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GLOBAL STRATEGY FOR PLANT CONSERVATION

Technical review of the targets and analysis of opportunities for their implementation: report of the meeting of technical experts on the Global Plant Conservation Strategy, Gran Canaria, 11-13 February 2002

Addendum

NATIONALLY BASED INITIATIVES THAT CAN CONTRIBUTE TO THE IMPLEMENTATION OF THE STRATEGY

A. INTRODUCTION

1. The proposed Strategy suggests that national targets developed within this framework may vary from country to country, according to national priorities and capacities taking into account differences in plant diversity. It further suggests that measures to implement the strategy will need to be put in place at international, national, and sub-national levels. This will include development of national targets and their incorporation into relevant plans, programmes and initiatives, including national biodiversity strategies and action plans. National targets will vary from country to country according to differences in levels of plant diversity and national priorities. Multilateral and bilateral funding agencies should consider putting in place policies and procedures to ensure that their funding activities are supportive of and do not run counter to the strategy and its targets. The Strategy notes that for each target, the scope of activities may need to be clarified and sub-targets, or milestones, developed. In order to monitor progress towards achieving the targets, baseline data and a series of indicators may need to be developed. This would draw upon relevant national and international data sets (such as national "red lists"), and make full use of the clearing-house mechanism.

2. The aim of the review contained in this paper is to identify existing activities at a national level that can contribute to the achievement of a global strategy for plant conservation, if adopted, and will also highlight regional and or thematic gaps. It illustrates the capacity for plant conservation in each country with a sample of activities. A similar review undertaken to identify existing international activities;

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submissions from relevant organisations working on the GPCS are to be found on the web page *http://www.biodiv.org/cross-cutting/plant/default.asp*.

3. This review has been compiled from the following sources:

- Relevant sections of national reports prepared by the parties to the Convention
- Information taken from the websites of government departments (e.g. environment, agriculture), research organisations (e.g. agriculture, forestry, natural resources and development), universities, botanic gardens and NGOs
- Case studies and reports published in recent journals, newsletters, reports and bulletins of a variety of organisations operating at national and other levels.

4. This review includes examples of specific activity for plant conservation in many countries worldwide. It is not intended to be a comprehensive review of all activities of relevance to the proposed Global Strategy for Plant Conservation, but provides an indicative illustration of significant and relevant activities at national and sub-national levels throughout the world that can contribute to the achievement of the Strategy, and in particular to the achievement of the 16 targets included in this draft Strategy.

5. The review does not provide a comprehensive review of protected area protection and protected area networks at national levels, although these represent the major means by which *in situ* conservation of wild plants is undertaken in all parts of the world. Neither does the review the very large range of national wildlife protection legislation that is of relevance to plant conservation and protection. Information on national Red Data Lists for Plants is presented elsewhere (eg. Walters and Gillett, 1998) and has not been included. The information included in the *Progress Report on the Global Taxonomy Initiative* (UNEP/CBD/SBSTTA/6/INF/4) on relevant taxonomic activities in relation to plants has not been repeated but is relevant to several targets, particularly Target 1. The role of plants in sustainable development and sustainable use has been considered to some extent but this coverage is not intended to be comprehensive (e.g. on the conservation of medicinal plants, minor crops and crop relatives); further information on these are provided in the Country Reports from the *Report on the State of the World's Plant Genetic Resources* (1996, FAO Commission on Genetic Resources for Food and Agriculture). Some activities in raising public awareness of the importance of plant diversity are included, particularly those undertaken by a range of national organisations and other bodies (such as national park authorities, botanic gardens and a range of NGOs). The incorporation of environmental education and awareness issues on plant conservation into national educational curricula was beyond the scope of the present review and so has not been addressed.

B. REVIEW OF THE NATIONALLY-BASED INITIATIVES

I. UNDERSTANDING AND DOCUMENTING PLANT DIVERSITY

Target 1: A widely accessible working list of known plant species, as a step towards a complete world flora.

1.1. Introduction and background

A working list of known plant species at national level on a taxonomic and/or thematic basis may be created from Floras, checklists, monographs, journals and relevant taxonomic databases.

Most of this information included in this review is taken from the *Progress Report on the Global Taxonomy Initiative* - UNEP/CBD/SBSTTA/6/INF/4 (12 February 2001). From the results of a

questionnaire sent to all the parties to the CBD in April 2000, 54% of 59 countries have undertaken some taxonomic needs assessment at the national or regional level (UNEP/CBD/SBSTTA/6/INF/4). 59% of countries had identified taxonomic needs and 44% countries have some form of registers of taxonomists.

1.2. Examples

Countries with comprehensive understanding of their floras
Countries with comprehensive understanding of their floras are those with the best taxonomic facilities, in Europe (UK, Ireland and Portugal have complete and up-to-date floral inventories), North America, Australia, New Zealand and South Africa. Some of these countries have electronic databases of their floras and some of these are accessible on the internet. However, countries such as Australia with an extremely diverse for (12 endemic plant families - more than any other country in the world) consider they need to accelerate research in the taxonomy, geographic distribution and evolutionary relationships of terrestrial, marine and other aquatic plants giving priority to least known groups including non-vascular plants, and fungi. Most European countries are also involved with European initiatives such as Euro+Med PlantBase (an integrated system to replace *Flora Europaea*) and *Atlas Florae Europaeae*.

Countries with efficient databases
Other countries have established efficient databases, such as Egypt with a database with more than 35% of its biota included. In Greece, the Greek flora is documented in two databases: the Data Bank for the Greek Natural Environment (5,517 taxa, 430 sites) and the database of *Flora Hellenica* (5,605 spp.).

Countries producing a list of accepted names as a priority
A Flora of the Philippines has been listed as priority in the National Biodiversity Study and Action Plan.

Countries with inventories of their flora.
The inventories are undertaken at different scales. For instance, in India, the Centre for Taxonomic Studies (Bangalore) and Rapinat Herbarium (Tiruchirapalli) and Centres for advance studies (CAS) is undertaking the documentation of state and regional Floras. In Brazil, the National Botany Plan (Plano Nacional de Botânica) is promoting the compilation of flora at State level which will lead to a new *Flora Brasiliense*; the Taxonomic Diversity Programme (Programa Diversidad Taxonômica) set up in 1996 coordinates the taxonomic effort. Other inventories are addressing specific priorities, such as the case of Turkey which has set as a priority the improvement of inventories at ecosystem and species level on jurisdictional boundaries; the Laboratory of Botany (Institute of Botany) in Latvia preparing a new issue of the *Flora of Vascular Plants* and Floras of mosses and woody plants, and; Malawi undertaking a checklists of plants in protected areas and sites of high plant diversity and taxonomic treatments and revising major plant taxa.

Many countries having put in place measures to improve the taxonomic effort.
Malawi, has been undertaken a comprehensive collection of plant species throughout country. Other national institutions are responsible for supplying information to authorities and the public and have been strengthened accordingly such as the case of the Norway's natural history museums. SABONET, the Southern African Botanical Diversity Network, operating in Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe has conducted a taxonomic needs assessment for each country with the aim of improving the capacity of these countries to undertake taxonomic inventories.

Other countries having determined main taxonomic interest in thematic groups
Some examples are Austria, focusing on vegetable varieties, Malawi which as published a major ethnobotanical survey of the flora, and Santa Lucia, which has identified the need for inventories of aromatic and medicinal plants necessary for a successful biodiversity utilisation programme.

Countries having identified a need to strengthen their national institutions for taxonomy. This is the case for instance of The Bahamas, Gambia and Guyana.

1.3. Thematic and geographical gaps

Many countries are working on national lists of known plant species. Many countries have undertaken taxonomic need assessments and have increased their national capacity for taxonomic research. However, very few are widely accessible electronically. This must be a priority for all those working on checklists.

Although most countries have floras, checklists and other reviews available, these are of mixed quality and comprehensiveness.

Target 2: A preliminary assessment of the conservation status of all known plant species, at national, regional and international levels.

2.1. Introduction and background

The 2000 IUCN *Red List of Threatened Species* records just over 5,600 plant species as threatened. This artificia lly low figure is due to the current period when the conservation status of so many floras and groups are being reassessed to apply the new (1994) IUCN Red Data Book Categories – applying quantitative measures of endangerment for the first time. The previous *IUCN Red List of Threatened Plants* of 1997 listed almost 34,000 threatened plants, to which the old Red List Categories were applied. This figure represented c.12.5% of the world's vascular flora, which was acknowledged at that time to be a considerable underestimation of the true picture. Examination of that IUCN list indicates that in many areas of the world the status of the flora is still poorly known. For example in Colombia and Brazil, countries with totals of over 50,000 species each, less that 2% of their floras are recorded as threatened. In other countries where the flora is better known the percentage of threatened species is 10% and above, as in Australia, South Africa, Spain and the United States.

There is also considerable variation in the percentages of threatened species known in different families, some of which is due to inadequate knowledge of conservation status.

178 countries are recorded as having lists of threatened plants.

The examples given below involve conservation status reviews and monitoring of plant species in the wild, some of which also contribute to the achievement of Target 3.

2.2. Examples

National assessments inform on the number of plants on the national Red List, such as 35% in the case of Netherlands, 505 vascular plants (including 238 bryophytes) in Sweden and between 33% and 95% of plant and animal species considered to be rare and endangered (depending on taxonomic group) and some being extinct in Switzerland. The Estonian National Environmental Monitoring Programme has monitored 142 species of vascular plants and 440 sites since 1994, and the Hungarian National Biodiversity Monitoring System (organised by the National Authority for Nature Conservation) since 1998. The Agency for Nature Conservation and Landscape Protection of the Czech Republic co-ordinates rescue and monitoring programmes for threatened species; a national register includes 267 critically endangered species. In Greece, a database of endemic rare and threatened plants of the Greek flora *Chloris* (Department of Botany, University of Athens) (2,000 taxa) contains all threatened and protected Greek taxa and >90%) of endemic taxa). The National Herbarium of Swaziland has re-assessed 198 species for a national Red Data List, which will be useful for when the schedules of protected flora are appended to the Flora Protection Bill, 10, 2000 by the Swaziland Government.

2.3. Thematic and geographical gaps

Up to data and comprehensive Red Lists of threatened plants are incomplete or lacking for many countries. Few countries have comprehensively assessed their national flora with reference to the 1994 IUCN Red Data Book categories.

Target 3: Development of models with protocols for plant conservation and sustainable use, based on research and practical expertise.

3.1. Introduction and background

Plant conservation will need to focus on protective and active management of habitats to maintain plant diversity and ecological processes and also on the management of individual plant species and populations to retain viable populations and prevent loss or extinction. Conservation protocols and techniques are the practical management steps and tools required to maintain and restore levels of botanical and habitat diversity; this requires the integration of the scientific approach with applied practical approaches.

This section includes conservation strategies, research, pilot projects, recovery plans and the assessment of techniques for restoration and methodologies for the transfer of the successful techniques. Examples of the monitoring of biodiversity are to be found in Target 2. Baseline data on the status of plant diversity is discussed in Target 2 (species) and Targets 4-5 (habitats). The importance of capacity for conservation management is discussed in Target 15 and networks for ensuring continuity of information in Target 16.

3.2. Examples

Plant Recovery Plans and Programmes
In Lesotho, the Micropropagation Unit at the Royal Botanic Gardens, Kew has used *in vitro* techniques for *Aloe polyphylla*. The micropropagation of orchids from seed has also been carried out in Madagascar at the Royal Botanic Gardens, Kew, U.K. and by hand-pollination at the National Botanic Garden of Tsimbazaza. In South Africa, the National Botanical Institute through its Horticultural Research Programme, studies the propagation and cultivation of South African plants as an essential element of habitat restoration projects. Kirstenbosch Botanic Garden has published the results of their horticultural research on native plants in a series of booklets. Some South African examples of integrated *in situ* and *ex situ* programmes are the propagation and cultivation of *Raspalia trigyna* (at Kirstenbosch) and *Stapelia clavicorona* (at Lowveld and Pretoria National Botanical Gardens) for reintroduction into the wild.

In Malaysia, *Aleisanthia rupestris* has been propagated with a view to reintroduction, in conjunction with stronger controls for its habitat (Universiti Malaya).

Many plant recovery plans are being put in place for specific species such as to save *Narcissus cavanillesii* from extinction in Portugal, for *Atropa baetica* and *Echinospartium algibicum* in southern Spain (by The Comisión Interministerial de Ciencias y Tecnología (CICYT)), and for *Clianthus puniceus in* New Zealand. Other management systems are established for the preservation of the biodiversity of particular ecosystems such as for Garry Oak (12 species), NS Coastal Plains (7 species), and tallgrass communities (10 species) in Canada, and for the semi-natural grasslands in Sweden (by The Swedish Biodiversity Centre. In USA, of 742 endangered and threatened plant species, 585 have recovery plans, which are administered by the U.S. Fish and Wildlife Service.

The Andromeda Botanic Garden in Barbados has been undertaking recovery programmes for several priority native species e.g. *Adiantum tenerum* var. *farleyense*, Barbados Farley Fern and the Barbados Mastic (*Mastichodendron sloaneanum*). In Brazil, field experiments involving multi-species plantations

(generally native) are in progress to assess techniques for restoration and establish methodologies for the transfer of the successful techniques (e.g. Conservation and Restoration of the Atlantic Forest Coastal Lowlands part of the Project for the Conservation and Sustainable Use of Biodiversity – PROBIO).

Nationally-based initiatives with regional scope
The Swiss Commission for the Conservation of Wild Plants (CPS) and the Swiss Floristic Network (CRSF) have investigated 41 species threatened at the European level, and a first group of 91 species threatened at the national level. Scientific research and field work on priority species has led to the publication of 132 conservation data sheets and preparation of conservation action plans. A scientific advisory committee from the Bern Botanic Garden and the local canton is conserving *Viola elatior*.

Research Programmes
Other research programmes and projects are supporting overseas territories. Royal Botanic Gardens, Kew, United Kingdom, manage The *Sustainable Environment and Development Strategy* for St Helena, South Atlantic; in it, 8 species, including *Nesiota elliptica* and *Trochetiopsis* spp., are recommended for *ex situ* propagation. In Costa Rica, a System-wide Genetic Resources Programme (SGRP)-supported programme is examining the effects of fragmentation on the maintenance of genetic diversity in a forested area in the northeastern region (CGIAR - Consultative Group on International Agricultural Research created the SGRP).

3.3. Thematic and geographical gaps

In regard to basic conservation needs, the development of practical management techniques for understanding plant populations and their inherent diversity must be a priority. These techniques include the development of practical and cost-effective methodologies in habitat management and restoration, increased research to devise strategies to deliver genetically and ecologically sound reserve boundaries, the development of monitoring protocols and the development of more focussed recovery programmes, which have local ownership by relevant stakeholders.

At a geographical level, many species-rich countries with threatened and heavily utilized taxa need to boost their capacity for research into understanding the basic needs of threatened species and plant communities and to develop conservation protocols and techniques for plant conservation.

II. CONSERVING PLANT DIVERSITY

Target 4: At least 10 per cent of each of the world's ecological regions effectively conserved.

4.1 Introduction and background/overview

Ecological regions are extensive zones of similar ecosystem type and can include all types of landscape, depending on different degrees of modification, from pristine to monocultures. Conservation includes not only botanical features of special conservation value, but also resources for local communities. Some countries conserve biodiversity through the identification of important ecological areas.

This Target (conservation of ecological areas) has some overlap with Target 5 (protection of areas of plant diversity). Both provide a method of identifying conservation priorities and action and are complementary. Some specific examples are given for Target 4, but many of them are also applicable to Target 5.

4.2. Examples

Some national parks have been set up taking into account regional priorities and bordering countries. This is the case of a new national park in Albania, which has been set up, linking those in bordering Macedonia (FYROM) and Greece, with the assistance of the Albanian Environmental Association for the Protection and Preservation of Nature and Environment and the German European Natural Heritage Fund (EURONATUR). The park includes arid grasslands and the last remaining high beech and oak forests; ecological data is being evaluated and conservation measures introduced. In Sweden, the conservation of biodiversity is undertaken mainly following the priorities included in the EU Habitats Directive and Natura 2000, but it is not species-focussed.

Other strategies are focusing primary on national and species priorities. In Antigua /Barbuda, the conservation efforts are focused on coastal and marine resources, mangrove and wetland systems. In Grenada, the Forestry Department and the Forest Management Project are creating three more forest reserves, which will result in approximately one third of the island's forests being protected. In Chile, the conservation of the native forests is a priority through legislation and other conservation methods (CONAMA Comisión Nacional del Medio Ambiente). The proposed Species at Risk Act (SARA) in Canada will cover all wildlife species listed as being at risk nationally and their critical habitats, with the objective of helping their numbers to recover; ecosystems have recovery plans for species such as Garry Oak (12 species), NS Coastal Plains (7 species), and Tallgrass Communities (10 species).

4.3. Thematic and geographical gaps

Further work on identification and assessment of ecological regions of each country needs to be undertaken as a basis for strengthening national networks of protected areas that are ecologically representative and comprehensive in their coverage.

Target 5: Protection of 50 per cent of the most important areas for plant diversity assured.

5.1. Introduction and background/overview

An IPA (Important Plant Area) is 'a natural or semi-natural site exhibiting exceptional botanical richness and/or supporting an outstanding assemblage of rare, threatened, and/or endemic plant species and/or vegetation of high botanic value'. The guidelines for selecting IPAs (Palmer and Smart 2001) are based on three broad criteria that have been developed and refined since 1995 (UNEP/CBD/SBSTTA/7/INF/10). The programme is most advanced in Europe, although the methodology is designed for use anywhere in the world. A number of preliminary studies have been completed, and attempts have been made to identify IPAs in a range of countries, including Belarus, Czech Republic, Greece, Slovenia, Sweden Turkey and the UK. The study for Turkey is particularly well advanced. A balance has been achieved between endemic-rich mountain areas and lowland habitats such as coastal sand dunes. Other countries and regions considering the initiation of programmes include Uganda, Kenya and Australasia.

Another initiative for identifying regions of high plant diversity have been the publication of *Centres of plant diversity: a guide and strategy for their conservation* (WWF and IUCN 1994, 3 volumes) which identifies a total of 234 sites (CPD) in the world based on statistics of floristic richness and endemism and The Hot Spot Approach (Biodiversity hotspots for conservation priorities Myers *et al.*, 200 Nature 403:853-858).

All ecological regions will probably fall within Target 5, so the examples used will also apply to Target 4; some examples more focussed on the ecological regions are put in Target 4. This Target illustrates the designation of conservation areas, the use of laws to protect important areas for plant diversity (conservation of important botanical sites) (cf. Target 7 laws (collection, damage of threatened species) relating to *in situ* conservation of threatened species).

5.2. Examples

Plant Diversity Management
In Morocco, priority is given to *in situ* conservation within reserves and protected areas, through the Institut Agronomique et Veterinaire Hassan II, Institut Scientifique (Wild flora) and Universities (Argan tree). Indigenous species include *Pinus maritima, P. halepensis, Cedrus atlantica* and *Tetraclinis articulata* In Mauritius, *a* range of national initiatives are being undertaken to conserve the endemic flora of Mauritius, much of which is reduced to tiny surviving populations; these include the formation of a National Park in the Black River Gorges area to conserve remnant native forest, as well as the maintenance of smaller nature reserves elsewhere in the island. In Lebanon, there are four national nature reserves, including the Forest of Ehden, which contains 126 threatened species and fourteen protected zones which include the cedar groves of Tannourine and Hadath el Jobbe; a survey of coastal vegetation, identifying threatened plant species and areas for plant conservation, is under way in collaboration with the Royal Botanic Gardens Kew and the University of Reading. The miombo woodland reserves in Zambia (also present and other southern, central and east African countries) conserves the diversity of *Brachystegia* spp. and many other plants.

In Armenia, at least 60% of the species of fauna and flora found are represented within the protected areas system. Several Special Areas of Conservation for plant species have been proposed in several countries such in micro-reserves in Valencia, Spain (140 already established) where are located most of the rare and endemic plants of Valencia and over 12 listed in the Habitats Directive. In Norway, areas of conservation have been established at ecosystem basis (e.g. for forests, mountains areas, mires and wetlands). Austria has designated 94 conservation areas (under the pan-European Nature 2000 scheme), covering a total of 8514 km^2.

In Jamaica, the Natural Resources Conservation Authority (NRCA) has responsibility for the creation and management of protected natural areas in Jamaica. NRCA collaborates with a variety of local groups to help manage such areas, such as the Blue Mountain/John Crow Mountain National Park. A Portland Bight Sustainable Development Area is being created which contains important dry limestone forests with over 300 vascular plant species (25% are endemic to Jamaica). Dominica has considerable surviving native vegetation which is protected as nature reserves and includes trees such as Gommier (*Dacryodes excelsa*). In Belize, the Protected Areas System Plan currently comprises 55 state and private areas with an additional 29 being proposed.

Legislation and Regulation
In Bahamas, the national strategy emphasizes the need to develop a more comprehensive system of protected areas and enhance regulatory and enforcement mechanisms. In Bulgaria, a Biodiversity Act is being proposed to protect habitats and the biodiversity within them. Protected areas include many forest reserves, as well as wetlands and other habitats. In Norway, the Nature Conservation Act is the only national legal authority for protection of flora in Norway, but where a new Biological Diversity Act is envisaged. In Guatemala, la Comisión Nacional del Medio Ambiente (CONAMA) with the Earth Council have developed an Action Plan, laws and a National Strategy for Environmental Education to protect the environment.

5.3. Thematic and geographical gaps

Although much work has been undertaken to identify and assess the world's most important areas for plant diversity, their protection is currently inadequately assured. For example, in the 1990s, IUCN undertook a major survey of the regions of the world that are richest in plant diversity. The survey involved over 400 collaborators working to document the importance and status of 233 sites worldwide. The three-volume book that resulted from this survey documents the geography, vegetation, flora, useful plants, social and environmental values, economic assessments, threats and conservation of each site. But an analysis of the conservation status of each site indicated that they are seriously under-protected and

many fall outside the boundaries of national protected area systems. The survey concluded that only 21% are totally within protected areas and a only a further 35% are more than 50% protected. Of the 233 sites only 33 (14%) were regarded as safe or reasonably safe. There are no accurate figures as to what percentage of the world's flora occurs in these sites but estimates suggest that they may include over 200,000 endemic species. Many of the sites are recorded as being threatened by a range of factors, including agricultural expansion, logging, rising population pressure and over-collecting. Many of the threats identified are a complex mixture of socio-economic factors leading to particular ecological consequences.

Target 6: At least 30 per cent of production lands managed consistent with the conservation of plant diversity.

6.1 Introduction and background/overview

Production lands can be managed to conserve plant genetic resources and also wild species, outside protected areas. Production lands can be interpreted to include home gardens, farms and plantations. Production lands comprise a significant proportion of most countries.

In situ conservation of crops is undertaken by farmers, foresters and local communities to assure the genetic basis of future agricultural growth. The maintenance of traditional management practices by local communities can contribute to ensure the maintenance of genetic diversity. Partnerships between scientists, communities, landowners ensure advances in agriculture and the maintenance of the diversity of plant genetic resources.

The conservation of wild plants in production lands can be undertaken through the implementation of appropriate management regimes implemented by landowners and farmers, sometimes in association with governmental authorities and other non-governmental bodies. NGOs such as The Nature Conservancy in the United States and The National Trust in the U.K are major landowners in their own countries had have implemented significant programmes to promote the management of the production lands under their care and stewardship in a way that is consistent with the conservation of plant diversity. Other relevant examples are provided in 6.2.

6.2. Examples

In Ethiopia, on-farm landrace conservation (e.g. sorghum, chickpeas and teff) (National Plant Genetic Resources Center/Ethiopia (PGRC/E) and traditional on-farm conservation practices for natural trees, intercropped with coffee, and other food crops. In Mali, URG (l'Unité des Ressources Génétiques) has developed participatory strategies for *in situ* conservation and community management of local varieties of sorghum, millet, cowpea and bambaranut. In Uganda, where conservation is mainly done in the field, the National Agricultural Research Organisation (NARO) has a programme to collect and document distribution and status of *Dioscorea* spp.

In Nepal, LI-BIRD (Local Initiatives for Biodiversity, Research and Development) is one of the NGOs involved with the IPGRI (International Plant Genetic Resources Institute) programme "In Situ Conservation On-Farm" i.e. utilization and management of rice landraces, indigenous vegetable varieties and other crops.

In Sweden, through the Threatened Plant Unit of the Swedish University of Agricultural Science, landowners are informed of the presence of red-listed species on their property and shown how to protect them; this project covers the whole of Sweden and most of the threatened species (e.g. 505 vascular plants and 238 bryophytes). In United Kingdom, the National Trust works with a variety of conservation agencies to monitor and protect species on its land.

In Bolivia, Fundación PRONPA, in collaboration with IPGRI (International Plant Genetic Resources Institute), organized a workshop on the maintenance of Andean tuber diversity in the centres of origin. In Mexico, Jardín Botánico UNAM (Universidad Nacional Autónoma de México) has undertaken *in situ* conservation projects of beans, corn, squash and edible greens.

6.3. Thematic and geographical gaps

International organisations such as IPGRI (International Plant Genetic Resources Institute) and FAO (Food and Agriculture Organisation) – through the Global Plan of Action for Food and Agriculture – have identified plant genetic resources which need conservation in production lands. National Biodiversity Action Plans include national priorities. Production lands with important plant diversity need to be identified nationally in the same way as ecological areas (Target 4) and important areas for plant diversity (Target 5).

Target 7: 60 per cent of the world's threatened species conserved *in situ*.

7.1. Introduction and background

Habitat loss is certainly the most important factor causing the decline and loss of plant species. This can often be correlated with population growth and the resulting additional pressure on remaining natural areas. Other important factors are over-collecting and the unsustainable exploitation of plants from habitats that may be otherwise be apparently little affected. Urbanisation, pollution, agricultural intensification and land use changes, the spread of invasive alien plants, animals and pathogens are all contributing to this crisis for plants. The impact of global warming and climate change in general still cannot be quantified adequately for plant loss but must surely be significant. Habitat protection (through the designation and management of protected areas) represents the major means undertaken worldwide for the conservation of species *in situ*. Nevertheless this review also includes examples of national legislative measures taken to governing the protection of wild plant diversity *in situ* (including their collection) as well as reintroduction, rehabilitation and other restitution activities.

7.2. Examples

Legislation and regulation
Milicia excelsa (Iroko) is protected by legislation in Ghana, Ivory Coast and Mozambique, while in Kenya, a Presidential ban on logging of indigenous timber was implemented in 1986.

In Austria, four of the 15 higher-plant species native are protected by the respective nature conservation laws of the Federal provinces. In Canada, a proposed Species at Risk Act (SARA) will cover all wildlife species listed as being at risk nationally and their critical habitats, with the objective of helping their numbers to recover. In Hungary, a total of 695 plant species were given protected status by the government in 2001. In Malta, the Environment Protection Act was passed in 2001.

The National Programme for Management of the Flora (Programa Nacional de Gestión de la Flora – June 1999) in Argentina, under the auspices of the Secretaría de Recursos Naturales y Desarrollo Sustentable, includes the development of national laws to protect the flora. In Brazil, there are regulations governing the exploitation of the Paraná Pine *(Araucaria angustifolia*) and the harvesting, transport, commercialisation and processing of ornamental, medicinal, aromatic and toxic plants, and the Brazil-nut tree *(Bertholletia excels*a) is protected from felling, sawing or commercialisation.

Restoration and Rescue Programmes
In Mauritius, the restoration of several important plant habitats is being undertaken, such as on Ile aux Aigrettes, a small off-shore island on the south-east coast, which contains the last surviving remnant of *Diospyros egrettarum* (ebony) woodland. In South Africa, the *in situ* pollination of cycad species

(*Encephalartos* spp.) is being undertaken in Lilie Flora Reserve to produce seed. Other projects include the conservation of *Protea odorata* (two small populations left) in the Western Cape; concerted efforts to clear invasive plants (e.g. *Acacia saligna*), fencing to prevent browsing by cattle, reseeding

The M.S. Swaminathan Research Foundation conserves *Crotolaria longipes* in Southern India through cultivation, reintroduction and habitat management. In Sri Lanka, the restoration of dry-zone forest (Dambulla) is performed by removing competition.

In Armenia, the Vandzor Botanic Garden is undertaking a reforestation project with native species; reintroduction programmes address endangered species and endemics such as *Juniperus sabina*. The Scottish Wildlife Trust in United Kingdom has increased the numbers of plants of *Primula scotica* on an Orkney island from 659 to 3,980 in eleven years. In U.S.A., while *Astragalus perianus* has been recovered, some species have been delisted because new populations have been discovered, such as *Tumamoca macdougalii* and *Hedeoma apiculatum*; other species have been delisted because they are no longer regarded as distinct after taxonomic revision.

In Bolivia, a project to conserve *Puya raimondii* is being undertaken by TROPICO – a private organisation; Danish and North American aid agencies (DANIDA and USAID) have started programmes to preserve *Polylepis* forests. In Dominica, a U.S. NGO, the Rare Species Conservatory Foundation, supports nature reserves. In Mexico, natural populations of bromeliads are being managed, cultivated, reintroduced in Chiapas, Mexico (ECOSUR).

7.3. Thematic and geographical gaps

Recovery programmes are currently being implemented mainly in developed countries, in North America, Europe and Australasia but few have yet been undertaken in developing countries. Extensive protection of plants is undertaken throughout the world, through the inclusion of many natural habitats in protected areas. However, studies are somewhat limited in how they document the extent to which such protected areas capture and maintain the indigenous plants of each region and in measuring the effectiveness of current management techniques in preventing genetic erosion of *in situ* plant populations.

Target 8: 60 per cent of threatened plant species in accessible *ex situ* collections, preferably in the country of origin, and 10 per cent of them included in recovery and restoration programmes.

8.1. Introduction and background/overview

Ex situ conservation involves the collection, conservation and maintenance of samples of organisms outside of their natural habitats, usually in the form of seed, pollen, spores, vegetative propagules, tissue or cell cultures and other genetic material of growing or preserved individuals. *Ex situ* conservation of plants is practised by a wide variety of bodies, especially genebanks (seed bank, field genebanks, *in vitro* collections) and botanic gardens and arboreta, acting at national levels and cooperating internationally. Significant *ex situ* collections are also maintained by other bodies, such as plant breeding and other experimental and research institutions, which may be of importance for plant conservation.

The majority of the world's countries have some available facilities to support *ex situ* conservation. Botanic gardens currently occur in 153 countries. Most national forestry and agricultural departments have facilities for the cultivation and propagation of plants, although these are generally used to support forest and agriculture production and development, rather than *ex situ* conservation. Facilities to support *ex situ* conservation may also be available in other research institutes such as university departments and plant breeding facilities. In some countries, private growers and landowners have also provided support for *ex situ* conservation. The development of *ex situ* conservation facilities for plants associated with particular protected areas such as national parks has been undertaken in several countries. National genebanks occur in many countries. They provide facilities for the conservation of germplasm (mainly

breeders' lines, cultivars, landraces and wild crop relatives). The need for *ex situ* conservation of plants is included in the National Biodiversity Strategies and Action Plans of many countries.

8.2. Examples

Ex-situ conservation
The Agricultural Research Centre, Tripoli, Libya, maintains over 5,000 accessions of plant genetic resources for food and agriculture. The Centre National de Recherche Agronomique et de Développement Agricole (CNRADA). In Ghana, the Plant Genetic Resources Center of the Council for Science and Industrial Research (CSIR) maintain a field genebank of timber and economic species. The Kenyan Forest Research Institute (KEFRl) (trees and ornamental plants) and the National Gene Bank (KARI) (crop plants) undertake the *ex situ* conservation of crop and tree genetic resources; additionally, over 80,000 accessions held in various local genebanks. In Tunisia, a genebank was created in 1986 at the Institut des Régions Arides (IRA Médenine) to conserve the indigenous vegetation of arid and desert regions and to use the most promising species for revegetation of degraded areas; over the last decade IRA has undertaken the seed gathering (40 taxa) and live collections (143 taxa). In Lesotho, Katse Botanical garden has a representative collection of the flora found in the four regions of Lesotho including medicinal and rare plants. The Botswana National Museum has recently established a botanical garden which has brought into cultivation species from six vegetation types (Okavango and and Chobe) and medicinal plants from Botswana.

Kebun Raya Indonesia (Indonesian Botanic Gardens) include large numbers of native plants, where preference is given to threatened species; orchids and forest trees are a particular strength of the collection.

The National Seed Genebank in Sadovo, Bulgaria conserves around 50,000 seed accessions of more than 300 species of cultivated plants and their wild relatives. "Seeds of Diversity", a Canadian Heritage Seed Programme in Canada, co-ordinate a Living genebanks of vegetable, fruit, herbs and ornamentals (over 1,000 varieties). The Greek Gene Bank of the departments of the Agricultural Research Centre of Macedonia and Thraki conserves and documents around 7,500 accessions of plant genetic resources; the Botanical Garden (Institute) of the Academy of Sciences of Moldova, the Dendrological Garden, Taul Park, and Tiraspol Arboretum are the main holders of about 3,000 plant species preserved. In USA, in support of the implementation of the Endangered Species Act (1973), the Center for Plant Conservation (CPC) coordinates a network of 31 botanic gardens implementing a national conservation collection programme for over 580 native plants. The National Seed Storage Laboratory (NSSL at Fort Collins, Colorado) stores the base collection of the National Plant Germplasm System (NPGS) which includes crop and wild germplasm. The holdings of the NPGS (in 2001) comprises 441 339 accessions covering 1557 genera and 10121 species. Indigenous and exotic plant groups are collected and preserved by the North American Plants Collections Consortium (NAPCC), usually in botanic and private gardens. Other NGOs such as Seed Savers Exchange (SEE), Iowa and Native Seeds/SEARCH, focus on the horticultural and agricultural plants of the United States.

In Brazil, botanic gardens are closely involved in species conservation e.g. the Rio de Janeiro Botanic Garden bromeliad collection (729 taxa which represents 69% of the genus, 1,868 accessions and 6,471 specimens). A Colombian project to document the botanic garden *ex situ* collections in electronic databases was completed in 2001; it was funded by the U.K. government's Darwin Initiative and implemented by the national botanic garden network, the Alexander von Humboldt Institute and Botanic Gardens Conservation International. In Guyana, *ex situ* conservation is carried out, mainly for economically important crops.

Restoration and Recovery Programmes
In Sudan, *Medenia* (palm) thought to be extinct, has been rediscovered in Sudan and introduced into cultivation.

In Malaysia, the Universiti Malaya has propagated *Aleisanthia rupestris* with a view to reintroduction and stronger controls for its habitat.

In Italy, the University of Palermo manage a project to conserve *Abies nebrodensis*, involving the cultivation of 110,000 young trees *ex situ* for re-establishment of wild populations, derived from a population of 30 survivors *in situ*. In Portugal, eight threatened native species are being conserved in an *ex situ* programme at Jardim Botânico de Madeira; the garden has initiated restoration programmes for eight of the most vulnerable plant species, such *as Pittosporum coriaceum, Sorbus maderensis* and *Andryala crithmifolia*.

The Mexican Association of Botanic Gardens (Asociación Mexicana de Jardines Botánicos) actively supports gardens in each vegetation type and state to cultivate native plants; botanic gardens maintain National Collections of several genera that are important nationally, such as *Agave, Yucca, Dasylirion, Nolina*, and Bromeliaceae.

Nationally-based Initiatives with Regional Scope
The Millennium Seed Bank of the Royal Botanic Gardens, Kew, in United Kingdom, is assembling seed samples from arid and semi-arid areas of the world. The Nordic Gene Bank (NGB) in Sweden is a joint gene bank for conservation of plant genetic resources for all five Nordic countries – Denmark, Finland, Iceland, Norway and Sweden; it includes all plants in agriculture and horticulture (except ornamentals) and clonal archives for fruit trees, berries and landscape plants and *in vitro* preservation of potatoes. NGB supports the Southern African Development Community (SADC) Plant Genetic Resources Centre (SPGRC) for indigenous plant genetic resources of the 12 countries of the SADC (South Africa Development Community: Angola, Botswana, Lesotho, Malawi, Mozambique, Swaziland, Tanzania, Zambia, Zimbabwe, Namibia, South Africa, Mauritius). In Peru, a project in collaboration with Spain have allowed the collection of cherimoya and tomato genetic resources in Ecuador and Peru, as well as establishing a regional genebank for cherimoya (*Annona cherimola*), managed by the Peruvian Programme on Genetic Resources and Biotechnology.

8.3. Thematic and geographical gaps

Although *ex situ* facilities are widely distributed worldwide, they are least well developed and resources in many countries of high biodiversity, in countries in Africa, Asia and Latin America. Few *ex situ* collections are likely to be genetically representative of wild species diversity. Furthermore, only a small proportion of the known threatened flora of many regions is currently known to be conserved in *ex situ* collections, and many of these are in *ex situ* collections on countries outside their natural ranges. For biological reasons, seed bank collections do not contain major collections of tropical species – only a small proportion of tropical plant species have seeds that are suitable for long-term storage.

Target 9: 70 per cent of the genetic diversity of crops and other major socio-economically valuable plant species conserved, and associated local and indigenous knowledge maintained.

9.1. Introduction and background/overview

The value of the genetic diversity of crops and wild crop relatives lies not only in their importance for agriculture but also in their potential for further crop development to meet the changing needs of humankind. The importance of their conservation has been recognised as an objective of the international importance through the adoption in 1996, by 150 countries, of the Global Plan of Action on the Conservation and Sustainable Use of Plant Genetic Resources for Food and Agriculture. In 2001 an International Treaty on Plant Genetic resources provided an international framework for the conservation and exchange of plant germplasm and allowed for the development of appropriate benefit sharing procedures.

The species included in this target include all those useful to humankind including for food and medicine, building materials, forage and a multitude of other uses. National priority needs to be assessed on the basis of national distribution, production and use. It is important that specific local needs and uses are recognised and that locally important plant species are included in these in-country conservation activities.

9.2. Examples

Plant Genetic Resources Conservation
The National Plant Genetic Resources bank in Angola maintains about 1,200 accessions of local crop varieties. In Jordan, the National Center for Agricultural Research and Technology Transfer has a seed and field gene banks of plant genetic resources, including species, land races and local accessions of vegetables and fruit trees and indigenous herbal and medicinal plants; a duplicate collection of more than 4,000 accessions of cereals, legumes and forages of Jordanian origin held by ICARDA (International Center for Agricultural Research in the Dry Areas) is being established at the NCARTT (National Center for Agricultural Research and Technology Transfer) gene bank.

The Finnish Forest Research Institute mandate for the conservation and sustainable use of biological diversity on wild and domesticated varieties includes: the conservation of genetic diversity of dominant forest tree species, such as Scots pine, Norway spruce and silver birch, which are adapted to the northern margin of their range, and the conservation of the diversity of native hardwood species, the micropropagation of recalcitrant adult Scots pine and the secondary metabolites of some medicinally important plants by the University of Oulu. The Greek Gene Bank of the departments of the Agricultural Research Centre of Macedonian and Thraki contains 7,500 accessions of mainly local landraces and wild relatives, as part of the National Strategy for the Agricultural Biodiversity.

In Antigua/Barbuda, the Department of Agriculture considers local varieties of crops such as eggplant, table squash, corn, Barbuda lima bean, a priority for conservation and intends to expand seed storage facilities. In Argentina, local communities conserve *in situ* crop varieties such as maize, fruit and medicinal plants. In Paraguay and Bolivia, national inventories of wild crop relatives are being supported by USDA; a rescue mission to collect endangered wild peanut relatives has been undertaken by IPGRI and the National Geographic Society in Bolivia. In Brazil, there are nearly 194,000 accessions of plant germplasm including duplicates (76% are exotic and 24% are native/local populations). For instance, there are 1,096 accessions of *Arachis* which represents 74 of the 80 species and 56 of the 57 Brazilian species; the native and exotic fruit germplasm bank has 60 native species, principally of the northeast Brazil; germplasm banks have been set up in 27 sites with collections of major crops, medicinals, palms, ornamentals, condiments, industrial plants and others.

Local and Indigenous Knowledge Maintained
In Egypt, an extensive programme began in 1998 to develop the National History Museum and Gene Bank to develop capacity in the study and research of biodiversity and the collection and maintenance of plant genetic resources, especially wild relatives of crop and fodder plants; this will complement other collections at the Field Crop Research Institute and the Desert Research Centre. In Ghana, the development of a medicinal plant garden at Aburi Botanic Garden and a Home Gardens Project (in collaboration with BGCI) is promoting the cultivation of endangered medicinal plant species and the preservation of indigenous knowledge, while the Crop Research Institute is collecting *Solanum macrocarpon* (egg plant) and the Plant Genetic Resources Center of CSIR has a field genebank of timber and economic species. In Nigeria, International Institute of Tropical Agriculture (IITA) is undertaking the collection, conservation, and characterization of selected African food crops and related species to improve the conservation and utilization of plant biodiversity to promote sustainable food production in sub-Saharan Africa.

In Moldavia, in 1999, the Centre of Vegetal Genetic Resources was established to carry out work on the collection of cultivated plants and their relatives.

In Grenada, the government's Agronomy Division has an ongoing programme of identifying locally grown fruit to serve as stock for propagation. Guyana is being supported to conduct broad-scale plant exploration to collect, conserve and characterize native crops (IPGRI).

Nationally-based Initiatives with Regional Scope
The Research Institute of Crop Production at Prague, Czech Republic, has established a National Information System on Genetic Resources and a national gene bank, with a collection of 50,000 samples. The Czech Republic has responsibility for the European Wheat Database (in co-ordination with France), the European Flax Database and databases of selected grasses.

9.3. Thematic and geographical gaps

The long term security of the crop resources of the world can only be assured by the comprehensive conservation and documentation of each nation's natural resources. This remains an ongoing and expensive task. It is critical that local as well as national needs are recognised in the collation of data and the conservation of resources. There remains large areas in which our knowledge of the crop resources of the world are inadequate. It is equally critical that the associated knowledge that has developed and evolved alongside these resources is also preserved and continues to be relevant to local and national needs.

Target 10: Management plans in place for at least 100 major alien species that threaten plants, plant communities and associated habitats and ecosystems.

10.1. Introduction and background/overview

The spread of invasive alien species is recognised a major threat to plant diversity, habitats and ecosystems, hence to food production and health. Invasive species cause enormous damage to biodiversity and agricultural systems. Studies in the USA and India indicate that the economic damage caused by invasive species is of the order of US$100 billion per year. Invasive species are found in nearly all major taxonomic groups of organisms.

Control methods applied at national levels can be classified as follows:

- Public education and awareness
- Quarantine and phytosanitary legislation and control
- Physical, chemical, biological and environmental control

10.2. Examples

Legislation and Regulation
The Federal Quarantine Act of 1908 in Australia serves as quarantine and phytosanitary control framework to monitor the introduction and movement of potentially invasive plants and their propagules; the booklet *Making your Garden Bush-Friendly* aimed at alerting Sydney residents to the dangers of depositing garden waste in forest or flushing seeds down storm-water drains. In Canada, sixteen wetland plants and 44 upland plants, mostly aliens, are identified as invasive (of varying degree) of natural habitats and the application of federal and provincial Weed/Seed Acts for the management of non-native plants and the maintenance of the ecological integrity of National Parks is being investigated. The USA Federal Plant Quarantine Act of 1912 and Federal Seed Act of 1980 serve as quarantine and phytosanitary control framework to monitor the introduction and movement of potentially invasive plants and their

propagules; a booklet entitled *The Banana Poker Caper* alters Hawaii residents to the invasive *Passiflora mollisssima*.

Research and Development
In Canada, in line with the provincial Weed/Seed Acts, Nova Scotia provincial government is cutting down 10,000 affected conifers to eradicate the infesting brown spruce longhorn beetle *Tetropium fuscum.* In Norway, *r*esearch on the effect of alien trees *Picea sitchenis* (spruce) and *P. contorta* (lodge pole pine) on broad-leaf species are being conducted.

In Costa Rica, the Parque Nacional Palo Verde (Area de Conservación Tempisque (ACT) is undertaking a project to eliminate invasive plant from its lakes. The national biodiversity strategy of Bahamas emphasises the need to control alien and invasive species.

In Mauritius, hand weeding of 3 ha plots by Mauritius Forestry Service is being undertaken to eliminate *Psidium cattleianum*; similar hand weeding also occurs on Ile aux Aigrettes, an offshore island, of *Flacourtia indica.* In South Africa, the Working for Water Programme employs several thousand people to clear invasive acacias and pines which are lowering water tables. In the Kruger National Park, 113 plant taxa have been identified as invasive; 7 of these have serious ecological impacts. The South African Park management has the strategy of eliminating 10 of these from the Park, with some control of a further 14; others are reckoned to be too expensive to control, to pose no serious risk or to be regularly renewed from outside the Park. Total destruction of all vegetation is being undertaken in an area for elimination of *Pereskia aculeata* in Natal Province coastal reserves.

10.3. Thematic and geographical gaps

The Global Invasive Species Programme has identified major themes in terms of ten major strategic responses to the problem of invasive alien species. One of these themes is the preparation of national strategies and plans. As the Programme is implemented, existing thematic and geographic gaps between and within individual countries will be identified and can then be addressed.

III. USING PLANT DIVERSITY SUSTAINABLY

Target 11: No species of wild flora endangered by international trade.

11.1. Introduction and background

The survival of plants that are threatened by international trade is addressed by CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). Plants protected by CITES (roughly 25,000 species) are listed in the three Appendices according to how threatened they are by international trade. They include some whole groups such as cacti and orchids. But in some cases only a subspecies or geographically separate population of a species may be listed. The majority of the world's national governments are parties to the Convention on Trade in Endangered Species of Wild Fauna and Flora (CITES) and implement appropriate national controls on international trade in species listed under the Convention. The Convention stipulates that each government which is a Party coordinates its efforts through one or more national Management Authorities and Scientific Authorities.

The degree and sophistication of effort that each national Party employs to monitor and control imports and exports of CITES-listed species varies. When resources are available and adequate some countries have built the capacity of national police, wildlife rangers and customs forces who are trained to carry out enforcement actions, and may include units specialising in CITES-enforcement. In other countries, governments may either not have the funds to be able to carry out the effective enforcement of CITES or may not have effective control of some areas of their national territory. Some educational and awareness raising efforts have been made to inform the travelling public about the existence and purpose of CITES.

Another means to reduce or eliminate unsustainable exploitation of wild plants in international trade is to promote the substitution of wild collected plants in trade with cultivated material. This is particularly significant for medicinal plants. Some examples of national efforts to promote the cultivation of medicinal plants are also described.

11.2. Examples

The Canadian offices of TRAFFIC International and WWF have set up two CITES kiosks at Lester B. Pearson International Airport, Toronto. They are designed to inform international travellers about CITES, its activities, and ways in which travellers can help its efforts by not buying and transporting illegal plant and animal souvenirs. The kiosks stock CITES brochures, exhibit a number of confiscated souvenirs and computer displays giving information about the work of WWF, TRAFFIC and Environment. In France, in February 1997, customs officers seized a consignment of 540 cacti illegally imported from Mexico, including CITES-listed species such as *Ariocarpus* and *Echinocactus*. In Germany, trade in protected species is regulated by the Federal Ordinance on the Conservation of Species (*Bundesartenschutzverordnung*) as well as other regulations for CITES-listed species. Germany is one the world's major importers, processors and exporters of medicinal plant material; in 1993 the Environment Ministry carried out a major survey of the medicinal plant trade, in order to determine any unsustainable exploitation and hence any further necessary legislation or CITES-listing. In Spain, the Córdoba Botanic Garden serves as advisor to the ICONA, Spanish national Scientific Authority. It also prepares material for SOIVRE, the national Management Authority. The United Kingdom maintains specialised units for the enforcement of CITES regulations; an example is the CITES Enforcement Team of H.M. Customs & Excise at Heathrow Airport, London.

11.3. Thematic and geographical gaps

Nearly all national governments of the world are members of the CITES Convention, and thus notional geographical gaps are few. The recognition and addressing of thematic gaps is the responsibility of the biennial Conferences of the Parties.

Target 12: 30 per cent of plant-based products derived from sources that are sustainably managed.

12.1. Introduction and background/overview

At the Earth Summit, the United Nations Conference on Environment and Development (UNCED), the question of sustainability and the use of plant resources was paramount. Under the CBD, "sustainable use means the use of components of biological diversity in a way and at a rate that does not ead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations". A range of national initiatives are being undertaken to enhance the conservation and sustainable use of plant resources. This takes the form of legislation and regulation, production of products from wild habitats as well as encouraging wise and sustainable practices by land managers local communities

12.2. Examples

In situ *Sustainable Practices*
In Cameroon, *Ancistrocladus korupensis*, a plant which contains an important alkaloid, has been brought into cultivation in the Korup National Park (Michellamine B - drug for the Acquired Immune Deficiency Syndrome (AIDS). Research undertaken by Center for International Forestry Research (CIFOR) and Limbe Botanic Garden 'Conservation through Cultivation' unit on non-timber forest products (NTFPs) such as *Prunus africana* hopes to ensure the sustainability of the resource through its domestication

programme. In Kenya, a project supported by the United Nations Environment Programme is beginning to target key species that SAFORGEN (Sub-Saharan Africa Forest Genetic Resources Network) has identified as especially important. Kenya has chosen two food trees, *Tamarindus indica* and *Dialium orientale*.

In Canada, the planting of ginseng (*Panax quinquefolium*) has been undertaken in Canadian natural forests to create a new method of utilizing natural forest resource base (Ecologic Institute International, Canada).

In Antigua /Barbuda, conservation efforts are focused on coastal and marine resources, mangrove and wetland systems and agro-biodiversity. In Argentina, national Programme for Management of the Flora (Programa Nacional de Gestión de la Flora - June 1999) is being implemented under the auspices of the Secretaría de Recursos Naturales y Desarrollo Sustentable, including the sustainable development of wood and non-wood products. In Bolivia, rubber and copaiba tapping is promoted to encourage sustainable use of forest through development of non wood forest products (Ecologic Institute International, Canada).

Legislation and Regulation
In Armenia, the collection and storage of wild medicinal plants are controlled by legislation; the aims of a draft law on flora includes ensuring the sustainable conservation of plants and their genetic diversity and provide for inventory, study and monitoring of plant populations e.g. Guidelines for the sustainable use of timber. Australia has a substantial body of legislation, programs and strategies for sustainable natural resource management at Federal, State, Local and farm levels.

Brazil has regulations governing the exploitation of the Paraná Pine *(Araucaria* angustifolia) and the harvesting, transport, commercialisation and processing of ornamental, medicinal, aromatic and toxic plants. In Mexico, regulations control the collection and use of *Euphorbia antisyphilitica* for wax; chicle latex (*Manilkara zapote*) tapping in S.E. Mexico aims to encourage sustainable use of forest through development of non wood forest products (Ecologic Institute International, Canada).

12.3. Thematic and geographical gaps

Despite the many activities that are going on in the world to address the needs for sustainable production there is still relatively few well documented model programmes operating in many regions. The knowledge of what is currently unsustainable and the technology and understanding to develop new practices and initiatives remains poorly understood.

Target 13: The decline of plant resources, and associated local and indigenous knowledge, innovations and practices, that support sustainable livelihoods, local food security and health care, halted.

13.1. Introduction and background/overview

This multi-faceted target encompasses both the decline of plant resources and the association between those resources and local peoples knowledge and needs. Plant resources can be both wild or domesticated or wild and managed. They may be for direct consumption, use or for trade. The local knowledge held may be restricted to specialists such as healers or gathers, farmers or may be gender related. Working with local knowledge-holders is a vital part of practical conservation. Sustainable livelihoods refers to the source of plant resources continuing to be available to benefit the activities of the individuals engaged without undermining the natural resource base.

Existing indices of quality of life are available including the World Health Organisation (WHO) and the United Nations Development Programme (UNDP). Likewise there are methods for measuring the decline in plant resources. Such research, undertaken on a case by case basis, is an essential step in practical conservation. Global indicators are complicated by the diversity of the species used, the shortage of reliable statistics and by the impact of external commercial forces. Despite the rise of the plant sciences, there has been a decline, over the centuries in the sum total of human knowledge about plants. There is a great deal of evidence of this phenominum but no global indicator as such.

Factors affecting the ability to meet this target are both internal and external to the communities themselves. They include the nature of the global demand for plant resources, continuing urbanisation, privatisation of land and access restrictions, globalisation of cultures and economies and the opportunities for alternatives to current resources.

13.2. Examples

Legislation and Regulation
Australia has established substantial body of legislation, programs and strategies for sustainable natural resource management at Federal, State, Local and farm levels. The *National Strategy for the Conservation of Australia's Biological Diversity* provides the framework for protecting Australia's biodiversity. The Strategy's stated aim is "to bridge the gap between current activities and those measures necessary to ensure the effective identification, conservation and ecologically sustainable use of Australia's biological diversity". Environment Australia administers a number of programs, including through the Natural Heritage Trust, Bushcare, Endangered Species Program, and the Natural Reserve System, aimed at protecting and conserving our biological resources. Turkish Government permit system designed to protect the natural stands of *Liquidambar orientalis* of overharvesting for the production of storax.

The Protected Areas System Plan in Belize is currently made of 55 state and private area with an additional 29 being proposed. The Government of Belize has enacted laws for the protection and sustainable use of the natural resources, which include the Forest Act and the Wildlife Protection Act. In Brazil, there are regulations for the Brazil-nut tree *(Bertholletia excelsa*) prohibiting its felling, sawing or commercialisation (Brazilian Forestry Development Institute (IBDF).

Local and Indigenous knowledge, innovations and practices
In Swaziland, taboos restrict the seasonal (summer) collection of *Alepidea amatymbica* roots, *Siphonochilus aethiopicus* and *Agapanthus umbellatus* rhizomes in Swaziland; the collection is restricted to the winter months after seed set as summer gathering is believed to cause storms and lightning. In Ghana, home Garden Project to promote the cultivation of endangered medicinal plant species working in collaboration with local villages and traditional healers (Aburi Botanical Garden with U.K. partners BGCI); sacred forests traditionally respected for spiritual reasons are now being established specifically for the protection of tree species. In Zimbabwe, the propagation and re-introduction of *Warburgia salutaris* in south-eastern Zimbabwe (where it is locally extinct) has enhanced conservation of an endangered species and improved the livelihoods of local rural people (WWF-Zimbabwe Zimbabwean NGO, SAFIRE (Southern Alliance for Indigenous Resources).

In Indonesia, a Medicinal Plant Group established at Bogor Botanic Garden to support the conservation of medicinal plants and undertakes work to document the use and distribution of medicinal plant species. In Vietnam, indigenous medicines project conducted by UK-based NGO Frontier to assess sustainability of current harvesting patterns in Sapa National Park, includes community-based threatened species propagation and cultivation project activities.

In Norway, farmer's organisations have a voluntary system for registering biological diversity.

In Mexico, the Jardin Botanico Medicinal "De La Cruz-Badiano" functions to 'conserve […] the medicinal flora of the Valley of Mexico' and to 'awaken interest in the preservation of knowledge of medical botany in the Valley of Mexico' and to 'serve as a horticultural centre, providing information about local growing conditions'. In Paraguay, Cerra Corá National Park, undertake a collaborative project with National University of Asunción and the Conservation Data Center (CDC) of Paraguay's Department of National Parks and Wildlife to assess the value of economically important plants to local communities. The project began with ethnobotranical study in four indigenous and two campesino communities living near the park; conclusions contributed to the development of a Management Plan and Conservation Strategy for the Park's flora.

Nationally-based initiative with regional scope
In Costa Rica, the Mesoamerican Network on Plant Genetic Resources REMERFI - Red Mesoamericana de Recursos Fitogenéticos Costa Rica, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama for conservation and sustainable use of genetic resources especially at the local level by small-farmer and indigenous communities.

13.3. Thematic and geographical gaps

Conservation efforts are moving closer towards integration with local community objectives and the need to involve local people and their needs in any initiative is now well recognised. Despite the vast array of community based activities and the awareness of the importance of indigenous knowledge there remains an ever increasing rate of loss. Despite the rise of the plant sciences, there may even have been a decline, over the centuries in the sum total of human knowledge about plants. The importance of capturing knowledge and promoting the transmission of this to future generations needs to be fully addressed.

IV. PROMOTING EDUCATION AND AWARENESS ABOUT PLANT DIVERSITY

Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, educational and public awareness programmes.

14.1. Introduction and background/overview

The incorporation of an awareness of plant diversity and conservation into educational programmes is an agenda setting and marketing exercise helping people to know what and why this is an important issue, what can be done about it and how to do that. Education provides the motivation for people to effect changes in their lives and workplace and the benefits of education are a deep seated appreciation of issues and incorporate the principles into their way of life. The value of education to conservation can only be realised if the knowledge and interest is followed through with appropriate action. In order for the Strategy targets to be met by 2010, it is important that the objective of this target is aimed at those who will effect change in the next ten years. A wide range of educational programmes of relevance to plant conservation are offered through formal and informal educational programmes in many countries.

14.2. Examples

In Cameroon, public awareness exhibitions, fairs and radio coverage have promoted awareness about the threat from over-exploitation of locally important vegetable, Eru; this has resulted in the training of farmers and the development of a cultivation manual for this species. In Morocco, the Botanic Gardens and Institute Agronomique et Vétérinaire (IAV) Hassan ll, Society for the Protection of Animals Abroad (SPANA) and the Association of Teachers for Life and Earth Sciences, with financial support from the British Council, produced education materials to be distributed by the Ministry of National Education.

In Philippines, outreach schools programmes have been initiated by the Department of the Environment and Natural resources (DENR) to teach sustainable development and biodiversity management in schools and communities near protected areas. A School of Horticulture at the Singapore Botanic Garden has established a public education arm to provide new initiatives and impetus for educational outreach; this approach was based on a business and market orientation making it both user focused and user friendly. In Vietnam, a conservation network (CEN) has been established providing a global forum for the exchange of conservation information in Vietnam; the UK-based NGO, Frontier is collaborating with national authorities to develop and environmental education element for the national curriculum.

The web page of the Finnish Clearing House Mechanism that deals with education and public awareness offers links to tools, institutions, and material for education. In Germany, Fair-Trade-Movement volunteers supported a programme of consciousness raising regarding the trade in cocoa and explored the relationship between the tropics and products derived from them; based at Kassel university the programme consisted of a greenhouse tour, a "tropical pot-pourri table" a small exhibition and role playing exercises. In Russian Federation, a special education programme to enhance the schools' curricula holds an Apothecaries' Garden Day Festival in Moscow each year. The Spanish Royal Botanic Garden of Madrid runs a public training programme aimed at unemployed youth to help them to qualify for professions related to the rehabilitation of the environment. In USA, a Junior Master Gardener program of the Texas Agricultural Extension Service teaches science and horticulture concepts to youth aged 9-19, encouraging personal responsibility and community involvement.

The Argentinean San Carlos Centro Botanic Garden is working with high school teenagers to study and understand the global environment and to promote the environmental sciences; videoconference facilities have enabled students to listen to a range of talks and debates. The Brazilian NGO ECOAR Institute for Citizenship whose objective is to advance environmental education and encourage sustainable forestry, hold workshops on how to design projects within the Brazilian Environmental Network; they publish books and Guidelines to promote good citizenship, ecological awareness and to strengthen community initiatives dealing with social and environmental issues. In Mexico, workshop has been held in rural schools in Chichuahua to motivate children to care for nature, through for instance a series of memory and drawing games; further participatory assessment, many other botanic gardens have developed programmes to recover fast disappearing local plant knowledge and raise awareness, some of those being applied at local community level.

14.3. Thematic and geographical gaps

The long-term task of education is to foster and reinforce attitudes and behaviours that recognise the importance of plant biodiversity. As yet, many countries have not embraced the imperative for including biodiversity conservation into their national agendas or into the national curricula of their schools and other educational establishments. There remains an urgent need for governments to recognise the fundamental importance of engendering personal and community based responsibility for the national conservation objectives.

V. BUILDING CAPACITY FOR THE CONSERVATION OF PLANT DIVERSITY

Target 15: The number of trained people working with appropriate facilities in plant conservation increased, according to national needs, to achieve the targets of this strategy.

15.1. Introduction and background/overview

The effective implementation of the Global Strategy for Plant Conservation can take place at two levels. At a national level, policy and physical infrastructure must be in place and at an institutional level a policy framework that supports the effective conservation and sustainable use of plant resources needs to

be in place. National need in terms of biodiversity and conservation management will dictate the priority areas.

Plant conservation is cross-cutting discipline, involving a variety of skills and technologies. In most instances, plant conservation expertise at a national level is a composite of the professionals of the forestry, agriculture and natural resource management sectors, rather than the product of specialist training. Plant conservationists working at the field level need to be able to work across disciplines corresponding to the reality of the ways that plants and plant resources are managed and used thus requiring interdisciplinary skills (taxonomy, horticulture, conservation biology research, social science, ethnobotany, resources economics and commercial practice). These can be acquired through courses in tertiary institutions but require supplemental training in specialised areas depending on the issues and problems to be addressed.

These examples illustrate institutional capacity building, training in country and overseas.

15.2. Examples

Institutional capacity building
In Djibouti, a UNDP programme to create capacity at the national level to address biodiversity concerns has been incorporated in the actual implementation of its national planning. In Gabon, capacity building is being undertaken at National Herbarium of Gabon for the protection and sustainable management of the tropical (CENAREST). Specialist institutions such as INBio (Instituto Nacional de Biodiversidad) in Costa Rica play an important part in capacity building.

Some training initiatives
In Spain, an MSc course on the management, conservation, and control of species in international trade has been offered by Cordoba Botanic Garden and the University of Cordoba. In Ukraine, a course on information systems and management of plant records have been held by the Ukrainian botanic garden network, with BGCI. In United Kingdom, a range of courses are offered by national institutions of relevance to plant conservation, such as: International Diploma Courses in Botanic Garden Management and Botanic Garden Education (Royal Botanic Gardens, Kew and Botanic Gardens Conservation International (BGCI), an MSc in the Conservation and Utilisation of Plant Genetic Resources (Birmingham University), Plant Conservation Techniques Course (Royal Botanic Gardens, Kew), MSc Biodiversity Conservation and Monitoring (Hull University).

A Colombian project to develop information systems and management of plant records in all of Colombia's botanic gardens was completed by the Colombian Botanic Gardens Network, the Alexander von Humboldt Institute and Botanic Gardens Conservation International (BGCI) in 2001. In Peru, the Universidad Nacional Agraria La Molina, Lima, offers an MSc in ecotourism.

In Lebanon, a survey of coastal vegetation, identifying threatened plant species and areas for plant conservation, is under way in collaboration with the Royal Botanic Gardens Kew and the University of Reading, with training for Lebanese postgraduate students in plant identification and collection of herbarium samples. In Tanzania, a Botanical Training Programme was developed and implemented as a collaborative effort between the National Herbarium, Tanzania and the Missouri Botanical Gardens, USA; the focus was to develop a cadre of field botanists, the foundation of the pyramid of experts.

In Vietnam, propagation and nursery practices for conservation have been offered at the Tam Dao National Park, with CREDEP (Centre for Research and Development for Ethnomedicinal Plants) and Botanic Gardens Conservation International (BGCI).

Some training initiatives – national scope

SABONET (Southern African Botanical Diversity Network), based in South Africa, organises courses in the participating countries (Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia and Zimbabwe) on a variety of topics related to plant conservation.

15.3. Thematic and geographical gaps

While there may be adequately trained experts in several disciplines in plant sciences, the much needed broad-based capacity is limited especially in developing countries, small island states and countries with economies in transition. Unfortunately, this situation is further compounded by the lack of adequate physical and financial resources, which pose a constraint on the few available practitioners.

While many short courses are offered by a variety of national and international organisations of relevance to plant conservation, these are inadequate to provide the necessary capacity building initiatives and training in many countries. Interdisciplinary training is often challenged by a compromise of depth for breadth. Hence, there is an urgent need to integrate these principles as foundational components especially in forestry and conservation biology faculties in tertiary institutions. This obviously has implications for curriculum development in the long term, but in the short term as a remedial action, training modules could be incorporated into available courses. There is an urgent need to ensure that this type of training is sustained by follow-up activity that evaluates the application and impact in the field. Networking opportunities should be maximised to enable sharing of experiences and options for further collaborations. This collective experience will be essential to meet the overall plant conservation targets.

Effective implementation of these targets at the national level and based on national needs and priorities requires capacity building commensurate with the priorities identified. For example, species-rich countries with threatened and heavily utilized taxa will urgently need to boost their capacity if they are to achieve national targets.

Target 16: Networks for plant conservation activities established or strengthened at national, regional and international levels.

16.1. Introduction and background/overview

The effectiveness and success of activities undertaken by individual institutions can be enhanced with the support of resources obtained through networking with other organizations, institutions and colleagues. Networks can play an extremely valuable role in developing and strengthening the member institutions. Few organisations have all the skills, expertise and resources necessary to undertake plant conservation programmes on their own. Networking is one to the greatest tools and resources available to create and build new capacity for plant conservation.

Most conservation work programmes are through collaboration between organisations either nationally or internationally. These networks can be formal or informal, sometimes created around or in support of particular projects.

Some examples of project-specific networks can be mentioned. For instance, in Chile, there are several collaborative projects for Chilean natives: *Tecophilaea cyanocrocus* (CONAF Corporación Nacional Forestal, Chile, Royal Botanic Garden, Kew and the Alpine Garden Society, U.K.). In Czech Republic, the Research Institute of Ornamental Gardening, Pruhonice, works with nature-conservation bodies, cultivating and propagating endangered species. In Egypt, the Academy for Scientific Research and Technology, in collaboration with Bedouin communities, local authorities and NGOs has developed nurseries for the conservation and sustainable development of wild medicinal plants on the Mediterranean coast. The majority of examples included in this review describe however, more formal network organisations established in countries worldwide.

Protected area networks are relatively well established in most countries and can consist of private and/or state-owned areas. An example is that of the Protected Areas System Plan of Belize is currently made up of 55 state and private areas, with an additional 29 currently being proposed. At the local level in Spain 140 micro-reserves have been established in Valencia, which contain most of the rare and endemic plants of Valencia and over 12 listed in the EU Habitats Directive.

Ex situ and in situ conservation of plant genetic resources for food and agriculture is enhanced through networks that operate variously at national and international levels. These include networks of national collections of plant genetic resources maintained in a series of linked institutions, in seed banks and maintained by other collections holders. Such networks operating at national levels often have significant links with international bodies such as FAO and IPGRI. For example, in Scandinavia the Nordic Gene Bank stores material of plants of interest for Nordic agriculture and horticulture. In Moldova, cultivated plant genetic resources are maintained in the live collections and seed banks of 11 research, scientific and educational institutions.

Some networks of relevance to plant conservation have broad links and participation amongst a wide cross-section of organisations and individuals, drawn from government agencies, universities, amateurs and professionals scientists, protected area managers and NGOs such as horticultural societies, natural history clubs, and often have operational or cooperative links with regional and international networks.

Formal networks can be defines as ones that generally operate on the basis of a written constitution, specific aims and objectives, set of rules and regulations, a membership and a programme of activities.

16.2. Examples

Government led networks
Implementation of the provisions of the CBD is often achieved through the mobilisation of networks of institutions and other organisations at national and sub-national levels. For instance, in Czech Republic, ten institutes and institutions co-ordinate collection, documentation, evaluation, conservation and use of genetic resources, under the National Programme on Plant Genetic Resources Conservation and Utilization. In France, Conservatoires Nationaux Botaniques of France were set up by the Ministry of the Environment in Brest, Bailleuil, Nancy, Porquerolles and Gap-Charance to carry out an integrated programme of in situ and ex situ conservation for endangered plants in their regions. Plant conservation is also enhanced through networks of academic institutions, such as the Academies of Science in such countries as Armenia, China Georgia, Kazakhstan, Russia, Ukraine and Uzbekistan.

Other national initiatives
The Swiss Floristic Network CRSF, with the Swiss Commission for the Conservation of Wild Plants, CPS, have carried out investigations on 41 species threatened at the European level, and a first group of 91 species threatened at the national level. The US Native Plant Conservation Initiative is a network of eight federal agencies, such as the Bureau of Land Management and US Fish and Wildlife Service and 45 other non-governmental partners, such as the Flora of North America Project and the New York Botanical Garden. Between them, the agencies and other bodies involved in this initiative manage 500 million acres of public land, including habitat for about 50% of listed threatened plants in the United States. The Nature Conservancy (TNC) is an independent national organisation with a network of offices and projects throughout the country of relevance to plant conservation.

Botanic garden networks
There are over 40 national botanic garden networks worldwide. Jardins Botaniques de France et des Pays Francophone (founded in 1979) includes some 76 botanic gardens and botanical reference-collections in French-speaking countries, with the aim of promoting co-operation, organising meetings, and by means of a botanic gardens charter. The Mexican Association of Botanic Gardens (Asociación Mexicana de Jardines Botánicos) has a membership of 51 botanic gardens and affiliated institutions; it actively

supports gardens in each vegetation type and state to cultivate native plants. For instance, there are 17 gardens in xerophytic habitats which represents 50% of the area and 20% of the total flora of Mexico. In USA, the Center for Plant Conservation (CPC) is a consortium of 31 cooperating botanic gardens managing a national collection of over 580 native plants; CPC has set up a Genetic Conservation Program in Hawai'i in collaboration with five CPC participating institutions, state and federal conservation agencies, NGOs and larger landowners to conserve 110 of the state's critically endangered plants.

Plant conservation networks
Networks can focus on the conservation of threatened plants at a national level. As example, in India, for medicinal plants, FRLHT – the Foundation for Revitalization of Local Health Tradition, is a network of State Forest Departments and regional environmental and health NGOs in southern India, working to conserve medicinal plants and provides a national database (Indian Medicinal Plants Distributed Databases Network - INMEDPLAN). Another example is the Australian Network for Plant Conservation (ANPC) which links many botanic gardens, research institutions, and governmental agencies for integrated plant conservation, and involves significant voluntary bodies such as the Society for Growing Australian Plants. Finally, Plantlife, a UK charity with 12,000 members and owning 22 nature reserves, carries out surveys and rescue programmes for endangered plants under its Back from the Brink scheme, working with statutory conservation agencies and volunteers. Also in the U.K., National Council for the Conservation of Plants and Gardens (NCCPG) is a membership body networking 600 national collections holders containing 50,000 plant taxa of horticultural or ornamental interest.

National and local membership societies provide resources in terms of funds, publicity and volunteers for many plant conservation projects of national and local importance. Scientific societies (both professional and amateur), in particularly provide volunteers for monitoring and botanical recording in some countries. The Mauritius Wildlife Foundation, a voluntary organisation, supports the conservation of the local flora, providing both funds and practical support through its network of members and supporters to undertake 'on-the-ground' conservation projects. In Malta, an active network involving state and local community groups monitors native plant populations and help to coordinate local population protection. The Bolivian NGO F.A.N. (Fundación Amigos de la Naturaleza) raises environmental awareness among its members and in the wider community.

Conservation organisations can take advantage of other networks to contribute to their programmes. For example in Norway, farmers' organisations have a voluntary system for registering biological diversity.

16.3. Thematic and geographical gaps

The resources and capacity of networks in support of plant conservation vary greatly according to region. The best-supported networks are in developing countries. There are very few well-established multi-disciplinary network organisations active at national levels to help deliver integrated projects for practical plant conservation. Such networks are urgently required in countries where there are recognisd important centres of plant diversity.
