

## **Challenges and Strategies in Promoting Conservation and Use of Neglected and Underutilized Crop Species**

Stefano Padulosi, Pablo Eyzaguirre, and Toby Hodgkin

There is an increasing interest in neglected and underutilized crop species (NUS) throughout the world, reflecting a growing trend within agriculture to identify and develop new crops for export and domestic markets. The FAO Global Plan of Action for the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture, which was adopted in 1996 by approximately 150 countries, identified the improved conservation and use of NUS as one of its 20 main activities. Interest in NUS stems from a variety of factors, including their contribution to agricultural diversification and better use of land, their economic potential and the opportunities they provide for diet diversification. NUS are being often presented as new species though they have been used by local populations in traditional ways for many centuries. Their novelty is thus not related to their introduction to new areas but rather to the ways in which old and new uses are being re-addressed to meet today's needs.

The International Plant Genetic Resources Institute (IPGRI) has been concerned to improve conservation and use of NUS, and has spearheaded, over the last few years, specific activities at national and international level for the better conservation and use of these species. Collaborative works on a number of NUS-oriented Networks have been supported together with the production of a series of monographs on selected NUS. IPGRI's strategy for meeting the challenges of NUS promotion is based on the premise that the deployment of plant genetic diversity in agriculture will lead to more balanced and sustainable patterns of development. Because NUS may never command a large percentage of national resources and are often characterized by local specificity they require however an approach different from that used for other crops. Key elements of the IPGRI's strategy for NUS conservation consists in enhancing conservation through use, identifying specific indicators to measure threats of genetic erosion, promoting the interest of national programs and other agencies and facilitating exchange of information and collaboration among interested parties. IPGRI is particularly concerned to develop general tools and methods for promoting conservation and use of NUS which can be adapted to different contexts and enable national programs and local institutions to use them for the species to which they give priority.

### **TRENDS IN THE USE OF PLANT GENETIC RESOURCES**

Today, only 30 plant species are used to meet 95% of the world's food energy needs (FAO 1996). These crops are widely and intensively cultivated and have been selected from a large agrobiodiversity basket containing more than 7,000 food species (Wilson 1992), which is approximately 1/10 of the estimated number of edible species present in nature (Myers 1983). Although an analyses of the data on a country-by-country basis, indicates that food supply is provided on average by 103 species, yet the exploitation of our plant genetic diversity wealth remains still far lower than what existing potentials would in fact allow (Prescott–Allen and Prescott–Allen 1990).

The reasons behind such a narrow focus of agriculture are well understood. Such factors as physical appearance, taste, nutritional properties, cultivating techniques, processing qualities, environmental adaptability, range of possible uses, and storability have fuelled the promotion of these “major crops” and ensured their success across continents and their acceptance by so many different cultures. The success of the breeding programs of these crops depends on the genetic diversity collected through thousands of germplasm collecting missions. Today, more than 6 millions of accessions of genetic resources for food and agriculture are stored in some 1,300 germplasm collections around the world (FAO 1996). Most of this *ex situ* conserved diversity (about 80%) belongs to major crops and their close relatives (Padulosi 1998a). The presence of a limited amount of germplasm of the so called “minor crops” in gene banks and its poor representation in terms of genetic diversity (Padulosi 1998a) represents a great challenge for the successful improvement and promotion of this group of species. Yet the narrow agricultural portfolio of today's agriculture raises serious questions

on how effectively major crops alone can contribute towards food security, poverty alleviation, and ecosystem conservation as we become more and more aware of the fact that diversification of crops at all levels and in all types of agro-systems is the most crucial element for sustainability (Collins and Hawtin 1998). Emerging opportunities over the last few years for “minor” crops (particularly those underutilized or neglected) signal a new attention of the public opinion on biodiversity and its sustainable use along with an increasing interest of the public and private sector towards “new” crops, “new” uses and new markets.

## **CHALLENGES AND OPPORTUNITIES**

### **The True Novelty of Neglected and Underutilized Crop Species**

Interest on NUS stems from a variety of concerns and needs, including their contribution to agricultural diversification, better use of marginal land and changing environments, food security and a more balanced diet, better safeguard of our agrobio-diversity and associated cultural heritage, self-reliance of agricultural systems, additional source of income to farmers, and employment opportunities (Padulosi 1998a). Although some of these aspects might have a “new” connotation, often NUS are being presented as new crops in spite of the fact that they have been used by local populations in traditional ways for generations. This point is fundamental to underscore the importance of these species in our life (Bhag Mal 1994). Indeed the true novelty of underutilized and neglected species and their potentials is not related to their introduction to new areas but rather to the ways in which old and new uses are being re-addressed to meet today’s needs. Any work in support to underutilized and neglected species must be consistent with this aspect to achieve their sustainable promotion and safeguard. From an international perspective, emerging global and national attention on neglected and underutilized species originates basically from three major areas of interest and concern: new markets and uses, the environment, and food security and nutrition.

### **Development of New Markets and New Uses**

Modern technologies have the ability to transform crops and other plants into diverse products, from plastics to surgical tissue, to extend shelf life of fresh vegetables, and to enhance commercialization and marketing systems. These benefits undergird the growing demands for “new” foods and plant products.

### **Concern on Environmental Change and Ecosystem Stability**

Climate change, degradation of land and water resources have led to growing interest with crops and species that are adapted to stresses and difficult environments. Many of these species are neglected and underutilized and their use is restricted to the niches where they are maintained by poor farming communities in marginal environments (high mountains, desert margins, poor soils, etc.). The deployment of a wider species diversity within agro-ecosystems enhance greater stability and ecosystem health.

### **Concern Over Food Security and Nutrition**

Many neglected and underutilized species are nutritionally rich and are adapted to low input agriculture. The erosion of these species can have immediate consequences on the nutritional status and food security of the poor. Also, growing market opportunities for such species may generate additional income to those poor farmers in less favored environments.

## **A STRATEGY FOR THE PROMOTION OF NEGLECTED AND UNDERUTILIZED CROP SPECIES AT IPGRI**

IPGRI is an autonomous international scientific organization operating under the aegis of the Consultative Group on International Agricultural Research (CGIAR). IPGRI’s Headquarters are based in Rome, Italy, with regional Offices located in various locations around the world. IPGRI’s mandate is to advance the conservation and use of plant genetic resources for the benefit of present and future generations. IPGRI works in partnership with other organizations, undertaking research, training, and the provision of scientific and technical advice and information.

**Table 1.** List of constraints per type of crop indicated by the participants to the conference on neglected and underutilized crop species priority settings for the central and west Asia and north Africa region held in Aleppo on 9–11 Feb. 1998. Highest numbers indicate highest weight of correspondent constraints.

Constraints (ranked by degree of importance)	Medicinals, aromatics	Forest trees	Fruit trees, nuts	Vegetables	Forages, browses	Industrial crops	Ornamentals	Legumes	Cereals
Low competitiveness	3	3	3	3	3	3	3	3	3
Lack of knowledge on uses	3	3	3	3	3	3	3	3	3
Lack of research on genetic diversity assessment and use	3	3	3	3	3	3	3	2	2
Policy & legislation	3	3	3	3	3	3	1	1	1
Loss of traditional knowledge	3	3	2	3	2	2	2	1	1
Lack of market/poor commercialization	3	2	2	2	3	3	3	1	1
Low income	2	3	2	2	3	3	1	2	2
Lack of propagation techniques	3	3	2	1	2	2	3	1	1
Scarce knowledge on cultural practices	3	2	2	2	2	1	3	2	1
Lack of attractive traits	1	2	3	3	1	2	1	1	1

**Table 2.** List of constraints in national programs to promote conservation and use of neglected and underutilized crop species, areas of action, activities required and comparative advantage.

Constraints (ranked by degree of importance)	Area of action	Activities	Comparative advantage
Low competitiveness	Enhance competitiveness	Promote better links between growers and marketers Investigate new areas of cultivation	Study environmental adaptation Ecogeographic distribution
Lack of knowledge on uses	Enhance documentation, information, public awareness	Carry out surveys on use Ethnobotanic studies Public awareness material	Study uses of genetic resources and gather ethnobotanic information Disseminate the information and raise public awareness on usefulness
Lack of research on genetic diversity assessment & use	Enhance research on genetic diversity	Characterization Evaluation Descriptors lists	Descriptors lists Characterization Evaluation

Policies & legislation	Promote better policies/legislation Carry out public awareness	Seminars, meetings, public awareness material etc. Investigate on restrictions affecting use Study ways to support NUS Public awareness to stimulate interest from public and private sector	Technically valid recommendations on sustainable use of wild/gathered species Genetic erosion assessment surveys/ monitoring Study various land use systems and recommend better ways to use genetic resources of NUS Tackle the distortions resulting from subsidies/policies in favor of narrow range of species Carry out impact studies for value-added strategies Survey conservation status and recommend/ carry out conservation actions accordingly
Loss of traditional knowledge	Enhance documentation & information on traditional knowledge Carry out public awareness Promote participation of farmers/users	Gathering info. on traditional knowledge Documenting traditional knowledge Public awareness on role of traditional knowledge	Ethnobotany work Community participation Promote local knowledge systems
Lack of market/poor commercialization	Carry out marketing and commercialization studies Promote niche studies	User definition Promotion campaign Market niche studies Studies on price, processing presentation to user	Strategies for diversity-rich markets
Low income	Support NUS income Investigate on better agricultural systems Promote new uses	Study alternative ways to support NUS income	Public awareness Study crop compatibility for enhancing cultivation possibilities
Lack of propagation techniques	Enhance research on propagation techniques	Carry our research on most suitable technologies	Carry our research on most suitable technologies
Scarce knowledge on cultural practices	Enhance research on agronomic aspects	Research on yield, pests, harvesting, growth rate	Research on yield, pests, harvesting, growth rate.
Low quality	Enhance breeding work	Research on taste, flavor, appearance etc.	Research on taste, flavor, appearance etc.

IPGRI has been concerned to improve conservation and use of underutilized and neglected species since its establishment in 1974, and has spearheaded, over the last few years, specific activities at national and international level for the better conservation and use of these species. Collaborative works on a number of Networks have been supported (Padulosi 1998b) together with the production of a series of 23 monographs on selected species.

IPGRI's strategy for meeting the challenges of the promotion of underutilized and neglected species is based on the premise that the deployment of plant genetic diversity in agriculture will lead to more balanced and sustainable patterns of development.

The IPGRI strategy on underutilized and neglected species aims at four main goals:

1. **Enhance the conservation** through use of plant genetic resources of a wider range of useful species
2. **Strengthen the work of other actors** who are working on the documentation, evaluation, domestication of neglected or underutilized species
3. **Strengthen research on the choice of species** based on strategic factors for conservation, development, and food security
4. **Identify criteria** for research, development, and conservation actions on neglected and underutilized species that place the conservation and use of these genetic resources in the context of national and global strategies for sustainable agriculture, to improve the livelihoods of the rural poor, and to broaden the bases of food security.

### Selecting Priority Species

In view of the fact that there are so many NUS species for which greater attention is being called for around the world, IPGRI has developed a specific approach for guiding their selection process. IPGRI will select those species that will allow to work with a wide spectrum of partners for the development and test of new approaches on plant genetic resources conservation and use that are of a wide-scale significance. These selected species will serve as models for the conservation and use of genetic resources of other NUS of local/regional significance, that are key to the livelihood of farmers in similar environments or the same region.

As part of this selection process across the regions of its Institutional mandate, IPGRI has organized in 1998 an International Conference in Aleppo, Syria, focusing specifically on the Setting of Priorities on NUS for the Central and West Asia and North Africa Region (CWANA). The Conference output consisted of a number of key presentations addressing the status of NUS across CWANA and of the identification of those limiting factors that halt their full exploitation along with a list of priority actions needed for their sustainable promotion. In addition, a number of species (divided into 9 categories viz. medicinal and aromatic species; forest species; fruit trees and nuts; vegetables species; forage and browses; industrial species; ornamental

**Table 3.** Recommended species selected by the participants attending the conference on neglected and underutilized crop species. Species have been selected on the basis of their contribution to: 1. Food security, 2. Ecosystem conservation and 3. Poverty alleviation in the central and west Asia and north Africa region.

Groups of species	Recommended species
Cereals	<i>Secale cereale</i> ; hulled wheat (einkorn, emmer, spelt); <i>Stipa lagascae</i>
Forages & browses	<i>Atriplex halymus</i> ; <i>Salsola</i> spp.; <i>Lathyrus</i> spp.; <i>Hedisarum</i> spp.; <i>Dactylis glomerata</i>
Forest trees	<i>Juniper</i> spp.; <i>Pistacia</i> spp.; <i>Quercus</i> spp.; <i>Acacia</i> spp.; <i>Abies</i> spp.
Fruit trees & nuts	<i>Pistacia vera</i> ; <i>Ceratonia siliqua</i> ; <i>Cydonia oblonga</i> ; <i>Ziziphus</i> spp.; <i>Prunus</i> spp. (wild relatives of fruit species)
Industrial	<i>Carthamus</i> spp.; <i>Rhus</i> spp.; <i>Crocus</i> spp.; <i>Laurus nobilis</i> ; <i>Stipa tenacissima</i>
Medicinal & aromatic	<i>Origanum</i> spp.; <i>Artemisia</i> spp.; <i>Thymus</i> spp.; <i>Rosmarinus</i> spp.; <i>Coriandrum</i> spp.
Ornamental	<i>Tulipa</i> spp.; <i>Nerium</i> spp.; <i>Iris</i> spp.; <i>Limonium</i> spp.; <i>Cercis siliquastrum</i>
Pulses	<i>Trigonella foenum-graecum</i> ; <i>Lupinus</i> spp.
Vegetables	<i>Cichorium</i> spp.; <i>Capparis</i> spp.; <i>Brassica</i> spp.; <i>Malva</i> spp.; <i>Scolymus</i> spp.

species; pulses and cereals) assessed by participants as particularly valuable for the whole region were also recommended as priority in future initiatives in this domain (Tables 1, 2, and 3).

### Monographs Produced by IPGRI

A series of monographs have been produced by IPGRI on neglected and underutilized species. Crops covered include: aibika/bele, *Abelmoschus manihot* (L.) Medik.; Andean roots and tubers: ahipa, arracacha, maca and yacon; bambara groundnut, *Vigna subterranea* (L.) Verdc.; black nightshades, *Solanum nigrum* L. and related species; breadfruit, *Artocarpus altilis* (Parkinson) Fosberg; buckwheat, *Fagopyrum esculentum* Moench; carob tree, *Ceratonia siliqua* L.; cat's whiskers, *Cleome gynandra* L.; chayote, *Sechium edule* (Jacq.) SW.; chenopods, *Chenopodium* spp.; coriander, *Coriandrum sativum* L.; grass pea, *Lathyrus sativus* L.; hulled wheats, (*Triticum monococcum*, *T. dicoccum*, and *T. spelta*); lupin, *Lupinus* spp.; niger, *Guizotia abyssinica* (L.f.) Cass.; oregano, *Origanum* spp.; peach palm, *Bactris gasipaes* Kunth; physic nut, *Jatropha curcas* L.; pili nut, *Canarium ovatum* Engl.; safflower, *Carthamus tinctorius* L.; sago palm, *Metroxylon sagu* Rottb.; tef, *Eragrostis tef* (Zucc.) Trotter; traditional African vegetables; yam bean, *Pachyrhizus* DC.

### REFERENCES

- Bhag Mal. 1994. Underutilized grain legumes and pseudocereals: Their potentials in Asia. RAPA/FAO, Bangkok.
- Collins W. and G. Hawtin. 1998. Conserving and using crop plant biodiversity in agroecosystems. In: W.W. Collins and C. Qualset (eds.), Biodiversity in agroecosystems. CRC Press, Washington, DC.
- FAO. 1996. Report on the state of the world's plant genetic resources for food and agriculture, prepared for the International Technical Conference on Plant Genetic Resources, Leipzig, Germany, 17–23 June 1996. Food and Agriculture Organization of the United Nations, Rome, Italy.
- Myers, N. 1983. A wealth of wild species: Storehouse for human welfare. Westview Press, Boulder, CO.
- Prescott–Allen R. and C. Prescott–Allen. 1990. How many plants feed the world. *Conservation Biol.* 4:365.
- Padulosi, S. 1998a. Criteria for priority setting in initiatives dealing with underutilized crops in Europe. Paper presented at the European Symposium on Plant Genetic Resources for Food and Agriculture, Braunschweig, Germany, 29 June–5 July 1998. (in press).
- Padulosi, S. 1998b. The underutilized Mediterranean species project (UMS): An example of IPGRI's involvement in the area of underutilized and neglected species. Third Regional Workshop of MEDUSA, Coimbra, Portugal 27–28 April 1998. CIHEAM-MAICh, Crete, Greece. (in press).
- Wilson, E.O. 1992. The diversity of life. Penguin, London.