national and international partners in compliance with the International Treaty on Plant Genetic Resources for Food and Agriculture	2		
Diversifying market opportunities—Adding value to bananas	14		
Subtotal	16		
SDC			
<i>In situ</i> conservation of agricultural biodiversity—Phase IV	2		
Rehabilitation of a waste-dumping site in Nabk (Syria) through the establishment of a biodiversity garden	25		
Strengthening the scientific basis of <i>in situ</i> conservation of agricultural biodiversity—Phase V	245		
System-wide Genetic Resources Programme	214		
CGIAR system-wide efforts to develop technical inputs to the Governing Body of the International Treaty concerning the sustainable use of PGR under Article 6 of the Treaty	10		
System-wide PGR Policy Research Unit, CGIAR and SGRP	175		
Subtotal	671		
SIDA			
ASARECA technical backstopping to EAPGREN	31		
Central Advisory Service on Intellectual Property—CAS-IP	202		
Genetic resources policy	61		
Subtotal	294		
Spain			
Cooperation in the conservation of forest genetic resources in Latin America	19		
Management, improvement and conservation of forest genetic resources in sub-Saharan Africa	61		
Strengthening regional collaboration in conservation and sustainable use of forest genetic resources in Latin America and sub-Saharan Africa	26		
Institutional strengthening for sustainable resource use in the Amazon region	5		
Subtotal	111		
TBRI			
Regional information system for banana and plantain for Asia and the Pacific			10
Uganda			
Novel approaches to the improvement of banana production in Eastern Africa—the application of biotechnological methodologies			253
UNEP-GEF			
<i>In situ</i> conservation of crop wild relatives through enhanced information management and field application			1722
Conservation and use of crop genetic diversity to control pests and diseases—Phase 1			183
<i>In situ</i> conservation of agricultural biodiversity (horticultural crops and wild fruit species) in Central Asia			940
Subtotal			2845
University of Birmingham			
Technical guidelines on genetic reserves management publications			7
USAID			
Assessing banana <i>Xanthomonas</i> wilt control options on-farm			7
USDA			
Cocoa productivity and quality improvement, a participatory approach			10
CacaoNet 2007 and support to CFC-Cacao 2007			44
Collaboration with Bioversity International to support research and conservation of crop genetic resources			7
Subtotal			61
VVOB			
Associate Scientist—Technology transfer in Eastern and Southern Africa			134
Wageningen University			
Feasibility study for the pesticide reduction plan for banana			14
World Bank			
CGIAR genebank upgrades for SGRP monitoring			20
CGIAR Genetic Resources Policy Committee			81
CGIAR ICT-KM E-publishing project			49
ICT-KM II—preparatory phase			12
ICT-KM Planning for the Future			78
ICT-KM Investment Plan Management			129

Restricted grants 2007

ICT-KM CGXchange	140	<i>Musa</i> genome frame-map construction and connection with the rice sequence	14
ICT-KM CGIAR MTP Analysis Program	99	Managing the GCP in the post-International Treaty world: a proposal for a technical training workshop and related materials	20
ICT-KM VRC-Web content and usage analysis (WUA)	31	Phenotyping in the field: global capacity accessible to the GCP—inventory of phenotyping resources and capacity for the GCP	26
Soil quality and health of bananas in LAC	76	Phenotyping in the field: global capacity accessible to the GCP—inventory of phenotyping resources and capacity for the GCP	19
Collective action for the rehabilitation of global public goods in the CGIAR genetic resources system—Phase II (GPG 2)	663	Subprograms leader—2006	15
System-wide and ecoregional program	300	Subtotal	654
Subtotal	1678	Harvest Plus Challenge Program	
Subtotal Temporary Restricted Grants	21 638	Addressing micronutrient deficiencies in urban and peri-urban populations in West and Central Africa through <i>Musa</i> -based foods (amendment 2)	112
Challenge Programs		Analyzing the potential for addressing micronutrient deficiencies in sub-Saharan Africa through <i>Musa</i> -based foods	10
Generation Challenge Program		Subtotal	122
2006 GCP fellowship and travel grants	101	Sub-Saharan Africa Challenge Program	
Application and development of web services technology	6	Improving human nutrition and income through integrated agricultural research on production and marketing of vegetables in Malawi and Mozambique	294
Capacity-building	153	Subtotal Challenge Programs	1070
Challenge Programs—Unlocking genetic diversity in crops for the resource poor	5	Total Restricted Grants	22 708
Implementation of web services technology in the GenerationCP consortium	120		
Management of the GenerationCP central registry	68		
Development of GenerationCP Domain Models Ontology	15		
Creation and maintenance of templates for GCP data storage in repositories	11		
GenerationCP data quality improvement and assurance	30		
Application and development of web services technology	51		

Selected publications

Bioversity publications

- Bioversity Annual Report 2006
- SGRP Annual Report 2006
- Bioversity International in focus
- GeneFlow 2007
- Plant Genetic Resources Newsletter 149–151 (*with FAO*)
- A strategic framework for the implementation of a European genebank integrated system (AEGIS) (*with ECPGR*)
- Assessment of plant genetic resources for water-use efficiency (WUE): managing water scarcity (*with INRA, IDRC and AARINENA*)
- Buckwheat in China
- Climate change and forest genetic diversity: Implications for sustainable forest management in Europe (*with EUFORGEN*)
- Conserving coffee genetic resources. Topical reviews in Agricultural Biodiversity (*with CATIE and IRD*)
- Catalogue of introduced and local banana cultivars in the Philippines: Results of a demonstration trial by the Institute of Plant Breeding, University of the Philippines Los Baños (*with IPB-UPLB and DA-BAR*)
- Delivering distance education on plant genetic resources (*with CIAT, REDCAPA and UNC*)
- Developing crop descriptor lists: Guidelines for developers. Bioversity Technical Bulletin No. 13
- Descriptors for durian
- Descriptors for wild and cultivated rice (*Oryza spp.*) (*with IRR*)
- Descriptores para feijão frade ou caupi
- Diversity studies in the interaction between the anthracnose fungus *Colletotrichum gloeosporioides* and its host plant *Stylosanthes* spp. in Mexico
- Emmer in Turkey
- *Ex situ* conservation of plant genetic resources
- Guía para el manejo eficaz de un banco de germoplasma. Manuales de Bioversity para Bancos de Germoplasma No. 6 (*with CGN, FAO, SGRP and USDA-ARS-NPGS*)
- Manejo de semillas en bancos de germoplasma (CD-ROM) (*with ILRI, FAO, CTA, GCDT, USDA-ARS-NPGS and IICA-PROCINORTE-NORGEN*)
- Manual para el manejo de semillas en bancos de germoplasma. Manuales para Bancos de Germoplasma No. 8 (*with ILRI, FAO, CTA, GCDT, USDA-ARS-NPGS and IICA-PROCINORTE-NORGEN*)
- Minimum list of descriptors for coconut (*with CIRAD and COGENT*)
- Participatory plant breeding to promote Farmers' Rights (*with ICARDA, IDRC and GRPI*)
- Plant genetic resources and food security in West and Central Africa
- Recent advances in banana crop protection for sustainable production and improved livelihoods. Programme and abstracts (*with ISHS and ProMusa*)

- Report of a network coordinating group on forages. Ad hoc meeting, 21–22 April 2005, Lindau, Switzerland (*with ECPGR*)
- Report of a task force on on-farm conservation and management. Second meeting, 19–20 June 2006, Stegelitz, Germany (*with ECPGR*)
- Rucola: un grande ritorno. La storia d'una pianta
- Triticale and rye genetic resources in Europe. Ad hoc meeting, 28 September 2006, Nyon, Switzerland (*with ECPGR*)

Peer-reviewed publications

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From January 2008, all Bioversity activities are carried out within one of 10 Projects

Projects

Project F01: Enhancing the contribution of agricultural biodiversity to human wellbeing

aims to enhance the use of agricultural and forest biodiversity to improve people's well-being, by demonstrating ways in which biodiversity can support nutritional and health benefits and by identifying new biodiversity-based income options for the rural and urban poor.

Project F02: Productivity, resilience and ecosystem services from community management of diversity in production systems

is concerned with developing practices that support communities in their use of genetic diversity to maintain and improve productivity, resilience and resistance in production systems.

Project F03: Managing biodiversity to improve livelihoods in commodity crop-based systems

focuses on enabling rural communities to better use coconut, cacao and *Musa* diversity to increase their incomes, food security, health and natural resource endowments.

Project F04: Conserving and promoting the use of genetic resources of commodity crops

aims to promote the conservation, characterization, evaluation and effective use of the genetic diversity of coconut, cacao and *Musa*, three commodity crops of special importance to smallholders in developing countries. The project seeks to strengthen international research capacity through networks

and consortia, and facilitates consensus building through action-oriented platforms.

Project F05: Enhancing the *ex situ* conservation and use of genetic diversity

aims to improve the *ex situ* conservation and use of agricultural biodiversity, including crop wild relatives, as a means of mitigating the impacts of global threats such as environmental degradation, water scarcity and climate change.

Project F06: Conservation and use of forest and other wild species

aims to document the diversity within useful wild species, including wild relatives of crops; study and make known the benefits it confers; analyze the threats to its persistence; and provide knowledge, strategies, mechanisms and tools to facilitate its conservation and sustainable use.

Project F07: Biodiversity informatics

aims to improve the management of, access to, and use of genetic resources information through standardized information gathering and management, facilitating information use, exchange and access, and capacity building.

Project F08: Policy and law

contributes to genetic resources policy development at global, regional, national and CGIAR system-wide levels. The Project is the administrative home of the CGIAR Central Advisory Service on Intellectual Property (CAS-

IP) and provides the secretariat for the Genetic Resources Policy Committee (GRPC) of the CGIAR.

Project F09: Strengthening global systems for conservation and use of genetic resources

contributes to the development of more effective global and regional collaboration on conservation and use of agricultural biodiversity. Through the Project, Bioversity discharges its responsibilities as convening Centre of the System-wide Genetic Resources Programme (SGRP) and, in partnership with FAO, provides support for the Global Crop Diversity Trust (GCDT). It also hosts the Global Facilitation Unit (GFU) on Underutilized Species of the Global Forum on Agricultural Research (GFAR), and the Platform for Agrobiodiversity Research (PAR).

Project F10: Status, trends and valuation of agrobiodiversity

aims to assess the status, trends and values of agricultural biodiversity at the genetic level, to provide tools and mechanisms for long-term monitoring of genetic erosion and to evaluate the cost of agrobiodiversity loss, its drivers and strategies to counter them.

Establishment agreement

The international status of Bioversity is conferred under an Establishment Agreement which, by December 2007, had been signed by the Governments of:

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BARI, Mr Abdullah	Scientist, PGR Information/Data Management and Analysis Methodologies (Aleppo, Syria)
BROWN, Dr Anthony	Honorary Research Fellow (Canberra, Australia)
CHANDRABALAN, Ms Dorothy	Scientific Assistant (Serdang, Malaysia)
CHO, Dr Myoung Rae	Seconded Senior Scientist (Serdang, Malaysia)
CUNNINGHAM, Dr Anthony*	Honorary Research Fellow (Fremantle, Australia)

Professional staff

GARMING, Dr Hildegard	Post Doctoral Research Fellow (Turrialba, Costa Rica)
GEORGE, Dr Maria Luz	Coordinator, COGENT (Serdang, Malaysia)
HANCOCK, Dr Wayne*	Field Project Leader (Addis Ababa, Ethiopia)
KAMULINDWA, Mr Julius Araal**	Project Administrator (Kampala, Uganda)
KANNIAH, Ms Jayashree	Scientific Assistant (Serdang, Malaysia)
KARAMURA, Dr Deborah	<i>Musa</i> Genetic Resources Specialist (Kampala, Uganda)
KARAMURA, Dr Eldad	Regional Coordinator, Eastern and Southern Africa (Kampala, Uganda)
LUSTY, Ms Charlotte	Scientist, Programme and Strategy Development (Montpellier, France)
MOLINA, Dr Agustín	Regional Coordinator (Los Baños, Philippines)
PEREZ VINCENTE, Dr Luis Fernando	Honorary Research Fellow (Turrialba, Costa Rica)
PICQ, Ms Claudine	Coordinator, Information/Communication and Publications (Montpellier, France)
POCASANGRE, Dr Luis	Associate Scientist, Technology Transfer (Turrialba, Costa Rica)
PONSIOEN, Mr Guido	Information/Documentation Specialist (Montpellier, France)
ROSALES, Dr Franklin	Regional Coordinator, Latin America and Caribbean (Turrialba, Costa Rica)
ROUARD, Mr Mathieu	Bioinformatician (Montpellier, France)
ROUX, Dr Nicolas	Senior Scientist, Coordinator, <i>Musa</i> Genomics and Genetic Resources (Montpellier, France)
RUAS, Mr Max	Database Manager and Computer Technology Specialist (Montpellier, France)
STAVER, Dr Charles	Senior Scientist, Sustainable <i>Musa</i> Production and Utilization (Montpellier, France)
TINZAARA, Mr William	Associate Scientist (Kampala, Uganda)
SWENNEN, Prof. R.	Honorary Research Fellow (Heverlee, Belgium)
VAN DEN BERGH, Dr Inge	<i>ProMusa</i> Coordinator (Montpellier, France)
VAN DEN HOUWE, Ms Inès	Scientist, Germplasm Conservation (Heverlee, Belgium)

POLICY RESEARCH AND SUPPORT UNIT

HALEWOOD, Dr Michael	Head, Policy Research and Support Unit (Rome, Italy)
CHISHAKWE, Mr Nyasha	Policy Specialist (Nairobi, Kenya)
KAMAU, Mr Kennedy**	Web Developer, GRPI (Nairobi, Kenya)
LEWIS-LETTINGTON, Mr Robert	Policy and Legal Specialist, GRPI (Nairobi, Kenya)
LOPEZ NORIEGA, Ms Isabel	Legal Specialist (Rome, Italy)
MOORE, Dr Gerald	Honorary Research Fellow (Rome, Italy)

CAPACITY DEVELOPMENT RESEARCH AND SUPPORT UNIT

GOLDBERG, Ms Elizabeth	Head, Capacity Development Research and Support Unit (Rome, Italy)
RUDEBJER, Mr Per	Scientist, Capacity Development Research and Support Unit (Rome, Italy)
VAN SCHAGEN, Mr Boudy*	Associate Scientist, Communicating Agrobiodiversity Science and Problem-based Learning (Nairobi, Kenya)

PUBLIC AWARENESS RESEARCH AND SUPPORT UNIT

RAYMOND, Ms Ruth	Head, Public Awareness Research and Support Unit (Rome, Italy)
MOORE, Ms Cassandra	Programme Specialist, Public Awareness (Rome, Italy)
VEZINA, Ms Anne	Editor/Scientific Writer (Montpellier, France)
OBEL-LAWSON, Ms Elizabeth	Scientific Assistant (Nairobi, Kenya)
BAENA, Ms Margarita	Capacity Development and Public Awareness Specialist (Cali, Colombia)
KHALIL, Mr Rami	Media and Public Awareness Officer (Aleppo, Syria)

HUMAN RESOURCES UNIT

FINOCCHIO, Mr Francesco	Director, Human Resources (Rome, Italy)
LAMBERT, Ms Ingrid	Human Resources Manager (Rome, Italy)
LIBERTO, Ms Giselle	Human Resources Officer (Rome, Italy)
ROSE, Ms Sarah	Senior Human Resources Officer (Rome, Italy)

CORPORATE SERVICES

O'DONOGHUE, Mr Gerard	Director, Corporate Services (Rome, Italy)
BUONAIUTO, Mr Massimo	Multimedia/Web Specialist (Rome, Italy)
DI PAOLO, Mr Fabio	Programme Specialist, Publications Distribution and Marketing (Rome, Italy)
GARRUCCIO, Ms Maria	Library and Information Services Specialist (Rome, Italy)
GLOVER, Ms Melanie	Budget/Audit Officer (Rome, Italy)
HARMANN, Ms Karen	Senior Accountant (Rome, Italy)
KANE-POTAKA, Ms Joanna	Head, Information Marketing and Management (Rome, Italy)
LUZON, Ms Josephine	Finance Manager (Rome, Italy)
NEATE, Mr Paul	Information Dissemination and Communications Manager (Rome, Italy)
PAPINI, Ms Silvia	Office Manager (Rome, Italy)
STABILE, Mr Lorenzo	Database Developer/Information Systems Analyst (Rome, Italy)
TAZZA, Ms Patrizia	Design/Layout Specialist (Rome, Italy)
THOMPSON, Ms Helen	Programme Specialist, Library and Information Services (Rome, Italy)
VALORI, Mr Dario	Information Technology Manager (Rome, Italy)

REGIONAL OFFICES Sub-Saharan Africa

BAIDU-FORSON, Mr Joseph	Regional Director (Nairobi, Kenya)
AVOHOU, Mr Hermane	Scientific Assistant, SAFORGEN (Cotonou, Benin)
KAMAU, Mr Henry	Scientist, Training/LCA Initiative Coordinator (Nairobi, Kenya)
KWEKA, Mr Demetrius**	Associate Expert (Nairobi, Kenya)
VODOUHE, Dr S. Raymond	Regional Coordinator for West and Central Africa (Cotonou, Benin)

Americas

RAMIREZ, Dr Marleni	Regional Director (Cali, Colombia)
LASTRA, Dr Ramón**	Honorary Research Fellow (Cali, Colombia)

Asia, Pacific and Oceania

SAJISE, Dr Percy	Regional Director (Serdang, Malaysia)
ARORA, Dr R.K.	Honorary Research Fellow (New Delhi, India)

CHIN, Prof. H.F.	Honorary Research Fellow (Serdang, Malaysia)
KIU, Ms Jee Jee	Administrative Officer (Serdang, Malaysia)
LIM, Mr Eng Siang	Honorary Research Fellow (Serdang, Malaysia)
VELUTHATTIL, Mr Surendrakumar	Administrative Officer (New Delhi, India)
ZHANG, Dr Zongwen	Associate Scientist, East Asia Coordinator (Beijing, China)

Central and West Asia and North Africa

AYAD, Dr George	Regional Director (Aleppo, Syria)
HADJ HASSAN, Dr Adnan	Honorary Research Fellow (Aleppo, Syria)
KABIROV, Mr Azam*	Coordinator (Tashkent, Uzbekistan)
MAMELLY, Mr Adib	Finance and Administration Officer (Aleppo, Syria)

Europe

TUROK, Dr Jozef	Regional Director (Rome, Italy)
BOZZANO, Mr Michele	Programme Specialist, Forest Genetic Resources (Rome, Italy)
DEL GRECO, Ms Aixa	Scientific Assistant (Rome, Italy)
KOSKELA, Dr Jarkko	Scientist, EUFORGEN Coordinator (Rome, Italy)
LIPMAN, Ms Elinor	Scientific Assistant (Montpellier, France)
MAGGIONI, Mr Lorenzo	Scientist, ECPGR Coordinator (Rome, Italy)
SPELLMAN, Ms Olga	Programme Specialist, Editing and Layout (Rome, Italy)
VINCETI, Dr Barbara	Scientist, Forest Biodiversity (Rome, Italy)

GLOBAL CROP DIVERSITY TRUST

FOWLER, Dr Cary	Executive Director, Global Crop Diversity Trust (Rome, Italy)
DAOUD, Ms Layla***	Project Officer, Global Crop Diversity Trust (Rome, Italy)
GUARINO, Mr Luigi***	Senior Science Coordinator, Global Crop Diversity Trust (Rome, Italy)
LAIRD, Mr Julian	Director of Development, Global Crop Diversity Trust (Rome, Italy)
CLYNE, Ms Anne	Finance Officer (Rome, Italy)
TOLL, Ms Jane***	Project Manager, Global Crop Diversity Trust (Rome, Italy)
WARUHIU, Ms Kijo*	Scientific Specialist, Global Crop Diversity Trust (Rome, Italy)

Professional staff

OTHER HOSTED STAFF

ASSAF, Ms Jenin	Programme Officer, ICT-KM (Rome, Italy)
HENSON-APOLLONIO, Dr Victoria	Senior Scientist, Project Manager, Central Advisory Service on Intellectual Property (CAS-IP) (Rome, Italy)
IZAC, Dr Anne-Marie	Chief Alliance Officer (Rome, Italy)
OLIVEROS, Mr Oliver	GFAR/DURAS Project Coordinator (Montpellier, France)
PASTORE, Ms Antonella*	CGXchange Project Coordinator (Rome, Italy)
PORCARI, Ms Enrica	Chief Information Officer, ICT-KM Programme Leader (Rome, Italy)
WILDE, Ms Vicki	Gender & Diversity Program Leader (Rome, Italy)

* *Joined during 2007*

** *Left during 2007*

*** *Changed/moved position during 2007*

Credits

Managing editor: Jeremy Cherfas

Writers: Cassandra Moore, Anne Vezina

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