



Meeting the Millennium Development Goals



with Agricultural
Biodiversity





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Foreword

In September 2005 the United Nations General Assembly will review progress towards the achievement of the Millennium Development Goals (MDGs). This will be an important opportunity to enhance understanding of the contributions that plant diversity can make to improve the livelihoods of poor people.

Agricultural biodiversity plays a significant role in household food security and income generation, but its wider use to address nutritional deficiencies and other aspects of poverty is yet to be fully realized. The challenge of the MDGs is not simply to halve hunger but also to attack the hidden hunger caused by unbalanced diets and to do so sustainably.

Global food security and effective nutrition, to say nothing of economic growth, depend on agricultural biodiversity. And yet this diversity continues to decline, placing the future supply of food and rural incomes at risk.

The International Plant Genetic Resources Institute, the Global Facilitation Unit for Underutilized Species and the M.S. Swaminathan Research Foundation, with the support of sponsors, organized an international consultation meeting in Chennai, India, in April 2005 to examine the value of agricultural biodiversity in meeting the MDGs.

The meeting set out to underscore the contribution that agricultural biodiversity makes to improving livelihoods. It also addressed policies, institutional constraints and other issues that challenge the full deployment of biodiversity and hence limit the achievement of the MDGs. By doing so, it sought to draw greater attention and commitment from policy-makers and the donor community.

One outcome of the meeting is an action plan to promote local, community-centred systems that will deliver improved food security and health, based on the cultivation of a wide range of food crops, vegetables, fruits and medicinal plants. We hope that this action plan will be widely adopted, because the eradication of hunger and poverty must become an overriding priority for public action and investment. Every child, woman and man should have the opportunity for a productive and healthy life. This will be possible only if we integrate cutting-edge science and technology with dying wisdom and vanishing crops.

This booklet covers some of the specific cases in which rural people have made use of agricultural biodiversity in various ways to improve their livelihoods. It is our hope that, by showing what some have achieved, all will be encouraged to deploy agricultural biodiversity more effectively. Farmers planning their next season, policy-makers drawing up Poverty Reduction Strategic Plans, people choosing a more nutritious diet: all can benefit from agricultural biodiversity.

Emile Frison

Director General, IPGRI

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The Millennium Development Goals (MDGs) call for the world to reduce by half the proportion of people who suffer from hunger, before the year 2015. The proportion of people living on less than US\$ 1 a day should similarly be halved. And the targets should be reached without damaging the environment. These are noble aims; if they are to be realized we need to broaden our thinking beyond the classic protein-energy malnutrition that has dominated the debate to date.



Market in Bamako, Mali.

Malnutrition contributes to at least half of the 10.4 million child deaths each year.

The Millennium Development Goals call for the world to reduce by half the proportion of people who suffer from hunger, before the year 2015.



P. Bordini/IPGRI



Hidden hunger

Protein–energy malnutrition is important. Worldwide, 150 million children under five years old (27%) are underweight. Malnutrition contributes to at least half of the 10.4 million child deaths each year, deaths that are particularly damaging because they rob the future. It would be wonderful indeed to ensure that every child has enough to eat, but protein and energy are not enough. The world also needs to address hidden hunger.

Hidden hunger is the lack of so-called micronutrients, the vitamins, minerals and other components of the diet whose impact

on the body is so profound relative to the amount needed.

For example, iodine deficiency affects brain development and intelligence, yet can be treated with iodized salt at a cost of just 5 cents per person per year. Vitamin A deficiency has many effects, the most obvious being blindness. Deficiency afflicts around 120 million children a year. Between 250 000 and 500 000 of them go blind, and half of those die within 12 months. Vitamin A deficiency is also a major cause of illness in young mothers. It too can be treated with supplements, but reaching the people who need them is not as easy as it is with iodized salt. Then there is iron deficiency, perhaps the most common deficiency in the world today. Some 2 billion people, a third of the world's population, are anaemic as a result of iron deficiency. Controlling infections, such as parasitic worms and malaria, can help, as can dietary supplements. For the poorest people, however, these are not options.

Added to the spectre of specific micronutrient deficiencies is the perverse observation that diseases once associated with affluence are increasing in many developing countries. Obesity, cardiovascular disease, type II diabetes and cancers of various sorts are all on the rise among poorer people. This tends to be a consequence of urbanization, where poor people survive on an oversimplified diet based on the cheapest refined carbohydrates and fats.

The challenge of the Millennium Development Goals, then, is not simply to halve hunger but to reduce hidden hunger too.



Just add diversity

For the people most at risk, women and children in the poorest rural areas, perhaps the single most effective solution is to increase dietary diversity. The World Health Organization agrees: “For vulnerable rural families (e.g. in Africa and South-East Asia), growing fruits and vegetables in home gardens complements dietary diversification and fortification and contributes to better lifelong health.”

Around the world, a few indicative studies have shown that dietary diversity as such contributes to lower mortality, greater longevity and a decrease in the diseases of affluence. Single components, such as leafy vegetables or orange fruits and vegetables, have an influence to be sure. But diversity on its own is a powerful source of good nutrition and thus better health. It grows into a virtuous cycle with multiple, mutually reinforcing benefits.

For example, many leafy vegetable species—more than 200 in Kenya alone—have traditionally been used in local diets. Usually these species are more nutritious than imported, non-local vegetables such as cabbage or carrot. They are also well adapted to local growing conditions and so can be more productive at the same time as being less damaging to the environment. And they are generally grown by women in home gardens.

Promoting traditional leafy vegetables thus gets straight to the heart of the problem. Women feed their children, and women who enrich the diversity of their family’s diet with traditional leafy vegetables improve their children’s health. But there is more. If a woman grows a surplus to sell, she has the income to buy medicines, education and the like for her children and herself. That too contributes to better livelihoods and enhanced prospects for the family.

Another example is that of the so-called minor millets, traditional crops of the semi-arid regions of Africa and South and South-East Asia. These crops are well adapted to marginal agricultural conditions and are an important source of food and nutritional security for people in marginal areas. Their grains are high in energy and rich in micronutrients, vitamins and essential amino acids, which can be deficient



A. King/IPGRI



Diverse varieties of cañihua (*Chenopodium pallidicaule*) cultivated on a riverbank in the altiplano of Bolivia. Local farmers call the purple variety 'condoinaira', the pink 'coipara' and the yellow 'chilliwaachi'.

in major cereals such as rice, wheat and maize. Policies that promote major cereals have diminished the dietary role of these nutritious millets in regions where they were traditionally grown. Current work in southern India is helping reverse this trend by encouraging cultivation, processing, marketing and promotion of these crops. Such efforts have not only enhanced the nutritional

status and food security of farm families, but also increased their income.

Marketing is also important. In the cities, where people buy staples and are relatively easy to reach efficiently, supplements and fortification are undoubtedly useful. However, with the growth of peri-urban agriculture and better supplies of traditional foods, city dwellers gain access to fresh, high-quality local produce that is more nutritious and better for them. This is exactly the kind of development called for by the United Nations Task Force on Hunger. Effort is often needed to overcome a certain prejudice, which sees the Western diet as 'modern' and traditional foods as 'backward'. Even in rural areas, where the use of a wide range of foods remains an option, effective promotion may be needed in order to preserve not only agricultural biodiversity but also the skills and knowledge to make use of it. However, when people are helped to see for themselves the benefits a diverse diet brings, and given affordable access, they adopt these foods, becoming healthier and more productive.

Dietary diversity contributes to lower mortality, greater longevity and a decrease in the diseases of affluence.



Meeting the Millennium Development Goals

Boosting dietary diversity benefits everyone, holistically and sustainably. It targets poverty and hunger, Millennium Development Goal One, head on.

Dietary diversity is even more valuable because it also directly addresses Goals Four and Five; to reduce by two-thirds the mortality rate of children under five and to reduce by three-quarters the maternal mortality ratio. And it does so with considerably less impact on the environment, contributing to Goal Seven, to ensure environmental sustainability.

Thus the use of dietary diversity, in the form of species neglected so far by mainstream research, adds a new dimension to the ongoing struggle against hunger and poverty. In addition to the micronutrients that satisfy hidden hunger, many of these crops can also supply substantial amounts of protein and energy, tackling systemic protein–energy hunger too. Because they are hardy and well adapted they require fewer inputs and do less damage to the environment, especially in places short of water. Because they are often grown by women they target the most vulnerable members of society. Adding value to the crop by commercializing it makes farmers more likely to conserve these valuable resources.

Meeting the Millennium Development Goals for hunger and poverty is often taken to mean giving each person access to more food. That alone will not be enough. People need more variety of foods. Dietary diversity can satisfy hidden hunger at the same time as meeting so many other human and environmental needs.

This booklet is a contribution to the discussion of how to meet the Millennium Development Goals. Its main focus is the use of agricultural biodiversity to enhance nutrition and improve livelihoods. In addition it looks at certain policy constraints and at other aspects of the multifactorial approach to alleviating poverty and boosting food security.



I. Manrique/CIP



Andean treasures

The high Andes mountains, running down the spine of South America, have given the world many of its most important crops. Long before the well-known Inca and Maya civilizations, the people of the region had domesticated many species. Two groups stand out for special mention: roots and tubers, and Andean grains. Among the roots and tubers are potato, sweet potato and cassava, which were introduced to Europe, Asia and Africa in the early 16th century and have gone on to become globally important crops. Their importance today in agriculture and cuisine, and also as a source of industrial starch, cannot be overstated. One year's global harvest of potatoes is said to be worth more than all the gold the Spaniards extracted from the New World.

Then there are the so-called Andean grains, 'so-called' because in a strict botanical sense they are not true cereal crops and botanists generally use 'grain' to denote the seeds of a true cereal. Botanists, however, will surely permit the phrase as being descriptive and useful. Andean grains range throughout the Andes from Colombia down to Chile and Argentina at altitudes between 2500 and 4200 metres above sea level. The most important members of this group are quinoa (*Chenopodium quinoa*), cañihua (*C. pallidicaule*), amaranth (also known as kiwicha, *Amaranthus caudatus*) and chocho (also known as tarwi, *Lupinus mutabilis*). Andean people use these grains in a wide array of sweet and savoury dishes and in many different forms: whole grains, flour, flakes and popped. In addition to the grain, the leaves too are often eaten as vegetables.

The use of dietary diversity adds a new dimension to the ongoing struggle against hunger and poverty.



New value for old roots

Andean roots and tubers are showing great promise in efforts to fight hunger and improve livelihoods.

In addition to the ‘big three’—potato, sweet potato and cassava—many other roots and tubers have their origins in the high Andes. Still restricted to their native range, they are mostly grown by poor indigenous farmers who value the diversity these crops bring to diets and subsistence agriculture. Achira (*Canna edulis*), maca (*Lepidium meyenii*), yacon (*Smallanthus sonchifolius*) and ulluco (*Ullucus tuberosus*), to name just a few, share extraordinary pest and disease resistance, nutrient efficiency and adaptation to marginal and often harsh high-altitude environments.

Occasionally these crops are traded locally but they are neglected in urban areas, where they have a reputation as poor people’s food and are seen as inconvenient because they take a long time to cook and have a short shelf life. Yet recent research has shown that Andean roots and tubers possess interesting nutritional properties, notably particular starch qualities and high levels of vitamins, minerals and functional nutrients. A new appreciation of these properties has resulted in increased demand and has given farmers, who already use Andean roots and tubers for their own subsistence, opportunities for greater income.

One such case is yacon, a root from Peru related to the sunflower and Jerusalem artichoke. Fifteen years ago, yacon was little more than a botanical curiosity, neglected by science, unaccounted for in agricultural statistics and absent from urban markets. Poor farmers would typically grow a few yacon plants at the edges of their fields and occasionally unearth a large succulent root to quench their thirst as they worked the fields. But yacon was not used in cooking or processed in any way, nor was there

Yacon is a traditional crop in the Andes of Peru which is enjoying a renaissance after its beneficial properties were investigated in Japan. A farmer near Huanuco in Peru with yacon roots he has just lifted.

Andean roots and tubers possess interesting nutritional properties.



much indigenous knowledge surrounding the crop's use. Also, its delicate taste and unattractive appearance limited its commercial use.

In 1983, a plant collector took a few plants from South America to his native New Zealand and a few years later the plant was brought to Japan, a crucial step in yacon's further development. Japanese scientists found that yacon is high in oligofructose, a type of sugar with low caloric value that is reputed to be important for gut health and that is lacking in modern diets. Moreover, they discovered that yacon leaves contain an active principle that lowers blood sugar, and a novel use of yacon as a source of herbal tea was invented.

The news of yacon as a low-calorie food suited to diabetics made newspaper headlines back in Peru in the late 1990s, and the demand from domestic retailers and Japanese importers quickly resulted in an unparalleled revival of this ancient crop. Today yacon roots are a ubiquitous sight in groceries and supermarkets in Peru. Farmer organizations, food companies and research institutions have also developed a range of convenience products such as herbal tea, dried root slices, juice and syrup. The yacon boom has allowed many farmers to benefit by selling yacon for the fresh market or as a raw material for industry. Other farmers, especially those with entrepreneurial inclinations or organized in associations, are retaining added value by processing yacon themselves. And the benefits have gone mostly to poorer farmers, who have privileged access to planting material because the crop is vegetatively propagated. Furthermore, yacon is narrowly adapted to particular growing conditions. Together, these two factors have prevented larger farmers from muscling in on the yacon boom.

Yacon offers a few important lessons that are widely applicable to the development of underutilized crop diversity as a means for poor people to increase their income. Firstly, the expansion of urban demand was crucial for yacon to make the transition from a classic subsistence crop to an income earner for the rural poor. Processed convenience products, which facilitate urban consumption, are often an essential precursor for expanded use. Promoting these products, and the crops from which they are derived, is most effective when campaigns focus on key attributes that differentiate these products from substitutes. Campaigns that dwell on multiple properties tend to confuse consumers. Finally, one reason for yacon's resurgence in Peru was the interest shown in it internationally. However, there may well be obstacles in place that indirectly prevent international trade (see p 23), which raises the issue of the continued need for international flows of germplasm to power crop improvement and development.



Pagan produce?

The history of Andean grains in some respects mirrors that of roots and tubers, except that it was outside influence that devalued them in the eyes of local people.

The diverse package of Andean grains was the nutritional foundation that supported the Pre-Colombian cultures of the Andes. Early Spanish chroniclers often refer to them as the main crop of the Inca Empire. The grains were mainly used as food, although there are also records of medicinal benefits and of their use in ritual ceremonies. Quinoa, for example, was always included among the offerings to Inti, the Inca God of the Sun. Amaranth seeds were mixed with honey and human blood to mould ritual figures, such as birds and snakes, that were eaten during religious ceremonies. It is said that the Spanish conquistadores considered Andean grains as pagan and discouraged or even completely forbade their cultivation. Incontrovertible evidence for this is lacking, but the fact is that Andean grains were gradually displaced by introduced crops and their importance declined considerably.

More recently Andean grains have suffered the same decline in social status as many other indigenous crops around the world, and the urban population especially has marginalized them. While they were once high-quality ingredients of traditional recipes, they have now been replaced by cheaper but less nutritious products such as pasta and rice. Bolivia, for example, consumes nearly ten times more rice and pasta than quinoa each year.

In addition to the negative perception of Andean grains, their consumption is also often discouraged by high prices and low quality. Limited supply is one of the main factors behind generally high prices, while poor post-harvest management accounts for the often unattractive presentation of the final product. The small seed size of most of the Andean grains makes threshing and winnowing a complicated and difficult process, which results in poor-quality primary products if not properly done. Several institutes and progressive farmers have worked together to develop tools to improve harvesting and processing. These include mechanical harvesters, threshing machines, winnowers, silos and so on, which between them help to raise the quality of the grain and reduce costs. At present, however, only about one in five farmers



A. King/IPGRI



Fields planted with bright varieties of cañihua (*Chenopodium pallidicaule*) for characterization and evaluation at Fundación PROINPA's research station in the altiplano of Bolivia.

While the grains themselves may be traditional and local, farmers need to adopt modern techniques to derive more value from their traditional crops.

has adopted these improved tools. Most are still using traditional techniques and as a result suffer lower yields of inferior quality. The clear message is that while the grains themselves may be traditional and local, and valuable for those very reasons, farmers need to adopt modern, possibly imported, techniques to derive more value from their traditional crops.

Nutritious and productive

Andean grains offer exceptional nutritional value. They are high in protein and are an important source of essential amino acids, especially the lysine and threonine that are often low in diets based on maize. Andean grains are also easily digestible and, with their valuable amino acid balance, are often recommended for babies, children and elderly people. Leaves are high in protein and iron, which is easily assimilated thanks to the high levels of vitamin C also present. This gives them a medicinal use beyond a diverse diet. Cañihua and amaranth leaves are used to treat people suffering from anaemia, especially pregnant women and nursing mothers. They are also prescribed for tiredness and altitude sickness. Cañihua is good for people suffering from amoebic dysentery or typhoid fever, while quinoa is used as a painkiller and anti-inflammatory and to prevent the formation of scars.

Their nutritious and medicinal value makes Andean grains valuable to those who eat them, but they have



other virtues of more direct interest to the farmers who grow them. They tolerate insect pests, diseases, drought, frost and salinity and therefore perform very well in marginal lands. Quinoa and cañihua in particular are reported to be very tolerant to salinity, frost and drought. In Bolivia there are reports of acceptable production in areas with less than 100 mm rainfall per year. Growing Andean grains is thus a limited risk for the farmer in many areas of the higher Andes.

A final asset of Andean grains is that they offer a wide range of processing possibilities, not all of them for food. Amaranth flowers contain considerable amounts of betacyanins, natural and non-toxic red pigments that could be useful in the food and cosmetic industries. There is also a local tradition that the ashes of cañihua stems repel insects, spiders and ticks, which offers potentially interesting opportunities for additional diversification. It is their use as food, however, that is most likely to boost the value of Andean grains to small farmers.

Traditionally they have been used in a wide range of food products aimed at local consumption. But because of their exceptional nutritional value these products are becoming of interest to relatively affluent consumers in developed countries, especially in the organic and wholefood circuits. In addition to the traditional uses, food technologists are developing novel products, such as pasta, breakfast cereals and power bars. Sales will increase demand for the primary products, which could form an important source of additional income for local farmers, especially if they are involved in the first steps of processing as well.



Yacon on sale in Japan. Its popularity there was crucial for marketing in Peru.

Promoting the benefits of Andean grains is essential to increase their use and to create new food habits in the population.



M. Hermann/IPGRI



Marketing value

None of this, however, is likely to materialize without adequate promotion of the benefits of Andean grains, especially for children and pregnant women. Promotion is without any doubt the hardest, though the most essential, step to increase the use of Andean grains and to create new food habits within the population. It will need tackling at every level, from

international and national policy forums (for example in drawing up Poverty Reduction Strategy Plans) to local village extension services, each using different and appropriate means of communication.

A good example is the way Andean grains are now part of school breakfasts and subsidies for poor nursing mothers. School breakfasts in Bolivia demand up to 120 tonnes of quinoa flour a year and about 30 000 poor nursing mothers each receives 3 kg of quinoa a month. These programmes improve the health of recipients at the same time as providing opportunities to local farmers and processors, exactly the kind of intervention called for by the UN's Hunger Task Force in its report on meeting the Millennium Development Goals.

Successful promotion, however, will need to be accompanied by enhanced production. To some extent the solutions to the problems of production exist; they need to be applied. For example, the limited supply of primary products can be tackled by the distribution of high-quality seed material, already available through national breeding programmes. At the same time credit systems can make it easier for local farmers or cooperatives to acquire post-harvest machinery, which assures high-quality products. Local enterprises should also try to take advantage of the current international demand for Andean grains by processing, and thus adding value, locally.

Their ease of cultivation, even in the harsh circumstances that often prevail in the Andes, their high nutritional value and their multiple uses make Andean grains an opportunity not to be missed. An opportunity, furthermore, that can benefit not only the local population but also other people living in similar circumstances.



The benefits of buckwheat

Buckwheat (*Fagopyrum* spp.) is another grain that is not a grain, much favoured because it is hardy, thrifty and very nutritious. In Shouyang County, in the mountains in the eastern part of Shanxi, China, it has proved financially valuable too. Many farmers live below the national poverty line, and crops are a major source of their income. The area suffers from limited rainfall during the growing season, and farmers generally grow a mixture of maize, millet, buckwheat, beans and potatoes. The farmers select their crops with care and have discovered that buckwheat is especially useful in poor soils and with low inputs.

IPGRI supported a project that used buckwheat within a livelihoods approach to improve the lot of the farmers. A buckwheat association brought together farmers, local extension agents, private sector players and researchers, who together devised ways of making more of this neglected crop. The results are exemplary. For example, farmer Zhang Tianchang has just one hectare of marginal land with soil too poor to grow crops such as maize and potatoes. The buckwheat association provided him with buckwheat seeds and training to cultivate the crop. As a result he now earns almost US\$ 330 a year, enough to support his children at school.

Processing can add further value. He Zengbao, a farmer who lives in the village of Pingtou, processed 15 tonnes of buckwheat grain, grown by his family and neighbours, into 10 tonnes of buckwheat flour. The buckwheat association helped sell the flour in

Buckwheat is a neglected species that is being promoted by an IPGRI project in China. Here farmers and researchers evaluate varieties in the field.

Farmer Zhang Tianchang now earns almost US\$ 330 a year from growing buckwheat, enough to support his children at school.



Z. Zhang/IPGRI



the nearby markets of Yuci and Yangqu. But while the grain would have fetched US\$ 2000, the flour brought in more than US\$ 3000. Processing increased its value by a half. Trading companies, also

members of the association, are further increasing the value by converting the grain into products such as instant noodles. The processed buckwheat sells in Beijing, Shanghai and other big cities in China and is also exported to Japan and South Korea.

This model, of a network built around multiple players, could obviously be extended, adapted and applied to different crops in different countries.

Better bananas

Bananas (*Musa* spp.) are certainly not underutilized. They support millions of people living in tropical Africa. But to some extent they have been neglected by mainstream research. In the Great Lakes region of Uganda, Tanzania, the Republic of Congo, Rwanda and Burundi a unique set of very diverse varieties, endemic to the East African highlands and known as East African highland bananas, underpins agricultural production. In addition to being a staple food and important source of income these varieties are also used in cultural functions. In recent years, however, natural disasters, civil strife and an increased emphasis on marketing, among other factors, have resulted in farmers losing some of the less commercial endemic banana varieties. That is now changing for the better as bananas receive more attention from researchers.

Given the limited resources available to farming communities, farmers tend to conserve material that meets their overall household needs in the most efficient and cost-effective way. So from the outset it was clear that one way to promote the conservation of diversity on farms was to broaden the options for using different varieties. Farmers would value and look after varieties that meet a need, and meeting more needs would improve the livelihoods of farming families. An IPGRI project that began in 1999 focused on understanding the socioeconomic, cultural and gender factors involved in how farmers select and make use of banana diversity. The key discovery



was that conservation values are already an integral component of the social and cultural environment of the banana-growing communities of the Great Lakes region.

As with so many similar efforts, the project followed many paths. Exchange visits and on-farm demonstrations introduced farmers to new approaches to tackling pests and diseases and managing soil fertility. The farmers who took part in these enjoyed higher productivity, which in turn encouraged their neighbours to join them, and many of the participants reported an improvement in their livelihoods. Visits to field genebanks at research institutes, and then exchange visits between the project sites, exposed farmers to more banana diversity. As a result each household is now growing an average of three more cultivars than it was before the visits. Most of these additional cultivars have socio-cultural uses, for example to make banana beer.

New marketing strategies for green cooking highland bananas, selling small quantities and even single bananas for example, have spread among the project sites, creating an incentive for the conservation of these cultivars. Similarly, the farmers in Bushenyi and Masaka in Uganda have adopted Tanzanian techniques for preparing banana wine from green cooking highland bananas, which again has increased the incentive to conserve more varieties. Farmer field schools, originally set up by the project to show farmers how to prevent the loss of diversity at one site, are now used by the district extension service to teach a whole range of good management practices.

The project and local partners set up banana diversity conservation associations at the various sites. Perhaps the strongest evidence of the impact of the project is that farmers are willing to put up their own hard-earned cash to join these associations. At one



Bananas on sale at a market in Uganda.

Conservation values are already an integral component of the social and cultural environment of banana-growing communities of the Great Lakes region.



C. Bournselli/PCRI



site, paid-up membership exceeds 500 farmers, compared with 30 at the start of the project, a clear demonstration that farmers benefit from their membership. The associations empower local communities by helping them develop a strong negotiating voice. They also provide a forum through which important issues affecting the conservation of agricultural biodiversity can be discussed and solutions and actions agreed.

The project and the farmer associations offered the opportunity to link with other development and extension efforts in the region. One of the most worthwhile has been a link between the Bushenyi site in Uganda and Ecotrust, a Ugandan nongovernmental organization (NGO) funded by the United States Agency for International Development (USAID). Ecotrust gives poor farmers a dairy cow and the training to make use of her. Farmers learned to prepare organic manure and use it to improve the fertility of their soil. And the cow's milk provided the protein that is sometimes missing from the banana-based diet of the area. Agricultural biodiversity, not merely the genetic diversity of banana varieties but also the species (indeed kingdom) diversity of adding a cow to the mix, enables a dramatic improvement in the lives of farmers in the East African highlands.

Nutritious millets

Associations of farmers have also proved invaluable in promoting the use of millets such as finger millet. *Eleusine coracana* is a true grain, one of the so-called minor millets that are enjoying something of a renaissance in parts of India and Nepal. Farmers and consumers are coming to appreciate the better qualities of the minor millets, which are being successfully rebranded as nutritious millets. These qualities are shared by many of the neglected and underutilized species that are the focus of this booklet: they are nutritious and they thrive under marginal growing conditions, making them a better bet for growers and urban dwellers alike and sparing the environment. But they also suffer from low status, making them a hard sell to modern consumers. IPGRI and the M.S. Swaminathan Research Foundation, in partnership with local NGOs and communities, have been exploring the potential of the nutritious millets to boost livelihoods and improve health and nutrition.



In Kaski district in Nepal a pilot project examined all aspects of the entire production chain, from the farmers' choice of varieties right through to the preferences of consumers. It aimed to identify the best options for adding value to finger millet at the same time as promoting its benefits to consumers and policy-makers. In two villages, Kalabang and Ralmare, farmers identified their favoured traditional varieties and then worked with researchers to evaluate several improved lines. Of these, three in particular impressed the farmers with their high yields and plump grains. The emphasis now is on working in a participatory fashion with the modern lines to improve some of the traditional landraces, which people prefer for particular foods but which are difficult or unprofitable to grow.

While the farmers were working on production, others were working on public awareness, disseminating the good news about millets through radio, print, fairs and festivals, workshops and school programmes across Kaski region. Surveys revealed that as a result some groups, identified as intellectuals, diabetics, the younger generation and foreigners, increased their demand for millet. Micro-entrepreneurs told the same story. After the publicity efforts, department stores and others came looking for increased amounts of millet-based foods to sell in Pokhara, the main town of Kaski. Demand for millet grain quadrupled between 2001 and 2004. Sales of millet cookies increased even more. One micro-entrepreneur reported a leap from 50 to more than 600 packets a month in just 18 months. Whole new classes of food, such as millet *namkin*, a savoury snack, came onto the market, with sales increasing 20-fold over the course of a year.

Just as Japan's enthusiasm for yacon inspired farmers in Peru, this increased demand for millet from



A project to reinvigorate the growing of nutritious millets is taking place in India and Nepal. Farmer evaluation of local landraces and modern varieties is an important component of the project.

The Kaski project is an example of successful collaboration among groups that run the gamut from international research centres to individual farmers and cooperatives.



S. Padulos/IPGRI



the towns fed back to the villages. Rural people began to appreciate the nutritional importance of millet and project partners reinforced the message by organizing food fairs in the villages, where locals learned how to use more millet in their daily diet. Incomes have increased as a result of the increased demand for millet, and farmers are now setting about capturing more of the added value for themselves. An

entrepreneurial group worked with the project to buy a small millet mill. Now, like the buckwheat farmers in China, they can offer other local farmers a cheaper milling service while marketing the more valuable flour under their own brand name in Pokhara.

The Kaski project is an example of successful collaboration among groups that run the gamut from international research centres to individual farmers and cooperatives, and it offers a series of lessons for consideration elsewhere. Farmers picked their preferred varieties and worked to improve local landraces, preserving the environmental benefits of the crop. Higher quality and assured supply attracted industry to make use of millet. Micro-entrepreneurs were essential to the process of adding value. And wide-ranging public awareness activities underpinned the whole effort by sensitizing consumers—urban and rural—to the benefits of millet.

Tropical fruits blossom

Fruits are an important component of many tropical ecosystems, with a distinct dual personality. On the one hand there is the handful of mainstream crops of global and local trade: banana, citrus, mango, pineapple, papaya. On the other there is the brimming basket of hundreds of lesser-known species that are grown in small orchards and backyards and harvested from the wild. Both have a role to play in improving the well-being of the rural poor. An IPGRI project in 10 Asian countries (Bangladesh, China, India, Indonesia, Malaysia, Nepal, the Philippines, Thailand, Sri Lanka and Vietnam) has made enormous strides in enhancing the value of tropical fruits.

Fruits are a source of both good nutrition and opportunities for employment and income, especially for women. Fruits are often rich in vitamins and minerals and



their vitamin C, for example, can make nutrients such as iron in other foods more available to the body. In agricultural areas fruit trees contribute diversity to farming systems, while in nearby forests tropical fruit species are important as food and shelter for plants and animals. In both cases, fruit trees raise the stability and productivity of the ecosystem. Local people often gather fruits from forests to eat and to sell locally. Some species are also used in social forestry programmes, which aim to restore and make use of degraded land near settlements. Mango, tamarind, wood-apple and custard-apple are fruits commonly included in such schemes. Many farmers deliberately plant fruit trees in gardens and on field margins to help stabilize soils and to contribute fertility, timber, animal feed and many other benefits.



A key consideration in the development of tropical fruits, especially of the less-well-known species, is the need to collect, characterize and evaluate different species and varieties with a view to making them more useful to create improved varieties. IPGRI's tropical fruit project brought together thousands of different varieties of its priority species, identifying lines that might be useful to breeders, conserving the diversity in field genebanks and on farms and developing technologies such as cryopreservation to enable diversity to be stored more efficiently.

Given the importance of fruits to local people, much effort has been put into working with communities. During a Fruit Tree Plantation Fortnight in Bangladesh, 30 mango growers learned how to propagate favoured varieties and how to improve productivity. In India, an NGO called Snehakunja helped to collect local mangoes. Farmers in China provided vital information about two varieties of pomelo: 'Boloxyanyou' has an exquisite pineapple fragrance while 'Anjianwuheyoyou' is seedless, both valuable traits. A Chinese variety of mango called 'Tai Ya' has a red skin and exemplary storage quality. In Sri Lanka, people use the bark and roots of three mango varieties, 'Mee amba', 'Atamba' and 'Valamba', to treat broken limbs. In Vietnam, community nurseries have produced grafted seedlings of litchi, mango and pomelo, earning



A. King/IPGRI



A farmer in Chitwan District, Nepal, is growing one of the Indian mangoes that bears fruit all year round.

themselves an income and giving local growers the opportunity to get hold of productive varieties. Throughout the region, diversity fairs have proved popular. Farmers, researchers and local enterprise owners come together at these fairs to exchange planting material and the traditional knowledge to make best use of it, promoting the spread of good varieties and good practices at the same time as conserving biodiversity and information about it. Some shows, for example in Bangladesh, help the assembled farmers further by including workshops on improved production techniques and the importance of agricultural biodiversity in their farming systems.

One of the distinctive elements of work with tropical fruits is that while there are hundreds of species and scores of approaches, there are also commonalities that can be applied—or at least investigated—across a wide range of conditions. Networks are a vital tool in these efforts, and in Asia the project not only collaborated with existing networks but also helped to establish the Asian Fruits Genetic Resources Network (AFGRN). The effectiveness of the project has also been reflected in the willingness of several of the partner countries to give tropical fruit species greater prominence in their efforts to promote economic development, devoting funds to sustain these efforts.

Farmers, researchers and local enterprise owners come together at diversity fairs to exchange planting material and traditional knowledge.



One man's success story

As a counterpoint to aggregate statistics and regional or global collaborations, consider the case of one farmer and one neglected species: Elisamia Abraham Pallagyo and the African eggplant.

Mr Pallagyo is 48 years old, married, with four children, and lives in Nambala village in the Arumeru District near Arusha in Tanzania. His enterprise, dedication and hard work have boosted his income from Tshs 400 000 a year (about US\$ 350) to more than Tshs 2 500 000 (US\$ 2300) over the past five years and have offered similar opportunities to the many people he now employs.

His steadfast focus has been on the African eggplant (*Solanum aethiopicum*), an important indigenous vegetable crop of sub-Saharan Africa. Pallagyo started off with less than a hectare of land, on which he grew three varieties: 'Tengeru white' and 'Manyire Green' are local, while 'DB3' is a new line, bred by the World Vegetable Center, that outperforms the other two. Pallagyo prefers 'Tengeru white' because it tastes better and yields larger, heavier fruits. His customers like 'DB3' but seed is currently in very short supply.

Pallagyo concentrated on quality and marketing. He employs local women to harvest the crop, which must be done even when demand is low as fruits left on the



Elisamia Abraham Pallagyo; African eggplant entrepreneur.

A cell phone has become an essential business tool, enabling Pallagyo to stay in touch with his customers and to keep on top of market fluctuations.



M.L. Chadha

plant inhibit the formation of further flowers. The women pick about 10 to 15 plastic buckets of eggplants each per day, earning them around US\$ 2.50 a day. Pallagyo also buys the crop from other farmers and the whole harvest passes to additional workers to sort, grade and pack. The workers carefully evaluate the eggplants on the basis of colour. Creamy white fruits are preferred, while reddish and yellowish ones are rejected. So are mottled, rusted and immature fruits. Two grades, one for the largest, undamaged, cream-coloured fruits, the other for the rest, ensure that Pallagyo gets the best possible price.

A problem for all rural farmers is access to markets. To begin with Pallagyo used local transportation to reach the Tengeru market, where he sold his produce to retailers. His success enabled him to invest first in a bicycle, worth Tshs 28 000. Better transport brought bigger profits and a further investment of Tshs 700 000 in a motorbike. As the business grew a second-hand Toyota pick-up became affordable and that has further enhanced the collection of the harvest and delivery of the sorted and graded produce. A cell phone has become an essential business tool too, enabling Pallagyo to stay in touch with his customers and to keep on top of market fluctuations.

In addition to an improved standard of living for his family, Pallagyo has added an extra half a hectare to his land. And his enterprise has benefited his neighbours too, because they now have employment and a market for their own produce. And in the markets, customers are assured of a steady supply of high-quality African eggplants.

Edible and useful

Sometimes agricultural biodiversity delivers its benefits not through food but through inedible but valuable products. The ancient Greeks and later the Romans used leaves of the noble laurel (*Laurus nobilis*) as a wreath to honour their gods and prominent citizens. And all around the Mediterranean, people flavour their food with



laurel leaves (also known as bay). But a few communities in Syria are beginning to enjoy improved livelihoods as they market traditional laurel products in the form of oil and soap.


Laurel is an evergreen tree that grows wild along the coastal area of Syria at altitudes above about 200 metres. The trees flower around mid-April, and the oil-rich fruits are small, round to oblong, very dark berries that ripen between October and December. In the mountains behind Lattakia and Tartus, and in particular in the communities of Kessab and Kadmus, laurel is a key element in the multiple uses of wild biodiversity, which has been exploited for centuries. A few farmers grow laurel deliberately in their home gardens but most gather laurel leaves and berries from the wild. The people use a small quantity of the dried leaves in their own kitchens and therapeutically and they sell the rest in village markets and to traders, who then distribute them to herb shops throughout Syria.

The most valuable product is laurel oil, which village women extract in a process handed down from mother to daughter and largely unchanged by time. The women gather the ripe berries from the wild and from their gardens and boil them for six to eight hours over a wood fire. As the oil gathers on the surface of the water they skim it off with a wooden spoon and pour it off through a filter into bottles. From about 16 kg of berries the women extract about 10 litres of oil, which they sell for about US\$ 8 per litre to small local soap factories. The sale of oil provides about a third of their yearly income for the 300 or so families involved in this business.



Oil extracted from laurel berries is used to make traditional soap in Syria. After cutting from the large block and while still soft, cubes of soap are stamped with the maker's mark.

Syrian laurel soap is recognized around the world as a fine product.



Legend has it that the Syrian queen Zenobia used laurel oil to keep her skin and hair fresh and shiny. Making soap from laurel oil is believed to have begun in Syria about 2000 years ago. The oil is mixed with olive oil and lye (caustic soda) and boiled before being poured into a mould to cool. The solid block of soap is then cut into smaller cubes, stamped with the maker's mark and stored in a dry place for six months or more. Around 50 small workshops near Aleppo between them make 20 000 tonnes of soap a year, but almost all use laurel oil imported from Turkey. The villages of Kessab and Kadmus, however, use local laurel oil, and one particularly innovative soap factory in Kessab offers a direct income to 20 families, with a further 150 benefiting from the market for the berries they collect and process.

Syrian laurel soap is recognized around the world as a fine product. In addition to simple cleansing it also nourishes, softens, refreshes, deodorizes and protects the skin and its mild antiseptic properties make it ideal for sensitive and damaged skin. Pure laurel oil, too, finds a place in the cosmetics market as a moisturizer and massage oil. The challenge now for the communities of Kessab and Kadmus is to make use of growing global interest in natural and traditional products. At present very little Syrian laurel soap is exported, but the Kessab factory hopes to capture some of the market among relatively affluent consumers in Europe, North America and Japan with its finely packaged bars of high-quality laurel soap.

Obstacles

With more and more projects demonstrating the value of neglected and underutilized species for improving nutrition and livelihoods, it is legitimate to ask why more is not being made of them. Because policies at various levels are generally not supportive and may be directly opposed. A clear example is the European Union's Novel Foods Directive. Its laudable intention is to protect European consumers from the dangers of unsafe food; its impact has actually been to prevent access to the very foods affluent consumers desire at the same time as blocking opportunities for poor farmers to improve their situation.

The Novel Foods Regulation (EU 258/97) states that foods not present in the EU before 1997 must be documented free of allergenic, toxic and other hazards before they can be offered for sale. Unfortunately, the fact that people outside the EU may



have a long and untroubled history of eating their particular indigenous crops counts for nothing. Indeed, it is a good thing that potatoes and coffee, to name but two examples, were introduced to Europeans before 1997, as it is unlikely they would be permitted today. Regulators do not accept indigenous knowledge as evidence when they evaluate novel foods, and since it was introduced in 1997 the Regulation has denied approval for several exotic traditional foods. Examples include the natural sweetener *Stevia rebaudiana*, nangai nuts from Pacific trees of the genus *Canarium* and the Andean root, maca (*Lepidium meyenii*). All three have a history of safe use not only in their country of origin but also in other developed markets outside Europe.

The cost of conducting a 'scientific' evaluation for such foods, combined with the length of the application period and its uncertain outcome, discourages firms from seeking permission, even though there may be great demand from consumers. By November 2003 only one exotic plant product had been authorized as a novel food: the juice of the noni fruit (*Morinda citrifolia*). This is marketed by a large company based in the USA that was able to supply the extensive food-safety evidence needed. The authorization is limited to noni juice. Any other product, such as noni jam or dried whole fruit, would need a separate authorization. Furthermore, the authorization is specific to the applicant. A competitor cannot market noni juice unless they can present evidence that their product is substantially equivalent. While this aspect of the Regulation offers applicants a certain amount of protection for their investment in the process of authorization it also creates an effective marketing monopoly for products that are in the public domain in their country of



A farmer from the Jalsuri community in Bolivia surveys a large-scale quinoa field. The grain produced in this field will be sold to an agro-industry for processing. Local NGOs have helped to link cooperatives and agro-industries, enabling farmers to profit from the production of landraces.

It is a good thing that potatoes and coffee were introduced to Europeans before 1997, as it is unlikely they would be permitted today.



origin. The applicant essentially appropriates the indigenous knowledge associated with a given food by scientifically substantiating it.

The Regulation thus denies the very people it sets out to protect the chance to add novel and possibly beneficial diversity to their diet. And in so doing it also denies small producers in developing countries the chance to better themselves by supplying a new market and thus earning more money.

Concerns about the safety of exotic foods are unlikely to go away. Even an amended Regulation will probably require some indication of information about nutrition and composition that is just not available for many traditional foods.

If selling into the European market is a component of a development project's strategy then the project must consider this in its planning and in any products that it may develop.

Policy problems

The International Treaty on Plant Genetic Resources for Food and Agriculture, which regulates the exchange of plant materials between countries, sets a different kind of obstacle. It establishes a multilateral system of access and benefit-sharing to facilitate access to key genetic resources with minimal procedural and administrative costs. The Treaty envisages a mechanism for sharing benefits whereby the 'owners' of a commercialized product that incorporates material obtained from the multilateral system will pay a royalty into a designated fund. The payment is mandatory if measures to protect intellectual property prevent the product being used for further research and breeding. It is voluntary when the product can be freely used for those purposes. The details of the level of royalties, the organization and governance of the fund and disbursements from it have yet to be agreed. However, the Treaty clearly envisages that benefits will flow primarily to farmers in developing countries, who conserve and use crop diversity. This much is welcome, and an improvement on existing bilateral agreements. The difficulties arise from the species covered by the Treaty.

Initially it applies to 35 crops and some 80 forages that are under the control of member governments, including practically all the crops on which humanity depends for its basic food supply. But the multilateral system does not cover underutilized species,



and if they are to be improved by breeding and the exchange of materials then some system to enable the free flow of genetic resources will need to be put in place. Measures will be needed to make arrangements for regional exchanges of locally relevant materials that are not on the Treaty's list or, eventually, expansion of the list itself.

In conclusion

This booklet has presented just a few of the many ways in which agricultural biodiversity can power development and help the world to meet the Millennium Development Goals. In particular, agricultural biodiversity, and with it dietary diversity, can help combat the double burden of obesity and malnutrition now faced by poor people.

Certain themes recur. Locally important species, neglected in the rush to increase global production, are a valuable resource. They supply important nutrients and the opportunity to boost incomes and are often more environmentally sustainable. Marketing, to increase demand and educate farmers and consumers alike, is a vital ingredient in the mix. So too is public awareness, not just for the people making use of these crops but for the policy-makers and development specialists, so that they too realize the benefits of agricultural biodiversity. Empowering farmers, through associations and networks, is valuable in its own right and also, by enabling the spread of good ideas, research results, lessons

Capturing added value is an important aspect of using neglected species to improve livelihoods. Farmers in Bolivia are given a demonstration of quinoa milling as they consider linking with *Procesadora de Granos Andinos*, a small-scale agroindustry processor.



A. King/PGRI

learned and improved techniques, can help entirely different kinds activity to cross fertilize one another.

In the end meeting the Millennium Development Goals will take political will, financial commitment and a readiness to attempt innovative solutions. Agricultural biodiversity can be a key element in ridding the world of poverty and hunger.

Meeting the Millennium Development Goals will take political will, financial commitment and a readiness to attempt innovative solutions.



Global Facilitation Unit for Underutilized Species

GFU is a multi-stakeholder initiative under the umbrella of the Global Forum on Agricultural Research (GFAR) and hosted by the International Plant Genetic Resources Institute. It supports work on underutilized plant species by networks, organizations and others through: (i) providing access to up-to-date information, (ii) analyzing existing policies and formulating recommendations to policy-makers on how to amend these policies in order to create an enabling environment for these species and (iii) increasing public awareness on the role of underutilized plant species for the livelihoods of poor people.



The International Plant Genetic Resources Institute

IPGRI undertakes, encourages and supports research and other activities on the use and conservation of agricultural biodiversity, especially genetic resources, to create more productive, resilient and sustainable harvests. Our aim is to promote the greater well-being of people, particularly poor people in developing countries, by helping them to achieve food security, to improve their health and nutrition, to boost their incomes and to conserve the natural resources on which they depend. IPGRI works with a global range of partners to maximize impact, to develop capacity and to ensure that all stakeholders have an effective voice.



M.S. SWAMINATHAN RESEARCH FOUNDATION

M.S. Swaminathan Research Foundation (MSSRF) at Chennai, India, is an autonomous non-profit trust established with initial funds coming from the World Food Prize received by Professor M.S. Swaminathan in 1987. The mission of MSSRF is fostering of a pro-nature, pro-poor, pro-women and pro-employment orientation to technology development and dissemination in rural areas. MSSRF undertakes R & D activities in five major programme areas, namely, Coastal Systems Research, Biodiversity and Biotechnology, Eco-technology and Food Security, Gender and Development, and Informatics. The development models demonstrated in these programme areas by the MSSRF over the last 15 years have received wide acceptance.

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