1. Principles for Conserving Farm Genetic Resources

More often than not, agricultural genetic resources have been the primary, if not sole feature in national biodiversity strategy discussions on agrobiodiversity. There is a compelling reason for this focus: the future food supply of the world depends on the exploitation of genetic diversity for crop and animal improvement (Reid and Miller 1989, World Conservation Monitoring Centre 1992, Gollin and Smale 1999). At the same time, many of the world's farmers depend directly on the harvests of genetic diversity they sow for food, fodder and other economic, cultural and ecological activities (Brush 1991, Bellon 1996, Zimmerer and Douches 1991, Mellas 2000, Jarvis 1999). The use of locally adapted crop varieties may also serve to improve ecosystem health by their reduced needs for pesticides and fertilisers and their effect on improving soil structure (Zhu et al. 2000, Gliessman 1998, Glass and Thurston 1978, Vandermeer 1995, Pimental et al. 1997). Moreover, the availability of locally adapated crop varieties to particular microniches may be one of the few resources available to resource-poor farmers to maintain or increase production on his or her field (Jarvis et al. 2000).

From this brief discussion, sweeping from world food security to resource-poor farmers, it is apparent that farm genetic resouces have value both at a global level- in terms of agricultural genetic diversity and ecoystem health- and at a highly localised level, in benefiting poor farming communities.

Since the early 1980s, plant genetic resources in particular have become a hotly debated political issue. Within this global limelight, much has changed in the principle and concept of ownership of plant genetic resources. The resources once considered the "global commons", which may have benefited a smaller audience than this- is now of much common concern, and recognised national rights. Yet each government still has a long way to go in applying those rights in ways that provide maximum benefits to themselves, and to the global community.

One major omission from many discussions of farm genetic resources is the diversity of domesticated livestock. At present, there is a frustratingly small awareneness that the genetic resources of animals are a global asset of inestimable value to humankind, for use in both traditional farming systems and modern agriculture. Along with little awareness, there is little investment in livestock genetic diversity conservation. Yet livestock resources account for 35 to 40% of total agricultural production worldwide. Of the 5,000 known breeds of land races of domesticated and semi-domesticated animals used for food and agricultural production, over 30% have been lost in modern times, and about 30% of those remaining are considered at risk (Rege, pers. comm.). ***Ex-situ*** conservation of animal genetic resources is highly problematic. As genetic diversity erodes, our capacity to maintain and enhance livestock productivity and sustainable agriculture decreases, along with the ability to respond to changing conditions. Farm animal genetic resources must be considered equally along with plant genetic resources, in this component of agrobiodiversity conservation.

Key principles for the conservation of farm genetic resources are:

1.1 Baseline information needs to be strengthened.

1.2 It is important to identify ecosystem management practices and associated techniques and policies to promote positive and mitigate negative impacts on farm genetic resources.

1.3 Need to develop linkages between agricultural genetic conservation and use and benefit sharing, as agricultural genetic biodiversity resources are essential to global agricultural productivity.

1.4 Strengthening community management of agricultural resources increases plants and animal diversity essential for secure livelihoods.

1.5 Develop appropriate partnerships.

1.6 The private sector should take responsibility for ensuring that their activities support the conservation of agricultural genetic resources.

1.7 Issues of access, benefit sharing and intellectual property rights are central to the NBSAP process so planners need to carefully consider the position of various stakeholders.

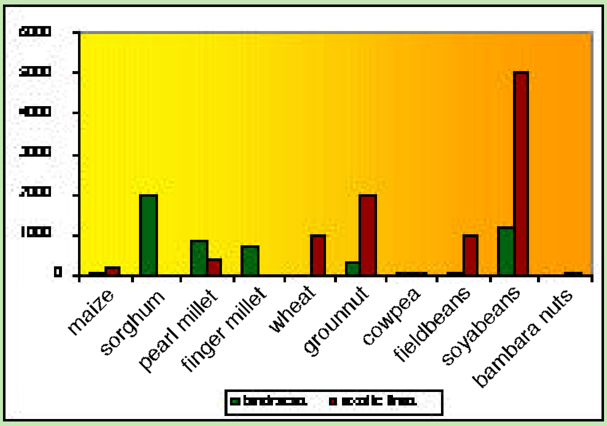
1.8 Recent advances in biotechnology have profound implications for agricultural genetic resources and these need to be addressed by the NBSAP process.

1.9 Expanding global trade increases access to biodiversity for countries, but the potential hazards to agricultural genetic resources need to be addressed by the NBSAP process.

Principle 1.1 Baseline Information needs to be strengthened.

The primary task for those concerned with the conservation and maintenance of farm genetic diversity is to understand, collate and make useable all available information on agricultural genetic resources. In order to conserve, it is first critical to know what one has. In the case of international organisations, this may be as simple as a survey of all accessions in a genebank. For most countries, however, the baseline information needed is much broader, as it needs to include both ***in-situ*** and ***ex-situ*** agricultural genetic resources, and information on the status wild relatives of domesticated species.

Up until now, most National Biodiversity Strategies and Action Plans have referred to accession lists in a national genebank, which indeed is an essential first starting point in documenting what has been identified and collected. However, it is now recognised that ***ex-situ*** conservation is not enough. Conservation of wild relatives of crops, and i***n-situ***, on-farm conservation by rural and tribal men and women remains fairly unrecognised and undocumented, yet such recognition and documention is sorely needed.



Zimbabwe has included the following information in their NBSAP: "Zimbabwe is rich in domestic plant genetic resources which include cereals, pulses, industrial and horticultural crops, indigenous and exotic vegetables, roots and tubers, and medicinal plants." Of major food crops in Zimbabwe, the accessions as recorded at left have been made.

The Zimbabwe NBSAP notes that wild relatives of some of these crops also exist, including cotton, coffee, indigenous vegetables, rice, sorghum, pearl millet, finger millet, cowpeas and bambara nuts, but that very little work has been done to document the diversity and distribution of these wild relatives.

At present in Zimbabwe, some farmers still use landraces of traditional crops such as sorghum, millet, cowpeas, bambara nuts, pumpkins and water melons for food security. However, agricultural commercialisation has adversely affected this practice. A number of initiatives have been mounted to arrest this trend by government and non-governmental organisations, which include:

- Mapping the distribution of local landraces and documentation of traditional knowledge systems in order to facilitate their on-farm conservation, by the Gene Bank of Zimbabwe.
- The promotion of on-farm conservation of traditional landraces of sorghum, pearl millet, cowpeas, and bambara nuts by ENDA-Zimbabwe; and
- The promotion of in-situ conservation and sustainable utilisation of traditional vegetables and fruits by the Community Technology Development Association (COMMUTEC)

These efforts have been rather uncoordinated, however, and the NBSAP notes a need to develop capacity in the identification, documentation, conservation and utilisation of these landraces and to coordinate the efforts of the different actors. Additionally, more information on farmer cultivation and storage of landraces is needed. As well, there is a need for a central depository of all agriculturally important plant and animal genetic resources that is linked to all other depositories.

BEST PRACTICES

Cataloguing, characterising and databasing genetic resources
Making information available

Best practices in this regard require means of cataloguing, characterising and databasing genetic resources, and making this information accessible to end users. For efforts to reach out to rural communities, new methodologies are constantly being developed and tested to utilise farmer variety names, to use farmers' understanding of breeding characteristics in characterisation, and to develop coalitions of groups within a country to build appropriate databases.

The initial starting point must be to measure the amount and distribution of farm genetic diversity maintained ***in situ*** by farmers. One of the methodolgical problems that faces any conservation initiative is to decide what kind of diversity is to be measured and analysed. A key element in understanding farm genetic diversity is to understand the relationship between what farmers recognise or name as a variety and the genetic distinctiveness of this unit. In many cases, farmer-identified varieties may be a good first approximation of genetic diversity and its characterisatio. An exemplary national experiences in this regard can be found in the Ethiopia Flora Project, which developed capacity on plant taxonomy and collection of intra-specific crop diversity.

On-farm research is essential in the characterisation process, and may turn up some surprising results. For example, in the case of the sponge gourd in Nepal, farmers only tend one or two plants of this out-crossing plant. Thus, the "population" is really an entity that is maintained at a village level, not an individual farmer level (Pandey et al 2001).

With respect to livestock races and breeds, which are more genetically uniform than plant landraces, use of local names is more problematic. In pastoral areas such as the West African Sahel and Central Asia, individual breeds range over many countries and tend to have a different name in each region (Blench, 2001). Nonethless, great strides have been made in recent years in developing a global domestic animal database (see DAD-IS in Tools, next page).

In addition to collecting information and cataloging accession, sharing it within a country is also important. There is a growing realisation that material placed into national genebanks should be able to be withdrawn, as well, by local people for use in their on-farm breeding programmes, and protocols are being developed in some countries to make national genebanks available to farmer groups on request. Brazil, for example, has initiated a study on biological characterisation and means of cataloguing accessions available in its germplasm banks, with the aim of making this available through an information service. Ethiopia's Biodiversity Institute, with its 50,000 accessions of over 100 crop species, also focuses on programmes to assist farmers to conserve and use landraces, including those which it maintains in its accessions but which may have been depleted on-farm by drought (Worede et al 2000)

TOOLS:

- IPGRI has a number of resources available in plant genetic resources for agricultural and biodiversity planners in this regard:
  http://www.ipgri.org
- A large number of on-line publications and newsletters in relation to crop genetic resources can be found at the IPGRI publication page:

http://www.ipgri.org/publications/publist.asp

- In particular, for devising systems of in-situ conservation of agricultural genetic resources, the following publication is recommended:
  Jarvis, D.I., L. Myer, H. Klemick, L. Guarino, M. Smale, A.H.D. Brown, M. Sadiki, B. Sthapit and T. Hodgkin. 2000. A Training Guide for In Situ Conservation On-Farm. Version 1. International Plant Genetic Resources Institute, Rome Italy. Available by download at: http://www.ipgri.cgiar.org/publications/pubfile.asp/ID PUB=611)
- The Food and Agriculture Organisation of the United Nations is taking a lead on data gathering and exchange in relation to farm animal genetic resources.
  http://www.fao.org/agriculture
  or
  Animal Genetic Resources Group, Animal Production Service
  Agriculture Development
  Food and Agriculture Organization of the United Nations
  Viale delle Terme di Caracalla
  00 1000 Rome, Italy
  Telephone: (39 - 6) 5225 - 3364
  Facsimile: (39 - 6) 5225 - 5749
- DAD-IS (Domestic Animal Diversity Information System) is a communication and information tool developed by FAO to be used by countries as a clearing house for information and data, offering a secure system that gives countries control over collating, releasing and maintaining their data, and an element of a strategic framework for the management of farm animal genetic resources.
  http://dad.fao.org
- Conservation of wild relatives. An exemplary set of Guidelines for southern India on *in-situ* conservation of wild relatives and related taxa of cultivated plants are offered online, including case studies (http://ces.iisc.ernet.in/hpg/cesmg/situfin.html#SEC1). The guidelines are well designed and applicable to much of the region, and beyond.

Principle 1.2 Identify ecosystem management practices and associated techniques and policies to promote positive and mitigate negative impacts on farm genetic resources.

Farm genetic resources have been conserved over millennia through social systems that reinforced conservation because it was useful. The maintenance of diversity in local varieties or breeds depends both on natural selection and on farmer management, or “human selection”. In order to develop a cohesive national conservation strategy, it is important to understand the ways in which these two interact and their relative importance. A challenging environment- as in mountainous countries with a range of rapidly changing soil types and drainage characteristics- will tend to favour the maintenance of within-variety diversity. Farmers themselves, regardless of the physical environment, may be a force for variation: farmers may seek variation in some characteristics such as maturity time, while trying to eliminate it in others, such as flavour. The final determining force in on-farm conservation is the seed supply system within a country, and this is clearly an area where national agricultural policy has a large influence. Seed supply systems and the ways in which farmers select, keep and exchange seeds are critical to on-farm genetic diversity patterns.

Modern cultivation has threatened the age-old bonds between local farmers and traditional crops. Thirty years ago, up to 75 varieties of millet, sorghum, lentils, pigeonpea and cowpea were grown in the Deccan region of India. The advent of hybrid seeds, chemical fertilisers, bore wells, and government loans has since lured many farmers into gambling on cash crops like cotton and sugarcane — sometimes tragically (Lumb 1988).

As farm genetic resources are being lost, national biodiverstiy planners need to assist agricultural policymakers to identify the practices, techniques and policies that can stem this loss.

Farm genetic resources by and large exist within farming systems managed by people, and cannot be conserved in the same way an ecosystem can be protected. In many respects, diverse farming systems that promote farm genetic diversity are a product of risk-averse farmers who bank on diversity rather than take risks with monocrops and high yielding crops. Such farming systems are dynamic, and cannot be conserved by trying to "freeze" development. As mentioned with respect to Zimbabwe, agricultural commercialisation will often adversely affect on-farm genetic conservation, when landraces are replaced by commercial seed varieties. The introducion of irrigation, which permits more uniform growing conditions that improved varieties require, may also lead to loss of on-farm genetic resources. Agricultural policy should not try to prevent the introduction of modern techniques, but should offer farmers greater room for making their own decisions, and integrating the best of traditional practices and modern technologies. At the end of the day, it is not the landraces themselves that is most important to conserve, it is the process of farmer innovation and adaptation to local conditions that needs support.

BEST PRACTICES

Early warning systems of genetic erosion
Participatory/decentralized breeding
Seed and livestock/diversity fairs
Strengthening cultural identities
Community gene banks
Improve seed storage practices
Access to credit for farmers planting landraces
Increase demand for landraces

Some effective practices that have been identified to help stem on-farm genetic diversity losses include early warning systems among farmers, and participatory breeding with farmers and plant breeders. Farmers will be the first to know when particular varities or landraces are beginning to disappear, and will know what desirable traits should be salvaged and incorporated in improved seed. In Nepal (Rijal 2001) farmers did not want to contribute to community gene banks, as their cultural practice has always been that farmers keep their own seeds. Farmers did feel, however, that it would be useful to maintain a registry of local varieties throughout the community, and to keep track of who has which variety and whether the variety was increasing or decreasing in the village. Through the initiative of a local non-governmental organisation (NGO) LiBird, and the National Agricultural Research Council, such a system, maintained by the farmers themselves, has been put in place.

Seed and livestock diversity fairs are also helping to recover and conserve agricultural genetic resources (see India, box). Fairs and exhibitions may not be a part of a community's traditional activities, but they build off of historical practices of exchanging seeds, and linked agricultural/cultural festivities. (Gonzales 2000) For example, in the Cuzalapa valley of Mexico, farmers constantly exchange small lots of maize seed, providing seed for planting at any time of the year and introducing new diversity into existing landraces (Louette ***et al*** 1997).

Community seed banks, and improved local seed storage practices, are an important form of support to ***in-situ*** conservation. For example, in Tigray, Ethiopia, farmers have established a community seed bank that currently holds a wide range of traditional crops. The seeds are selected by the local farmers based on specific cultural, technological, and ecological criteria. In a nation-wide project, a network of twelve community 'genebanks" are linked both to the national genebank and to small local seed storage systems such as clay pots, rock hewn mortar and underground pits.

In the past, farmers were more likely to receive credit from banking institutions when they invested in improved varieties and modern technologies such as tractors and irrigation. A new paradigm might emerge, for granting credit to farmers for planting landraces and conserving traditional systems of farming.

Increasing the demand for landraces is possible, and has succeeded in a modest way in a number of situations, as long as their use is integrated into improving the lot of the farmer (see Peru, box).

It should be noted, however, that change is inevitable, and many of these "best practices" can potentially have negative impacts. For example, through a seed diversity fair, farmers may decide to abandon their local races, and work with seed from other locations. Again, however, the fact that the farmer is applying his or her accumulated understanding to improving farm genetic resources is a "best practice" which ensures genetic diversity in a broad sense, despite what may occur with a particular landrace.

The Deccan area of India succeeded in bringing farmer participation to the ongoing NBSAP process, which proved to be useful also in reviving nearly extinct crop varieties. A biodiversity festival was organised in which about 70 villages around the Zaheerabad region of Deccan were visited by bullock carts displaying seeds of a variety of crops. Discussions with farmers took place in each village about agrobiodiversity that they planned to conserve, enhance for sustainable use, and equitably distribute. This resulted in a BSAP for agrobiodiversity conservation for each village.

Key participants reported that the response to the festival had been enormous, including from many of the larger, cash-cropping farmers who were sceptical of the return to traditional seeds, but nevertheless were sufficiently impressed to promise to try them. In many villages, elders recounted the ways their lives were better when they had the old seeds, now nearly gone.

The discussions amongst the farmers brought up many crucial benefits of mixed organic farming: an increase in the nutritive values of the food they consumed, a variety of fodder available for their cattle, an enhancement of soil fertility and prevention of its erosion, an increase in immunity against illnesses and disease, a decline in pest attacks, and a means of managing climatic unpredictability. Many challenges and constraints were also voiced, one of the biggest ones being the shortage of farmyard manure. Over the years it has become increasingly difficult for farmers to maintain their livestock. There has been a reduction in the availability of fodder. Grazing lands previously available to rural communities are often appropriated for various developmental purposes, with little thought about the consequences to villagers. What also came up repeatedly was the need for a change in government policies to boost the marketing value of traditional varieties, by even including them in the public distribution system.

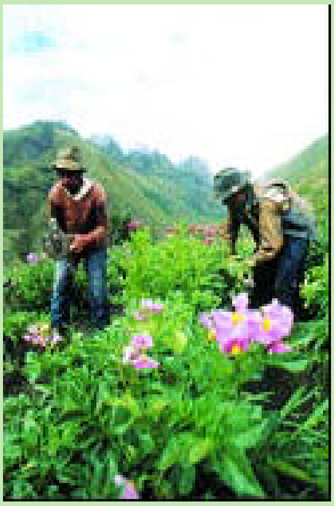
from S. Padmanabhan and A. Kothari, Kalpavriksh - Environmental Action Group, pers communication

TOOLS:

- Early warning systems, and participatory/decentralised breeding both require the expertise and participation of farmers, working with national breeding programs. Again, one of the best tools for this are the resources being provided by IPGRI: http://www.ipgri.org.
  including their large number of on-line publications and newsletters:
  http://www.ipgri.org/publications/publist.asp
  and, in particular, for devising systems of participatory breeding the following publication is recommended:
  Jarvis, D.I., L. Myer, H. Klemick, L. Guarino, M. Smale, A.H.D. Brown, M. Sadiki, B. Sthapit and T. Hodgkin. 2000. A Training Guide for In Situ Conservation On-Farm. Version 1. International Plant Genetic Resources Institute, Rome Italy. available by download at: http://www.ipgri.cgiar.org/publications/pubfile.asp/ID PUB=611)
- Seed and livestock diversity fairs: a good description can be found in Gonzales 2000.
- Developing demand for landraces: Ethiopia in particular has experience in promoting greater use of landraces in the informal market, as described in this article:
  Worede, M., T. Tsemma and R. Feyissa. 2000. Keeping diversity alive: an Ethiopian perspective. pp. 143-161. In: Brush, S.B. (ed.). Genes in the Field. Lewis Publishers, Boca Raton, FL.

Principle 1.3 There is a need to develop linkages between agricultural genetic conservation and use and benefits sharing.

The practices above, in principles 1.1 and 1.2 depend on the cooperation and participation of the state agricultural research sector, and of farmers. In order to make these practices sustainable, appropriate economic incentives need to be in place. This requires a proper valuation of the private and public functions of biodiversity. But first, adverse measures need to be removed.



Peru: While many kinds of modern seed improvement schemes lead to erosion of genetic diversity, as uniform modern varieties are promoted, an interesting project in Peru showed another way forward. To combat low yields of indigenous potato varieties in the highlands of Peru, a programme was launched to produce better seed quality- but instead of using modern potato varieties alone, it relied on varieties that farmers were already planting and valuing, based on prior surveys; this included 20 modern and 16 native varieties. Good clean quality seed was produced, and while the researchers fournd that it only increased production by 20%, farmers were willing to pay two to three times the normal price for this seed, but in small quantities and in the first year. Farmers bought the seed and used it to improve their own landraces; with the clean seed and new genetic material, they felt that they could manage to markedly improve their production for the subsequent five years. In this way, a demand was created and fulfilled- not a high volume market, but a very specialized, low volume but high value demand, for clean good quality seed which incorporated landrace characteristics.

from Thies, 2000

South Africa: The measure for the promotion of crop diversification at the farm level applied in South Africa to date has been the removal of agricultural subsidies. For example the Marketing of Agricultural Products Act 47 of 1996 came into effect in January 1997 and is based on the view that state intervention in agricultural markets should be the exception rather than the rule. Another example is that with the termination of the General Export Incentive Scheme in July 1997, export subsidies with respect to agricultural products are now zero. These radical reforms have had two aims, namely, increasing efficiency and productivity, and increasing opportunities for access to markets for small and medium-scale farmers.

BEST PRACTICES

- Removal of adverse subsidies for genetic resources
- Payment for ecological services
- Benefit-sharing agreements
- Market creation and support for commercialisation of biodiverse products

Agriculture is often an intensively subsidised economic sector. Therefore many prices are distorted and do not reflect the real costs of production. In many developed countries, large subsidies are applied to the agricultural sector. These have often been duplicated in developing countries, promoting the use of purchased seeds and other agricultural inputs. For many years, government seed programmes have concentrated almost exclusively on main staple crops and improved varieties. As the processes of seed multiplication, certification and marketing are often heavily subsidised, these policies favour the use of modern varieties. None of this can be said to benefit the conservation of genetic resources, and the inefficiencies of government seed programmes have made many of these largely ineffective (GTZ 2000). The removal of subsidies in countries such as South Africa (see box) provides a model for other countries.

Activities that can help countries to remove subsidies that have an adverse impact on the conservation of agricultural genetic resources are detailed in a series of publications by GTZ (see tools). Making subsidy systems more transparent, having strong national programmes of agricultural genetic resource conservation, and cooperating with other countries to multilaterally remove supports are some of these.

In some cases, countries have replaced adverse subsidies with “payments for ecological services”: environmental funds and public financing for positive incentives. If indeed genetic diversity can only be conserved ***in-situ*** by maintaining traditional farming systems, and yet this is not wholly advantageous to the farmers, then countries may need to consider compensating or supporting farmers for maintaining certain practices. China has had some experience with this undertaking, as has Austria (see boxes).

In the agricultural sector much thought has been devoted to developing international mechanisms for sharing the benefits of genetic resources. The road to commercialisation of agricultural genetic resources is often long and convoluted, such that there is not a ready source of income to be divided up between ***in-situ*** conservators and those who eventually may earn money from commericalising the conserved resources. Yet there should be some means of linking present-day conservators with future benefit streams The current vehicle being considered in international negotiations is a legally-binding treaty is called the ***International Undertaking on Plant Genetic Resources*** (IU). It covers major food crops and forages developed in farmers’ fields and stored in public gene banks. It aims to ensure the conservation, sustainable use and ‘free flow’ of the genetic resources of these crops and forages

China: The Chinese government has taken a direct role in the conservation efforts for the Hu-sheep. The remainder of the endangered Hu-sheep population has been placed into the hands of farmers, who are not allowed to sell, slaughter or exchange any of the animals without official permission, although they are compensated with a subsidy. In the core area of the project the keeping of any other type of sheep is prohibited. A herd book is kept and the lowest performing individuals are eliminated.

from Kölher-Rollefson, 2000

and, when they are used commercially, that farmers in developing countries receive a fair share of the benefits. The text of the International Undertaking is still being agreed upon by the international community, as of October 2001.

Creating markets for biodiverse agricultural products should be the most direct means of benefit sharing, providing immediate benefits to producers. But, while market incentives for organic agriculture are well established, the same is not yet true for genetically diverse agriculture. Yet, there is a need, within organic agriculture, for varieties that can produce under conditions of low agricultural inputs.

Local initiatives appealing to cultural pride may be a highly constructive tool, and one that should be promoted. One example given among the case studies of the Convention on Biological Diversity is that of a regional initiative to reinstitute a local cheesemaking industry from the endangered Aubrac cattel breed in France (http://216.95.224.231/agro/Casestudies.html).

A key ingredient of appropriate market incentives is that a larger share of profits are returned to producers rather than remaining with middlemen. In India, the Deccan Development Society has established an alternative market under their control where prices are more advantageous to farmers.

Austria: Austrian agriculture is characterised by a wide diversity of small farms, with almost half facing the challenging management problems of farming in mountainous regions. Whereas in most other European countries agricultural enterprises tend to be more intensive, in Austria an average farm is about 13 hectares, and an average dairy farmer has seven cows. Instead of subsidising agricultural inputs, Austria offers its farmers incentive payments for such activities as practising organic agriculture, NOT applying agricultural inputs or using high-yielding, intensive farm practices, and maintaining natural areas on-farm. The total number of participants in the programme own 64% of Austria's agricultural and forest landholdings. Requests for support for organic farming has been the most popular form of participation. Austrian policy makers have concluded that the programme is a success, and key to this success has been the fact that it has been broadly inclusive of all agricultural land, and all farmers. Famers are now much more sensitive and aware of environmental and conservation issues. One of the primary benefits to the country, besides supporting its farming sector, is that a healthy, green farm landscape is a major tourist draw for Austria.

from Thies, 2000

- An excellent series of publications on agrobiodiversity conservation are available at this web site, including a useful discussion of incentive measures, in the publication by Evy Thies (2000).
  http://www.gtz.de/agrobiodiv/english/pub/pub.htm

- With respect to payment for ecological services in conserving genetic resources, calculations have been made for the minimum land area needed to conserve traditional varieties, and ways of determing appropriate level of compensation, based on the opportunity costs of foregoing conversion to modern varieties; see: Virchow, D. 1999. Conservation of Genetic Resources. Costs and Implications for a Sustainable Utilisation of Plant Genetic Resources for Food and Agriculture. Springer Verlag. ISBN: 3-540-65343-0.

- Developments with respect to the International Undertaking on Plant Genetic Resources can be monitored by visiting the relevant United Nations Food and Agriculture Web page at: http://www.fao.org/ag/cgrfa/iu.htm

Principle 1.4 Strengthening community management of agricultural resources increases plant and animal diversity essential for secure livelihoods.

A number of the best practices listed before are targeted to communities, for example, seed and diversity fairs, strengthening cultural identities, community gene banks , and improving seed storage practices.

In addition to these more direct “interventions”, it is critical for both agricultural and biodiversity planners to recognise that communities, and community groups, are their allies. Indirect forms of support and planning for community mobilisation, awareness raising and capacity building are also advantageous to biodiversity conservation.

BEST PRACTICES

Encourage and facilitate formation of community based groups/community based organizations (CBG/CBOs), who participate fully in planning and management of Agricultural Genetic Resources, and evaluation.
Use of mass media and other avenues to regularly provide information relative to Agricultural Genetic Resources.
Incorporate Agricultural Genetic Resources in the educational system.

Integrating initiatives to conserve agricultural genetic resources with community develop-

Ethiopia: A partnership between breeders and the gene bank in Ethiopia is returning farmers’ varieties to areas from where they had disappeared. The best yields are selected from seed originally collected from the area where the reintroduction will take place and mix it to form a multiline mixture. On land which had been planted to pulses as in traditional fertility management, these composites yielded better than their counterparts, improved varieties planted in the same area with the application of the recommended amounts of fertilser

The farmers are also interested in new seeds and knowledge. Moreover, they stress the importance of transmitting the selection skills to new generations. This ensures that technological knowledge and skills for genetic resources conservation are retained in the community. Institutional memory is sustained through generations of social change (Berg, 1996).

ment will increase the capacity of farming communities to manage their resources in a sustainable manner. For example, in the model given on page 14 of the Deccan region of India, a roving festival instigated a conversation among farmers on the nutritive value of the foods they consumed, and the quality of fodder available for their cattle. Development that builds the capacity of communities to address these agricultural production issues, including using diverse farm genetic resources, has benefits all around.

Poverty and the ability to save seed are strongly linked. In countries where 60 - 90% of the seed planted is farmer produced and exchanged, poor households have less capacity to save seed as they more frequently need to sell or consume their entire harvest. Poor farmers often have to rely on whatever seed source they have access to at planting time, and are often not a part of the same social network of seed exchangers, particularly if they are women (Almekinders 2001). Yet in some communities, it is the older and poorer women-farmers who know the most about native varieites (Zimmerer 1991). The erosion of this knowledge may be stemmed by encouraging inclusive community groupings where benefits and knowledge - and genetic material- can be exchanged.

The public, be they farmers, consumers or policy-makers, often are not aware of their cultural heritages of farm genetic resources, and their value in sustainable agriculture. The consumption of local varieties and minor crops can be promoted by pointing out their value in the context of cultural heritage and identity in combination with nutritional values (Almekinders 2001). Sweet potato snacks are promoted in Bagio, the Northern Philippines, through publications, newsletters and events which stress their relationship to the subsistence of small-scale farmers in the region, and their role in providing revenue for farmers maintaining sweet potato diversity.

TOOLS

- Chapter 7 of the following publication provides a framework for working with communities and organisations to develop on-farm conservation initiatives:
  Jarvis, D.I., L. Myer, H. Klemick, L. Guarino, M. Smale, A.H.D. Brown, M. Sadiki, B. Sthapit and T. Hodgkin. 2000. A Training Guide for In Situ Conservation On-Farm. Version 1. International Plant Genetic Resources Institute, Rome Italy. available by download at: http://www.ipgri.cgiar.org/publications/pubfile.asp/ID PUB=611)
- The following two publications contain useful discussions of community-level management of farm genetic resources:
  Köhler-Rollefson, I. 2000. Management of Animal Genetic Diversity at Community Level. GTZ, Eschborn.
  Almekinders, Conny. 2001. Management of Crop Genetic Diversity at Community Level. GTZ, Eschborn.
  They can be downloaded at: http://www.gtz.de/agrobiodiv/english/pub/pub.htm
- As part of the In Situ Agricultural Biodiversity Conservation Project of the Intermediate Technology Development Group (ITDG) and the Overseas Development Institute, UK (ODI), an annonated bibliography of on-farm management of crop genetic diversity is available at http://www.ukabc.org/abc_bibliog.pdf

Principle 1.5 Develop appropriate partnerships.

Just as communities (Principle 1.4) and the private sector (Principle 1.6) have distinct and critical roles to play in the conservation of agricultural genetic resources, it should be recognised that in almost every successful campaign to promote on-farm conservation, a broad array of institutions have taken a role. Part of a national strategy should be to give official recognition and support to those institutions playing an intermediary role between communities and government agencies.

NGOs and research organisations can help to facilitate local, regional or national participation. They vary greatly in their aims and capacities, from being highly technical or delivery-oriented, to acting as advocates for community rights or environmental conservation. Such organisations may be particularly effective in developing a special focus on supporting the rights of traditionally-excluded constituencies: smallholder and subsistence farmers, women farmers, etc., and ensuring that they have the opportunity to participate in decisions about proposed programmes.

BEST PRACTICES

Develop partnerships among farmers, policymakers and researchers and all other stakeholders in conservation and useof agrobiodiversity.

Have a special focus on traditionally-excluded constituencies: smallholder and subsistence farmers, women farmers, etc.

TOOLS

- Certain international and regional NGOs focus on providing guidance on these issues at national and community levels. Links to many of these can be found at: http://directory.google.com/Top/Science/Environment/Biodiversity/Agricultural/ or

Partnerships in **Mexico, Morroco, Nepal:** To understand and support the mechanisms of *in situ* conservation on-farm, the International Plant Genetic Resources Institute, together with national partners in nine countries, has undertaken a global project on “Strengthening the Scientific Basis of *in situ* Conservation of Agricultural Biodiversity”. As diverse as each country project is, most include key collaborations with NGOs, national agricultural research centres, universities and community organisations. Three of these are described here:

The project in Mexico is situated in the centre-north of the Yucatan peninsula, an area where almost 50,000 families still practice a form of shifting cultivation with a mixture of maize, lima bean, cassava, yam, squash and other crops, all of which are cultivated in a multicropping system with large genetic diversity. Yet this farming system is threatened with disappearance, and any modification of the system will have serious implications for crop genetic diversity. A group of agricultural research organisations and universities from the national level work with a local NGO and the government extension service on participatory plant breeding, agro-ecosurveys, and farming system research to support existing *in-situ* conservation.

In Morroco, a unique array of agro-ecosystems with an equal range of genetic diversity for certain crops is under threat. The project has three sites, one in the Atlas Mountains, one in an oasis area and one in the Rif Mountains. The crop focus is on barley, durum wheat, faba bean alfalfa and bread wheat. The NPGRP, part of the NARs, works with the extension service and a number of NGOs.

Nepal is a rich centre of crop genetic diversity reflecting extreme ranges in altitude, ecological variation, antiquity of agriculture, and numerous ethnic and cultural groups. Three regions have been selected for the project, representing high, medium and low-altitude crop production systems. Upland, rainfed and irrigated production systems have been included. Major crops addressed in the project include rice, finger millet, barley, buckwheat, taro, sponge gourd and pigeon pea. The project focuses on participatory approaches to research, conservation, and plant breeding. The partners in Nepal aim to find an institutional and professional balance among the national agricultural research service and NGO researchers in implementing the project.

from Jarvis and Ndungú-Skilton, 2000

via the “links” on the www.ukabc.org web page. Some of those with well-developed capacity in facilitating advocacy and action on agricultural genetic resources for food and agriculture are:
Intermediate Technology Development Group International
Action Aid
ETC Group, International
AS-PTA, Brazil
Semillas, Colombia
Acción Ecológica, Ecuador
GRAIN, International
PELUM network, Southern and Eastern Africa
Navdanya, India
UBINIG, Bangladesh
SEARICE, Philippines
MASIPAG, Philippines
Seedsavers Network, Australia
Pro Specie Rara, Switzerland
Arche Noah, Austria
HDRA Heritage Seed Library, UK
SAVE, Europe
IPBN, International (Indigenous Peoples Biodiversity Network)
Seed Savers Exchange, USA
CLADES, Latin America
IATP, International

- One approach to develop common purposes among different organisations and a definition of each partners’ responsibilities is to use project planning and management tools in stakeholder meetings. A sourcebook that explains the use of such tools is available at:
http://www.worldbank.org/html/edi/sourcebook/sba102.htm

Principle 1.6 The private sector should take responsibility for ensuring that their private activities support the conservation of agricultural genetic resources.

Presently, it is the informal seed sector in developing countries that ensures food security for the rural population and sustains local management systems for plant genetic biodiversity conservation. The farm animal breeding market is not also not very commercialised; control of breeding animals is determined more by cultural practices than by market potential. Many of these “informal” practices are highly advantageous for biodiversity conservation. For example, in Rajasthan, India, a village bull is traditionally selected and maintained by the community as a whole. Villagers pool their resources to purchase a bull from a reputed breeder, share the upkeep by providing a fixed amount of grain and green fodder per household, employ a keeper, and make a joint decision on when and how to dispose of the bull to avoid inbreeding. National agricultural and biodiversity planners should support such informal sector and cooperative village economic ventures, at the same time as recognising a future role for the formal sector.

Undoubtedly, in the future, the formal private sector will take on a stronger role. If substantial incentives are to be provided to farmers conserving agricultural biodiversity, most of these incentives will need to be provided by the private sector. It will be up to government policy to lay out the rules and regulations to ensure that this is so. With respect to the seed and livestock breeding industries, the government has a critical role to play in crafting and enforcing laws and regulations; ultimately it is the state that sets standards and establishes the incentives and penalties to assure that these are achieved.

BEST PRACTICES

- Support complementarities between the formal and informal seed sectors
- Modify regulatory and legal frameworks of formal seed supply systems, especially with regard to registration and certification.
- Develop a coherent Agricultural Sector Programme and a National Seed Policy in which the importance of the informal sector is recognised.
- Private sector development:
  - a. Financial conditions (credit/investment, tax and seed import/export procedures) favourable for (small-scale) private initiatives
  - b. Administrative and legal conditions favourable for small-scale private enterprises

Large-scale, government-led seed industries in biodiverse developing countries have rarely functioned well. The formal seed sector has not been able to address widely varying agro-ecological conditions or the needs and preferences of small-scale farmers. In many cases, farmers produce in many cases seed of similar or higher quality and at more affordable costs than the seed programmes. However, informal systems also have severe limits. In particular, low yields or crop failures impact heavily on seed availability. Once collapsed, the local system does not easily recuperate. In such a situation, local varieties are easily lost and replaced by relief-supplied seeds (GTZ, 2000).

Better interaction between the formal and the informal systems can serve both. The farmers' demand for seed in developing countries is complex and diverse. It is not realistic or efficient for the formal seed sector to aim at covering the total seed demand. Instead of

Canada: In the New Brunswick province of Canada in the late 1970s there were no mills for processing bread wheats. All flour was imported- although it had been grown in the area justa hundred years ago. A group of enterprising people put together the Speerville Mill Cooperative and began milling wheat. The cooperative wished to encourage local growers to produce organic flour, for a high-value, regional market. As farmers began to plant wheat again, the New Brunswick Department of Agriculture assisted by beginning milling wheat farm trials, at the request of the milling cooperative. Varieties that could be grown under organic conditions were identified. But as demand has outstripped supply, the Speerville Mill began to think seriously about how to increase production. Farmers, at the same time, were expressing dissatisfaction with the most common milling wheat variety, which had been bred in western Canada under dry conditions. The variety yielded poorly and suffered weed and disease problems under the humid, maritime conditions of New Brunswick. Moreover, it had been selected for response to conventional management (using herbicides, synthetic fertilisers, fungicides and other pest control products) and did not respond as well as was hoped in organic production.

The Martime Certified Organic Growers and Speerville Mill, in cooperation with the New Brunswick Department of Agriculture, initiated a new set of trials on organic farms, using a diverse collection of wheat varieties, including various "heritage" wheats from the Canadian Genebank, Seeds of Diversity Canada, farmer-saved seed and seed dealers.

While trials are still ongoing, farmers are realising that not all characteristics can be found in one variety. Nutrient quality has been an important criteria to the farmers and to the mill, and it was noted that yield is often inversely related to protein content. In 1998, all growers supplying Speerville Mill grew at least two varieties of wheat.

from J. Scott, in Almekinders and De Boef, 2000

Bangladesh: The Bangladesh-German Seed Development Project supported by GTZ, is implemented with the Bangladesh Agricultural Development Corporation (BADC), which traditionally has been the organisation responsible forfertiliser supply to agriculture. With regard to the informal sector, the project evaluates the potential for small-scale seed enterprise development. It specifically targets the development of organisations and capacities of small farmers in Bangladesh to produce, process and market seeds. It is also important in relation to the re-orientation of the perceptions of public sector technicians, in particularly those in BADC.

replacing the informal sector, the formal sector can build on farmers' capacities and knowledge regarding local conditions and seed selection to address more effectively the seed demands of small-scale farmers. The informal system can be significantly strengthened, for instance, by introducing improved genetic materials and adapting improved seed technology to local conditions. A more diverse portfolio of varieties and seeds provided by the formal sector offers farmers a wider choice. This enhances the use of crop genetic diversity in farmers' fields.

The regulatory and legal framework of the national formal seed system in many countries becomes a factor that limits the development of the informal seed system. National seed regulations are usually based on international standards, which are often useless or incompatible with farmers' reality. They impose restrictions on free exchange and marketing of seeds. The combination of compulsory variety registration and seed certification, as practised in European and other countries, is an especially heavy constraint both on the efficient functioning of the formal seed sector and on the development of alternative seed systems. At present the seed policy in many countries is restricting informal seed sector development. A legal framework has to support a pluralistic variety of seed supply, with farmers being served by a number of institutions, including those in the private sector. On-farm seed production and exchange, maintenance, development and registration of local varieties should not be restricted by national seed policies. In a system with multiple seed sources to select from, seed control or certification may not be relevant for all seed planted, but can concentrate on, for instance, breeder and foundation seed.

It is critical to support activities to improve seed production and marketing relating to farm genetic resource conservation. The opportunities for successful small seed enterprises need careful analysis: Seed enterprises can only be sustainable if seed demand is sufficiently large and constant. Yet conservation of biodiverse farming systems requires a diverse portfolio of genetic resources.

It is difficult to find an exemplary model of private sector involvement in agricultural genetic resource conservation; it may be that these models are only on the horizon, currently under construction. But if we can take a milling cooperative and farmer groups as representing the private sector, there are interesting case studies (see box, Canada) which may serve as good models. Some exemplary development projects (see box, Bangladesh) also suggest the way forward.

TOOLS

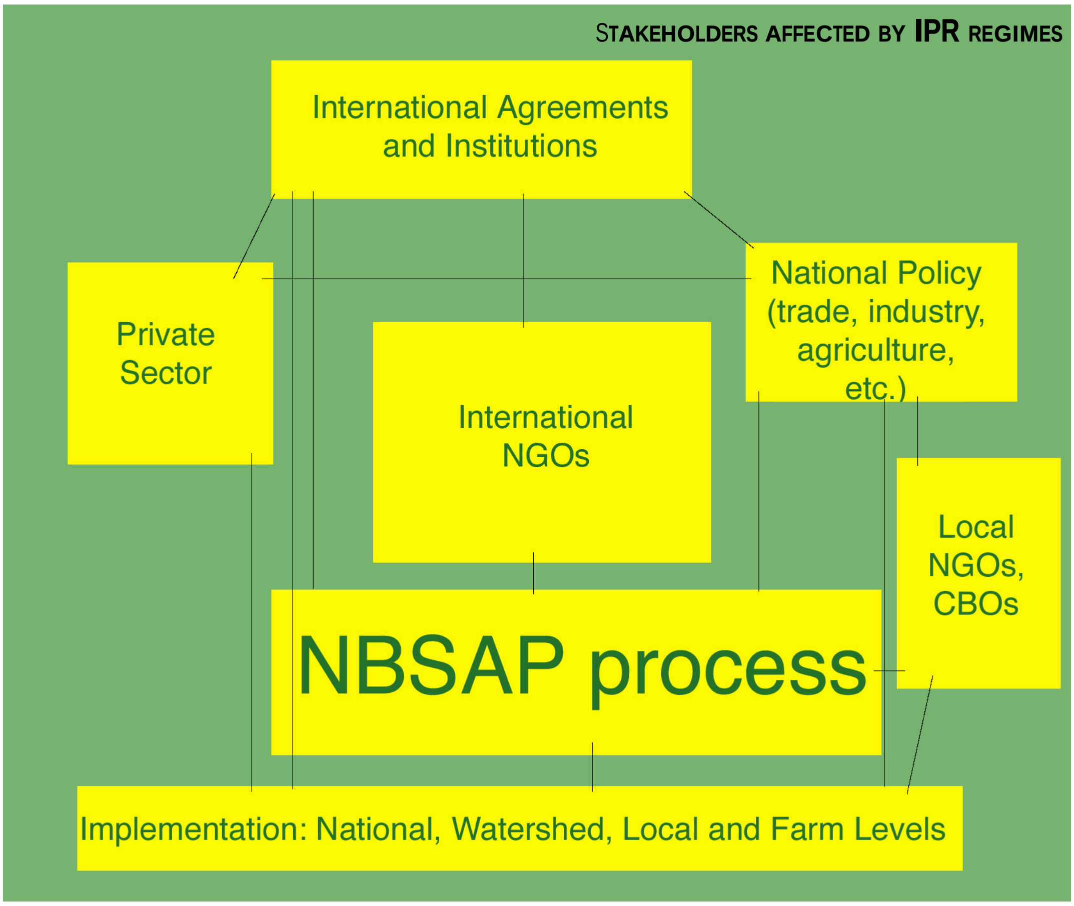
- much of the foregoing information is derived from the excellent small booklet produced by GTZ, "Support for the Informal Seed Sector in Development Cooperation - Conceptual Issues" available online at http://www.gtz.de/agrobiodiv/english/pub/pub.htm.

- A useful discussion of seed laws can be found in:
  Louwaars, N. and R. Tripp. 2000. Seed legislation and the use of local genetic resources. pp. 269-275 in C. Almekinders and W. de Boef, Encouraging Diversity. ITDG Publications

Principle 1.7 Issues of access, benefit sharing and intellectual property rights are central to the NBSAP process so planners need to carefully consider the position of various stakeholders.

Many other working groups related to the Convention on Biological Diversity or the United Nations Food and Agriculture Organisation are addressing these issues in depth, which we will not try to do here. Nonetheless a "guide to best practices" for managing agricultural resources in biodiversity-friendly ways needs to touch on the subject as well, as it could potentially have tremendous influence on future practices. We have tried here to simply distill the critical points to which national biodiversity planners will need to pay attention.

At present, the recognition of intellectual property rights for farmers' varieties and traditional knowledge of agrobiodiversity is problematic. Existing laws are clearly not able to protect the use of traditional knowledge. Traditional knowledge ***per se*** is "generally known" and therefore cannot be protected under current national and international patent law. In general, only the results of research and development obtained on the basis of traditional knowledge is commercially valuable, and that after many years of research investment. There is discussion of a law dealing with Community Intellectual Property Rights, and also a law dealing with Farmer's Rights. The International Undertaking on Plant Genetic Resources addresses a version of these concepts, in relation to thirty-five staple crops and twenty-nine forage crops. None of these are yet in force, but NBSAP planners should be aware of them, and they should be introduced to stakeholder consultations for consideration.



The CBD does promote a

first step of requiring access-seekers to obtain “prior informed consent” from indigenous and local communities, based on full knowledge and information, before making use of indigenous knowledge or genetic resources.

A fuller discussion of knowledge systems in relation to agricultural biodiversity can be found in section 3.5

BEST PRACTICES

Develop an appropriate and broad stakeholder consultation process (include e.g. ministries, farmers/herders, private sector, lawyers, scientists, NGOs to consider the issues, in relation to national biodiversity strategies.
Develop national policies to support distribution of benefits from IPR to farmers and holders of traditional knowledge.

The diagram on the previous page (“stakeholders affected by IPR regimes”) is a first approximation of the key stakeholder groups and their relationship to national biodiveristy planning teams.

National policies on benefit sharing with communities and farmers are still at an early stage. A few countries are experimenting with innovative mechanisms (see box, Ecuador) although there is not as yet much experience with these.

TOOLS

- Developments with respect to the International Undertaking on Plant Genetic Resources can be monitored by visiting the relevant United Nations Food and Agriculture Web page at: http://www.fao.org/ag/cgrfa/iu.htm
- CBD web pages on access and benefit sharing can be found at: http://www.biodiv.org/programmes/socio-eco/benefit/default.asp.
- The Biodiversity Planning Support Programme features a new publication on “Preparing a National Strategy on Access to Genetic Resources and Benefit Sharing, available on line at; http://www.undp.org/bpsp/thematic_links/access.htm#absrbgk, and containing many useful links to national case studies and supplemental material.

Ecuador: From traditional knowledge to trade secrets- the Cartel project in Ecuador

The pilot phase of a project entitled “The Transformation of Traditional Knowledge into Trade Secrets” is underway in Ecuador. The project starts from the premise that biological diversity shares a similar cost structure to that of an information good: extremely high opportunity cost in the maintenance of habitats. It is argued that in a parallel to patents, copyrights and trademarks, which are accepted as instruments to enable the emergence of a market for information goods, oligopoly rights over genetic resources should be allowed to enable the emergence of a market for habitats. Thus the project attempts to achieve a cartelisation of traditional knowledge in Ecuador. It is a collaborative effort by the Inter-American Development Bank and several NGOs. The project sets out to catalogue traditional knowledge and maintains the database at regional centers, which is safeguarded through a hierarchy of access restrictions. After filtering, the knowledge that is not yet public will be negotiated as a trade secret in a Material Transfer Agreement (MTA). The benefits from the MTA are to be split between the Government and all communities that deposited the same knowledge in the database. Quite similar approaches to handle indigenous and local knowledge have been chosen for example in India.

from E. Thies 2000

Principle 1.8 Recent advances in biotechnology have profound implications for agricultural genetic resources and these need to be addressed by the NBSAP process

As with the preceding principle, there are many other working groups considering biotechnology issues, and we cannot do the subject justice in this short guide. Nonetheless, biodiversity planners should be aware of these working groups, and the models presently available to national governments to formulate policies related to biotechnology in agriculture.

BEST PRACTICES

Harmonization of biotechnology, biosafety and biodiversity policies
Provide appropriate incentives to private sector to transfer techniques to enable developing countries to use biotechnology in appropriate ways for sustainable development.

Most of the focus on biotechnology issues right now is on the implementation of the supplementary agreement to the Convention on Biological Diversity known as the Cartagena Protocol on Biosafety. The Protocol seeks to protect biological diversity from the potential risks posed by living modified organisms resulting from modern biotechnology. It establishes an advance informed agreement (AIA) procedure for ensuring that countries are provided with the information necessary to make informed decisions before agreeing to the import of such organisms into their territory. The Protocol also contains reference to a precautionary approach and reaffirms the precautionary language in Principle 15 of the Rio Declaration on Environment and Development. The Protocol also establishes a Biosafety Clearing-House to facilitate the exchange of information on living modified organisms and to assist countries in the implementation of the Protocol.

TOOLS

- The CBD web page on biosafety (http://www.biodiv.org/biosafety/) provides many linkes, including to a simplified list of frequently asked questions: http://www.biodiv.org/biosafety/faqs.asp.
- A new book just recently published by the International Food Policy Research Institute looks at policies affecting the adoption of GM crops in four important developing countries: Kenya, Brazil, India, and China. The author identifies five policy areas in which governments of developing countries can either support or discourage GM crops: intellectual property rights, biosafety, trade, food safety, and public research and investment:
  Paarlberg, R.L. 2001. The Politics of Precaution: Genetically Modified Crops in Developing Countries. IFPRI, Washington D.C. 184 pp.

Principle 1.9 Expanding global trade increases access to biodiversity for countries, but the potential hazards to agricultural genetic resources need to be addressed by the NBSAP process.

Unintentional introductions of alien and invasive species through international trade is posing one of the greatest threats to the world's biodiveristy. Although we do not know all of the pathways by which alien species find their ways to distant shores or fields, agricultural policies and practices are strongly implicated, as can be seen from the following list of pathways, both intentional and unintentional.

•Intentional introductions for: Agriculture, Forestry, Soil conservation, Horticulture, Hunting, Biological control, Research, and Other
•Unintentional introductions through contaminants of: agricultural produce, nursery stock: cut flowers, timber, seeds and inorganic material.
from: the Global Invasive Species Program/Pathways of Invasives project component, available from the website: http://www.biodiv.org/programmes/cross-cutting/alien/links.asp

Here again, the number and depth of international and national initiatives addressing alien species issues is tremendous, and national biodiversity planners are best served by being referred to relevant bodies of information.

BEST PRACTICES

National agricultural and biodiversity planners should integrate trade and biodiversity issues into national legislation and regulations

New Zealand: New Zealanders recognise that to preserve the country's flora and fauna, clean air, fresh water, open spaces and green pastures, they must be vigilant against alien invasive species. They have established a BioSecurity Authority to provide greater focus and coordination in the New Zealand Government's programme to protect the health and welfare of the animal and plant populations intheir 268,000 square kilometres, from alien invasions. The Biosecurity Authority is the largest Government provider of biosecurity services in the world. It employs over 80 technical experts and operates well-established frameworks for setting standards and managing associated risks. On the New Zealand Ministry of Agriculture and Forestry Biosecurity webpage (http://www.protectnz.org.nz/grids/index.asp?id=12&area=12), there is a link for producers and growers, which begins:

"Welcome to the Producers and Growers section of the Protect New Zealand web-site. If you are a farmer, horticulturist, or involved in forestry or any other form of primary production, you can find information here about the biosecurity issues facing New Zealand and your business. It outlines what is being done and what you need to know to protect our agricultural economy and our fragile environment."

The website, and programme literature seek to help people identify "creepy crawlies" that they may encounter intheir backyard, in container loads of imported goods or other places, so that they can call and report new infestations before they are out of control.

International cooperation is needed on identification, early warning, monitoring e.g. biological controls

Island states are usually the most vulnerable to alien invasive species, and often can serve as excellent lessons of what not to do, as well as lessons of strong proactive programmes, such as that of the New Zealand BioSecurity programme (see box).

TOOLS

- The CBD web page on alien species (http://www.biodiv.org/programmes/cross-cutting/alien/default.asp) provides basic information and links (http://www.biodiv.org/programmes/cross-cutting/alien/links.asp) to related websites.
- From this links page, the "IUCN Guidelines for the Prevention of Biodiversity Loss Caused by Alien Invasive Species" is available, with many practical actions suggested for national governments.
- The New Zealand Ministry of Agriculture and Forestry Biosecurity webpage (http://www.protectnz.org.nz/grids/index.asp?id=12&area=12) provides an excellent national model