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COMMISSION ON GENETIC RESOURCES FOR FOOD AND AGRICULTURE

TECHNICAL REVIEW OF STATUS AND TRENDS OF THE WORLD'S FOREST GENETIC RESOURCES

by

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This background study paper is made available to the Commission on Genetic Resources for Food and Agriculture to inform decision-making on future work on forestry genetic resources, in the context of its Multi-Year Programme of Work.

The content of this document is entirely the responsibility of the author, and does not necessarily represent the views of the FAO, or its Members.

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NOTE

The present Working Paper was prepared to support discussions at the meeting of the14th Session of the Panel of Experts on Forest Gene Resources (31 Jan-2 February 2007).

This Paper is complemented by the following two studies commissioned by FAO:

- "The State of Forest Genetic Resources in the World: feasibility study and work options", by M. Bariteau. First version published as FAO Forest Genetic Resources Working Paper FGR/76E (FAO, Rome December 2004), after incorporation of comments by the 13th Session of the Panel of Experts on Forest Gene Resources (November 2003).

- Overview paper by L. Graudal on Indicators for Genetic Diversity in Forestry (due to be submitted in December 2006).

Based on the discussions and guidance from the Gene Panel, and following the incorporation of comments, components of the present paper, together with components from the two related studies mentioned above, have been used for the preparation of Working and Information Documents, "The World's Forest Genetic Resources: Status and Needs", for presentation at the 11th Session of the Commission on Genetic Resources for Food and Agriculture (June 2007).

1. BACKGROUND

At its 10th Regular Session, the Commission on Genetic Resources for Food and Agriculture (CGRFA)[2] requested the Secretariat to prepare an analysis of the human and financial resources available within FAO to support work on the various sectors of genetic resources for food and agriculture, and identify gaps. The immediate priority should be to continue work on plant and animal genetic resources. In the medium and longer term, the Commission should implement its full mandate[3][4]. The Secretariat was requested to prepare a document on the status and needs of sectors of genetic resources for food and agriculture, other than plants and animals, including the various areas of biodiversity for food and agriculture, and the agro-ecosystem approach to genetic resource conservation and cross-sectoral matters. Based on analysis of the human and financial resources available in FAO and identification of gaps, the Commission is expected to adopt a medium-term programme of work at its 11th Session in June 2007 (FAO 2004; see especially Paragraphs 84-89)[5]. The discussions of the Commission related to forest genetic resources will be supported by a Working Document (Secretariat Note) entitled, "The World's Forest Genetic Resources: Status and Needs".

The present Background Study Paper, which will provide components for the Working Document and possible related Information Documents for the CGRFA, has been prepared for discussion at the 14th Session of the Panel of Experts on Forest Gene Resources (31 January-2 February 2007). The Panel will review the paper with a view to complementing the information provided in it and discuss the contents, components, substance and recommendations to be transmitted to the CGRFA.[6]

2. HISTORICAL REVIEW OF ACTION IN FOREST GENETIC RESOURCES

SALIENT POINTS

FAO's activities in plant genetic resources have dynamically changed over the past 60 years in response to emerging needs and priorities of member countries and the international community. The Panel of Experts on Forest Gene Resources, established in 1968, has guided the work in the forestry field. A first Global Plan of Action in FGR was elaborated in 1975 and constituted an informal framework to harmonize and coordinate action at international level. FGR were not included in the Leipzig Global Plan of Action on PGRFA in 1996 and there is presently no agreed-upon global plan in this field. The 13th Session of COFO (1997) stressed the importance to further strengthen FAO's FGR programme; underlined the importance of the Panel of Experts on FGR; and requested FAO to support interested countries and regions to convene forest genetic workshops to review status, trends, needs and gaps, with a view to harmonizing and intensifying FGR activities at regional, sub-regional and eco-regional levels based on national priorities and action.

[2] A list of Acronyms and Abbreviations is found at the end of the document (Section 14).

[3] Conference Resolution 3/95 requested that the mandate of the Commission be broadened to cover all components of biological diversity of interest to food and agriculture: http://www.fao.org/docrep/meeting/X3241e.htm.

[4] While action has concentrated on crop and, lately, domestic animal genetic resources, FGR have been formally included in the work of the CGRFA since its establishment and the recommendations of the Panel of Experts on Forest Gene Resources have been regularly reported to it.

[5] Report on the 10th Regular Session of the CGRFA: ftp://ext-ftp.fao.org/ag/cgrfa/cgrfa10/r10repe.pdf.

[6] The draft is complemented by the following two studies commissioned by FAO: (i)"The State of Forest Genetic Resources in the World: feasibility study and work options" (Working Paper FAO-FGR/76E, December 2004); and (ii) Draft overview paper on Indicators for Genetic Diversity in Foresty.

Discussions on plant genetic resources within FAO were first begun in 1948. Over the 60 years of FAO's existence, perceptions of global needs and priorities have greatly changed. FAO programmes and priorities have shifted and evolved over the years in response to such changes.

The work of FAO in forest genetic resources, carried out in line with priorities and recommendations of its member Governments, aims at providing technical and scientific support to national institutes in member countries on the management of these resources, including their conservation and sustainable use. The backbone of support, which is coordinated with work of international partners, is the transfer of information, know-how and technologies among and between countries through mechanisms of networking and twinning.

The Panel of Experts on Forest Gene Resources, a Statutory Body of FAO established in 1968, has acted as a point of reference for such work (FAO 1968-2003)[7]. The Panel, which meets on a biennial basis, is mandated to, (i) review work on FGR, world-wide; (ii) examine priorities for action at national, regional, eco-regional and global levels, based on up-to-date information received from member countries and through networks of national and international experts; and (iii) guided by such information, make recommendations on the main focus and operational priorities of FAO, with due concern to collaboration and complementarity of programmes and activities with those of other international organizations active in this field. Outputs include regularly up-dated reports on status and priorities for action by region and sub-region, and lists of tree and shrub species and provenances for which priority action by FAO, and by countries concerned, is recommended in the areas of exploration, collection, evaluation, conservation and use. While the priority lists and related recommendations are based on priorities of countries, special attention is paid to those species and activities which are important in more than one country and for which recommended action thus has an international dimension. The Panel provides expert advice to the Committee on Forestry (COFO) and to the Commission on Genetic Resources for Food and Agriculture (CGRFA), and to other FAO Governing and Subsidiary Bodies, as appropriate.

A costed, global programme for the improved use of forest genetic resources was discussed and endorsed by the Third Session of the Panel (FAO 1975)[8]. The programme, which proposed action by region, species and lead agency, was formally only partially implemented due to lack of resources and donor interest at the time. Nevertheless, it provided a common point of reference for activities undertaken by the then comparatively small group of national and international agencies and institutions concerned, who recognized the benefits and increased efficiency which could be derived from such collaboration.

Environmental issues, including those related to biological diversity, rose to the forefront of the international agenda at the United Nations Conference on Environment and Development, UNCED (Anon 1992)[9]. A number of conventions, action plans and frameworks were developed and agreed upon at, and following, UNCED. The main purposes of these were to promote dialogue, catalyze coordinated action, and monitor progress towards stated goals. The Convention on Biological Diversity (CBD), and the Forest Principles, can be specifically mentioned among these (Anon 1992)[10].

The greatly expanded number of institutions and programmes involved in "biodiversity" following UNCED[11], the increased scope of the work (including expanded numbers of species targeted for attention and the need to integrate action at landscape, ecosystem, species, population and molecular

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[7] Panel Reports are found at: http://www.fao.org/forestry/site/16370/en/.

[8] Global Plan of Action on FGR (1975): http://www.fao.org/DOCREP/006/H0710E/H0710E00.HTM.

[9] UNCED Home Page: http://www.un.org/geninfo/bp/enviro.html.

[10] CBD: http://www.biodiv.org/convention/articles.asp?lg=0&a=cbd-02; Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of all Types of Forests ("The Forest Principles"): http://habitat.igc.org/agenda21/forest.htm).

[11] See Section 5, "International Action and Institutions Involved".

levels), the growing need for inter-sectoral collaboration and rapid advances in the field of genetics, have led to new expectations, challenges and opportunities.

The Fourth International Technical Conference on Plant Genetic Resources for Food and Agriculture, held in Leipzig, Germany in June 1996[12], within the framework of the Commission on Genetic Resources for Food and Agriculture, adopted two main documents: the "State of the World's Plant Genetic Resources"; and a "Global Plan of Action for the Conservation and Use of Plant Genetic Resources for Food and Agriculture" (FAO 1996)[13]. While information on forest genetic resources had been provided to the Technical Conference, FGR were not included in the final Plan of Action adopted in Leipzig. Instead it was recommended that action be reviewed in the light of the work of the Inter-Governmental Panel on Forests (IPF), established in 1995 to provide an international forum for forest policy deliberations. Neither the IPF, nor its successor arrangement, IFF, addressed the issue of forest genetic resources.

The conservation and sustainable utilization of forest genetic resources was discussed at the 13th Session of the Committee on Forestry in March 1997 (FAO 1997)[14] [15]. The Committee recognized the value of these resources in local and national development, including food security, poverty alleviation, environmental, conservation, economic and social advancement and the maintenance of cultural and spiritual values.

The Committee recognized the work done by FAO in the forest genetic resources field. It noted that the work carried out in preparation of the Leipzig Conference and, over the years, by the Panel of Experts on Forest Gene Resources and by national institutes and international partners, provided a solid foundation for continuing a stepwise process towards strengthening joint, coordinated action. It recommended that FAO's efforts to help explore, conserve, evaluate and better utilize forest genetic resources be continued and further strengthened in collaboration with national institutes and international governmental and non-governmental partners. It recognized that the management of forest genetic resources formed part of sustainable forest management, and highlighted the need to integrate FGR considerations into national forest programmes and other cross-sectoral action frameworks at national and regional levels.

The Committee agreed that there was an urgent need for concerted action to strengthen national, regional and international activities in the conservation and sustainable use of forest genetic resources, to help enhance country capacities and to support the exchange of information, experiences and know-how. Efforts in this regard, which rested on the principles of national sovereignty over natural resources, should be country-driven in recognition of the fact that the most appropriate action varied according to environmental, social and economic circumstances, institutional and legal frameworks, and prevailing needs and priorities of countries concerned. Work towards a global framework for action should proceed in a stepwise manner, within the overall framework of the CGRFA and with the technical and scientific advice of the Panel of Experts on Forest Gene Resources. The Committee requested FAO, in conjunction with Regional Forestry Commissions and countries that requested it, to convene regional and sub-regional forest genetic workshops complementary to those already held prior to the Leipzig Conference for boreal and temperate zones[16].

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[12] Report on the Leipzig Conference: http://www.fao.org/ag/AGP/AGPS/GpaEN/gpatoc.htm; for summarized information on outcome in relation to FGR, see Forest Genetic Resources No.24: http://www.fao.org/forestry/site/16372/en/

[13] These two documents can be found on-line at: http://www.fao.org/ag/aGp/agps/Pgrfa/pdf/swrfull.pdf and http://www.fao.org/ag/AGP/AGPS/GpaEN/gpatoc.htm

[14] Secretariat Note COFO 97/5: http://www.fao.org/docrep/meeting/W3712e.htm

[15] Report on the 13th Session of COFO: http://www.fao.org/docrep/meeting/003/W4631e.htm

[16] See below section, "Regional, Sub-Regional and Eco-Regional Workshops"; and related national level action listed in Table, "Availability of National Reports from Individual Countries".

The recommendations of COFO were subsequently endorsed by the 112th Session of the FAO Council[17] . The need for action was further stressed by the 11th, 12th and 13th Sessions of the Panel of Experts on Forest Gene Resources (FAO 1968-2003)[18] and by a number of other authoritative fora, such as the XI World Forestry Congress (Antalya, Turkey October 1997).

3. RECENT DEVELOPMENTS

SALIENT POINTS

FAO, in collaboration with international partners, supported a series of Regional/Sub-Regional/Eco-Regional, country-driven, action-oriented FGR Workshops in which a core of common parameters were recorded by countries concerned at national and regional levels, using harmonized concepts and mutually compatible evaluation principles and methods. The Panel of Experts on FGR considered possible objectives, operational implications and feasibility of a global assessment of FGR, and noted that such an assessment should be part of a comprehensive, longer term plan which included inter-sectoral linkages and broad stakeholder participation. It expressed concern over the lack of a global picture of status and trends and reliable estimates of rates of loss of FGR, and stressed the need to improve available information in collaboration with related global assessment processes, notably FRA. It noted the urgent need to clarify mechanisms for priority setting for species and FGR operations, and to define indicators for forest biological diversity and FGR.

As noted above, three regional/eco-regional workshops on forest genetic resources had been held prior to the Leipzig Conference. Following the recommendations of the 13th Session of COFO, FAO and Bioversity International (up to late 2007 known as IPGRI), in collaboration with international partners, have supported countries in the organization of a number of workshops in which participants discussed priority action based on national documentation on the status and needs of forest genetic resources (see Section 10 below, headings: “Regional, Sub-Regional, Eco-Regional Workshops on Forest Genetic Resources”; and “Availability of National Reports from Individual Countries.Conservation of Forest Genetic Resources”). In these workshops, standardized reporting formats, agreed-upon concepts and terms, and common mechanisms for priority setting in determination of priority species and activities, were used.The outcome was a series of plans for the conservation and management of forest genetic resources, based on priorities and needs of individual countries and endorsed for action under a regional or sub-regional umbrella.

The 12th and the 13th Sessions of the Panel of Experts on Forest Gene Resources recommended that FAO continue to support countries and national institutions in additional regions in which countries had expressed a wish to be involved. It noted that the final aim was to develop, step by step, a country-driven, participatory, global assessment and action framework for the conservation and sustainable use of forest genetic resources. The Panel urged countries and international institutions concerned to ensure timely follow-up to the recommendations of those workshops already concluded.

The 13th Session of the Panel considered a discussion paper on the possible objectives, operational implications and feasibility of carrying out a global assessment of forest tree genetic diversity. The Panel echoed the concern expressed in the paper over the lack of a global picture of the status and trends in forest genetic diversity and the lack of reliable estimates of the rate of loss in forest genetic resources. It stressed the need to improve available data, with due regard to, and collaboration with, related global assessment processes. It noted the urgent need to clarify a number of scientific and technical issues on which a global assessment was to be based, including principles for setting priorities (species and tree populations; operational priorities), and the definition of forest biological diversity and genetic indicators. It agreed that any assessment programme focussing on FGR should be

[17] Report on the 112th Session of the FAO Council, June 1997: http://www.fao.org/docrep/W5631E/W5631E00.htm.

[18] Reports on Sessions 1-13 of the Panel of Experts on Forest Gene Resources: http://www.fao.org/forestry/site/16370/en/.

seen as part of a comprehensive, longer term plan, in which both bottom-up and top-down approaches should be used in a balanced manner (analysis of country-derived information; and expert advice). It highlighted the need for broad stakeholder participation, and inter-sectoral contacts and cooperation in data gathering and analysis. The Panel noted that the present FAO work programme in forestry, forest genetic resources and genetic resources activities in other sectors of agriculture, already contained a number of elements of a proposed global assessment for forest genetic resources which, with advantage, could be built upon; and stressed the need for continued and further strengthened collaboration with other international institutions and mechanisms for maximum impact and benefit.

4. SCOPE OF THE PAPER, BASIC CONCEPTS, TERMINOLOGY

SALIENT POINTS

The paper deals with the forestry sector and with the management and susttainable use of forest tree and shrub genetic resources of actual or potential value for human well-being.

The present paper was prepared in response to a request from the CGRFA which referred to,

"..the status and needs of *sectors* of genetic resources for food and agriculture..... including the various *areas* of biodiversity for food and agriculture, and the *agro-ecosystem approach* to genetic resource conservation, and *cross-sectoral matters* " (see Section 1, "Background", above).

The paper deals with the **forestry sector**.

The term, "forest", as defined in the Global Forest Resources Assessment (FAO 2005)[19], denotes land spanning more than 0.5 hectares, with trees taller than 5 meters and a canopy cover of more than 10%, or trees able to reach these thresholds *in situ*. It does not include land that is predominantly under agricultural or urban land use. A forest area is thus determined both by the presence of trees and the absence of other predominant land uses. While the trees, according to the definition, should be able to reach 5 metres, areas under reforestation in which the trees have not yet reached, but are expected to reach, a canopy cover of 10% and a tree height of 5 meters, are included, as are temporarily unstocked areas resulting from human intervention or natural causes, which are expected to regenerate.

"Conservation" is defined as the management of human use of genetic resources so that they may yield the greatest sustainable benefit to present generations, while maintaining their potential to meet the needs and aspirations of future generations (Anon 1981, 1991; CBD 1992).

"Forest biological diversity" denotes the variability among forest living organisms and the ecological processes of which they are part. It includes variation at landscape, ecosystem, species, population, individual, and molecular levels of biotic organization. As these levels are inter-related, a comprehensive approach to conservation is necessary. At the same time, it is essential to specify clearly the level or levels targeted by specific management action (including non-intervention), as it is possible to conserve an ecosystem and still lose specific species, or to conserve a species and lose genetically distinct populations, genes or valuable gene complexes. "Ecosystem conservation cannot be reduced to conserving genes, nor can gene conservation be reduced to conserving ecosystems" (Namkoong 1990).

In addition to a clear statement of objectives, conservation requires dynamic management. Neither natural ecosystems nor breeding programmes are static. Genetic conservation must not be aimed at freezing a given state, which would imply an arbitrary fixation of dynamically evolving, living

[19] Forest Resources Assessment 2005: http://www.fao.org/DOCREP/008/a0400e/a0400e00.htm. Terms used in FRA: ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E13.pdf and http://www.fao.org/forestry/site/32369/en/.

systems. A variety of management tactics can be used to affect the structure and levels of forest biological diversity, from the establishment of strictly protected areas and nature reserves, through management for the production of wood and non-wood products or environmental services such as soil and water protection or recreation, to intensive tree breeding.

FAO, according to its mandate, provides support to member countries and contributes to international action in programmes which deal with diversity found in agroecosystems and their component sectors, and which support food security, rural development, environmental stability and economic and social advancement at national and local levels. While FAO supports both utility and non-utility objectives, the primary focus of the work of the Organization and, consequently, of this paper, focussed on the forestry sector, is the conservation of diversity through **the management and sustainable use of forest tree and shrub genetic resources of actual or potential value for human well-being**[20].

Conservation of forest biological diversity is a cross-cutting activity with components in many sectoral and cross-sectoral programmes. As noted above, the present paper is mainly concerned with forest genetic resources. In the case of the work programme of FAO, FGR activities (in the PWB referred to as, "Improved knowledge and best practices for the management of forest genetic resources"), are closely integrated with the programme entities, "Sustainable management of natural forests and woodlands" and "Forest plantations and trees outside forests". While of relevance, the paper does not deal specifically with the programme of FAO concerned with support to member countries in the management of protected areas and biological diversity in more general terms (in the PWB referred to as, "Best practices and approaches to promote effective conservation and sustainable management of biological diversity, including wildlife, in forests and wildlands")[21] [22].

For easy reference, definitions of some relevant terms are given in the boxes below[23].

As noted in recently held meetings on Harmonizing Forest-Related Definitions (FAO 2002, 2005)[24], forests and related issues are viewed and perceived differently by various stakeholders, who have different management and use objectives to which terms and definitions are targeted. As was the case in the FAO/IUFRO efforts related to forest genetic resources terminology[25], the purpose of the harmonization process was to report on definitions and to identify common elements, differences and inconsistencies. The ultimate aim of the process, which compared, in table format, definitions for common forestry terms of the CBD, FAO/FRA, ITTO, UNFCCC and CPF, was to pin-point inconsistencies, improve common understanding and facilitate national and international reporting and other uses of definitions, while respecting the legitimacy of the objectives of the various stakeholders.

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[20] This is in line with the ITGRFA, in which the concept of "plant genetic resources for food and agriculture" is defined as: "any genetic material of plant origin of actual or potential value for food and agriculture". See FAO 2000: ftp://ftp.fao.org/ag/cgrfa/it/ITPGRe.pdf.

[21] See *e.g.* the FAO Medium Term Plan 2006-2011: http://www.fao.org/mtp/ , and Programme of Work and Budget 2006-2007: http://www.fao.org/pwb/2006/.

[22] Note however that much basic information aggregated on global, regional and eco-regional levels, notably through FRA, is related to variables such as forests in protected areas.

[23] See also Sub-Section 4(i) of the Bibliography at the end of the document (Section 13).

[24] For reports on the first two "Harmonization" meetings, see: http://www.fao.org/clim/docs/44_fodef.pdf and http://www.fao.org/docrep/005/Y4171E/Y4171E03.htm#TopOfPage.

[25] See FAO (2002): Working Paper FGR/42E: http://www.fao.org/forestry/site/7365/en/ and IUFRO/Silvavoc: http://www.iufro.org/science/special/silvavoc/forest-genetic-resources/.

SUSTAINABLE FOREST MANAGEMENT AND THE ECOSYSTEM APPROACH

The ecosystem approach concept (used within the framework of the CBD), and the concept of sustainable forest management (used in the international and national forest policy dialogue), contain a number differences and similarities. *Sustainable forest management* refers to meeting present needs for forest goods and services, while ensuring their continued availability in the longer term; and combines the production of wood and non-wood forest products with the conservation of soil, water and biological diversity, while the socio-economic, cultural and spiritual values of forests are maintained or enhanced. The conservation of biological diversity thus constitutes, by definition, an essential and integral element of sustainable forest management. *The ecosystem approach* is defined as the integrated management of land, water and living resources, which promotes their conservation and sustainable use in an equitable way. Accordingly, forest ecosystems should be managed for their intrinsic values and for the tangible benefits they provide to humans. It is clear that these two concepts are not contradictory but mutually supportive More specifically; reviewing the definitions, sustainable forest management can be seen as a means of applying the ecosystem approach to forests (FAO 2003)[26].

FOREST RESOURCES AND FOREST BIOLOGICAL DIVERSITY

In many fora, the term "biological diversity" ("biodiversity"), is increasingly used to refer to the management and use of forest resources rather than to biological diversity in forest ecosystems For example, reference to, "harvesting of forest biodiversity", "management of forest biological diversity" and "forest biodiversity products" (CBD 2002,2005), leaves the impression that "diversity" is synonymous with "resources". This is clearly not correct; resources are managed and harvested, and products are obtained from the resources, while biological diversity denotes "the variability among living organisms" (see discussion in FAO 2003)[27].

SOME DEFINITIONS RELATED TO [FOREST] BIOLOGICAL DIVERSITY AND [FOREST] GENETIC RESOURCES

International Treaty on Plant Genetic Resources for Food and Agriculture

Plant Genetic Resources for Food and Agriculture: any genetic material of plant origin of actual or potential value for food and agriculture.

In situ conservation*:** the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated plant species, in the surroundings where they have developed their distinctive properties. ***Ex situ conservation: the conservation of plant genetic resources for food and agriculture outside their natural habitat (FAO 2001)[28].

[26] See discussion in FAO (2003): Working Paper FM/ 25. http://www.fao.org/docrep/008/j1244e/j1244e00.htm.

[27] SOFO 2003: http://www.fao.org/docrep/005/y7581e/y7581e07.htm#P0_18.

[28] ftp://ftp.fao.org/ag/cgrfa/it/ITPGRe.pdf.

Convention on Biological Diversity

Conservation: the management of human use of genetic resources so that they may yield the greatest sustainable benefit to present generations, while maintaining their potential to meet the needs and aspirations of future generations. ***Ex-situ conservation****:* the conservation of components of biological diversity outside their natural habitats. ***In-situ conservation****:* the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties.

Biological diversity: the variability among living organisms from all sources including, *inter alia*, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems.

Biological resources*:* includes genetic resources, organisms or parts thereof, populations, or any other biotic component of ecosystems with actual or potential use or value for humanity.

Ecosystem**:** a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.

Forest biological diversity: the variability among forest living organisms and the ecological processes of which they are part; this includes diversity in forests within species, between species and of ecosystems and landscapes

Protected area**:** a geographically defined area which is designated or regulated and managed to achieve specific conservation objectives (CBD 1992)[29].

"Forest Genetic Resources Conservation and Management: Overview, concepts and some systematic approaches" [30]

Biological diversity**:** the variety of life forms, the ecological roles they perform and the genetic diversity they contain (sometimes abbreviated to biodiversity).

Genetic conservation**:** all actions aimed at ensuring the continued existence, evolution and availability of genetic resources. ***In situ conservation:*** the conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties. ***Ex situ conservation*****:** the conservation of components of biological diversity outside their natural habitats.

Genetic diversity**:** the sum total of genetic differences between species and within species.

Genetic resources**:** the economic, scientific or societal value of the heritable materials contained within and among species.

Ecosystem**:** a dynamic complex of plants, animal and micro-organism communities and their non-living environment interacting as a functional unit.

"Plant Genetic Resources: their conservation *in situ* for human use"

Conservation of genetic resources**:** *the actions and policies that assure their continued availability and existence.*

Biological diversity *("biodiversity"): the variety of life forms, the ecological roles they perform and the genetic diversity they contain.*

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[29] CBD, Article 2. http://www.biodiv.org/convention/articles.asp?lg=0&a=cbd-02.

For the definition of "Forest Biological Diversity" and other forestry related terms, see: http://www.biodiv.org/programmes/areas/forest/definitions.aspx.

[30] IPGRI, FAO and FLD (2004). http://www.ipgri.cgiar.org/publications/pdf/1018.pdf.

Ecosystem: *a community of plant and animal species and micro-organisms, considered together as a functional system and including the complex inter-relationships among plants, animals, microbes and man, and their environment.*

Genetic diversity: *occurs at gene level (the molecular level), the individual level, the population level, the species level and the ecosystem level.*

Plant genetic resources: *refers to the economic, scientific or societal value of the heritable materials contained within and among species* (FAO 1989).

5. INTERNATIONAL ACTION AND INSTITUTIONS INVOLVED

SALIENT POINTS

Over the past 35 years the number of international, regional and national institutions, mechanisms and discussion fora which are concerned with forests and forest biological diversity have greatly increased. While institutions generally cover different aspects of work, collaboration among them needs to be strengthened, based on their mandates and comparative advantages. Harmonization of action will help ensure that wasteful duplication of efforts is avoided, important FGR issues are not inadvertently neglected, reporting bourdon on countries is minimized, and provision of data and information is consistent across sectors, thus facilitating cross-sectoral linkages. The present Section attempts to map the international scene by providing a list of major players in the FGR field and their main focus of action; it is complemented by information in Appendix 1.

Growing environmental awareness at all levels of society and acknowledgement by decision makers of the importance of wise environmental management as a cornerstone for development have, over the past 35 years, led to important policy decisions and related action at international level. This has included development and ratification by national Governments of a number of international conventions and legally and non-legally binding action plans, for which the decisions taken at UNCED (Anon 1992)[31] provided an important, overall framework. The eight UN Millennium Development Goals, which set time-bound and measurable targets which should be reached by 2015, more recently stressed the need to ensure "environmental sustainability" as an integral part of development and human well-being (Goal 7)[32]. The Millennium Development Goals, and some notes on FAO's role and activities, are outlined in the Box at the end of this Chapter.

Many of the agreements have directly or indirectly affected policies and action in sustainable forest management, including the conservation of forest biological diversity and the management of forest genetic resources.

In response to actual or perceived needs, the number of agencies, institutions, mechanisms and discussion fora at international, regional and national levels which are concerned with forests and forest biological diversity have greatly increased. A summary of some of the major players at the international level, is given in the Table below. Additional information, in narrative form, is found in *Appendix 1*.

While a large number of international institutions are involved in forest biological diversity, they generally cover different aspects of work, and their mandates as inter-Governmental or non-Governmental fora, and roles as policy making, technical, executing or funding agencies are, at least

[31] For information on UNCED, see: http://www.un.org/geninfo/bp/enviro.html ; and http://www.ciesin.org/docs/008-585/unced-home.html

[32] http://www.un.org/millenniumgoals/
See also document, "FAO and the Millennium Development Goals: the road ahead": http://www.fao.org/mdg/

to some degree, complementary. Collaboration among these institutions needs however to be further strengthened, based on the overall objectives and comparative advantages of each institution. For example, integration of the of the 130 activities in the CBD expanded Programme of Work on Forest Biological Diversity[33] with the more than 270 IPF/IFF proposals for action, constitutes a major challenge (see Boxes on the CBD Expanded Work Programme on Forests; and IPF and IFF Proposals for Action; below the Table). What is required are innovative approaches, effective support, and sincere and honest collaboration among partner institutions. Governments and members need to be aware of institutional complementarities and decisively contribute to streamlining activities when providing advice and making recommendations to governing bodies of the international institutions which they support.

Joint or coordinated action at the international level can help draw attention to conservation issues of global concern which might inadvertently be overlooked or neglected, streamline action among countries and regions to avoid wasteful duplication of efforts, and support national and regional measures to adequately conserve forest biological diversity and effectively evaluate, wisely manage and sustainably utilize forest genetic resources for present-day and future benefit. Effective, coordinated, international action can also help ease the international reporting burdon of countries, and facilitate the provision of information which is comparable between countries and regions, and consistent across sectors.

[33] http://www.biodiv.org/programmes/areas/forest/default.asp

Table 1. Some International Institutions involved in Forest Biological Diversity and related Treaties, Discussion Fora

Agency, Institution, Programme, Mechanism [34]	*Type of Organization*	*Inter-Governmental*	*Non-Governmental*	*Fields covered according to mandate*	*Major focus in forest biological diversity*	*NB*
1. Agencies and Organizations, Programmes						
FAO	UN Specialized Agency	x		Agriculture, including fisheries and forestry	Agroecosystems, species, genetic resources	
Unesco	UN Specialized Agency	x		Science, technology, education/training	Ecosystems, cultural landscapes, species	Administers i.a. the Man and the Biosphere Programme
UNEP	UN Programme	x		Cross-sectoral coordination of environmental issues, provision of leadership, promotion of action	Ecosystems, species, genetic resources	
World Conservation Monitoring Centre (UNEP-WCMC)	Institution operating within the framework of UNEP	x		Biological diversity assessment, generation and management of information	Ecosystems, species	Est.1988, earlier jointly managed by IUCN, UNEP and WWF. Part of UNEP since 2000.
World Bank[35]	UN Agency, international development bank	x		Investment in development	Ecosystems (species)	
UNDP	UN Programme	x		Funding and coordination in support of development programmes	Ecosystems (species)	
ITTO	Organization established under	x		Trade, tropical forest	Ecosystems, species	Member countries

[34] A list of Acronyms and Abbreviations is found at the end of the document (Section 14).

[35] The "World Bank" is the name generally used for the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA).

Agency, Institution, Programme, Mechanism [34]	*Type of Organization*	*Inter-Governmental*	*Non-Governmental*	*Fields covered according to mandate*	*Major focus in forest biological diversity*	*NB*
	the auspices of the UN			management	(genetic resources)	include producers and consumers of tropical timber
Bioversity International (earlier known as IPGRI)	CGIAR Centre		x	Research on genetic resources	(Ecosystems), species, genetic resources	
CIFOR	CGIAR Centre		x	Research in forest development	Ecosystems, species	
ICRAF	CGIAR Centre		x	Research in agroforestry	Agro-ecosystems, species, genetic resources	
IUFRO	International Secretariat supporting research networks		x	Forest research networking	Ecosystems, species, genetic resources	
IUCN	Advocacy; special interest group organization		x	Conservation of nature and natural resources	Ecosystems, landscapes, species (genetic resources)	
WWF	Advocacy; special interest group organization		x	Conservation of nature and natural resources	Ecosystems, species	National agencies using same acronym are largely or fully independent of WWF Internat. (Gland, CH)
2. Conventions, Treaties, Mechanisms						
Forest Principles		x		Sustainable forest management	Ecosystems, species, genetic resources	Non-legally binding agreement
International Treaty on Genetic Resources for Food and Agriculture	Governmental forum to discuss and to negotiate issues rel.to genetic resources for food and agriculture, to ensure their conservation+sustainable use and fair & equitable sharing of benefits derived	x		Conservation, sustainable use, benefit sharing of genetic resources for food and agriculture (crop,animal, Fish, Forest Genetic Res)	(Ecosystems), species, varieties, genetic resources	Legally binding instrument.
CBD		x		Conservation of biological diversity	Ecosystems, species, genetic resources	Legally binding convention
UNFCCC		x		Climate change	Ecosystems, species	Legally binding convention

Agency, Institution, Programme, Mechanism [34]	*Type of Organization*	*Inter-Governmental*	*Non-Governmental*	*Fields covered according to mandate*	*Major focus in forest biological diversity*	*NB*
UNCCD		x		Combatting desertification	Ecosystems, species	Legally binding convention
GEF	International Fund for environmental programmes (coordinated by UNDP, UNEP, the WB)	x		Funding of environmental programmes	Ecosystems, species, genetic resources	Administers programmes executed by countries
CITES	Convention with Secretariat in UNEP[36]	x		Environmental effects of trade and marketing	Species	Lists rare and endangered animal and plant species for national level regulation of international trade and transit.
3. Discussion and Policy Making Fora[37]						
FAO Committee on Forestry (COFO)[38]	Brings together Heads of Forest Services + senior Government officials to identify/discuss emerging policy and technical issues	x				Reports to FAO Council → FAO Conference
- Regional Forestry Commissions	Brings together Heads of Forest Services + senior Government officials in 6 Regions to identify/ discuss policy and technical issues	x				Report to COFO, FAO Council → FAO Conference
– Panel of Experts on	Internat. Expert Group				Between the three Statutory	Report to COFO,

[36]Other conventions for which UNEP provides a Secretariat, which are of some relevance to the subject of this paper, include *i.a*: the Conservation of Migratory Species of Wild Animals (CMS), the Convention on Wetlands (RAMSAR), and the World Heritage Convention (WHC).

[37] Institutions and mechanisms listed in sections [1] and [2] of this table also serve as discussion and policy making fora which can provide information and feedback; they thus complement the discussion and policy making mechanisms listed in section [3].

[38] For more information on FAO Statutory Bodies, see: http://www.fao.org/forestry/site/statutorybodies/en/.

Agency, Institution, Programme, Mechanism [34]	*Type of Organization*	*Inter-Governmental*	*Non-Governmental*	*Fields covered according to mandate*	*Major focus in forest biological diversity*	*NB*
FGR – *Silva Mediterranea* – Internat.Poplar Comm.	Circum-Meditteranean Issues *pulus and Salix issues*	(x)		See footnote [8]	Bodies, eco-systems, species, FGR	FAO Council → FAO Conference
CGRFA	FAO Member Govts (presently 168 Member Govts + EU)	x		Genetic resources for food and agriculture, including crop, animal, fish and forest genetic resources	(Ecosystems), species, genetic resources,	Presently major focus on crop and animal genetic resources; other sectors to be included in stepwise manner. Reports to FAO Council⟶ Conf.
UNFF	Discussion forum	x		Forest biological diversity		Successor arrangement to IPF and IFF
CPF	*Discussion forum, coordinating mechanism*	*(x)*	*(x)*	*Forest biological diversity; the 14 collaborating institutions*[39]*, between them, cover all levels of diversity*		*Partnerhip of FO-related organiza-tions, Secretariat: UNFF; chaired by FAO FO Dept. Successor arrangement to ITFF.*

[39] FAO, UNDP, UNEP, WB, ITTO, CIFOR, ICRAF, IUFRO, IUCN and Secretariats of UNFF, CBD, UNCCC, UNCCD, GEF.

CBD EXPANDED WORK PROGRAMME ON FORESTS

Source: CBD 2003, 2005[40]

The CBD Expanded Work Programme on Forests was approved at the Sixth Session of the Conference of Parties held in The Hague, Netherlands, in April 2002. Activities related to forest genetic resources are specifically mentioned in Goals 4 and 5.

Discussions related to Goal 5, "Access and Benfit Sharing of forest genetic resources" (ABS), on the promotion of the fair and equitable sharing of benefits resulting from the utilization of forest genetic resources and associated traditional knowledge, have been incorporated, in general terms, in overall discussions on ABS.

The proposed programme of work which is outlined in Goal 4, "To Promote the Sustainable Use of Forest Genetic Resources", has formed an integral part of the CBD discussions on forestry. Objectives 1-3 of Goal 4, refer to forest biological diversity in general. The activities in *Objective 4, Goal 4*, refer specifically forest genetic resources, and are reproduced below.

Goal 4. To promote the sustainable use of forest biological diversity

Objective 4

Develop effective and equitable information systems and strategies and promote implementation of those strategies for *in situ* and *ex situ* conservation and sustainable use of forest genetic diversity, and support countries in their implementation and monitoring.

Activities

- Develop, harmonize and assess the diversity of forest genetic resources, taking into consideration the identification of key functional/keystone species populations, model species and genetic variability at the DNA level.
- Select, at a national level, the most threatened forest ecosystems based on the genetic diversity of their priority species and populations and develop an appropriate action plan in order to protect the genetic resources of the most threatened forest ecosystems.
- Improve understanding of patterns of genetic diversity and their conservation *in situ*, in relation to forest management, landscape-scale forest change and climate variations.
- Provide guidance for countries to assess the state of their forest genetic resources, and to develop and evaluate strategies for their conservation, both *in situ* and ex situ.
- Develop national legislative, administrative policy measures on access and benefit-sharing on forest genetic resources, taking into account the provisions under Articles 8(j), 10(c), 15, 16 and 19 of the Convention on Biological Diversity and in conformity with future decisions of the Conference of the Parties, as appropriate.
- Monitor developments in new biotechnologies and ensure their applications are compatible with the objectives of the Convention on Biological Diversity with respect to forest biological diversity, and develop and enforce regulations for controlling the use of genetically modified organisms (GMOs) where appropriate.
- Develop a holistic framework for the conservation and management of forest genetic resources at national, sub-regional and global levels.

[40] http://www.biodiv.org/decisions/default.aspx?dec=VI/22

• Implement activities to ensure adequate and representative in situ conservation of the genetic diversity of endangered, over-exploited and narrow endemic forest species and complement the *in situ* conservation with adequate *ex situ*conservation of the genetic diversity of endangered, over-exploited and narrow endemic species and species of economic potential.

Extracts, IPF and IFF PROPOSALS FOR ACTION

Some proposals relevant to forest biological diversity and management of FGR (UNFF 2002)[41]

Progress through national forest and land-use programmes

IPF- Para 17(a) The Panel encouraged countries, in accordance with their national sovereignty, specific country conditions and national legislation, to develop, implement, monitor and evaluate national forest programmes, which include a wide range of approaches for sustainable forest management, taking into consideration the following: consistency with national, sub-national or local policies and strategies, and - as appropriate - international agreements; partnership and participatory mechanisms to involve interested parties; recognition and respect for customary and traditional rights of, *inter alia*, indigenous people and local communities; secure land tenure arrangements; holistic, intersectoral and iterative approaches; ecosystem approaches that integrate the conservation of biological diversity and the sustainableuse of biological resources; and adequate provision and valuation of forest goods and services.

Underlying causes of deforestation and forest degradation

IPF- Para 31(c) The Panel invited interested parties to lend support, as appropriate, to the preparation of the programme of work for forest biological diversity of the Convention on Biological Diversity, with respect to analysing measures for mitigating the underlying causes of biodiversity loss, as stated in decision III/12 of the Conference of the Parties to the Convention.

Forest conservation and protected areas

IFF- Para 85(b) The Forum encouraged countries to develop and implement appropriate strategies for the protection of the full range of forest values, including cultural, social, spiritual, environmental and economic aspects; recognition of the multiple functions and sustainable use of all types of forests, with particular regard to biological diversity; participation of communities and other interested parties; integration of the livelihood needs of indigenous and local communities; and planning and management on an ecosystem basis, in which special emphasis should be put on the continued integrity of genetic diversity.

Criteria and indicators

IPF- Para 115(f) The Panel requested that the Conference of the Parties to the Convention on Biological Diversity take note of the work of the various existing initiatives on criteria and indicators to ensure that the work done by the Convention on Biological Diversity on developing and implementing biodiversity indicators would be consistent with and complementary to them.

[41] http://www.un.org/esa/forests/pdf/ipf-iff-proposalsforaction.pdf); for main actors and degree of action, see: http://www.wrm.org.uy/actors/IFF/proposalsforaction.pdf)

Traditional forest-related knowledge

IPF- Para 40(b) Invited countries and relevant international organizations, especially the Conference of the Parties to the Convention, to collaborate with indigenous people and forest-dependent people who possess TFRK to promote an internationally acceptable understanding of TFRK, and to identify, respect, preserve and maintain TRFK, including innovations and practices that are relevant for the conservation of forest biological diversity and the sustainable use of forest biological resources.

IFF- Para 74(c) Called upon countries to work with relevant international organizations to help to develop a common appreciation and understanding of the relationship between the intellectual property rights, *sui generis* or other relevant systems for protection, and the CBD, including work, as necessary, on addressing issues related to the identification of origins of traditional forest-related knowledge, and of the knowledge that results from the use of forest genetic resources (as defined by the CBD), with a view to protecting such knowledge from inappropriate use.

Transfer of environmentally sound technologies to support sustainable forest management

IFF- Para 56(j). [IFF stressed the importance of implementing the IPF proposals for action on the transfer of environmentally sound technologies. In order to further their effective implementation, IFF] Urged countries to promote fair and equitable sharing of the benefits arising from the utilization of forest genetic resources (as defined by the CBD) and the results and applications of research, upon mutually agreed terms, and to work, as necessary, on addressing issues of the identification of origins of forest genetic resources within their intellectual property rights, sui generis or other relevant systems for protection, as appropriate, taking into account the work being advanced by the CBD and other relevant international agreements, in accordance with national laws**.**

Forest research

IPF- Para 94(c) The Panel urged the United Nations system, international financial institutions and countries to examine the need to expand the capacity of existing research institutions at the regional and subregional levels, and where appropriate the establishment of new regional/ subregional centres for research, development and extension, including for biological diversity and forest products and other forest goods and services.

THE MILLENNIUM DEVELOPMENT GOALS

Leaders gathered at the World Food Summit in 1996 committed their countries to cutting hunger by one-half by the year 2015. A series of international conferences and summits during the 1990s identified other major goals and quantified targets with the same time horizon. These were brought together in the Declaration adopted by the UN Millennium Summit in September 2000 and later restated in the form of eight Millennium Development Goals, listed below[42]:

1. Eradication of extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality

[42] http://www.un.org/millenniumgoals/.

5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a global partnership for development

While forests play a role, directly and indirectly, in most of the MDGs through their multiple social, economic and environmental functions, the two Goals to which sustainable forest management makes the most direct contribution are Goals 1 and 7.

FAO's long-standing work on promoting sustainable forest management contributes to the achievement of MDG 7, which is aimed at ensuring environmental sustainability. More recently, FAO has highlighted action towards helping countries enhance the contribution of forests to MDG 1.

An Inter-Divisional, FAO Forestry Department, Task Force on Poverty was established in March 2002. The Task Force has developed a framework for poverty reduction and collaboration on activities related to forests, poverty alleviation and food security, including also aspects of forest biological diversity and the management of forest genetic resources. Through its Regular Programme, and in collaboration with the National Forest Programme Facility, the Forestry Department provides direct support to countries to strengthen coherence and synergies between national forest programmes and broader sustainable development policy and planning processes, and to encourage civil society participation in decisions about forests. This is a key mechanism for assisting countries to adjust their policies and strategies so as to incorporate forests into overall sustainable development, and *vice versa*.

In the Inter-Departmental FAO Livelihood Support Programme; the Forestry Department's contribution is focused on the promotion of good governance, adaptive multi-stakeholder policy-making processes, knowledge and information sharing on livelihood-oriented forestry, and effective communication.

At the international level, FAO, in collaboration partner organizations, plays a key role in efforts to increase commitment to and implementation of sustainable forest management through, among other things, its Chairmanship of CPF.

The documents, "FAO and the Millennium Development Goals: the Road Ahead"[43] (FAO 2005); and, in relation to forestry, especially the document, "The Role of Forests in Contributing to the Millennium Development Goals"[44] (FAO 2005), provide additional information on this important issue.

6. WHY SPECIFICALLY FOREST GENETIC RESOURCES?

SALIENT POINTS

Some important differences in the relevance and balance in application of strategies and in the methods used for conserving and managing crop and forest genetic resources are highlighted. These are due to biological characteristics of the species, levels of knowledge on their variation and genetic makeup, the management systems applied and uses made of their products. While the need for inter-sectoral links are generally important, it is noted that the differences in approach and application makes also the availability of sector-specific expertise essentially important. This points to the need to continue to make full use of existing mechanisms such as the Panel of Experts on FGR and

[43] http://www.fao.org/mdg/.

[44] http://www.fao.org/docrep/meeting/009/J3884e.htm.

to maintain databases such as REFORGEN for the collection, storage and provision of sector-relevant information.

There are important differences in the relevance and balance in application of strategies and, more specifically, in the methods used for conserving and managing crop and forest genetic resources[45]. These differences in approaches and implementation need to be considered at both the policy and technical levels (see *e.g.* discussion in Bariteau 2004). While inter-sectoral links are important, the differences in approach and application puts into evidence the need for sector-specific expertise in planning and implementation.

Outbreeding, long-lived forest species are, by nature, among the most genetically variable organisms on earth. The goals of genetic management of forest genetic resources are far more diverse than in the case of crop genetic resources, the quality of environmental control over both time and space is far less, and breeding cycles far longer.

The ecological variability of conditions within forested landscapes and within single forest populations include many sources of variation and wide ranges of those variables. The time scales over which conditions change vary from days to decades, but are dominated by the generally long life cycles and wide distribution ranges of trees. Forest populations are dynamically changing over time and space, both in terms of their genetic and species composition. They have frequently developed complex mechanisms to maintain high intra-specific diversity, needed to allow the species to evolve and adapt to changing conditions. Forest genetic resources considerations thus do not start with simple, stable, optimally adapted, systems, and the aim is not to preserve a particular fixed state of diversity.

The conservation of forest genetic resources involves the conservation and sustainable utilization of an already existing and largely self-regenerating resource, consisting of tree populations which have generally to date undergone little selection by man[46]. Forests are managed for a wide range of different purposes. The products and values generated by forests involve the various harvested parts provided by trees (stems, fruits, leaves, resins etc.) and, in addition, forests provide a range of environmental services, such as soil and water conservation and carbon storage, habitats for biological diversity, and meet recreation needs of increasingly urbanized populations. Multiple use management of forests is a rule; management for commodity values only, like in agriculture, is hardly ever an option. On the other hand, conservation of genetic resources and the utilization of the forests and trees providing these resources are, when forests are adequately managed, mutually compatible and supportive.

A great variety of locally occurring tree species can provide the goods and services commonly sought from the forest. As foresters rely on genetic diversity within existing forests and plantations rather than on cultural practices to buffer against environmental heterogenity, changes in the environment and variations in end use requirements, adaptation to local environmental conditions and suitability to meet local and national needs, are of paramount importance. The general philosophy in forestry is thus the establishment of national FGR programmes, including seedbanks and breeding programmes, rather than the import and use of standard cultivars and varieties bred elsewhere, as frequently is the case in agricultural crops. In cases in which introduced species are used in plantation forestry and, thus, imports of reproductive materials occur, such transfers are based on similarities in ecological conditions and, with a few exceptions, generally involve movements South/South and North/North. While many established institutions involved in forest seed exchange and trade apply various types of

[45] While conservation methodologies applied in forestry differ decisively from those in agricultural crop species, some similarities in approach might possibly be found between forestry and fisheries as, in the fisheries sector, geneticists are also dealing with a widely distributed, genetically inadequately known, largely undomesticated and woefully unmanaged and over-utilized resource.

[46] As noted in Section 10, in relation to the Global Forest Resources Assessment Programme, only approximately 5% of the world's forests are planted, the rest being natural or semi-natural forests, which are under varying degrees of human management (http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=101&sitetreeId=16807&langId=1&geoId=0)

Material Transfer Agreements, much of the seed movement is sporadic and, worryingly, often suffers from the lack of documentation; the great problem, then, is the lack of information on the origin and genetic quality of the seedlots, rather than access[47].

While all countries that plant forest trees must have a seedbank for operational purposes[48], the genetic resources of forest trees are most commonly "stored" in living trees, in contrast to most agricultural crops for which genetic diversity can be relatively easily stored and conserved in seed banks[49]. The individual tree constitutes an excellent and dynamically adapting "storage facility" for genetic resources over the lifespan of a tree, which is often longer than the lifespan of seed or other, stored reproductive materials. While filling this "genebank function", trees and forests also provide other services to man. Their use for commodity purposes, at the end of the rotation, does not affect the availability of genetic resources, as seed is generally not the end product sought from them; seed is produced by trees on a continuing basis, and can be collected for the use in regeneration of the forest stand or storage purposes during a series of years prior to harvest of the final products. Alternatively, regeneration found under the harvested (or still standing) trees can be nurtured to provide a new generation of trees.

7. STRATEGIES AND METHODOLOGIES IN A FOREST GENETIC RESOURCES PROGRAMME

SALIENT POINTS

Only some 5% of forests in the world are in plantations, with the balance found in natural or semi-natural, largely undomesticated stands. Conservation of FGR is based on, (i) conservation in protected areas; (ii) incorporation of genetic considerations in natural and planted forest management; and (iii) incorporation of such considerations in tree improvement strategies. Main emphasis of the FGR strategy to be applied depends on characteristics of the species, including variation and variation patterns; present-day and potential uses; levels of security and integrity of populations, species, FGR; levels of genetic and silvicultural knowledge; institutional abilities; and financial possibilities. There is a need to intensify action in the various steps in FGR management, based on improved basic knowledge; and to incorporate a wider range of species in national programmes, using varying intensities of action. Ecogeographical and genecological zoning will help support definition of priorities and early application of strategies. Lack of skilled breeders is frequently a limitation to the use of traditional and advanced technologies and needs to be adequately addressed.

As mentioned in the previous Section, there are important differences in the balance of strategies and application of methodologies in programmes for crop and forest genetic resource conservation. A brief summary of action applicable to the forestry field is provided below.

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[47] A number of regional schemes to regulate the movement of forest reproductive materials are in place; their main purpose is to ensure adequate documentation on origin and provenance of the material imported and exported, including its genetic and physiological quality. See *e.g.* OECD (2001): http://www.oecd.org/dataoecd/23/16/2734540.pdf and http://www.oecd.org/LongAbstract/0,2546,en_2649_33727_2734530_119820_1_1_1,00.html.

[48] Seed availability to meet the needs of planned, yearly planting programmes requires the establishment of operational seed banks, as most tree species do not flower and produce seed each year but tend to do so with intervals of 2-8 years, and seed frequently takes 2-3 years to mature (on the tree).

[49] While storage life of orthodox seeds, using modern technologies, is long, stored germplasm must still be regenerated when germination falls below critical levels. Such regeneration will pose major difficulties in outbreeding, largely heterozygous forest trees. Trees need large areas for regeneration, and many tree species undergo a long vegetative period before flowering and fruiting (from 5 to 50 years). Control over the process of seedlot regeneration and natural selection during the regeneration process, will be consequently very poor, and costs for regeneration will be elevated.

Management Strategies

The strategies developed for the conservation of forest genetic resources imply varying intensities of intervention by man, ranging from non-intervention in strictly protected areas to forests managed for the production of timber and other wood products, non-wood products and specified environmental benefits and services such as soil and water protection. Goods and services derived from natural forests are complemented by the establishment of forest plantations and the planting of trees in farming systems. In these cases, production is generally concentrated close to the user, and productive or protective characteristics of the planted trees can be more closely controlled and enhanced through the use of selected or improved planting materials. The planting of trees offers the possibilities of combining genetic conservation with selection and breeding.

In line with the above, the conservation of forest biological diversity and forest genetic resources rests on a tripod of, (i) conservation in protected areas; (ii) the incorporation of genetic considerations in natural and planted forest management; and (iii) the incorporation of such considerations in tree improvement strategies.

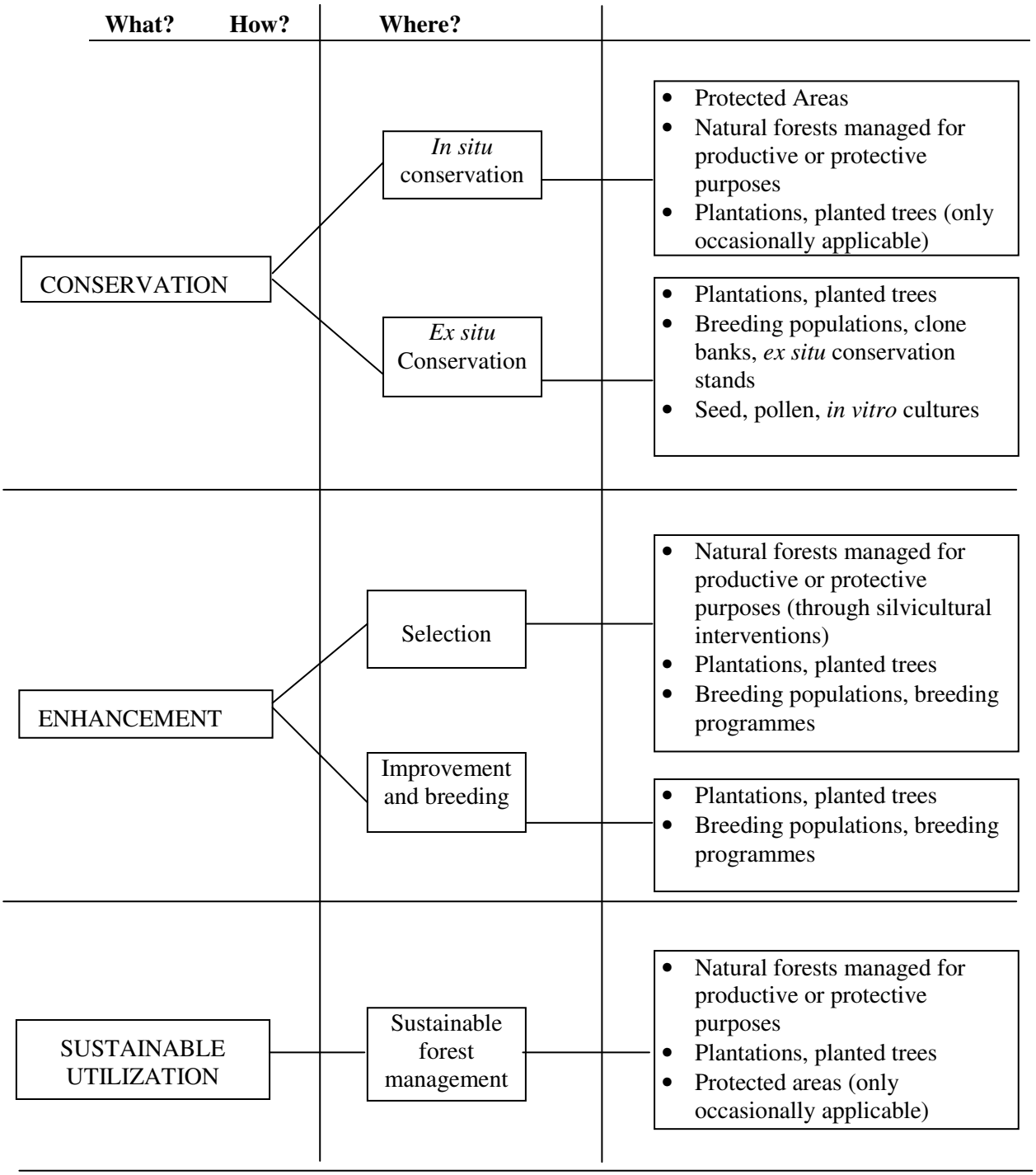
The management of an appropriate combination of genetic resource areas in various locations, under diverse environmental and silvicultural conditions, is the most efficient way to conserve genetic variation at its various levels. The variety of types of field repository of genetic resources (including nature reserves and other protected areas; private and publicly owned, managed and unmanaged, natural and semi-natural forests and forest plantations; trees outside forests managed in agroforestry systems and growing on homesteads and along rivers and roads; arboreta and botanic gardens; and field trials and live collections established within the framework of selection and tree improvement programmes), and the need to ensure complementarity among them, constitutes a major organizational, institutional and technical challenge.

The options are schematically shown in the Figures 1 and 2 below.

Fig. 1. Management of Genetic Resources of Forest Trees and Shrubs by Category of Land Use
(Based on Palmberg-Lerche 1998)

Management Category	Main Activity Supporting the Management of Forest Genetic Resources
PROTECTED AREAS ⇨	Conservation
MANAGED NATURAL FORESTS ⇨ ⇨ ⇨	Conservation [Enhancement] Sustainable utilization
PLANTATIONS, PLANTED TREES ⇨ ⇨ ⇨	[Conservation] Enhancement Sustainable utilization
TREE IMPROVEMENT, BREEDING ⇨ ⇨ (Incl. *ex situ* collections)	Conservation Enhancement

Figure 2. Management of Genetic Resources of Forest Trees and Shrubs: concept and components
(Source: Palmberg-Lerche 1998)



Variations in forest cover, quality and composition have direct impacts on the extent and patterns of genetic variation in forest trees, which have frequently developed genetically diversified local populations of actual or potential value. Such inter-population variation, referred to in forestry as *provenance variation*, may at times be as significant and practically important as that between different tree species, and must consequently be explored and used as a basic component in forest plantation and tree breeding programmes. Genetically diversified local populations which may possess valuable attributes, or reproductive materials collected from them, must also be included in genetic conservation programmes, with due regard to safeguarding such gene pools from hybridization with introduced provenances (see *e.g.* Palmberg-Lerche 2001).

The practical importance of systematic testing of provenance variation has been convincingly demonstrated[50]. The international provenance trials of *Eucalyptus camaldulensis*, coordinated by FAO in the 1960s, were among the first of a number of such trials. Experiments were established on 32 sites in 18 countries, and they showed that the potential gains in growth and yield which could be achieved by selection of the best-adapted provenances for prevailing environmental conditions, amounted to several hundred percent, with differences in growth between provenances ranging from 300% in northern Nigeria, to 800% in Israel. Spectacular provenance differences were also found in dry-zone *Acacia* and *Prosopis* species and provenances in a series of FAO coordinated trials in the 1980s and 1990s.

In China, yields, following species and provenance selection and the introduction of better silvicultural methods, more than doubled; and rotation times decreased by 30%. In spite of increased costs of plantation establishment and management, the mean internal rate of return in the plantation schemes reviewed, using a 5% discount rate, was 35%. In the case of *Acacia mangium*, the productivity of large-scale plantations in Indonesia was doubled by use of better adapted provenances, as compared to yields obtained using as a starting point the relatively poor quality seed previously used. These stands were also of better quality in regard to stem straightness and branching.

The mainfested, high level of differentiation in adaptive genetic traits among forest populations has underpinned the development of forest genetic studies and tree breeding programmes over the past century (see discussion in Bariteau 2004). However, only some 500 tree species have been systematically tested for their present-day utility for man, and scientifically valid, genetic information, even at a very basic level, is available for only some 50 tree species which are today being actively bred.

Forest tree species can be classified, for operational purposes, into three broad categories (based on Namkoong 1986):

1. Species and populations managed for present-day use. This group includes species of proven social and economic value. Management is carried out through silvicultural interventions in natural forests and through plantation development and management:

   Action: Silvicultural management and the management of seed production and breeding populations should include genetic management as a strong, basic consideration and as an integral part of action.

2. Species and populations with potential social and economic value. There is usually a need to increase knowledge about overall silvicultural requirements and characteristics of these frequently biologically inadequately known species, and there is almost always a need to clarify and investigate the inherent type and levels of variation and variation patterns in them.

[50] For more information on provenance variation in forest tree species, its significance and use, see references in section 2 (*e.g.* Palmberg-Lerche 1993, 2001); and sub-section 4[viii] of Bibliography (*e.g.* FAO 2002; Palmberg-Lerche 2002).

Action: *In situ* and *ex situ* conservation areas of representative samples of the genepool, based on morphological variation in the species and/or on ecological variation of the area of distribution (genecological zoning; see *e.g.* Graudal *et al.* 1997), should be demarcated or established, and these should be managed in parallel with on-going research and development programmes. When basic knowledge becomes available, genetic conservation can be more adequately targeted, and can be integrated in management and breeding programmes.

3. Species and populations which do not, applying knowledge of today, have a unique or specified socio-economic value. Species in this category serve as possible alternatives, and potential substitutes, in maintaining ecosystem functions and in the provision of related goods and services. Their use by man is usually extensive, rather than intensive. A vast number of forest tree species falls into this category.

Action: Knowledge should be gradually increased through studies on the ecology, phenology, genetics, variation, silvicultural needs and potential uses. Sustainable forest management practices should be applied in natural and semi-natural stands (ranging from non-intervention to more intensive practices). Individual tree species and populations, which can be assumed to be ecologically (and thus genetically) differentiated, should be regularly monitored. More vigorous action should be taken only if their status calls for direct intervention to safeguard the resources.

Operational Steps

The various phases or operations commonly recognized as essential steps in the management of forest genetic resources include:

- Exploration
- Collection
- Evaluation
- Conservation *in* and *ex situ*
- Utilization (enhancement =selection and breeding)

These operations are common to both forest and agricultural crops, but the degree of emphasis accorded to each varies greatly. As noted in the previous Section, forest management, in contrast to crop husbandry, is still concerned primarily with wild, or little domesticated, species. Exploration, including genecological surveys[51], followed by determination of intra-specific variation and variation patterns, is an essential first step in the process of domestication and improvement of forest trees. The process generally involves field testing, supported by the application of more recently developed molecular level methods.

In regard to *collection of reproductive materials* and *evaluation*, the first international provenance (seed source) trials, aimed at exploring, conserving and better utilizing the genetic variation in forest trees, were initiated more than 50 years ago under the coordination of IUFRO. This pioneering work, which has been continued over the years by IUFRO in collaboration with FAO and national institutes concerned, and which was based on genecological zoning (see above), originally focused on economically important tree species of the temperate and boreal zones. Activities have been subsequently extended to socio-economically important species of other regions and ecological zones of the world. Information which can be gained from these experiments on adaptive genetic diversity and variation patterns in the species included in them, is of major importance, and will help support

[51] Genecological exploration refers to the demarcation of areas which are considered uniform enough in terms of ecological conditions for making the assumption that tree populations found in them have, over time, through natural selection, adapted to the environment, and can therefore be assumed to have similar genetic characteristics. In forestry, this is commonly referred to as *provenance variation*.

the definition of genetic resource management strategies and the allocation of priorities for conservation. As stressed by Bariteau (2004), the existing but today largely neglected networks of comparative field trials, which cover a great number of countries, ecological conditions and species, is an extraordinary heritage which should be adequately valorized, used and safeguarded.

For many decades, FAO and its international partners (notably IUFRO, IPGRI- now known as Bioversity International- and other Centres of the CGIAR, and bilateral partners, notably DFSC), have been active in developing and advancing methodologies and action for the *conservation of forest genetic resources*, including *in situ* ex *situ conservation* (see references in sub-section 4(iii) of below Section 13, Bibliography). Since the early 1980s, special emphasis has been placed on the development of guidelines for the planning and implementation of *in situ* conservation strategies, in line with identified gaps in knowledge and application. While *in situ* conservation is the preferred strategy in forest trees (see Section 6 above regarding characteristics on FGR), *in situ* and *ex situ* conservation are complementary, and both should be given due consideration in an overall FGR programme.

Utilization, or *enhancement*, of genetic resources, refers to selection and breeding. Due to the need to ensure that planting materials are well-adapted to local environmental conditions and end use requirements, and that the products and services offered meet social as well as economic and environmental needs, such activities in forestry are generally carried out at the national level. In cases in which select or improved material is imported from elsewhere, testing in local environmental conditions is an essential step prior to large-scale use in forest plantations or tree planting schemes. Such testing will require several years or decades, and must be carried out as an integral part of a well-planned, long-term tree improvement programme in which due attention is paid to genetic conservation of local genepools and the maintenance of a broad genetic base in introduced materials.

In regard to the application of new technologies, the Panel of Experts on Forest Gene Resources has, over the past decade, stressed the role of FAO as an "Honest Broker" and an important source of relevant and objective information (El Kassaby 2004, Wheeler 2004, FAO 1968-2003- see especially the 11th, 12th and 13th Sessions of the Panel, held 1999, 2001, 2003). Problems will arise when sophisticated techniques are applied to un-developed genotypes, and when efforts are focused on advanced techniques without due attention to development of the basic breeding resource. A major constraint in the use of new biotechnological tools in forestry highlighted by the Panel is the frequent lack of skilled tree breeders supported by strong institutions, which are necessary to understand and adequately utilise the often theoretical information generated and to ensure its application in practical forestry and forest plantation programmes. The Panel stressed that adoption of biotechnologies in forestry should be part of a serious, long-term commitment to genetic improvement and to forestry in general, rather than a switch of efforts away from classical breeding and silviculture.

The application of biotechnologies in forestry, as in agriculture in general, encompasses a wide range of tools used to understand and manipulate the genetic make-up of target organisms. Methods applied or under research include, notably, micropropagation, molecular marker applications, genomics and genetic modification. Activities in forest biotechnology, referred to in the literature, have increased nearly three-fold over the past 5 years (Wheeler 2004). According to a recent study, there is an upward trend in the development of biotechnologies focused on characterization and utilization of naturally occurring genetic variation in forest trees, especially private sector research; while publicly funded and reported programmes on genetic modification technologies, particularly those which involve field testing and deployment, seem to be stable or diminishing. While receiving much attention in the public debate, less than 20% of all the biotechnology activities in forestry reported over the past 10 years were related to genetic modification. Worldwide, a total of some 200 field trials of genetically modified trees have been reported in 16 countries, the great majority of these being in the USA. Field trials of genetically modified trees are restricted largely to four genera[52]. Research focuses largely on gene stability and expression, functional genomics and tissue culture, herbicide tolerance, biotic

[52] *Populus* spp. 51%; *Pinus* spp. 23%; *Liquidambar* spp.11%; and *Eucalyptus* spp. 7%.

resistance, wood chemistry and reproductive traits. Only China had, by 2004, reported the commercial release of genetically modified trees (some 1.4 million plants established on 300–500 ha in 2002); these releases followed two stages of field testing and required government regulatory approval (Wheeler 2004)[53].

Sub-Sections 4(iii) and 4(vii) of below Section13, Bibliography, list some relevant documents and publications on technical aspects and progress in FGR operations, including the application of biotechnologies in forestry.

8. IDENTIFICATION OF PRIORITY SPECIES

SALIENT POINTS

Estimates of numbers of tree species vary from 80 000 to 100 000 and forests and trees provide a large number of goods and services. Setting priorities among species, activities, strategies and methodologies is essential. There is no single measure for "biodiversity" or FGR, and trade-offs will be necessary. As interests and values will vary, the need for wide stakeholder involvement and inter-sectoral agreements are highlighted. Common or compatible priority setting principles were applied within the framework of the regional FGR workshops supported by FAO. Information analysed as a basis for setting priorities included: value and attributes of species; management and occurrence; review of operational needs; levels of security and threats. Information on priority setting is expanded further in Appendix 2. There is a need to further review, refine and agree upon common or compatible priority setting mechanisms within and between countries so that programmes can be adequately focused to make optimal use of scarce resources.

General Considerations

International priorities in forest genetic resources, reflecting priorities at national level, have changed from an early focus in the 1960s and early 1970s on support to countries in genecological studies and seed collection underpinning species and provenance research of a few major timber species, to the management of genetic resources of a range of trees and shrubs for a great number of purposes and end uses. Such a shift, due largely to changes in the perception of the place and role of forests and trees in national development, has been accompanied by increased attention in all countries to native species which may provide alternatives to introduced species and which, at times, are part of traditions and therefore more familiar to, and better accepted by, local populations.

Estimates of the total number of tree species in the world vary from 80 000 to 100 000. It is clear that there is a need for priority setting among the many alternative species which may qualify for action. Priority setting is complicated greatly by the lack of even basic information on the variation, variation patterns and potentialities of many (or most) tree species. As Namkoong and Koshy noted (2000), the question is, then: "Is there a rational way to make mistakes [unavoidable in priority-setting]?"[54].

There is no single measure for "biodiversity", nor for "genetic resources"; measures are only possible for particular aspects in relation to particular goals. Goals for conservation action and for the management of forest genetic resources ought to be made explicit and agreed as broadly as possible at the beginning of any particular priority-setting exercise ("of what, for what, for whom, with what

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[53] For additional information on forest biotechnologies, see Sub-Section 4(vii) in Bibliography; and:
- FAO Biotechnolgy site: http://www.fao.org/forestry/site/7365/en/
- OECD Portal, "Biotechnology Regulatory Contacts in OECD Member Countries": http://www.oecd.org/document/17/0,2340,en_2649_34385_1890001_1_1_1_1,00.html.

[54] http://www.fao.org/docrep/008/x9662e/X9662E03.htm#top.

time-scale and with what human and financial resources"?). Conservation efforts must be accompanied by regular monitoring to ensure that progress is being achieved in reaching stated objectives (see above Section 9, "Indicators for Biological Diversity and Forest Genetic Resources"). This further underlines the fundamental need to accurately specify objectives at the very outset of programmes.

Relative priorities for action within any one country will be determined by countries concerned, by balancing socio-economic, environmental and cultural values assessed in the light of susceptibility or likelihood of loss or degradation of genetic resources of priority species, targeted for action. At the regional and international levels, priority-setting will, in addition, take into account common interests and commonality of priority species and activities, and possibilities to assign regional and sub-regional lead organizations for given species and/or activities.

The general aim of priority setting is to compare the consequences and trade-offs of a range of actions. It implies that some areas, species or genetic resources will be given lower priority than others. This is not to say that they have no conservation value, rather, that in relation to agreed-upon, common goals in any one programme, the actions are not as urgent as others (Williams 1999). When evaluations of priorities among stakeholders are similar, concerted action is possible, but when dissimilar, independent but harmonized action is more likely to succeed For many governmental, non-governmental, and supra-national organizations active in forest biological diversity and genetic conservation, it is likely that substantial differences in their evaluations and priorities exist, as well as in their capabilities for exercising different management techniques. In such cases, it will be necessary to form coalitions for action and harmonize these under a coherent framework, at appropriate level (Namkoong 1990).

Commitment at the national and local levels to specified objectives and priorities is a prerequisite for the implementation of sustainable conservation programmes. The environmental, economic and social effects of management interventions (including non-intervention) must be regularly monitored and analysed, and responsible decision makers must ensure that action is adjusted to meet stated objectives, should the need arise to do so. Information on expected and realized benefits and returns needs to be analysed and disseminated.

Priority Setting by the Panel of Experts on Forest Gene Resources

At the international level, priorities in forest genetic resources have regularly been identified by the Panel of Experts on Forest Genetic Resources (FAO 1969-1996). Priorities are defined by geographical region, species (including provenances and genetically diversified local populations) and operation. The priority species are, further, categorized according to end use, which provides an indication of their social,-economic and environmental values. Priorities for action for each priority species are given in the logical operational sequence of exploration, collection, evaluation, conservation and utilisation. Prioritisation is based on expert knowledge (country correspndents and Panel Members) and, as the Panel advises on regional and international action, on common concerns among countries (species should, at these levels, be of priority in more than one country).

Priority Setting in Regional Workshops

The determination of priority species for action used within the framework of the FAO supported regional, sub-regional and eco-regional forest genetic resources workshops[55], used similar guiding principles for priority setting. The guidelines used were discussed and endorsed by the Panel of Experts on Forest Gene Resources (FAO 1999), and adjusted by collaborating countries and participants in accordance with conditions, needs and institutional realities in countries concerned (see

[55] For more information on these workshops, see Section 10 below, headings: "Regional, Sub-Regional, Eco-Regional Workshops on Forest Genetic Resources"; and "Availability of National Reports from Individual Countries.Conservation of Forest Genetic Resources".

e.g. Patiño V. 2002[56], Zeh-Nlo 2002[57]). The methodology focussed on gaining information by defining:

1. Value and attributes/uses of target species
2. Occurrence and present management of target species
3. Operational gaps and needs
4. Levels of security and threats.

The priority setting guidelines are referred to in more detail in Appendix 2.

1. Value and attributes/uses of target species

Species under consideration were categorized into those of current socio-economic importance, those with clear potential for the future, and those of unknown value, and listed giving the information shown in the table below.

Species	Value code	Present, future or potential use*											
		ti	po	wo	nw	pu	fo	fd	sh	ag	co	am	xx

* Timber, Posts/Poles/Roundwood, Pulp/Paper, Fuelwood/Charcoal, Non-Wood Forest Products, Food, Fodder, Shade/Shelter, Agroforestry Systems, Soil and Water Conservation, Amenity, Aesthetic, Ethical Values, Other (to be specified).

2. Occurrence and present management of target species

Species/area type	Reserve, national park	Stands		Managed natural stands	Managed planted stands	Farmers' fields, homesteads	Experiments, field trials
		in situ	*ex situ*				

In order to estimate present status, quantified information was given in regard to occurrence and present management, and factual information or estimates were provided of the number of individuals in each of the categories shown in the table above, by major ecological zone (specified/briefly described), as follows:

< 100 individuals

between 100 and 500 individuals

between 500 and 1 000 individuals

between 1 000 and 10 000 individuals

> 10 000 individuals.

3. Operational gaps and needs

The following, standard operational steps, already implemented in many countries for a number of species, were used:

- Taxonomic exploration;
- Genecological exploration;

[56] http://www.fao.org/DOCREP/005/AC785S/AC785S00.HTM.

[57] http://www.fao.org/docrep/007/j2862f/j2862f00.htm.

- Collection of reproductive materials for testing (seed, scions);
- Testing/evaluation (field trials at provenance, progeny, clonal levels);
- Conservation and genetic management *in situ*;
- Collection for conservation *ex situ*;
- Conservation *ex situ;*
- Selection and breeding;
- Research on phenology, breeding systems, flowering/fruiting;
- Research on silviculture, management.

Relevant operations were prioritized on a scale of 1 (top priority, action should start with immediate effect) to 5.

4. Levels of security and threats to target species

Threats to the integrity of forest genetic resources include deforestation resulting from changes in land use, forest habitat degradation and alteration, inappropriate harvesting practices of wood or non-wood products, and damage from wildfires, pests and diseases, atmospheric pollution, and climatic fluctuations and change. In most regions of the world, these threats have increased in recent decades. In many cases the only basis for evaluating general trends and conservation status is to estimate, in general terms, the intensity of use as related to variation in diversity of the resources and the size of occurrence of individual species and populations.

Information or estimates were given of the number of individuals in each of the below management and use categories, in each major ecological or geographic zone (specified/briefly described):

(a) Protected (in protected areas, parks, nature reserves);

(b) Managed for protective purposes (soil and water conservation, shade/shelter);

(c) Managed for productive purposes (wood, non-wood products);

(d) Managed for grazing/browse;

(e) Unmanaged use and harvesting;

(f) Unmanaged grazing/browse (domestic animals, wildlife);

(g) Threatened by fires, biotic/abiotic factors (pests/diseases, floods, pollution, climatic fluctuations);

(h) Threatened by clearing for agriculture, pasture;

(i) Threatened by over-grazing

(j) Threatened by infrastructure development (roads, dams, mining, urban expansion);

(k) Other (specify).

The level of security was estimated or quantified on a scale of 1 to 5.

Examples of additional methods of priority setting, proposed by other actors or applied in other programmes, are given in the Box below.

SOME ADDITIONAL GUIDANCE ON PRIORITY SETTING[58]

IPGRI's Strategic Action Plan (2000)[59]

Priority populations for inclusion in regional and national [forest genetic resources

conservation] programs are identified based on:

· biological characteristics of the ecosystems and species;
· extent and nature of existing threats;
· environmental and economic value of different species;
· genetic diversity within species and populations;
· social and human importance of species and ecosystems.

Yanchuk and Lester (1996)

Status and conservation needs for 23 indigenous conifer species in the province of British Columbia, Canada were reviewed using the below prioritization criteria:

1. Is the species common?
2. Does the species have a large range?
3. What capacity does the species have for natural regeneration?
4. What is the status of the species in current reserves?
5. Is the species in provenance and breeding programmes?
6. What is the current or potential economic value of the species?

Graudal et al (1997)

The identification of genetic resources of priority is a cost/benefit consideration....There are three different ways of assessing priority:

- Survey of area and value production in planting programmes;
- Market survey of forest products consumption ;
- User preference measurements.

9. INDICATORS FOR BIOLOGICAL DIVERSITY AND FOREST GENETIC RESOURCES

SALIENT POINTS

Reliable information on status and trends are basic to monitoring forest biological diversity and managing FGR. There is no single measure of biological diversity, and no accepted methodology for linking changes in FGR to general forest resources parameters such as area and occurrence, species richness, naturalness, or forest fragmentation. Such parameters, many

[58] See also: Namkoong (1990), Namkoong and Koshy (2000), Koshy, Namkoong and Kageyama (2000).

[59] IPGRI is, since late 2006, known as Bioversity International.

of which are presently included in national and global forest resources assessments are not, on their own, able to provide information on status and trends in forest biological diversity and FGR. Developing adequate indicators is an urgent need. Such indicators should complement, and at the same time be fully integrated with, those being developed and implemented in other fields and sectors, notably criteria and indicators used in the definition and monitoring of sustainability of forest management..

Following UNCED, a number of regional, sub-regional and eco-regional processes were initiated to define, test and apply criteria and indicators for sustainable forest management[60]. The development and implementation of criteria and indicators facilitates efforts to assess status and monitor progress towards sustainable forest management or other specified goals. At the national level, criteria and indicators will serve as a framework for strategic planning, assessment and monitoring and, when called for, help adjust national and local level management interventions to achieve stated goals. Many countries have also used national and forest management unit level criteria and indicators as the basis, or starting point, for the development or adaptation of forest products certification schemes[61]. At the international level, the use of criteria and indicators will help countries meet reporting requirements and ensure that information provided is comparable and consistent.

CRITERIA AND INDICATORS FOR SUSTAINABLE FOREST MANAGEMENT

Criteria define the essential elements or principles against which sustainability of forest management is judged, with due consideration paid to the productive, protective and social roles of forests and forest ecosystems. Each criterion is defined by quantitative or qualitative *indicators*, which are measured and monitored regularly to determine the effects of forest management interventions over time (FAO 2001).

According to FAO (2003)[62] indicators should be:

- relevant, relating to an explicit objective;
- representative, covering the most important aspects of sustainability;
- accurate, correctly reflecting the extent to which the objective is met;
- feasible in terms of data availability and collection costs;
- credible, analytically sound and replicable using standardized measurements;
- sensitive, showing trends over time;
- responsive, reflecting changes in conditions and differences among places and groups of people.

[60] These processes, in which more than 150 countries are involved, include, notably the Pan-European Forest Process on Criteria and Indicators for Sustainable Forest Management; the Montreal Process on Criteria and Indicators for the Conservation and Sustainable Management of Temperate and Boreal Forests; the Tarapoto Proposal for Criteria and Indicators for Sustainability of the Amazon Forest; the Dry-Zone Africa Process; the Near East Process; the Lepaterique Process of Central America; the Dry Zone Asia Initiative; and initiatives of the International Tropical Timber Organization and the African Timber Organization. See *e.g.* Castaneda 2000 (http://www.fao.org/docrep/X8080e/x8080e06.htm#P0_0), and FAO 2001: (http://gilws05/docreptest/FAO/004/AC135E/AC135E00.HTM).

[61] As criteria and indicators, at both national and forest management unit level, are neutral assessment tools for monitoring trends over time, they cannot be used as substitutes for forest management standards agreed between producers and consumers, which underpin forest products certification. However, forest management unit level criteria and indicators should be compatible with, and can be used to guide, the development of performance standards used in certification. There is thus an indirect link between criteria and indicators for sustainable forest management and standards used for forest products certification (see e.g. FAO 2001): http://www.fao.org/docrep/meeting/003/X8783e.htm

[62] See SOFO 2003: http://www.fao.org/docrep/005/y7581e/y7581e02.htm#TopOfPage

Inventory and assessment will help establish a baseline for *status and distribution* of diversity for particular places at particular times. Monitoring addresses the issue of *change over time*. Communities and ecosystems are not fixed but dynamically changing. In order to rationally conserve and use forest biological diversity, we need to understand how diversity has changed and continues to change over time. Some of the observed changes will result from natural and others from human causes. The goal of assessment and monitoring against given indicators is to document change (or lack of change) against a given baseline and to analyze the underlying causes for change, with a view to adjusting management action to meet stated aims, as applicable (Namkoong 1990,1998; Solbrig 1991).

In view of the great variability of natural ecosystems and the lack of any single measure for biological or genetic diversity (see Section 8 above), developing appropriate indicators to measure the effects of management interventions is a challenging task. Some of these challenges are discussed in practical terms in relation to the Global Forest Resources Assessment in Section 10 below. In addition to FRA, a number of other programmes and projects have attempted to develop indicators for the various levels and the different components of biological diversity. These efforts have been made either as part of more general sustainable forest management activities, or have specifically targeted biological diversity at the ecosystem, species or intra-specific levels (see Sub-Section 4 (iv) in Section 13, Bibliography, for some references to such work).

As an example, some indicators identified by the CBD are listed in the Box below.

FOREST BIOLOGICAL DIVERSITY: INDICATORS IDENTIFIED BY CBD

Forest-related information (extracted from CBD 2004) [63]

- Trends in extent of selected biomes, ecosystems and habitats
- Trends in abundance and distribution of selected species
- Trends in status of threatened species
- Coverage of protected areas
- Connectivity and fragmentation of ecosystems
- Area of forest under sustainable management
- Proportion of products derived from sustainable sources
- Numbers [and cost of] alien invasions
- Incidence of human-induced ecosystem failure
- Health and well-being of communities who depend directly on local ecosystem goods and services
- Biodiversity for food and medicine
- Access and benefit-sharing
- Technology transfer

CBD (2004)

The 2010 Biodiversity Indicators Partnership, coordinated by UNEP-WCMC, which has more than 40 Partners, including representatives of national Governments, UN Agencies, other international Governmental and non-Governmental organizations, Secretariats of Multilateral Environmental Agreements and scientific institutions, will support reporting on the indicators which measure progress towards the CBD 2010 Target[64]. The Partnership will, further, help establish links between global and regional biodiversity indicator development, and relate this work to other targets and indicators used in the various multilateral environmental agreements, and other international initiatives such as the

[63] http://www.biodiv.org/doc/meetings/sbstta/sbstta-10/official/sbstta-10-09-en.pdf.

[64] http://www.twentyten.net/.

MDG, in line with recent discussions in the UN General Assembly[65]. In addition to collaboration offered by partner organizations, the 2010 Biodiversity Indicators Partnership will be supported by a number of projects and programmes, including, among others, the "Streamlining European Biodiversity Indicators" process of the European Union (SEBI 2010)[66] [67].

In spite of efforts it can be noted that indicators identified to assess and monitor forest biological and genetic diversity are, today, inadequate. They frequently include reference to type and distribution of ecosystems and habitats; area and distribution of protected areas; area of undisturbed or "pristine" forest[68]; area under sustainable forest management; connectivity and fragmentation of forest areas; abundance and distribution of tree species; numbers of threatened or endangered tree species; occurrence of introduced ("alien") species; and wood volume. The use of most of these indicators rests on simplified or erroneous assumptions. These include the assumptions that the level of genetic diversity is directly proportional to the area occupied by a given species, which is clearly not correct; and that numbers of species might be considered an appropriate indicator of diversity whereas, as discussed elsewhere in this paper, such numbers often reflect dynamics of ecosystems and environmental conditions and limitations rather than conservation status or effects of management (see additional discussions on the topic in relation to FRA in Section 10 below).

While a first entry point to assessing and monitoring forest diversity may be the ecosystem or species level, information on intra-specific variation will be essential for operational programmes aimed at genetic management and conservation (see *e.g.* discussion in Bariteau 2004). The development of agreed-upon, scientifically valid but at the same time widely applicable and practical indicators for forest genetic diversity is of highest priority. Reliable indicators at any levels of diversity do not, to date, exist.

10. SOURCES AND AVAILABILITY OF INFORMATION ON STATUS AND TRENDS

SALIENT POINTS

The reliability, applicability and practical use of available information to support priority setting and FGR management is woefully inadequate. Information generally refers to forest resources in general. Presently available sources of information include NFPs, FRA, CBD, the Panel of Experts on FGR, the regional/sub-regional/eco-regional workshops on FGR supported by FAO and international partners and the national and regional FGR reports prepared within their framework. It is noted that the regional workshops are tools to help catalyze action at national level, and facilitate the assessment of status and trends in countries using common core variables and basing priority setting on similar and well-defined principles and methodolo-gies. The resulting series of country-driven, participatory, regional action plans might, in the future, if countries so wish, contribute to an international framework for action in FGR. The workshops have generated excellent information on FGR in close to 50 countries in 7 regions, and are today, together with some forest genetic

[65] In his 2006 Report on the Work of the Organization, the Secretary-General asked the UN General Assembly to incorporate the CBD 2010 Biodiversity Target into the framework of the MDG, and to recognize a new target under MDG-7, "Significantly reduce the rate of loss of biodiversity by 2010" (see Report of the Secretary-General on the work of the Organization 2006, at: http://daccessdds.un.org/doc/UNDOC/GEN/N06/461/94/PDF/N0646194.pdf?OpenElement).

[66] http://biodiversity-chm.eea.europa.eu/stories/story194580.

[67] A useful annotated list some major global environmental assessment processes, including their mandates, scope, periodicity of assessments, working modalities, costs of assessments and links, can be accessed at the website of the Global Development Research Center based in USA: http://www.gdrc.org/uem/mea/assessments.html.

[68] Regarding future trends in "pristine forest" areas (and, maybe to a lesser extent, protected areas), it is interesting to consider this issue in relation to increasing pressure on forests from human and domestic animal populations, and aspirations for higher standards of living. See, in this regard, *e.g.* Salwasser *et al.* (1997), Table 4 (p.240), which illustrates proportional change in the area of the biosphere relative to the estimated human population over the past 300 years.

resources networks such as EUFORGEN and APFORGEN, the only available sources of reliable information on intra-specific genetic diversity in forest trees and shrubs. Future challenges for improving availability and use of FGR information include: the incorporation of FGR information into larger frameworks such as NFPs; development of indicators for assessing the status and trends in FGR which might with advantage be incorporated into mechanisms such as FRA; the expansion of coverage of the regional networks; and the generation of additional national level information on FGR status, trends, priorities and threats. Importantly, already available information needs to be verified, up-dated and regularly adjusted to reflect experiences gained and accommodate new needs and requirements. Existing plans need to be implemented at national and regional levels, ensuring inter-sectoral links and broad stakeholder involvement.

National Forest Programmes

To ensure implementation in the long as well as the short term, the full integration of forest biological diversity considerations, including genetic resources, in wider frameworks will be essential. Such framework programmes include rural development and poverty alleviation strategies, national environmental and biodiversity plans and notably, in the forestry field, national forest programmes.

The concept of "national forest programme" designates a wide range of approaches to the process of planning, programming and implementation of forest activities in a country, which will be applied at national and sub-national levels, based on a common set of guiding principles. NFPs apply a broad inter-sectoral approach in the formulation of policies, strategies and courses of action, as well as in their implementation, monitoring and evaluation. Their purpose is to establish a workable social and political framework for the conservation, management and sustainable development of all types of forests, which in turn will increase the effectiveness and efficiency of public and private operational and funding commitments.

In a recent global survey of the status of NFPs (2002)[69], out of 190 countries approached, a total of 76 countries responded to a questionnaire. In these, 26 countries were in various stages of planning NFPs, and 48 were implementing such plans. While the survey, as such, did not provide specific information on forest biological diversity and forest genetic resources, ample information is available from national NFPs on all aspects of forestry and related developmental issues. Analysis of status and threats to diversity can, potentially, be made based on such information. Information on overall status of forestry, including national forest-related legislation, forest policies and institutional issues, is of special interest in this regard. At the same time, FGR related information available for individual countries in which NFPs are in various stages of planning and implementation should be fed into the NFP planning process to help ensure that this important component of sustainability be adequately considered.

Up-to-date information on NFPs, including background, on-going programmes and reports, can be found on the FAO website, at: http://www.fao.org/forestry/site/nfp/en/

Global Forest Resources Assessments

Background

Article I, paragraph 1, of the Constitution of FAO, "Functions of the Organization", states that the Organization shall, "collect, analyse, interpret and disseminate information relating to nutrition, food and agriculture"[70]. The first FAO world survey of forests was carried out in 1947. Following its

[69] 2nd Session of the UNFF: http://daccessdds.un.org/doc/UNDOC/GEN/N01/722/42/PDF/N0172242.pdf?OpenElement.

[70] Basic Texts of the Food and Agriculture of the United Nations. 2006 Edition. http://www.fao.org/docrep/009/j8038e/j8038e00.htm

publication, the Sixth Session of the FAO Conference in 1951 recommended that the Organization "maintain a permanent capability to provide information on the state of the forest resources worldwide on a continuing basis". As requested, FAO has since that time regularly carried out global forest resources assessments at approximately ten-year intervals.

The global forest resources assessments have, over the years, produced comprehensive, comparable and authoritative baseline data for all countries and regions of the world, including information on the status and trends of forest resources, their management and uses and the services they provide. The assessments are based on country-derived information, and they are carried out in cooperation with a large number of national and international partners, including close to 200 officially designated national correspondents. The latest available assessment information relates to reference years 2000 and 2005 (FAO 2000, 2005)[71]. FRA 2005 contained information on 229 countries and territories. The Forestry Information System (FORIS) provides dynamic access to web users to up-to-date forestry data, by country[72] (see Section 11 below).

At the national level, information on forests is needed for policy development and implementation, for improving planning and prevailing forest management practices and for meeting national and international reporting requirements. At the international level, a number of global agreements on forestry and forest policy and conventions, such as those dealing with the conservation of biological diversity, climate change and combating desertification, need quality information to underpin models and analyses and to support regional and global reporting and monitoring. Forest data is also needed at both national and international level within larger frameworks, notably for measuring, monitoring and reporting on progress towards meeting the Millennium Development Goals[73]. (Anon 2002; see also discussion and Box in Chapter 5 above).

SOME FACTS REPORTED IN THE FOREST RESOURCES ASSESSMENT 2005

- About one-half of the world's forest area was located in the tropical and sub-tropical regions, predominantly in developing countries; the balance was in the temperate and boreal regions, predominantly in industrialized countries.
- Forests covered 27% of the world's total land area; the total forest area was 4 billion ha, corresponding to an average of 0.62 ha per capita.
- The area of forest was unevenly distributed. The ten most forest-rich countries accounted for two-thirds of the total forest area. Europe and South America had almost half their area under forest, whereas Africa, Asia and Oceania had less than one-fifth.
- One-third of the world’s forests were primarily used for production of wood and non-wood products.
- One-half of the removed wood was woodfuels.
- More than 300 million ha (8%) of forests were designated for soil and water conservation
- The area of forest in which conservation of biological diversity was designated as the primary function, amounted to 11% of the total forest area. These forests were mainly, but not exclusively, located within protected areas.
- The area of forests included in protected areas, reported in FRA 2000[74], was 12.4%.
- The area of primary forest decreased by an average of 5.8 million ha/an[75].

[71] FRA 2000: http://www.fao.org/DOCREP/004/Y1997E/Y1997E00.HTM
FRA 2005: http://www.fao.org/DOCREP/008/a0400e/a0400e00.htm
[72] http://www.fao.org/forestry/site/country/en/
[73] http://www.un.org/millenniumgoals/
[74] http://www.fao.org/DOCREP/004/Y1997E/Y1997E00.HTM

- Five percent of the tree species natives to a country were reported to be vulnerable or endangered.
- Forest plantations constituted about five percent of the world's total forest area.
- While definitions for "sustainable forest management" differed among countries, ITTO estimated that less than 1 million ha of tropical forest was in the year 2005 managed using "good forestry practice" (ITTO 2006)[76].
- Deforestation, mainly caused by conversion of forests to agricultural land, amounted to 13 million ha per year, while forest planting, landscape restoration and natural expansion of forests significantly reduced the net loss of forest area.
- The net change in forest area in the period 2000–2005 was estimated at – 7.3 million ha/an (as compared to –8.9 million ha/an in the period 1990–2000). Regionally, Africa and South America continued to have the largest net loss of forests, while the forest area in Europe continued to expand.
- In addition to deforestation (permanent loss of forest cover), un-managed harvesting of industrial wood and fuelwood, overgrazing, fire, insect pests and diseases, storms and air pollution continued to cause at times severe degradation of all kinds of forests.
- Based on FAO 2005[77] (unless otherwise stated)

In addition to statistical information, FRA 2000 and FRA 2005 provided global information on forests in the form of digitised maps (see below Box). These maps can be combined with spatial and statistical data from other sources for the computation of statistics at the global, regional and ecological zone levels, permitting new perspectives on the worlds forests.

GLOBAL FOREST MAPS

Three global maps were produced within the framework of FRA 2000. Each map was generated from a computerized geographic information system database (FAO 2002)[78]:

- The forest map, developed using coarse-resolution satellite imagery. It showed the extent and location of major forest formations in the world. A digital version of the map is available at: http://www.fao.org/DOCREP/004/Y1997E/y1997e31.jpg
- The ecological zone map, based on a standard global vegetation classification. The map was developed from national and regional vegetation maps, climate data and satellite imagery, and can be combined with other maps or data to help quantify or depict global forests or e.g. protected areas according to their ecological character. A digital version of the map is available at: http://www.fao.org/DOCREP/004/Y1997E/y1997e32.jpg
- The protected areas map, which showed the location, extent and type of protected area for each country. The map was developed in collaboration with UNEP-WCMC, from independent maps and point information supplied by countries. It is available from UNEP-WCMC: http://www.unep-wcmc.org/wdpa/: (see also

[75] This figure excludes the Russian Federation, where reported, large changes were due to the introduction of a new classification system.

[76] http://www.itto.or.jp/live/PageDisplayHandler?pageId=270.

[77] http://www.fao.org/DOCREP/008/a0400e/a0400e00.htm.

[78] Main Report, FRA 2000: http://www.fao.org/DOCREP/004/Y1997E/Y1997E00.HTM.

http://www.fao.org/DOCREP/004/Y1997E/y1997e0c.htm#bm12 and http://www.fao.org/DOCREP/004/Y1997E/y1997e0v.jpg for a protected area map included in FRA 2005)

- Additional maps, including a global forest area change map, were produced within the framework of FRA 2005 (FAO 2005)[79].

Variables used in FRA 2005

Information contained in the global forest resources assessments has, over the years, been gradually expanded more accurately to reflect priorities and data needs at all levels. FRA 2005 contained information on more than 40 variables related to the extent of forests, their conditions, uses and values, for three points in time: 1990, 2000 and 2005.

In addition to information on the above variables, FRA 2005 also provided data related to globally agreed indicators for sustainable forest management. Key findings were presented according to six themes, based on criteria defined in a number of on-going regional, sub-regional and eco-regional processes on criteria and indicators for sustainable forest management (see Section 9). These themes included: extent of forest resources; forest health; biological diversity; productive functions; protective functions; and socio-economic functions of forests.

Reliable data on forest status and trends are basic to assessing and monitoring forest biological diversity and provides the basis for the efficient management of forest genetic resources. Relevant data includes forest area, structure and composition. However, there is no accepted methodology for directly linking changes in these variables to their impacts on biological diversity in forest ecosystems, landscapes, species, populations and genes. This is particularly evident when information is aggregated at the global level.

Compounding the problem is the lack of agreement, at national and international levels, on the scientific validity of possible surrogate indicators which have been proposed in a number of fora for measuring and monitoring changes in biological diversity at the various levels. Furthermore, while international agreement on some potentially useful "forest biodiversity indicators" might be reached in the future, sampling strategies and intensity in present national forest inventories and in global forest resources assessments may not capture sufficiently detailed information on these frequently complex parameters to be of practical value. Compromises will doubtlessly need to be made based on technical possibilities, institutional capacities and economic feasibility of comprehensive forest inventories in countries concerned.

Data collected and analyzed within the framework of FRA 2005 which is considered to be of special relevance to biological diversity included, at the landscape and ecosystem levels, information on the area of forests and – more specifically, on the area of primary forest[80]; and, "forests designated for the conservation of biological diversity". Such information complemented FRA 2000 data on the proportion of forests in protected areas. At the species level, while there was a general lack of estimates of the number of tree species by country, countries were frequently able to report on endangered or threatened tree species[81].

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[79] Main Report, FRA 2005: http://www.fao.org/DOCREP/008/a0400e/a0400e00.htm.

[80] The two countries with the highest percentage of primary forests, as reported in FRA 2005, were Brunei Darussalam and Singapore (both 100%). It is clear that the data, as such, does not provide a useful indicator for biological diversity.

[81] Corresponding data was generally based on national or (IUCN) regional/international "Red Data Books". These report on the status at species level only (not considering intra-specific variation). It is also important to recognize that all species will be rare towards the limits of their area of natural distribution: thus, in further analysis, it is important to review information in a broader context, with due attention also to natural distribution ranges and transboundary considerations.

No data was collected in the framework of national/global forest resources assessments on genetic variation or, specifically, on forest genetic resources, nor was any attempt made to analyse related variables at regional or global levels[82].

FRA 2005 VARIABLES OF RELEVANCE TO FOREST BIOLOGICAL DIVERSITY

- area of forests;
- area of primary forests;
- forest area designated for conservation of biodiversity;
- tree species (composition of growing stock);
- number of native tree species;
- threatened (endangered) forest tree species

FAO (2005)[83]

It is acknowledged that data on the variables collected, on their own, is insufficient to provide a reliable picture of status and trends in forest biological diversity at the levels of landscape, ecosystem, species and intra-specific variation.

The issue of forest biological diversity and forest genetic resources indicators, and the urgent need to define and agree on common indicators, is discussed also in Section 9, "Indicators for Biological Diversity and Forest Genetic Resources".

Some summarized information on regional trends in variables related to forest biological diversity, as reported in FRA 2005, is given in the Box below. More detailed information, including graphical presentations and related tables, is found in the report from which the information was extracted. The full report, which also includes information reported by individual countries, provides a more accurate picture of status and trends than the regional summaries, as the latter do not recognize the existing, very important, within-region differences.

FOREST BIOLOGICAL DIVERSITY: TRENDS IN SELECTED VARIABLES

(Extracted from FAO (2005)84, Chapter 8, "Progress towards sustainable forest management")

Africa. The area of primary forest in Africa decreased by some 270 000 ha annually during 1990–2005. However, information for this variable was based on 46 countries that together account for only 67% of the forest area, with information missing from most of the countries in the Congo Basin (which represents the second largest area of tropical primary forest after the Amazon Basin). Some of this decrease was caused by deforestation, some by alteration of forests through selective logging and other human interventions. This 'altered' forest area was subsequently classified as 'modified natural forest'. On a positive note, there has been an increase in the area of forest designated primarily for conservation of biological diversity of close to 3 million ha since 1990. *General Conclusions*.

[82] Only preliminary work has been to date undertaken in regard to genetic and, specifically, genetic resources-related indicators. For an overview, see FAO (2002): http://www.fao.org/DOCREP/005/AC786E/AC786E00.HTM#Contents; for a discussion and some specific proposals see *e.g.* FAO(2002): http://www.fao.org/DOCREP/005/AC649E/ac649e03.htm#bm03

[83] http://www.fao.org/DOCREP/008/a0400e/a0400e00.htm

[84] ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E00.pdf

Progress towards sustainable forest management in Africa appears to have been limited during the last 15 years. There are some indications that the net loss of forest area has slowed down and that the area of forest designated for conservation of biological diversity increased slightly. However, the continued, rapid loss of forest area (the largest of any region during this 15-year period) is particularly disconcerting.

Asia. The area of primary forest decreased at the alarming rate of 1.5 million ha per year during the last 15 years, entirely explained by large losses in the sub-region of South and Southeast Asia, particularly in Indonesia. The cause of the decrease was not only deforestation but also alteration of forests through selective logging and other human interventions, which resulted in a subsequent classification of such forests as 'modified natural forest'. About 13% of the forest area is currently designated primarily for conservation of biological diversity, representing an average annual increase of some 850 000 ha or about 1.3% since 1990. *General Conclusions*. Forest area was almost the same in 2005 as in 1990 (572 million ha as compared to 574 ha, a decrease of 0.03 % per year), owing to large-scale afforestation efforts during the last 7-8 years, particularly in China. Forest health deteriorated, but forest fires, pests and diseases were still affecting a relatively small proportion of the total forest area in Asia (2.2, 2.6 and 2.4% respectively). The rapid decrease in area of primary forest is cause for concern, while the increase in area designated for conservation of biological diversity and for protective functions is commendable. In short, there has been mixed progress over the last 15 years.

Europe. Four percent of the forest area is currently designated primarily for conservation of biological diversity. If the Russian Federation is excluded, the share is about 12%. There was a large increase in this area since 1990 (1.2 million ha per year). The figures on primary forest include the Russian Federation, in which large changes were primarily owing to the introduction of a new classification system. Excluding the Russian Federation, there was still a slight increase, which is explained by the fact that areas of natural forest have been set aside and protected from human intervention. With time, these areas evolve into forests in which there are no clearly visible indications of human activity and ecological processes are not significantly disturbed, which is the definition of primary forests used in FRA 2005.

General Conclusions. Data availability was good and the status of forest resources in Europe was essentially stable, although forests suffered from occasional storms. The severe storms of 1999 were the main reason for the negative trend in the health and vitality of forests. The focus of forest management in Europe has clearly shifted away from productive functions towards conservation of biological diversity, protection and multiple uses.

North and Central America. Total forest area decreased, but the change rates were below 0.2% per year (N.B. however that the estimate excluded productive forest plantations).The area of forest designated for conservation of biological diversity increased by 712 000 ha per year since 1990, or more than 10 million ha in total. *General Conclusions*. Progress towards sustainable forest management was generally positive during the period 1990–2005, with none of the annual rates of negative trends being more than 0.20%, with the exception of the forest area adversely affected by insects, diseases and other disturbances. There was, however, considerable variation among sub-regions.

Oceania. There was a slight increase in area of primary forest. Information availability was insufficient on area of forest designated for biological diversity conservation (1990 data were missing for Australia). Total forest area, excluding area of productive forest plantations, decreased slightly, following the trend for forest area as a whole. *General Conclusions*. The status of the information for Oceania was generally very weak, and low data availability was a serious issue in the region. Data were insufficient for determining regional trends for two-thirds of the variables. Thus it is difficult to assess progress towards sustainable forest management.

South America. Primary forests currently account for 77% of the total forest area in the region but they continue to decrease rapidly. The net loss of primary forest increased from 3.0 million ha per year in the period 1990–2000 to almost 3.9 million ha in the period 2000–2005. Apart from deforestation, the decrease was caused by alteration of forests through selective logging and other human interventions, which resulted in a subsequent classification of such forests as "modified natural forests". The area of forest designated primarily for conservation of biological diversity increased by about 3.3 million ha per year in the last 15 years, or a total of 50 million ha, equivalent in size to the area of primary forest lost during this period. *General Conclusions*. Progress towards sustainable forest management was mixed. The increasing trend in the area of net forest loss is cause for concern, as is the rate of loss of primary forest. Yet there were also positive signs in the increased areas of forest designated for conservation of biological diversity and for social services.

Convention on Biological Diversity

Parties to the CBD have been requested, since 1998, to provide information on measures taken for the implementation of the Convention and the effectiveness of these measures through national reports, submitted to the Secretariat of the CBD and made available on-line[85].The first national reports focused on the measures taken for the implementation of Article 6 of the Convention, "*development and maintenance by contracting parties of appropriate policy and legal measures that promote the sustainable use of plant genetic resources for food and agriculture*". The third national reports also included questions on strategic objectives and goals established under the CBD Strategic Plan, with the aim of focusing on the experiences of implementation of national biodiversity strategies and action plans, thus facilitating the identification of obstacles and impediments to implementation. Parties are also invited to submit thematic reports on the issues to be considered in-depth at meetings of the Conference of the Parties, including forest biological diversity.[86] National reports are called for on a four-yearly basis. Forest-related information from the CBD is included among the sources used in the elaboration of the global forest resources assessment (see above).

Panel of Experts on Forest Gene Resources

The mandate and work of the Panel of Experts on Forest Gene Resources were briefly described in Sections 1 and 8 above (place and role of the Panel; and identification of priorities). The Panel makes recommendations on the future focus of FAO's forest genetic resources programme based on national, regional and global status, trends, needs and identified gaps at national, regional and international levels[87]. Panel Members have, over the years, reported on the state of forest genetic resources and on activities and priorities for action, by region and sub-region (see below Map). The reports are based on information gathered from individual countries through institutional contacts and networks of experts, in line with standardized reporting formats. Information is compiled in "Regional Updates", in which activities and priorities in some individual countries are also reported upon as "case studies"[88]. Specific topics, such as biotechnologies, are also covered by designated Panel Members (see *e.g.* El Kassaby 2004).

The Panel regularly up-dates lists of tree and shrub species and provenances for which priority action by FAO, and by countries concerned, is recommended in the operational areas of exploration, collection, evaluation, conservation and utilization of germplasm. The lists indicate priority on a scale from 1 to 3 for these operational steps. Species identified are, furthermore, classified according to end use: (i) main use, industrial wood (sawn logs, timber, heavy construction wood, plywood, chip and

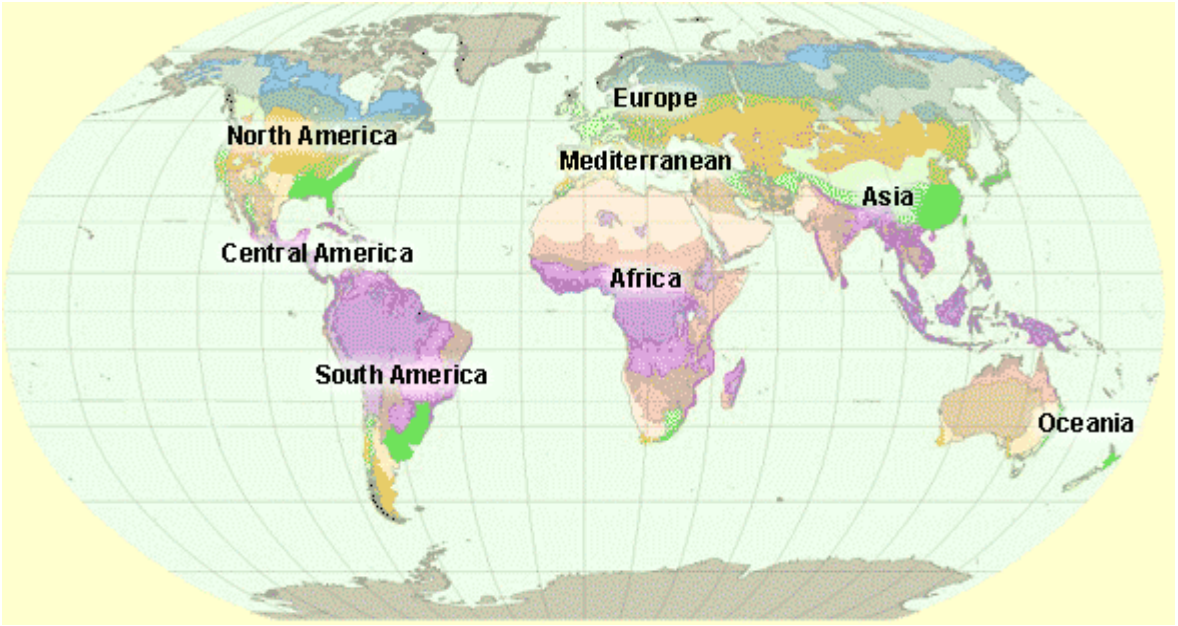
[85] http://www.biodiv.org/reports/default.asp
[86] For information on the CBD Expanded Work Programme on Forests, see Box in Chapter 5.
[87] http://www.fao.org/forestry/site/16370/en/
[88] See Section 13 Bibliography, Sub-Section (3). See especially FAO 2002, 2004, for "Regional Updates" (the former document is also available on-line: http://www.fao.org/DOCREP/005/AC646E/AC646E00.HTM)

particle board, wood pulp); (ii) main use, industrial non-wood products (gums, resins, oils, tannins or other products used in small, medium and large-scale local and non-local industries); (iii) main use, fuelwood, posts, poles (firewood and wood used for the production of charcoal and energy; roundwood used on-farm); and (iv) other uses (the provision of goods and services such as food, fodder, land stabilization, soil amelioration, shade, shelter and other environmental, recreational and cultural, religious values)[89]. The information provided by the Panel is lodged in the REFORGEN information system (see Section 11 below).

The Panel lists are not exhaustive lists of species in need of attention but, rather, they include those tree species and provenances which the Panel considers should be given highest priority in FAO's FGR programme. As noted in Section 8, the lists are based on expert opinion. The diversity of forest types, status and condition, and the different types and scales of values used to rank forest tree species among countries and cultures, makes the establishment of an objective, global list, very difficult. It is important that the global and regional lists prepared by the Panel be complemented by more detailed lists of priorities at local and national level.

[89] http://www.fao.org/forestry/site/16370/en/

Forest genetic resources by region



In a growing number of areas of the world, detailed information on the state of forest genetic resources as well as on the most urgent actions for their sustainable management are available. All geographical areas are covered by the work of FAO's Panel of Experts on Forest Gene Resources, in line with the sub-division shown on this map. Information on forest tree genetic diversity at: regional, eco-regional and national levels is accessible from this web page: http://www.fao.org/forestry/site/fgr-region/en/

Regional, Sub-Regional, Eco-Regional Workshops on Forest Genetic Resources

Since 1995 FAO, in collaboration with national and international partners, has helped convene a series of regional and sub-regional workshops to support countries in the development of action plans for the conservation and sustainable use of forest genetic resources within a regional framework (see Section 3, "Recent Developments", above). Plans and programmes will vary according to local environmental conditions, national needs and priorities, institutional possibilities and financial and resource-related realities. The aim of the workshops is therefore not the development of a single conservation model for all countries and all regions, but the elaboration of a flexible framework for national action which would be valid at the regional level, and which should be as consistent among regions as possible. This is facilitated by agreed-upon national and regional reporting formats, concepts and terms, and common mechanisms for priority setting in the determination of target species and activities (see Section 8 above). Harmonizing action at regional, sub-regional or eco-regional level will help make best use of scarce resources by avoiding duplication and overlap of effort, and by facilitating the sharing of technologies, information, know-how and genetic materials, on mutually agreed terms. They can also help ensure that important species are not inadvertently lost or depleted, by drawing attention to gaps in regional coverage of action. The regional synthesis reports prepared on the results and recommendations of the workshops provide useful information in support of policy and operational decision-making (see "Selected References by Region" at the end of the next sub-section, entitled, "National Reports from Individual Countries", and Section 13, Bibliography, Sub-Section 3). Togther with some regional forest genetic resources networks, such as EUFORGEN and APFORGEN, these regional/sub-regional/eco-regional workshops are presently the only available sources of reliable information on intra-specific genetic diversity in forest trees and shrubs.

The regional, sub-regional and eco-regional action plans on FGR which are developed in the workshops will, furthermore, serve as dynamic tools underpinning action by countries concerned. These action programmes could later, if countries so wish, be placed within a larger context, contributing to a comprehensive, international framework for action (FAO 1997, 1999).

A summary of the workshops organized to date is given in the below Table.

In addition to the countries which have participated in the workthops listed below, many other countries have elaborated national policies or special programmes for the conservation of biological diversity, including forest biological diversity and, at times, forest genetic resources[90]. The proposed above flexible, country-driven, step-by-step process towards coordinated action in forest genetic resources complements other initiatives currently undertaken at the national, regional and global levels, such as the elaboration of National Biodiversity Status and Action Plans within the framework of the CBD[91].

A number of species-specific and regional, sub-regional and eco-regional forest genetic resources networks and cooperative programmes have been established over the past years in all regions of the

[90] For an early effort in this regard, see "Statement of Forest Gene Resources, Australia", summarized in FAO Forest Genetic Resources Information No.10 (1981): http://www.fao.org/DOCREP/006/P3565E/P3565E08.htm#ch8.

[91] See http://www.biodiv.org/reports/default.asp.

world, based on geographical closeness, ecological similarities or common interest in certain species. These networks can serve both as providers and users of the information generated in the regional workshops, and support and be supported by implementation of national and regional action plans. Examples of such networks are given in the Boxes below[92].

[92] For additional information on many of these networks, see *e.g.* Palmberg-Lerche 2001:

http://www.fao.org/DOCREP/003/X9818E/X9818E00.HTM ; Palmberg-Lerche & Hald 2000: http://www.fao.org/docrep/x8080e/x8080e05.htm#P0_0 , and other references given in Sections (2) and (3) of the Bibliography.

Regional, Sub-Regional, Eco-Regional Workshops on Forest Genetic Resources[93] [94]

Region, Sub-Region or Eco-Region[95]	Year	Main International/ Regional or National Organizers[96]	Nbr of countries attending	Country reports on FGR[97]	List of national priority species	Regional summary or synthesis	Regional action plan or rec's.	Observations
Boreal Forests	1995	FAO/ Canadian Forest Service	20	18	x	x	x	
North America								
Temperate North America	1995	FAO, FAO-North American Forestry Commission/ USDA Forest Service (USA), Univ.California (USA)	3	x	x	x	x	
Europe, Central Asia and Transcaucasia[98]								
Europe	1995	IPGRI-EUFORGEN, FAO	27 (+Canada)			x	x	

[93] This non-inclusive list refers to regional, sub-regional or eco-regional forest genetic resources initiatives which used commonly agreed frameworks for priority setting and overall contents and focus, and in which the formats for national level reporting was identical or compatible between countries. It does not include regional meetings and workshops on biological diversity in general, even though many such meetings will contain components on forest biological diversity.

[94] See also complementary note, "*Availability of national reports from individual countries*". In addition to summarizing information which resulted from the workshops, the note provides a list of literature references and links for related regional and national activities which complements the general Bibliography at the end of the document.

[95] Regions/sub-regions/eco-regions are listed in this table according to the year in which the series of workshops was initiated (chronological order).

[96] See additional information *i.a.* at: http://www.fao.org/forestry/site/fgr/en/ and http://www.fao.org/forestry/site/fgr-region/en/ (FAO); and www.bioversityinternational.org (Bioversity International, ex-IPGRI).

[97] In some cases, countries that did not attend a given workshop still submitted country reports and, conversely, a few countries attending workshops did not submit reports. Furthermore, some country reports discussed in workshops are still in various stages of finalization, in-country or in supporting international institutions concerned. There are therefore some apparent discrepancies between the columns of "Countries Attending" and "County Reports"; and between the present summary table and the table entitled, "*Availability of National Reports from Individual Countries*".

[98] In Europe, the Bioversity International (ex-IPGRI) lead European Forest Genetic Resources Programme (EUFORGEN) has coordinated country-based action and disseminated information on forest tree genetic diversity and genetic resources since 1994. Information is generally aggregated by species or type of species, in species or (lately) thematic networks. Presently active networks include: *Forest Management, Conifers, Scattered Broadleaves, Stand-forming Broadleaves*. A very large amount of information has been generated and collated by member countries, which presently include: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Rep, Denmark, Estonia, Finland, France, Macedonia FYR, Georgia, Germany, Greece, Hungary, Iceland, Ireland, Italy, Lithuania, Luxembourg, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom (total 34); and the following collaborating countries: Albania, Azerbaijan, Belarus, Bosnia/Herzegovina, Israel, Latvia, Lichtenstein, Malta, Russian Fed., Ukraine (total 10). See: http://www.bioversityinternational.org/networks/euforgen/

Region, Sub-Region or Eco-Region[95]	Year	Main International/ Regional or National Organizers[96]	Nbr of countries attending	Country reports on FGR[97]	List of national priority species	Regional summary or synthesis	Regional action plan or rec's.	Observations
Newly Independent States of the Former USSR	1996	IPGRI-EUFORGEN/ Forest Service Belarus	7	8	x	x	x	
Africa								
Sahelian and North Sudanian Zones	1998	FAO, IPGRI, DFSC, ICRAF, IUFRO/CILSS, National Forest Seed Centre, Burkina Faso	18	x	x	x	x	
Eastern and Southern Africa	2000	FAO, IPGRI, DFSC, IUFRO/ SADC Secretariat, Forestry Division, Tanzania	9	x	x	x	x	
Central Africa	2003	FAO, ICRAF, IPGRI, DFSC, Cirad-Forêts, IUFRO, UNDP/ ATO, Direction des Forêts, Congo	6	x	x	x	x	
Pacific								
Oceania & Pacific Islands99	1999	SPRIG, AusAID, CSIRO, FAO, IUFRO/ SPC, SPREP, Samoa Forestry Division	18	x	x	x	x	
Oceania & Pacific Islands100	2000	SPRIG, AusAID, CSIRO, FAO, IUFRO/ SPC, SPREP, Samoa Forestry Division						
Oceania & Pacific Islands	2007	In preparation						
S/SE Asia								
South/South-East Asia	2001	IPGRI, APAFRI, FAO, DFSC/ Thai Royal Forestry Department	7	8	x	x	x	Also collaborating: DANIDA-FORGENMA

[99] Included Australia and NZ.

[100] Included Australia and NZ.

Region, Sub-Region or Eco-Region[95]	Year	Main International/ Regional or National Organizers[96]	Nbr of countries attending	Country reports on FGR[97]	List of national priority species	Regional summary or synthesis	Regional action plan or rec's.	Observations
								P & FAO-FORSPA projects
South/South-East Asia	2003	IPGRI, APAFRI, FAO, DFSC/ Forest Research Institute of Malaysia	12	12[+1]	x	x	x	Inception workshop, APFORGEN programme
Latin America								
Central America, Mexico, Cuba	2002	FAO, IPGRI, ICRAF, DFSC, IUFRO/CATIE (Costa Rica)	9	x	x	x	x	
South America	2006	IPGRI/ INIA For.Research Centre, Spain	9	4	x	x	(x)	Recommended to create regional network of experts

EXAMPLES OF REGIONAL COLLABORATIVE ACTIVITIES IN THE MANAGEMENT OF FOREST GENETIC RESOURCES[101]

- The Tree Seed Centre Network of the Southern African Development Community. http://www.sadc.int/english/fanr/forestry/index.php (see also Brouard and John 1995; Shumba and Mwale 1999).
- The Sub-Saharan African Forest Genetic Resources Programme, SAFORGEN. http://www.bioversityinternational.org/
- The Central America and Mexico Coniferous Resources Cooperative, CAMCORE. http://www.ces.ncsu.edu/nreos/forest/feop/camcore/camcore.html (see also Dvorak *et a*l 1996, Dvorak 1999).
- The Asia Pacific Forest Genetic Resources Programme, APFORGEN. http://www.apforgen.org/ and http://www.bioversityinternational.org/ (see also Koskela *et al* 2002).
- The ASEAN Regional Biodiversity Conservation Programme of the ASEAN Regional Centre for Biodiversity Conservation. http://www.econtur.de/Service/arcbc.htm
- The Central Asia and the Trans-Caucasus Network on Plant Genetic Resources, CATCN-PGR; and its Working Group on Forest Trees. http://www.bioversityinternational.org/ (see also Turok 1997).
- The European Forest Genetic Resources Programme, EUFORGEN (Phases 1-3). http://www.bioversityinternational.org/
- The Latin America Forest Genetic Resources Programme, LAFORGEN. http://www.bioversityinternational.org/
- The South Pacific Regional Initiative on Forest Genetic Resources, SPRIG (Phases 1-3). http://www.ffp.csiro.au/tigr/atscmain/whatwedo/projects/sprig/ (see Thomson 1998, 2000).

SOME EXAMPLES OF SPECIES-SPECIFIC NETWORKS AND NETWORKS COVERING PRIORITY GENERA[102]

- The Project on Genetic Resources of Arid and Semi-Arid Zone Arboreal Species for the Improvement of Rural Living focused on dry-zone Acacia and Prosopis species in arid and semi-arid areas in Africa, Asia, Latin America and the Near East. http://www.fao.org/DOCREP/006/Q5987E/Q5987E17.htm and http://www.dfsc.dk/pdf/Aridzone%20trials/APT-1062.htm
- The International Neem Network, which includes collaborating institutions in Asia, Africa and Latin America. http://www.fao.org/forestry/site/16368/en/
- The International Network for *Leucaena* Research and Development, LEUCNET. http://www.aciar.gov.au/web.nsf/att/JFRN-6BN97X/$file/pr57chapter06.pdf
- TEAKNET, focused on *Tectona grandis*. http://www20.brinkster.com/teaknet/
- The International Network for Bamboo and Rattan, INBAR. http://www.inbar.int/
- The International Centre for Research and Training on Seabuckthorn, ICRTS.

[101] Literature references in the box refer to the Bibliography at the end of the document.

[102] Literature references in the box refer to the Bibliography at the end of the document.

http://www.icrts.org/

- The International Poplar Commission, IPC and its Working Parties. http://www.fao.org/forestry/site/34797/en/

National Reports from Individual Countries

National reports prepared within the regional, sub-regional or eco-regional forest genetic resources initiatives outlined in the previous Sub-Section, have been prepared following a common framework. They contain a core set of common key elements, including information on national legislation, institutional set-up, general environmental conditions, status and threats to the integrity of forest genetic resources, on-going and planned FGR activities, lists of species identified for priority action using agreed-upon criteria for priority setting, organizations involved in FGR activities and bibliographic references. Examples of guidelines for national reporting can be viewed in Zeh-Nlo (2002)[103] and Patiño V. (2002) [104].

As shown in the below Table, thirty-six national reports have been prepared by countries in Africa, twelve by countries in South/South-East Asia, fourteen by countries in Latin America, eighteen by countries and territories in the Pacific, and nine by countries in Europe, Central Asia and Transcaucasia. In addition, eighteen countries which attended the Boreal Zone Workshop in Canada in 1995 and the North American Temperate Zone FGR Workshop held in USA the same year (1995), produced "Country Studies", available from the Workshop organizers (see list of Selected References by Region at the end of the tables for more details). In Europe, the Bioversity International (ex-IPGRI)/ EUFORGEN programme has catalyzed work generating large amounts of national and regional FGR related information, mainly by species and thematic area of work but also related to status and trends in participating countries[105].

National Reports from Individual Countries

Conservation of Forest Genetic Resources [106] [107]

[103] http://www.fao.org/docrep/007/j2862f/j2862f00.htm

[104] http://www.fao.org/DOCREP/005/AC785S/AC785S00.HTM

[105] See footnote related to the entry on Europe, Central Asia and Transcaucasia in the above table on Regional, Sub-Regional, Eco-Regional Workshops; the list of Selected References by Region at the end of the present Sub-Section, and Sub-Section 3 of Section 13, Bibliograhy, below.

[106] This non-inclusive list refers to national reports prepared within regional, sub-regional or eco-regional forest genetic resources initiatives, using commonly agreed frameworks for priority setting and overall contents and format of reports. In addition to these, a very large number of countries have, independently, prepared national forest genetic resources/forest biological diversity plans and programmes within the framework of national planning processes which are not reflected in this list. The list also does not include overall biological diversity conservation plans, many of which will contain components on forest biological diversity.

[107] There may be some apparent discrepancies between the present table and the summary table entitled, "*Regional, Sub-regional, Eco-regional Workshops on Forest Genetic Resources*" in regard to number of country reports. In some cases, countries that did not attend workshops submitted country reports in line with those discussed in the workshop and, conversely, a few countries attending workshops did not submit country reports. Furthermore, some country reports are still in various stages of finalization, in-country or in supporting international institutions concerned.

AFRICA

Country[108] [109]	Main International Institution administering information[110]	Document Reference[111]	Availability of documentation	
			Paper Copy	Electronic Copy
Benin	FAO	FAO FGR WP 12F-2001	x	x
Botswana	FAO	FAO FGR WP 11E-2001	x	x
Burkina Faso	FAO	FAO FGR WP 22F-2001	x	x
Cameroon	FAO	FAO FGR WP 15F-2001	x	x
Cameroon-2	FAO	FAO FGR WP 55(in preparation)	x	-
Central African Republic	FAO	FAO FGR WP 71F-2003	x	x
Chad	FAO	FAO FGR WP 10F-2001	x	x
Congo	FAO	FAO FGR WP 56 (in preparation)	x	-
Congo Rep.	FAO	FAO FGR WP 70F (in preparation)	x	-
Cote d'Ivoire	FAO	FAO FGR WP 5F-2001	x	x
Eritrea	FAO	FAO FGR WP 23E-2001	x	x
Ethiopia	FAO	FAO FGR WP	x	x

[108] See also http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=2321&sitetreeId=6607&langId=1&geoId=0:

- Regional Updates, FAO FGR WP 73E (2004); and FAO FGR WP 34E (2002) which provide overviews of status, trends priorities in major regions and sub-regions, based on country-derived information; and
- Reports on Regional/Sub-Regional Workshops FAO FGR WPs 2E/F (Sahelian and North Sudanian Zones, Africa. 2001); FAO FGR WP 4E (Pacific 2001); FAO FGR WP 41E (Dry Southern Africa Development Community Countries. 2003); FAO FGR WP 52S (Mexico, Central America and Cuba. 2003); and reports on workshops held in 1995/1996 on Boreal Zone Forest Genetic Resources (Canadian Forest Service in collaboration with FAO); North American Temperate Forest Genetic Resources (US Forest Service in collaboration with FAO); and European Forest Genetic Resources (IPGRI/EUFORGEN in collaboration with FAO).

Relevant related information can also be found in the following documents:

- "Lineamientos para documentos nacionales", FAO FGR WP 39S (2002);
- "Approche méthodologique ... Afrique Central", FAO FGR WP 75F (2002);
- "The state of forest genetic resources in the world: feasibility study and work options", FAO FGR WP 76E (2004)

[109] See also information from the IPGRI-coordinated Sub-Saharan African Forest Genetic Resources Programme, SAFORGEN, established in 1999 (http://www.bioversityinternational.org/).

[110] For additional collaborators in the organization of corresponding meetings, see complementary note, "Regional, *Sub-regional, Eco-regional Workshops in Forest Genetic Resources*". The present list refers to the international collaborating institution(s) which supported the publication/dissemination of the national reports listed, and thus gives an indication of where published or on-line information can be found.

[111] For FAO Forest Genetic Resources Working Papers, see: http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=2321&sitetreeId=6607&langId=1&geoId=0.

Country[108 109]	Main International Institution administering information[110]	Document Reference[111]	Availability of documentation	
			Paper Copy	Electronic Copy
		21E-2001		
Gabon	FAO	FAO FGR WP 74F (in preparation)	x	-
Gambia	FAO	FAO FGR WP 19E-2001	x	x
Ghana	FAO	FAO FGR WP 17E-2001	x	x
Guinea	FAO	FAO FGR WP 14F-2001	x	x
Kenya	FAO	FAO FGR WP 18E-2001	x	x
Leshoto	FAO	FAO FGR WP 40E-2003	x	x
Madagascar	FAO	FAO FGR WP 54F-2003	x	x
Malawi	FAO	FAO FGR WP 27E-2002	x	x
Mali	FAO	FAO FGR WP 9F-2001	x	x
Mauritania	FAO	FAO FGR WP 6F-2001	x	x
Mauritius	FAO	FAO FGR WP 58E (in preparation)	x	-
Mozambique	FAO	FAO FGR WP 30E-2002	x	x
Namibia	FAO	FAO FGR WP 29E-2002	x	x
Niger	FAO	FAO FGR WP 7F-2001	x	x
Nigeria	FAO	FAO FGR WP 16E-2001	x	x
Sao Tomé & Principe	FAO	FAO FGR WP 63F-2004	x	
Senegal	FAO	FAO FGR WP 8F-2001	x	x
South Africa	FAO	FAO FGR WP 28E-2002	x	x
Sudan	FAO	FAO FGR WP 20E-2001	x	x
Swaziland	FAO	FAO FGR WP 32E-2002	x	x
Tanzania	FAO	FAO FGR WP 26E-2002	x	x

Country[108 109]	Main International Institution administering information[110]	Document Reference[111]	Availability of documentation	
			Paper Copy	Electronic Copy
Togo	FAO	FAO FGR WP 13F-2001	x	x
Uganda	FAO	FAO FGR WP 57 (in preparation)	x	-
Zambia	FAO	FAO FGR WP 31E-2002	x	x
Zimbabwe	FAO	FAO FGR WP 35E-2002	x	x

SOUTH/SE ASIA

Country[112]	Main International Institution administering information[113]	Document Reference[114 115]	Availability of documentation	
			Paper Copy	Electronic Copy
Bangladesh	FAO	FAO FGR WP 68E-2003	x	x
Cambodia	IPGRI/APAFRI	Luoma-Aho *et al.*-2004	x	-
China	IPGRI/ APAFRI	Luoma-Aho *et al.*-2004	x	-
India	FAO	FAO FGR WP 65E-2003	x	x
Indonesia	IPGRI/APAFRI	Luoma-Aho *et al.*-2004	x	-
Lao PDR	IPGRI/APAFRI	Luoma-Aho *et al.*-2004	x	-
Malaysia	IPGRI/APAFRI	Luoma-Aho *et al.*-2004	x	-
Nepal	FAO	FAO FGR WP 69E-2003	x	x
Pakistan	FAO	FAO FGR WP 67E-2003	x	x

[112] See also information from the IPGRI-coordinated Asia Pacific Forest Genetic Resources Network Programme, APFORGEN, established in 2003 (http://www.apforgen.org/)

[113] For additional collaborators in the organization of corresponding meetings, see complementary note,

"*Regional, Sub-regional, Eco-regional Workshops in Forest Genetic Resources*". The present list refers to the international collaborating institution(s) which supported the publication/dissemination of the national reports listed, and thus gives an indication of where published or on-line information can be found.

[114] For FAO Forest Genetic Resources Working Papers, see: http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=2321&sitetreeId=6607&langId=1&geoId=0

[115] For documents related to APAFRI activities, see: http://www.apafri.org/ .

For documents related to IPGRI activities see: www.bioversityinternational.org ; or http://www.bioversityinternational.org/networks/euforgen/aboutus.asp

Country[112]	Main International Institution administering information[113]	Document Reference[114 115]	Availability of documentation	
			Paper Copy	Electronic Copy
Philippines	IPGRI/APAFRI	Luoma-Aho *et al.*- 2004	x	-
Sri Lanka	FAO	FAO FGR WP 66E-2003	x	x
Thailand	IPGRI/APAFRI	Luoma-Aho *et al.*- 2004	x	-
Vietnam	IPGRI/APAFRI	Luoma-Aho *et al.*- 2004	x	-

EUROPE, CENTRAL ASIA, TRANSCAUCASIA

Country[116 117 118]	Main International Institution administering information[119]	Document Reference[120 121]	Availability of documentation	
			Paper Copy	Electronic Copy
Albania	FAO	FAO FGR WP 62E-2003	x	x
Belarus	IPGRI-EUFORGEN	Goncharenko *et al.* 1998	x	-
Estonia	IPGRI-EUFORGEN	Goncharenko *et al.* 1998	x	-
Kazakstan	IPGRI-EUFORGEN	Goncharenko *et al.* - 1998	x	-
Lithuania	IPGRI-EUFORGEN	Goncharenko *et al.* 1998	x	-

[116] In addition the following countries which attended the Boreal Zone Workshop in Canada (Canadian Forest Service/FAO 1995); and the North American Temperate Zone FGR Workshop in the USA (USDA Forest Service/FAO 1995), produced "Country Studies", available from the Workshop organizers: Canada, Chile, China, Denmark, Estonia, Finland, Germany, Japan, Latvia, Lithuania, Norway, Poland, Romania, Russia, Sweden, Switzerland, Ukraine, USA.. Information from Austria and Iceland was included in the eco-regional plan for the boreal zone but no country studies reported having been prepared at the occasion.

[117] In Europe, the IPGRI-lead European Forest Genetic Resources Programme (EUFORGEN) has coordinated country-based action and information on forest tree genetic diversity and genetic resources since 1994. Large amounts of FGR national and regional level information has been generated, mainly by species and thematic area of work but also related to status and trends in member countries. See: http://www.bioversityinternational.org/networks/euforgen/aboutus.asp or www.bioversityinternational.org

[118] See also information from the IPGRI-coordinated Central Asia and Trans-Caucasus Network on Plant Genetic Resources, CATCN-PGR, which established a Working Group on Forest Trees in 1997 (http://www.bioversityinternational.org/)

[119] For additional collaborators in the organization of corresponding meetings, see Section above,

"*Regional, Sub-regional, Eco-regional Workshops in Forest Genetic Resources*". The present list refers to the international collaborating institution(s) which supported the publication/dissemination of the national reports listed, and thus gives an indication of where published or on-line information can be found.

[120] For FAO Forest Genetic Resources Working Papers, see: http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=2321&sitetreeId=6607&langId=1&geoId=0

[121] For documents related to IPGRI activities, see: www.bioversityinternational.org and http://www.bioversityinternational.org/networks/euforgen/aboutus.asp

Country[116 117 118]	Main International Institution administering information[119]	Document Reference[120 121]	Availability of documentation	
			Paper Copy	Electronic Copy
Moldova	FAO	FAO FGR WP 64E-2004	x	x
Russia	IPGRI-EUFORGEN	Goncharenko *et al.* 1998	x	-
Ukraine	IPGRI-EUFORGEN	Goncharenko *et al.* 1998	x	-
Uzbekistan	IPGRI-EUFORGEN	Kayimov and Alexandrovsky 2000	x	-

LATIN AMERICA

Country[122]	Main International Institution administering information[123]	Document Reference[124 125]	Availability of documentation	
			Paper Copy	Electronic Copy
Belize	FAO	Unpublished (in preparation)	(x)	
Bolivia	IPGRI/INIA For. Research Centre (Spain)	Unpublished (in preparation)	(x)	-
Chile	IPGRI/INIA For. Res.Centre (Spain)	Unpublished (in preparation)	(x)	
Colombia	IPGRI//INIA For. Res.Centre (Spain)	Unpublished (in preparation)	(x)	-
Costa Rica	FAO	FAO FGR WP 46S-2003	x	x
Cuba	FAO	FAO FGR WP 47S-2003	x	x
Ecuador	IPGRI//INIA For. Res.Centre (Spain)	Unpublished (in preparation)	(x)	-
El Salvador	FAO	FAO FGR WP 48S-2003	x	x
Guatemala	FAO	FAO FGR WP 53S-2003	x	x
Honduras	FAO	FAO FGR WP 51S-	x	x

[122] See also information from the recently established (2006) IPGRI-coordinated Latin America Forest Genetic Resources Programme, LAFORGEN (http://www.bioversityinternational.org/)

[123] For additional collaborators in the organization of corresponding meetings, see complementary note,

"*Regional, Sub-regional, Eco-regional Workshops in Forest Genetic Resources*". The present list refers to the international collaborating institution(s) which supported the publication/dissemination of the national reports listed, and thus gives an indication of where published or on-line information can be found.

[124] For FAO Forest Genetic Resources Working Papers, see: http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=2321&sitetreeId=6607&langId=1&geoId=0

[125] For documents related to IPGRI activities, see: www.bioversityinternational.org

Country[122]	Main International Institution administering information[123]	Document Reference[124 125]	Availability of documentation	
			Paper Copy	Electronic Copy
		2003		
Mexico	FAO	FAO FGR WP 60S-2003	x	x
Mexico-2	FAO	FAO FGR WP 61S-2003	x	x
Nicaragua	FAO	FAO FGR WP 49S-2003	x	x
Panama	FAO	FAO FGR WP 50S-2003	x	x
Uruguay	IPGRI//INIA For. Research Centre (Spain)	Unpublished (in preparation)	(x)	-

PACIFIC

Country or Territory[126] [127]	Main International Institution administering information	Document Reference[128 129 130]	Availability of documentation	
			Paper Copy	Electronic Copy
American Samoa	CSIRO/SPRIG	http://ftpsuva.spc.int/external/apia%5Freports/ (1999)	x	x
Cook Islands	CSIRO/SPRIG	http://www.ffp.csiro.au/tigr/atscmain/whatwedo/projects/sprig/cook.pdf *or* http://ftpsuva.spc.int/external/apia%5Freports/ (1999)	x	x
Guam	CSIRO/SPRIG	Unpublished- 1999	x	-
(Hawaii)	(CSIRO/SPRIG)	http://ftpsuva.spc.int/external/apia%5Freports/ *or* http://ftpsuva.spc.int/external/apia%5Freports/ (1999)	x	x
Kiribati	CSIRO/SPRIG	http://www.ffp.csiro.au/tigr/atscmain/whatwedo/projects/sprig/kiribati.pdf *or*	x	x

[126] For additional collaborators in the organization of corresponding meetings, see complementary note, "*Regional, Sub-regional, Eco-regional Workshops in Forest Genetic Resources*". The present list refers to the international collaborating institution(s) which supported the publication/dissemination of the national reports listed, and thus gives an indication of where published or on-line information can be found.

[127] See also information from the South Pacific Regional Initiative on Forest Genetic Resources, SPRIG, established in 1996. http://www.ffp.csiro.au/tigr/atscmain/whatwedo/projects/sprig/

[128] For FAO Forest Genetic Resources Working Papers, see: http://www.fao.org/forestry/foris/webview/forestry2/index.jsp?siteId=2321&sitetreeId=6607&langId=1&geoId=0

[129] For documents related to CSIRO/SPRIG activities, see:

http://www.ffp.csiro.au/tigr/atscmain/whatwedo/projects/sprig/apia.htm and

http://ftpsuva.spc.int/external/apia%5Freports/

[130] For documents related to IPGRI activities, see: www.bioversityinternational.org

Country or Territory[126] [127]	Main International Institution administering information	Document Reference[128] [129] [130]	Availability of documentation	
			Paper Copy	Electronic Copy
		http://ftpsuva.spc.int/external/apia%5Freports/ (1999)		
Marshall Isl.	CSIRO/SPRIG	http://www.ffp.csiro.au/tigr/atscmain/whatwedo/projects/sprig/marshall.pdf *or* http://ftpsuva.spc.int/external/apia%5Freports/ (1999)	x	x
Fed. States of Micronesia	CSIRO/SPRIG	http://ftpsuva.spc.int/external/apia%5Freports/ (1999)	x	x
Nauru	CSIRO/SPRIG	http://ftpsuva.spc.int/external/apia%5Freports/ (1999)	x	x
Niue	CSIRO/SPRIG	Unpublished- 1999	x	-
Palau	CSIRO/SPRIG	Unpublished- 1999	x	-
Papua New Guinea	CSIRO/SPRIG	Unpublished- 1999	x	-
French Polynesia	FAO	FAO FGR WP 25E+F- 2002 *or* http://ftpsuva.spc.int/external/apia%5Freports/ (1999)	x	x
New Caledonia	FAO	FAO FGR WP 33E/F- 2002	x	x
Samoa	CSIRO/SPRIG	Unpublished- 1999	x	-
Solomon Islands	CSIRO/SPRIG	Unpublished- 1999	x	-
Tonga	CSIRO/SPRIG	Unpublished- 1999	x	-
Vanuatu	CSIRO/SPRIG	Unpublished- 1999	x	-
Wallis & Futuna	FAO	FAO FGR WP 24E/F-2002	x	x

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(*See also* Section 13, Bibliography, at the end of the full document)

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[131] For Mexico, see references under heading, “Latin America”.

11. INFORMATION MANAGEMENT: DATABASES ON FOREST GENETIC RESOURCES

SALIENT POINTS

The REFORGEN database, established in the 1990s, continues to be highly relevant for the storage, organization and provision of data to policy makers and other users in the FGR field. Other databases, in and outside FAO, complement but do not duplicate REFORGEN information. There is a need to verify and up-date available information and put into place reliable mechanisms which should allow continued up-dating of data. There is also a need to expand the geographical coverage of information; and ensure the continued complementarity of REFORGEN with other available and incipient information management tools.

A database is a collection of records stored in a computer with a view of providing information to users in a systematic way. Databases are thus both receivers and providers of information. A large number of databases related to forest biological diversity are accessible on the web, however, issues such as definitions used, sources of data and status of verification and up-dating are not always specified. There is thus considerable variation in their reliability and usefulness.

Examples of some databases of major interest to FGR are listed below.

The FAO Worldwide Information System on Forest Genetic Resources[132]

The development of REFORGEN was initiated in 1993 to fill an identified gap in information. REFORGEN was developed for use by national institutions which, at the same time, are the main providers of the information. The early sets of data introduced in REFORGEN originated in, (i) responses to a questionnaire which was despatched in 1993 by FAO's Forestry Department to national correspondents in preparation of the Leipzig Conference on plant genetic resources, complementing a similar questionnaire sent to Member Countries by FAO's Agriculture Department; (ii) country-based data generated in the FAO and Bioversity International (ex-PGRI) regional, sub-regional and eco-regional forest genetic resources workshops organized since 1995; and (iii) information regularly provided by the Panel of Experts on Forest Gene Resources on priority species and activity.

REFORGEN covers a number of key topics related to the conservation and use of forest genetic resources. It is a tool for searching for information on forest tree species and the management of their genetic resources, and also provides information on institutions active in this field. Information is divided into two major groups:

(i) data by species, with related activities in a given country;

(ii) data on institutions dealing with FGR in a given country.

The overall objective of REFORGEN is to provide reliable and up-to-date information on forest genetic resources activities for use in planning and decision-making at national, sub-regional, regional and international levels. Its specific objectives are to:

- summarize, at national level, the status of the genetic resources of important tree and shrub species;
- describe, at national level, the main activities related to forest genetic resources;
- identify gaps in species coverage and current activities at sub-regional, regional and international levels;
- highlight areas of potential collaboration;

132 http://www.fao.org/forestry/site/16362/en/

- facilitate decision-making on forest genetic resources priorities at sub-regional, regional and international levels and, indirectly, support national level action.

REFORGEN includes data on more than 1600 species in 146 countries and territories. It complements databases *e.g.* on endangered species, and focuses on tree species of actual or potential value.

Should the need arise, there is scope for extending the system, time and resources permitting, to a wider range of topics, defined in collaboration and consultation with participating countries and institutions. At the present time, further inputs and data verification and up-dating are, however, prioritized.

Summarized information on REFORGEN is given in the Box below.

REFORGEN complements, and does not duplicate, other genetic resources databases in FAO, such as the World Information and Early Warning System on Plant Genetic Resources for Food and Agriculture (WIEWS), the Domestic Animal Diversity Information System (DAD-IS) and the database on the introduction of aquatic species (DIAS). For additional information and links, see the glossary of FAO-managed databases and information systems at:
http://www.fao.org/waicent/portal/glossary_en.asp

REFORGEN

FAO Gobal Information System on Forest Genetic Resources[133]

REFORGEN makes available summarized information on the status of genetic management of important forest trees and shrubs, by country or by species. The system can be used to get a quick overview of the state of diversity at the national, regional and international levels. It can also serve as a primer for more specialized geographic or topical searches.

REFORGEN includes information on:

- institutions dealing with conservation and utilization of forest genetic resources
- main native and introduced tree species and their major uses
- threats to species and populations
- tree species managed for in situ conservation
- ex situ conservation activities
- tree improvement programmes
- availability of forest reproductive materials for conservation and research purposes.

Related Databases

(i) FAO

Examples of FAO databases of relevance to forest biological diversity include, notably, the following information management systems.

- The Forest Resources Information System (FORIS), which supports the Global Forest Resources Assessment Programme. The database provides baseline information on status and trends in world's forest resources[134].

[133] See also: http://www.fao.org/docrep/008/x9662e/X9662E15.htm#top.

[134] For background and description, see: http://www.fao.org/docrep/005/ac610e/ac610e00.htm; to access country data, see: http://www.fao.org/forestry/site/32245/en/.

- The Planted Forests Database (PFDB), presently under development (2006), which will provide detailed information on forest plantations and the main species used in tree planting and plantation forestry[135]. Parameters will include: countries, species, ownership, purpose, forest land use action, reliability, reference year, gross area, net area, planting rage, starting year, ending year, mean annual increment, average, minimum and maximum annual increments, average, minimum and maximum rotation length, site index, minimum diameter, volume under bark. The information contained in PFDB will also allow studies and trend analysis on gross areas for outlook studies and carbon sequestration.
- Data on the status of invasiveness of forest tree species grown outside of their native habitat is available in database format[136]. The database provides summarized information on those forest tree species that have been reported as naturalized or invasive in at least one country or territory. Species behaving invasively within their native range are not included. The database is presently being expanded to include information on pest complexes (insects and diseases) in the area of origin of the tree species.
- A survey of insect/disease resistance breeding is presently (2006) underway in collaboration with the British Columbia Forest Service, Canada, using literature searches and expert inputs. The information will be lodged in a database which will include the following parameters: country, tree genus/species, target resistance (disease or insect species), technology used; and status (field or laboratory stage).

(ii) Examples of Other Databases

Many international, regional and national organizations and institutions have established databases and information systems which deal with, or can potentially support, FGR activities. The focus and main purposes of these vary widely. There are, for example, a large number of databases on forest tree taxonomy, nomenclature and botanical descriptions. This category includes the IUCN Red List of Threatened Species, maintained in a searchable database by the Species Survival Commission Red List Programme as part of the Species Information Service[137]; the IUCN World List of Threatened Trees (tree species potentially threatened by trade); the UNEP-WCMC Tree Conservation Database on endangered species; and UNEP-WCMC World List of Protected Areas.[138]

Global information systems focusing more narrowly on forest tree genetic diversity include, among others:

- the Tree Seed Supplier Directory and the Agroforestry Database maintained by ICRAF[139];
- the Organisation for Economic Co-operation and Development (OECD) database on approved basic forest materials, by species and participating country[140];
- "Dendrome", the collection of forest tree genome databases maintained by the University of California at Davis[141]; and in relation to institutions involved,
- the World Directory of Forest Geneticists and Tree Breeders compiled by the North American Forestry Commission and the International Union of Forest Research Organizations (IUFRO)[142].

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[135] http://www.fao.org/docrep/009/y9933e/y9933e00.htm.

[136] www.fao.org/forestry/site/24107/en

[137] http://www.iucnredlist.org/search/search-basic

[138] http://www.unep-wcmc.org/data/database/un_combo.html

[139] http://www.worldagroforestry.org/Sites/TreeDBS/tssd/Acknow.htm

[140] http://www.oecd.org/dataoecd/35/25/34733779.PDF

[141] http://dendrome.ucdavis.edu/

[142] http://www.iufro.org/.

In addition to the above, and at a regional level, Bioversity International (ex-IPGRI) has recently (June 2006) received funding from the European Commission for a project entitled, "Establishment of a European Information System on Forest Genetic Resources (EUFGIS)"[143]. Partner institutes in Austria, Denmark, France, Slovakia, Slovenia and UK collaborate in the project. The major goal is to establish a web-based, permanent and easily accessible information system to link national FGR inventories at Pan-European level. The project will create a network of national FGR inventories to provide data for the information system and develop minimum requirements for dynamic gene conservation units of forest trees, as well as common information standards for these units. Once operational, the new information system will support practical implementation of gene conservation of forest trees and sustainable forest management in Europe.

12. CONCLUSIONS AND PROPOSALS FOR THE WAY FORWARD

General Observations

Forests are the epitome of diversity. The overall goal in the management of forest genetic resources is to help ensure that forest biological diversity, at all levels, is conserved, managed and sustainably utilized in support of local and national development, including food security, poverty alleviation, environmental conservation, economic and social advancement and the maintenance of cultural and spiritual values.

The present paper covers the *forestry sector*, as linked to the development of nations and peoples, and focuses on *forest genetic resources*. The various biotic levels of diversity are however closely inter-related, and genetic management efforts must be both targeted and closely coordinated as it is possible to conserve an ecosystem and still lose component species, and to conserve species while losing valuable genetic variation. Management interventions (including non-intervention) also have varying effects on different social and economic sectors; this underlines the necessity of inter-sectoral dialogue, needed to agree on compromises based on local and national priorities. What is valued in biological diversity, how it can be managed, and for whom, are critical issues.

Many values derive from forest ecosystems as well as from their component parts. They include the provision of goods and services and the provision of environmental and life-support values. These latter values, such as soil and water protection, the conservation of biological diversity, carbon sequestration and recreation, are typically associated with the ecosystem and population levels; while goods are usually provided at the species or population levels; and evolution and adaptation to change, are dependent on genetic and molecular variation.

The conservation and use of biological diversity and forest genetic resources requires that they be managed, protected, and developed. The management of biological diversity includes integrating techniques for different levels of diversity among multiple areas. The key to success is vested in the development of programmes which harmonize conservation and sustainable use of forest genetic resources within a mosaic of land use options.

Outlook and Trends

While there is no accepted methodology for directly linking general information on changes in forests to the impacts that such changes may have on biological diversity, species, provenances, populations and genes; and while there is a lack of agreement on the validity of indicators for measuring and monitoring changes in diversity and variation at these levels, reliable data on forest status and trends is nevertheless of great importance to assessing and monitoring forest biological diversity and to the efficient management of forest genetic resources. Basic forest resources information, aggregated at global and regional levels within the framework of the Global Forest Resources Assessment, is

[143] http://www.bioversityinternational.org/networks/euforgen/news/eufgis.htm.

discussed in Section 10 of the present report. Indicators, which have been proposed for monitoring trends in forest biological diversity and FGR, are discussed in Section 9.

Based on available information on global forest resources, there is a worrying loss of ecosystems and forest habitats through deforestation due to changes in land use. In addition, extensive tracts of existing forests are being degraded to various degrees through damage from pests, diseases, fire, atmospheric pollution, climatic variation and fluctuations, and through lack of management or non-sustainable forest management practices, which prevail in many countries. Such degradation can be expected to have deeply negative effects on genetic resources in affected areas. Even in countries in which many or most forests are being conserved in protected areas or managed for productive or protective purposes, there is a general lack of consideration of genetic issues in such management.

The meetings of the FAO Panel of Experts on Forest Gene Resources have reflected the above trends through an exponential increase over the years in the number of species and provenances listed as being in need of attention. In the first meetings of the Panel in 1968 and 1969, some half a dozen species were prioritized for international action and support; in the 6th Session of the Panel, in 1985, the list of priority species had grown to cover 70 pages. This led to the need to re-think basic principles for including species on the Panel lists, and to added stress on defining and developing methodologies for priority setting (FAO 1968-2002). Simultaneously, the prioritised activities defined by the Panel, and in international action in general, shifted their main emphasis from collection and seed exchange to holistic gene management, in which genetic conservation and wise use of FGR were seen as part of comprehensive, sustainable natural resource management (see *e.g.* FAO 1989, 1993; and Section 7 of the present report).

Recent trends towards providing logistical and technical support to countries in the preparation of sub-regional and regional action plans, in which priority species and activities, and sharing of responsibilities are determined by countries concerned, are described in Section 10.

There is a need to greatly intensify awareness, information, know-how and action. It is clear that any delays will severely and negatively affect forest biological diversity and the continued availability of forest genetic resources.

Identification of Needs and Proposals for the Way Forward

Integration of forest biological diversity and forest genetic resources considerations into wider frameworks of action

Genetic resource management can be effective only if it is treated as an integral part of overall development and, in the case of *in situ* conservation, a component of overall land use. To ensure sustainability and long-term success, conservation concerns should be integrated into broader national and local development plans. Such plans might include national forest programmes and poverty reduction strategies, which promote harmonization of action between sectors and cooperation among national agencies dealing with these. Integration should be assured both at policy-making and implementation levels. Appropriate links should also be made to efforts of countries to meet the Millennium Development Goals, notably MDGs 1 and 7 to which forestry can make substantial contributions.

Forest management interventions (including non-intervention), which are based on national and local priorities, have varying effects on different social and economic sectors. To ensure sustainability of action, genuine efforts are needed to meet the needs and aspirations of a range of interested parties. This underlines the necessity of wide stakeholder participation, in order to agree on trade-offs and compromises. What is valued in biological diversity, how it can be managed. And for whom, are critical issues.

Inter-institutional and international collaboration

Over the past 35 years the numbers of international, regional and national institutions, mechanisms and discussion fora which are concerned with forests and forestry have greatly increased. While the institutions which deal with forest biological diversity and FGR generally cover different aspects of work, collaboration among such institutions needs to be strengthened and action further harmonized. Harmonization should take into account mandates and comparative advantages of each institute and be based on open dialogue and mutual trust in addition to more formalized agreements. Cooperation will help ensure that wasteful duplication of effort is avoided, important FGR issues are not inadvertently neglected, reporting burden of countries is diminished, and provision of national data and information is consistent across sectors.

In support of the above it is important that Governments and delegations to different international and regional fora inform themselves about institutional complementarities and contribute to streamlining activities when providing advice and making recommendations to governing bodies of the institutions which they support.

The Collaborative Partnership on Forests, which includes 14 major forest-related international organizations, institutions and convention secretariats, is an excellent example of constructive, technical and policy level dialogue and joint programming.

Commission on Genetic Resources for Food and Agriculture, and Panel of Experts on Forest Gene Resources

FAO's mandate and structure encompass a wide array of programmes that seek to maximize the total utility of agrobiodiversity in the widest sense, including the sectors of agriculture, forestry and fisheries. FAO is also mandated to support countries to maintain a global perspective on species and action priorities.

Inter-sectoral linkages are facilitated and encouraged in FAO's programme through joint programming and execution within the framework of, "Priority Areas for Inter-disciplinary Action" (PAIA), which help streamline action across sectors in agriculture. PAIAs cover areas such as biological diversity and genetic resources, biosecurity and biotechnology.

The FAO Global System encompasses the International Treaty on Genetic Resources for Food and Agriculture, the Commission on Genetic Resources for Food and Agriculture and an International Fund. While the Commission on has to date concentrated action mainly on crop genetic resources, it is gradually moving towards implementation of its full mandate (*cf.* Conference Resolution 3/95, which requested that the mandate of the Commission be broadened to cover all components of biological diversity of interest to food and agriculture).

In addition to reporting to the Committee on Forestry, the Panel of Experts on Forest Gene Resources has, over the years, provided information and supported the Commission in its areas of expertise (forest genetic resources, *in situ* conservation). As noted in Section 6 of this paper, there are a number of important differences in the application of strategies and in the methods used for conserving and managing crop and forest genetic resources. While the importance of inter-sectoral links is acknowledged, the availability of sector-specific expertise is therefore also important. These points to the need to continue to make full use of existing mechanisms such as the Panel of Experts on FGR and to maintain databases such as REFORGEN for the collection, storage and provision of sector- and user relevant information.

The Panel of Experts on FGR should also continue to provide technical and scientific guidance and support to member countries and the international community in issues in which FAO has expertise and comparative advantages. Two-way links between the Panel, the CGRFA and other relevant policy-making bodies should be assured, including in the case of the Forest Gene Panel notably COFO and FAO's

Regional Committees and Regional Forestry Commissions. Such links will allow both a sense of country ownership (based largely on technical and expert level involvement) and adoption and national implementation of strategies and methodolgies proposed (through discussions and decisions in policy-making fora).

Forest Resources Assessment

The availability of baseline data on forest status and trends is essential to assessing and monitoring forest biological diversity and provides the basis for the efficient management of forest genetic resources. Based on national inputs and information, the global forest resources assessment coordinated by FAO regularly collects and makes available information on forest area and trends, structure and composition, and analyses underlying causes of deforestation and forest degradation. Such information underpins the management of FGR, however, there is no accepted methodology for linking changes in these general variables to their direct impacts on biological diversity in forest ecosystems, landscapes, species, populations and genes. Objectives and sampling methods used in global and most national forest inventories presently do not capture information of basic importance to FGR conservation and management.

Forest biological diversity and FGR considerations need to be gradually, increasingly, incorporated in national forest inventories and in the global forest resources assessments.

While obtaining data from FRA, FGR expertise should be provided to the programme on the relevance and applicability of diversity-related data and indicators. The more than 170 National Correspondents, who have been officially nominated by Member Countries within the framework of FRA, should be specifically requested to ensure regular inputs and feedback from FGR experts in their respective countries.

Forging close links with FRA and making use of its established network of national and regional correspondents and functioning mechanism for assessing, monitoring and reporting on the status and trends of forests will help place FGR action in context and help promote regular assessment and monitoring of FGR at national and international levels.

Sources and availability of information

Availability of information on status and trends in forest biological diversity and FGR is today woefully inadequate (see also section above). While stressed in connection with a range of issues and constraints affecting conservation of forest biological diversity and the efficient management of FGR, the question is discussed more specifically in Section 10 of this paper.

Forest-related information largely refers to forest resources in general rather than to diversity and variation. Presently available sources of information for the two categories (forest resources, FGR) which are discussed in the paper include, NFPs, FRA, CBD, the Panel of Experts on FGR, the regional, sub-regional and eco-regional workshops on FGR supported by FAO and international partners, and the national and regional FGR reports prepared within the framework of the workshops.

Future possibilities for improving availability and use of FGR should include the incorporation of FGR considerations and information into larger frameworks such as NFPs; the development of valid indicators for assessing the status and trends in FGR within national forest inventories and programmes such as FRA; the expansion of coverage of the regional workshops and networks related to FGR; and the generation of additional national level information on FGR status, trends, priorities and threats using common concepts and methodologies for priority setting (see section below).

Regional, sub-regional and eco-regional workshops on forest genetic resources

The above workshops are tools to help catalyze action at national level, based on assessment of status, trends, needs and environmental and resource-related possibilities in participating countries. In the process of planning, participants used common core variables and based priority setting on similar and well-defined principles and methodologies. As a result, close to 50 countries covering most regions of the world have generated excellent national information on FGR, which has subsequently been placed within regional frameworks for action to further enhance collaboration and impact.

The eco-regional approach for defining common approaches and priorities, used in *e.g.* the boreal zone and arid and semi-arid areas of Africa, has proven exceptionally useful as similar technologies, species and patterns of resource use have provided additional common denominators for priority setting in such regions.

Collaboration at regional, sub-regional and eco-regional levels, which builds on national priorities and programmes, will help ensure that forest biological diversity and genetic resources programmes of individual countries are complementary, compatible and mutually supportive.

The above, country-driven workshops on FGR and the resulting participatory, regional action plans might, in the future, if countries so wish, contribute to an international, flexible overall global framework for action in FGR.

Step-by-step development of such a global framework for action is an appropriate manifestation of the concern and responsibility of the international community in this field. As stressed by COFO and the Panel of Experts on FGR, the aim is not to impose any given, standard "model" for conservation and genetic management, but to place priority action, defined by countries, within a common conceptual framework at regional, sub-regional, eco-regional and global levels, resting on the principles of national sovereignty over natural resources, as set out in the Forest Principles and the Rio Declaration.

In addition to helping countries and regions not yet involved to join efforts of national/regional FGR planning, the challenge for the future will be to ensure implementation of the national, regional, sub-regional and eco-regional forest genetic resources action plans already elaborated or in preparation, and to ensure the dynamic development and regular adjustment of the plans to reflect experiences gained and accommodate new needs and requirements.

Conservation Strategies and methodologies

Only some 5% of forests in the world are in plantations, with the balance found in natural or semi-natural, largely unmanaged and undomesticated forest stands. Conservation and management of forest genetic diversity and FGR imply, (i) the conservation of genetic resources in protected areas, (ii) the incorporation of genetic considerations in forest resource management for productive or protective goals, and (iii) the incorporation of such considerations in tree improvement strategies. Efforts should be country-driven as the most appropriate action will vary according to specific environmental, social and economic circumstances, institutional and legal frameworks, and prevailing needs and priorities of countries concerned.

There is a need to intensify action in the various operational steps in FGR management outlined in Section 7 of this paper. Such action should be based on gradually improved basic knowledge (see section on capacity-building above); and the incorporation of a wider range of species in national programmes, using varying intensities of management intervention.

Ecogeographical and genecological zoning will help support definition of priorities and early application of strategies.

Priority setting

Estimates of numbers of tree species vary from 80 000 to 100 000 and forests and trees provide a large number of goods and services which require varying types of management. There is a clear need for priority setting among the many alternative ecosystems, species and FGR, including notably genetically diversified provenances, which may qualify for action; and for the operational activities which support action at local, national, regional and global levels. Priority setting is complicated greatly by the lack of even basic information on variation, variation patterns and the biological and silvicultural characteristics of many (or most) tree species and of their potentialities.

There is no single measure of values related to forest biological diversity or FGR. Measures are only possible for particular aspects in relation to particular goals. Goals for conservation action and for the management of forest genetic resources should be made explicit and agreed at the beginning of any particular priority-setting exercise.

Relative priorities for action within any one country will be determined by countries concerned, by balancing socio-economic, environmental and cultural values assessed in the light of susceptibility or likelihood of loss or degradation of genetic resources of target species At the regional and international levels, priority-setting will, in addition, take into account common interests and commonality of priority species and activities, and possibilities to assign regional and sub-regional lead organizations for given species and/or activities.

Common or compatible priority setting principles for the definition of target species were applied within the framework of the regional, sub-regional and eco-regional FGR workshops supported by FAO and international partners (Section 10 of this paper; see also discussion under the related heading above). Information collected and analysed as a basis for setting priorities included: value and attributes of species; management and occurrence; review of operational needs; levels of security and threats (see Section 8 and Appendix 2 of this paper).

Priority setting will help ensure adequate coverage of conservation activities. It will also ensure that FGR programmes are adequately focused to make optimal use of scarce resources. There is an urgent need to support countries to review, further refine and agree on methodologies for priority-setting in programmes aimed at the management of forest biological and genetic diversity, targeting local, national and regional levels of action. Priority setting should include consideration of the *type of species* (based on end use categories: for productive, protective, social and other purposes), *type of activity* contributing to genetic management (conservation *in* and *ex situ*; exploration; testing and evaluation in field trials complemented as and if desirable by molecular level studies for optimal characterization; collection and wise use of physiologically and genetically good reproductive materials for a range of environmental and end use purposes); and *proposed intensity of management* (conservation of genetic resources in protected areas; the incorporation of genetic considerations into forest resource management; and the incorporation of such considerations into tree improvement and breeding strategies).

Indicators

As stressed above, reliable information on status and trends are basic to monitoring forest biological diversity and managing FGR. There is no single measure of biological diversity, and no accepted methodology for linking changes in FGR to general forest resources parameters, such as area and occurrence, species richness, naturalness, or forest fragmentation. While providing the basis for some general assumptions, such parameters, many of which are presently included in national and global forest resources assessments, are not, on their own, able to provide sufficient information on status and trends in forest biological diversity and FGR.

There are presently no agreed-upon specific indicators for monitoring changes in forest biological diversity and FGR. There is also lack of agreement, at national and international levels, on the

scientific validity of possible surrogate indicators which have been proposed in a number of fora or which are presently used for assessing status and monitoring changes in biological diversity at the various biotic levels.

Assisting countries and international institutions in the development, testing and implementation of forest biological diversity indicators at different levels (landscapes, ecosystems, species, populations, genetic level), is an urgent need. Such indicators should complement, and gradually be fully integrated with, those being developed and implemented in other fields and sectors, notably criteria and indicators used in the definition and monitoring of sustainability of forest management.

While international agreement on some potentially useful "forest biodiversity indicators" might be reached in the future, it should be recognized that periodicity, and sampling strategies and intensity, in national forest inventories and in global forest resources assessments may not capture sufficiently detailed information on these frequently complex parameters to be of practical value. Compromises will need to be made based on technical possibilities**,** institutional capacities and economic feasibility of comprehensive forest inventories in countries concerned. Such compromises must be based on balanced, factual information and expert advice rather than on what has been called, "policy makers' perception of public perception"[144].

Capacity Building, Training, Research, Awareness Raising

Institutional strengthening, training, and support to research, are needed for countries to be able to respond to pressing and increasingly varied needs in conservation and FGR management. This includes, among others, training and research aimed at capitalizing on recent developments in forest inventory (remote sensing, GIS), and forest genetics (traditional and more recent molecular marker technologies and other biotechnological tools, as applicable).

Support to training is needed both at professional and technical level. Sentizing policy-makers, the public and local populations to needs and benefits, responsibilities and advantages of FGR management action in the short, as well as in the longer term, is also of utmost importance.

Networking and institutional twinning, which has long traditions in forestry, has continued potential and should be vigorously promoted.

Information management and dissemination

The REFORGEN database supports the storage, organization and provision of data to policy makers and other users in the FGR field. Other databases, in and outside FAO, complement but do not duplicate the role that REFORGEN plays in this regard.

There is a need to verify and up-date existing information and to expand the country and species coverage of REFORGEN. Reliable mechanisms should also be established for institutionalizing regular up-dating and verification of data.

Dissemination of information using traditional and electronic means, exchange of knowhow and, where desirable, promotion of the exchange of genetic materials on mutually agreed terms and conditions, should be continued and intensified.

"Forests are, "*the epitome of diversity*". Present efforts in forest management and conservation often reflect values of dominant economic powers or a preservationist counter-culture, neither of which brings any higher level of justice to the people affected or concerned. It is our obligation not to abuse this complex system through ignorance, and to avoid management which would simplify

[144] D. Bartley, FAO/FI, *pers.comm.*

forests to manufacturing factories, or attempt to restore or preserve, a world that never existed. There is a need to forcefully stress the evolutionary interdependence between forests and humans and the need to focus on the issue of *how* to manage forest ecosystems and genetic resources, rather then *whether* to manage them".

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This Bibliography includes some relevant documents in which additional information can be found to the issues discussed. It is complemented by "*Selected References by Region*", found at the end of the Section entitled, "*Availability of National Reports from Individual Countries*": the *"Selected References by Region*" lists references which are directly relevant to, and complement, the corresponding Tables in that Section.

The Bibliography is sub-divided as follows:

1. Agreements, Treaties, Meeting Documentation
2. Overviews, Conservation Proposals and Action at International Level
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   - vi. Data management, Data Bases
   - vii. Biotechnolgies in Forestry
   - viii. Miscellaneous

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LIST OF ACRONYMS

(Conventions, organizations, programmes, networks)

AHTEG	*Ad hoc* Technical Expert Group on Forest Biological Diversity of the CBD
APFORGEN	Asia Pacific Forest Genetic Resources Network Programme (coordinated by Bioversity International)
APAFRI	Asia-Pacific Association of Forestry Research Institutions (IUFRO Chapter in Asia Pacific)
ATO	African Timber Organization
AusAID	Australian Government Overseas Aid Program
Bioversity	Bioversity International, CGIAR Centre, up to late 2006 known as the International Plant Genetic Resources Institute, IPGRI (see below)
CAMCORE	Central America and Mexico Coniferous Resources Cooperative
CATIE	Tropical Agricultural Research and Higher Education Centre (*Centro Agronómico Tropical de Investigación y Enseñanza*)
CATCN-PGR	Central Asian and Transcaucasian Network on Plant Genetic Resources (coordinated by Bioversity International)
CBD	UN Convention on Biological Diversity
CGIAR	Consultative Group on International Agricultural Research
CGRFA	Commission on Genetic Resources for Food and Agriculture (Secretariat in FAO)
CIFOR	Centre for International Forestry Research (of the CGIAR)
CILSS	Permanent Inter-State Committee on Drought Control in the Sahel (*Comité Inter-Etate pour la Lutte contre la Sécheresse au Sahel*)
Cirad-Forêts	Centre of International Cooperation in Agricultural Research for Development, Forestry Department (*Centre de coopération internationale en recherche agronomique pour le développement- département forêts*)
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
COFO	Committee on Forestry (FAO Statutory Body)
CPF	Collaborative Partnership on Forests[150]
CSD	Commission on Sustainable Development
CSIRO	Commonwealth Scientific and Industrial Research Organization

[150] Members:FAO, UNDP, UNEP, WB, ITTO, CIFOR, ICRAF, IUFRO, IUCN, and the CBD, UNCCD, UNFF, UNFCCC and GEF Secretariats (http://www.fao.org/forestry/site/6787/en/).

DANIDA	Danish International Development Agency
DFSC	Centre for Forest and Landscape and Planning, Denmark (up to 1.1.2004known as the DANDIA Forest Seed Centre)
ECOSOC	Economic and Social Council of the United Nations
EUFORGEN	European Forest Genetic Resources Programme (coordinated by Bioversity International)
FAO	Food and Agriculture Organization of the United Nations
FLD	Centre for Forest and Landscape and Planning, Denmark (up to 1.1.2004 known as the DANDIA Forest Seed Centre)
FORGENMAP	Forest Genetic Resources Conservation and Management Project (financed by DANIDA)
FORSPA	Forestry Research Support Programme for Asia and the Pacific(coordinated by FAO, co-financed by the Netherlands)
FRA	Global Forest Resources Assessment (coordinated by FAO)
GEF	Global Environment Facility (coordinated by UNDP, UNEP, WB)
ICRAF	World Agroforestry Center (of the CGIAR)
INIA	National Agricultural Research and Techonolgy Institute, Spain (*Instituto Nacional de Investigación y Tecnología Agraria*)
IFF	International Forum on Forests
IPF	Inter-Governmental Panel on Forests
IPGRI	International Plant Genetic Resources Insititute of the CGIAR; earlier known as IBPGR, the International Board on Plant Genetic Resources. IPGRI was, in December 2006, re-named Bioversity International
IPCC	Inter-Governmental Panel on Climate Change (of the UN)
ITFF	Inter-Agency Task Force on Forests[151]
ITGRFA	International Treaty on Genetic Resources for Food and Agriculture (Secretariat in FAO)
ITTO	International Tropical Timber Organization
IUBS	International Union of Biological Science
IUCN	World Conservation Union
IUFRO	International Union of Forest Research Organizations
KP	The Kyoto Protocol (of the UNFCCC)

[151] Predecessor to CPF

LAFORGEN	Latin America Forest Genetic Resources Programme (coordinated by IPGRI)
MAB	Man and the Biosphere Programme (Secretariat in UNESCO)
NFP	National Forest Programmes
OECD	Organisation for Economic Co-operation and Development
REFORGEN	Worldwide Information System on Forest Genetic Resources (coordinated by FAO)
SADC	Southern African Development Community
SAFORGEN	Sub-Saharan African Programme on Forest Genetic Resources (coordinated by IPGRI)
SBSTA	Subsidiary Body on Scientific and Technical Advice (of the UNFCCC)
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice (of the CBD)
SCOPE	Scientific Committee on Problems of the Environment (coordinated by UNESCO)
SPC	Secretariat of the Pacific Community
SPRIG	South Pacific Initiative on Forest Genetic Resources (financed by AusAID and CSIRO)
SPREP	South Pacific Regional Environment Programme
UN	United Nations
UNCED	United Nations Conference on Environment and Development
UN-DESA	United Nations Department of Economic and Social Affairs
UNEP	United Nations Environment Programme
UNEP/WCMC	United Nations World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
UNCCD	UN Convention to Combat Desertification.
UNFF	UN Forum on Forests
USDA	United States Department of Agriculture
WB	World Bank
WHC	World Heritage Convention (Secretariat in UNESCO)
WMO	World Meteorological Organization (of the UN)

WSSD	World Summit on Sustainable Development,
WTO	World Trade Organization
WWF	World Wide Fund for Nature

COMMONLY USED ABBREVIATIONS

ADG	Assistant Director-General
FGR	Forest (tree and shrub) genetic resources
FORIS	The Forestry Information System (administered by FAO/FRA)
GIS	Global Information System
ha	Hectares
MDG	The Millenium Development Goals
PAIA	Priority Areas for Interdisciplinary Action (in FAO's Programme of Work and Budget)
PGRFA	Plant Genetic Resources for Food and Agriculture.
NWFP	Non-wood forest products
PWB	Programme of Work and Budget
SFM	Sustainable forest management
WP	Working Paper

APPENDIX 1

INTERNATIONAL INSTITUTIONS INVOLVED IN FOREST BIOLOGICAL DIVERSITY

The aim of the below, brief descriptions of mandates and activities of international institutes, including international mechanisms, is to provide some information and entry points to additional information through web links and some literature references to institutions listed in the Table, "International Institutions Involved in Forest Biological Diversity". The information refers mainly to issues of relevance to forest biological diversity and forest genetic resources, however, some wider forestry issues are also referred to. The descriptions are non-inclusive and, as developments in the forest biological diversity field are rapid, readers are referred to the Home Pages of the institutions concerned for up-to-date information.

1. AGENCIES AND ORGANIZATIONS, PROGRAMMES

The Food and Agriculture Organization of the UN

FAO is an intergovernmental organization with 190 member countries plus one member organization (the European Community). The Organization was founded in 1945 with a mandate to raise the levels of nutrition and standards of living, to improve agricultural productivity, and to better the condition of rural populations. FAO is the largest specialized agency in the United Nations system and the lead agency for agriculture, forestry and fisheries. FAO provides a neutral forum for international discussion on issues related to food and agriculture, including forestry; provides advice to Governments in its areas of competence; facilitates exchange of information and know-how among nations; and assists countries in the development and execution of field programmes in support of sustainable agricultural development[152].

Dialogue at the international level is an essential complement to the efforts of individual countries to develop appropriate forest policies, institutions and practices. FAO supports a number of Statutory Bodies specifically designed to provide neutral fora for discussion in the field of forestry. The work of the FAO Forestry Statutory Bodies is a combination of problem identification and policy and technical advice, to FAO, its members and others as appropriate

FAO's Forest Genetic Resources Programme

Forest genetic resources is a traditional area of work of FAO's Forestry Department[153]. Through its forest genetic resources programme, FAO advises governments and national institutions on genetic conservation strategies and their links to wider issues of forest management, biological diversity conservation and rural development; supports the strengthening of institutions and capacities; and provides technical advice on the management of forest genetic resources including their conservation, enhancement and sustainable use. FAO, further, and acts as an "honest broker" in discussions on the use of new and conventional tree breeding technologies and in issues related to access and exchange of forest germplasm. In carrying out these programmes FAO collaborates closely with and national institutions through direct support and through the promotion of institutional networking and twinning. FAO also collaborates with a large number of international partners, and promotes harmonization of activities at regional and international levels. Information is disseminated widely, using a range of communication tools. The Panel of Experts on Forest Gene Resources, established in 1968[154], provides advice to FAO and, indirectly, to the world community, on programmes and priorities in the area of forest genetic resources (see Sections 2 and 10 of the present report).The work of the Panel

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[152] http://www.fao.org.

[153] http://www.fao.org/forestry/site/fgr/en/.

[154] http://www.fao.org/forestry/site/34798/en/.

complements the work of the Commission on Genetic Resources for Food and Agriculture, to which it regularly reports (see below).

Programmes which are closely related with the FGR programme of FAO include activities in protected areas and wildlife, sustainable forest management; plantation forestry; and the Global Forest Resources Assessment Programme (see information in Section 10).

Cross-sectoral issues are discussed in the Inter-Departmental Working Group on Biological Diversity in Food and Agriculture, which also oversees work in the corresponding Priority Area for Inter-disciplinary Action (PAIA)[155] [156].

Some major bodies related to the work on forestry and FGR are briefly described below.

Committee on Forestry

The Committee on Forestry (COFO) is the most important of the FAO Forestry Statutory Bodies[157]. The biennial sessions of COFO (held at FAO headquarters in Rome, Italy) bring together Heads of Forest Services and other senior Government officials to identify emerging policy and technical issues, to seek solutions and to advise FAO and others on appropriate action. Other international organizations and, increasingly, non-governmental groups participate in COFO. As the need arises, FAO also convenes special meetings of forestry Ministers, non-Governmental organizations and private industry. The Forestry Technical Statutory Bodies report to COFO and, through, COFO, to the FAO Governing Bodies (the Council and the Conference[158]).

Regional Forestry Commissions

Six Regional Forestry Commissions were established by the FAO Conference between 1947 and 1959[159]. Every two years, the Commissions bring together the Heads of Forestry in each major region of the world to address the most important forestry issues in the region. The Commissions consider both policy and technical issues. The Commissions play a key role in the international arrangement on forests, serving as a link between global dialogue at COFO and the UNFF, and national implementation. The Regional Forestry Commissions are also active in-between formal sessions. Most of the Commissions have technical working groups or sub-regional chapters that implement projects that benefit from collaboration among countries in the region. The North American Forest Commission has a working group on forest genetic resources[160].

Technical Statutory Bodies

FAO supports and benefits from the advice of a number of specialized technical bodies that meet regularly to focus on specific areas of forestry development and management. These bodies study and report on matters of importance for sustainable forestry, and may consist either of selected representatives of member countries or of individuals appointed in their personal capacity.

The *Panel of Experts on Forest Gene Resources*, focused specifically on FGR is, as noted above, described in some detail in Sections 2 and 10 of the present report. Other technical Statutory Bodies of relevance include, the *Committee on Mediterranean Forestry Questions, Silva Mediterranea*; the

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[155] http://www.fao.org/biodiversity/index.asp.

[156] http://www.fao.org/pbe/en/intro.htm.

[157] http://www.fao.org/forestry/site/2962/en/.

[158] http://www.fao.org/unfao/govbodies/Conffinal_en.asp; http://www.fao.org/unfao/govbodies/Councilfinal_en.asp.

[159] http://www.fao.org/forestry/site/statutorybodies/en/.

[160] http://www.fs.fed.us/global/nafc/welcome.html.

International Poplar Commission; and, to some degree, also the *Advisory Committee on Pulp and Wood Products*[161].

Commission on Genetic Resources for Food and Agriculture

The *Commission on Genetic Resources for Food and Agriculture* is a permanent forum where Governments discuss and negotiate matters relevant to genetic resources for food and agriculture[162]. The main objectives of the CGRFA are to ensure the conservation and sustainable utilization of genetic resources for food and agriculture, as well the fair and equitable sharing of benefits derived from their use, for present and future generations. The Commission aims to reach international consensus on areas of global interest, through negotiations. The Commission was originally established in 1983 as the Commission on Plant Genetic Resources, by the FAO Conference, (Resolution 9/83), to deal with issues related to plant genetic resources. In 1995, its mandate was broadened (Resolution 3/95), to cover all components of agro-biodiversity of relevance to food and agriculture, including animal, fish and forest genetic resources. It was then renamed the Commission on Genetic Resources for Food and Agriculture (CGRFA).

The United Nations Educational, Scientific and Cultural Organization

UNESCO, with Headquarters in Paris, was established in 1945, with the objective to contribute to peace and security in the world by promoting collaboration among nations through education, science, culture and communication, and to further universal respect for justice, for the rule of law and for the human rights and fundamental freedoms which are affirmed for the peoples of the world[163]. The *Man and the Biosphere Programme* (MAB)[164], encourages interdisciplinary research, demonstration and training in natural resource management, with a view to contributing to better understanding of the environment, including global change, and to greater involvement of science and scientists in policy development concerning the wise use of biological diversity[165]. The *World Network on Biosphere Reserves*, established within UNESCO/MAB in 1974, has three main objectives: (i) *in situ* conservation of biological diversity; (ii) long-term study of changes in ecosystems; and (iii) contribution to the sustainable development of local populations. By July 2003, there were 440 Biosphere Reserves in 97 countries. The Biosphere Reserve network thus covers the major ecosystems and areas of origin of genetic resources of the world. While countries themselves are responsible for protecting and managing the reserves under their national legislation, partnership in the network facilitates cooperative research and monitoring, and sharing of experiences Biosphere Reserves usually combine areas that are strictly protected and landscapes used by people, thus contributing to the conservation of agricultural biodiversity, including forest biodiversity. UNESCO encourages the use of the Biosphere Reserves in international research programmes, such as *Diversitas*[166], to increase scientific knowledge on biological diversity, including ecosystem functions and the origins and maintenance of diversity.

The United Nations Environment Programme

UNEP was established following the UN Conference on the Human Environment in Stockholm, Sweden in 1972. The mandate of this programme of the United Nations, lead by an Executive Director and based in Nairobi, Kenya, is to provide leadership and encourage partnership in caring for

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[161] http://www.fao.org/forestry/site/statutorybodies/en/.

[162] http://www.fao.org/ag/cgrfa/default.htm#secretariat.

[163] http://www.unesco.org/.

[164] http://www.unesco.org/mab/index.shtml.

[165] http://www.unesco.org/mab/.

[166] http://www.diversitas-international.org/.

environment by inspiring, informing, and enabling nations and people improve their quality of life without compromising that of future generations[167]. UNEP provides secretariat services for a number of international biological diversity-related conventions and agreements, including i.a. CBD, UNFCCC, UNCCC, CITES, RAMSAR and WHC.

The UNEP-World Conservation Monitoring Centre

The UNEP-WCMC was established in 2000 as the world biodiversity information and assessment centre of UNEP[168]. The Centre provides a range of biodiversity-related services to UNEP, the biodiversity-related conventions and their constituent party-states and other bodies in the non-governmental and private sectors[169]. WCMC was previously an independent organization jointly managed by IUCN, UNEP and WWF established in 1988; and prior to that the Centre was a part of the IUCN Secretariat.

The World Bank

The "World Bank" is the name generally used for the International Bank for Reconstruction and Development (IBRD) and the International Development Association (IDA). Together these two organizations provide low-interest loans, interest-free credit, and grants to developing countries. The World Bank is one of the world's largest sources of investment loans for development. The Bank's Agenda incorporates a number of specific objectives and support to the conservation and sustainable use of biological diversity[170]. The World Bank/WWF Alliance on Forest Conservation and Sustainable Use is a, "S*trategic, performance-based, global partnership*", with the objective to support countries in the establishment of new protected areas; strengthening the management of existing protected areas; and placing production forests under independently certified management[171].

The United Nations Development Programme

UNDP, through the provision of financial assistance and technical support, "*helps connect countries to knowledge, experience and resources to help people build a better life*"[172].

The International Tropical Timber Organization

ITTO facilitates discussion, consultation and international co-operation on issues relating to the international trade and utilization of tropical timber and the sustainable management of its resource base[173]. ITTO member countries are committed to work towards ensuring that all tropical timber products traded internationally by Member States originate from sustainably managed forests. In this regard, ITTO supports work in member countries related also to the conservation of biological diversity. This includes *i.a.* recent collaboration with CITES, to improve management and oversight of tropical timber species listed in the CITES appendices. A project entitled, "Strengthening National Capacity and Regional Collaboration for Sustainable Use of Forest Genetic Resources in Tropical Asia", was recently approved for funding by ITTO. The 3-year project (2006-2008) was proposed jointly by the Forest Research Institute of Malaysia, APAFRI and Bioversity International (ex-IPGRI), and will involve 7 countries in tropical Asia[174].

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[167] http://www.unep.org/

[168] http://www.unep-wcmc.org/resources/mandates.htm.

[169] http://www.unep-wcmc.org/

[170] http://www.worldbank.org/

[171] http://lnweb18.worldbank.org/ESSD/envext.nsf/80ByDocName/WBWWFForestAlliance.

[172] http://www.undp.org/

[173] http://www.itto.or.jp/

[174] http://www.apforgen.org/files/ITTO%20funds%20project%20on%20forest%20genetic%20resources.doc.

The Consultative Group on International Agricultural Research

The Consultative Group on International Agricultural Research (CGIAR), established in 1971 by the World Bank, FAO and UNDP, is an association of public and private members supporting a system of fifteen international centres, referred to as the "Allience of Future Harvest Centres". The overall mission of CGIAR is to, "contribute to food security and poverty eradication in developing countries through research, partnership, capacity building, and policy support through promotion of sustainable agricultural development based on the environmentally sound management of natural resources"[175].

The Future Harvest Centres work in more than 100 countries to mobilize cutting-edge science to reduce hunger and poverty, improve human nutrition and health, and protect the environment. The Centres maintain over 600 000 samples of crop, forage and agroforestry germplasm accessions in the public domain, most of which are designated in trust for the world community under agreements with FAO. The terms of the agreements signed between the FAO and the CGIAR Centres stipulate that the germplasm within the in-trust collections will be made available without restriction, under a standard Material Transfer Agreement, to researchers around the world, on the understanding that no intellectual property protection can be applied to the material. The CGIAR System-wide Information Network for Genetic Resources (SINGER), allows access to information on the collections[176].

The System-Wide Genetic Resources Programme (SGRP) established in 1994 and hosted by Bioversity International, Rome (ex-IPGRI), joins together the fifteen CGIAR Centres in a partnership to contribute to the global effort to conserve genetic resources and promote their sustainable use in agriculture, forestry and fisheries. The overall goal of SGRP is to maximize collaboration, particularly in the five thematic areas of policy, awareness, information, knowledge and technology, and capacity building.

Three CGIAR centres, in particular, have programmes relevant to the conservation and sustainable use of forest genetic resources: the Center for International Forestry Research (CIFOR); the World Agroforestry Centre (ICRAF); and Bioversity International (ex-IPGRI)

The CIFOR/ICRAF Biodiversity Platform focuses on, "biodiversity issues in multifunctional landscape mosaics". The Platform aims to collaboratively deliver international public goods on, relationships between biodiversity and livelihood security in multifunctional landscapes; ecological processes and spatial dynamics of biodiversity in landscape mosaics; opportunities for and constraints to providing incentives for biodiversity conservation, sustainable use and equitable benefit sharing in landscape mosaics; potential for harmonization of customary and statutory rules and laws in relation to multifunctionality of landscape mosaics. The focus is on inter- or transdisciplinary research encompassing biophysical, socio-economic and policy issues. The aim is to rigorously address issues of 'people and biodiversity', while also focusing on other topics, such as cross-sectoral interactions with land use, that are not addressed in many sector-specific research institutions[177].

Bioversity International, CIFOR and ICRAF, in collaboration with other interested CGIAR Centres, are presently (2006) in the process of outlining a joint strategy and action plan for forest and tree genetic resources ("Alliance of CGIAR Centres").

Bioversity International

The stated mission of Bioversity International, based in Maccarese, Italy, is to: "Undertake, encourage and support research and other activities on the use and conservation of agricultural biodiversity, especially genetic resources, to create more productive, resilient and sustainable harvests. The aim is

[175] http://www.cgiar.org/

[176] http://www.singer.cgiar.org/.

[177] http://www.cifor.cgiar.org/Research/ENV/Themes/Bio/biodiversity_platform.htm

to promote the greater well-being of people, particularly poor people in developing countries, by helping them to achieve food security, to improve their health and nutrition, to boost their incomes, and to conserve the natural resources on which they depend. Bioversity International works with a global range of partners to maximize impact, to develop capacity and to ensure that all stakeholders have an effective voice" [178].The organization, up to December 2006 known as the International Plant Genetic Resources Institute (IPGRI), has its roots in the International Board on Plant Genetic Resources (IBPGR), established by the CGIAR in 1974, with a secretariat shared with FAO and based at FAO Headquarters, Rome. In 1994, IBPGR- now known as Bioversity International- became an independent CGIAR Centre, which maintains close links with FAO through a Memorandum of Understanding.

While the main focus of work of Bioversity International, remains agricultural crops, issues related to forest genetic resources have over the past fifteen years been given increasing attention in the work of the organization. A decision-making framework for prioritizing forest tree species, populations and conservation management interventions was discussed at IPGRI in 2000 (Namkoong and Koshy 2000). Focusing attention on high priorities has allowed the collation of extensive information on target and "model" species. Issues related to access and transfer of genetic resources, transfer of technologies and funds, and property rights and the fair and equitable sharing of benefits, are increasingly debated also in the area of forestry. Bioversity International, with its expertise in policy research, has initiated activities to study the impact of different policy frameworks on forest genetic resources conservation and use.

Bioversity International supports a number of FGR networks.These networks, which serve as platforms for the implementation of regional and sub-regional activities in forest genetic resources by countries and institutions concerned, include: (i) the European Forest Genetic Resources Programme (EUFORGEN), established in 1994[179]; (ii) the Sub-Saharan African Forest Genetic Resources Programme (SAFORGEN), stablished in January1999[180]; (iii) the Asia-Pacific Forest Genetic Resources Programme (APFORGEN), established in July 2003[181]; and (iv) the Latin America Forest Genetic Resources Programme (LAFORGEN), established in September 2006[182].

The Centre for International Forestry Research

The mission of CIFOR, based in Bogor, Indonesia, is to contribute to the sustained well-being of people in developing countries, particularly in the tropics. It achieves this through collaborative, strategic and applied research, and by promoting the transfer and adoption of appropriate new technologies and social systems for national development[183]. CIFOR's research is clustered under three major topics aimed at addressing the needs of the rural poor as well as environmental concerns: (i) the environmental services and sustainable use of forests programme, oversees research on improving forest management practices, biodiversity in fragmented landscapes, and forest ecosystem services concentrating on watershed functions and climate change; (ii) the forests and governance programme, which examines the process of improving governance by developing and testing approaches for getting local groups to think through and monitor how they manage their forests; the programme also undertakes research on forest finance and trade, law enforcement and corporate accountability; and (iii) the forests and livelihoods programme, which investigates how to develop new approaches to integrating conservation and development and how use and trade of forest products contribute to the livelihoods of the rural and urban poor.

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[178] http://www.bioversityinternational.org/

[179] http://www.bioversityinternational.org/networks/euforgen/aboutus.asp

[180] http://www.bioversityinternational.org/Networks/saforgen/introduction.htm

[181] http://www.apforgen.org/

[182] http://www.bioversityinternational.org/information_sources/networks/laforgen.asp

[183] http://www.cifor.cgiar.org/

CIFOR's research on forest biodiversity focuses on, i.a., (i) the development of methods to assess 'what really matters' to communities living in tropical forest landscapes so that more informed decisions on policy, land use, and payments for biodiversity services, that will improve forest conservation, protect the needs of local people and advance the wiser management of tropical forests can be made; (ii) sustainable use of forests, with special emphasis on practices which will help conserve important environmental services such as biological diversity while providing 'safety nets' for the poor; (iii) illegal logging, law enforcement and conflict and the implications of governance failure, typically manifested by large-scale illegal logging, on forest biodiversity; and (iv) management of landscapes for sustainable livelihoods. CIFOR's biodiversity-related research activities support the sustainable use of forest genetic resources through processes and initiatives that span across national, regional and sometimes global scales. CIFOR has also been involved in international efforts to develop criteria and indicators for biological diversity, including genetic diversity, at forest management unit level

The World Agroforestry Center

The mission of ICRAF, based in Nairobi, Kenya, and earlier known as the International Centre for Research in Agroforestry, is to improve human welfare by reducing poverty, improving food and nutritional security, and enhancing environmental resilience in the tropics. ICRAF conducts strategic and applied research, in partnership with national agricultural research systems, for sustainable and productive land use in developing countries. More specifically, ICRAF's work is focused on the following areas: (i) agroforestry systems that help to restore soil fertility and regenerate degraded lands; (ii) cultivation systems that help lift rural poor out of poverty and improve their health and nutrition; (iii) agroforestry systems that enhance environmental services, such as watershed protection, biodiversity conservation, and carbon sequestration; and (iv) capacity building for agroforestry research and development[184]. ICRAF's Tree Domestication Programme (2001-2010), supports efforts to accelerate the identification, production, management and adoption of high quality germplasm of tree species to increase the level and stability of income, food security and environmental benefits of cultivated trees in small-scale farming systems.

The International Union of Forestry Research Organizations

IUFRO is a non-profit, non-governmental international scientific body founded in 1892, composed of an international network of forest scientists. The IUFRO Secretariat in Vienna, Austria was hosted by FAO (Rome) from 1949 to 1957. IUFRO continues to collaborate closely with FAO, through an Agreement signed in 1949. The objectives of IUFRO are to promote international cooperation in forestry and forest products research. IUFRO's activities are organized primarily through its 274 specialized Units in 8 technical Divisions, and links more than 15 000 scientists in 720 research institutions, worldwide. IUFRO Inter-Divisional Task Forces address specific, cross-sectoral issues[185].

IUFRO has been traditionally involved in supporting research in forest genetic resources. Genetics and forest genetic resources are addressed principally by Division 2 (Physiology and Genetics of Forest Trees). A Task Force on the Management and Conservation of Forest Genetic Resources was established in January 1998. The Task Force, which collaborated closely with FAO and IPGRI, provided a report on its work at the XXI IUFRO Congress in Kuala Lumpur in 2000.

The World Conservation Union and the World Wide Fund for Nature

The above two non-Governmental organizations, IUCN and WWF, are based in Gland, Switzerland. Members of IUCN come from some 140 countries and include 82 States, 100 government agencies, and 750-plus NGOs[186]. WWF records almost five million supporters distributed in five continents,

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184 http://www.worldagroforestrycentre.org/level1a.htm

185 http://iufro.boku.ac.at/

186 http://www.iucn.org/

and a global conservation network active in over 90 countries187. The two organizations, together and individually, have strongly promoted action related to the conservation of nature which, over the past thirty years, has received substantial international attention. Together with the WCMC (now part of UNEP, see above), they have also contributed significantly to the development of information systems and databases of protected areas, and threatened and endangered tree species.

Natural, semi-natural and managed ecosystems have been recognized as important reservoirs of biological diversity. Conservation action over the past decades has led to the establishment of a network of protected areas, which cover a range of objectives in addition to conservation. IUCN has proposed to classify these in eight categories, of which three refer to strictly protected areas and five to areas in which controlled resource utilization is allowed, with due concern to the maintenance or management of biological diversity.

The first IUCN Red List of Threatened Plants made its appearance in 1998, and was followed by a more detailed assessment of tree species in the World List of Threatened Trees. The more recently developed IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on taxa that have been globally evaluated using the IUCN Red List Categories and Criteria. The main purpose of the IUCN Red List is to catalogue and highlight those taxa that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). The list of threatened taxa is maintained in a searchable database by the Species Survival Commission Red List Programme as part of the Species Information Service.[188]

2. CONVENTIONS, TREATIES AND MECHANISMS

The Non-Legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests

The above Principles, often referred to as the "*Forest Principles*"[189], were agreed to by countries at UNCED (1992). They are presently under discussion in an *Ad-Hoc* Expert Group, established within the framework of the UNFF to consider revision of their contents and scope[190].

The International Undertaking on Plant Genetic Resources

The need to conserve crop genetic resources was first recognized at international level in the 1960s, when action was started to collect and conserve plant genetic resources to maintain the potential for breeding of cultivated plants to meet new and unforeseen needs and challenges faced by changing environments. In 1983, Member Countries of FAO agreed to establish the non-legally binding International Undertaking on Plant Genetic Resources, and requested the Director-General of FAO to establish a Commission on Plant Genetic Resources to oversee it. In 1995, the mandate of the Commission was broadened to cover all components of agrobiodiversity of relevance to food and agriculture. It was then re-named the Commission on Genetic Resources for Food and Agriculture (CGRFA)[191]. One hundred and thirteen countries adhered to the Undertaking, which sought to "ensure that plant genetic resources of economic and/or social interest, particularly for agriculture, will be explored, preserved, evaluated and made available for plant breeding and scientific purpose." The Undertaking recognized genetic resources as a common heritage of humanity, which needed to be conserved and made accessible to all. In 1993, lengthy and complex negotiations were started to adopt the Undertaking as a legally binding agreement, in harmony with the CBD.

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[187] http://www.panda.org/

[188] http://www.iucnredlist.org/search/search-basic

[189] http://www.un.org/documents/ga/conf151/aconf15126-3annex3.htm

[190] http://www.un.org/esa/forests/adhoc-nlbi.html ;http://www.un.org/esa/forests/pdf/aheg/nlbi/ahegnlbi-report.pdf

[191] http://www.fao.org/ag/cgrfa/default.htm

The International Treaty on Plant Genetic Resources

The International Treaty on Plant Genetic Resources for Food and Agriculture, which is a result of these negotiations, was adopted in November 2001 by the FAO Conference; it entered into force in June 2004 and presently is adherred to by 110 Parties[192].

The ITPGRFA is a comprehensive international agreement, developed in harmony with the CBD, which provides a framework for action in support of sound management of plant genetic resources for food and agriculture and access to these resources, related knowledge and technologies. It also provides the agricultural sector with a multi-lateral tool to promote cooperation and synergy with other sectors, particularly with trade and the environment.

Through the Treaty, countries agreed to establish an efficient, effective and transparent Multilateral System to facilitate access to plant genetic resources for food and agriculture, and to share the benefits in a fair and equitable way. The *Multilateral System* applies to over 64 major crops and forages. An important component to the ITPGRFA and the Multilateral system is the *Global Crop Diversity Trus*t, established in October 2004, with the goal of providing a secure and sustainable source of funding for the world's most important crop diversity collections. The Trust provides a funding strategy to mobilize funds for activities, plans and programmes the help, above all, small farmers in developing countries. This is the basis for Farmers' Rights, which include the protection of traditional knowledge, and the right to participate equitably in benefit-sharing and in national decision-making about plant genetic resources.

The Convention on Biological Diversity

The stated objectives of the CBD are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the use of genetic resources. Provisions of the CBD on scientific and technical cooperation, access to genetic resources and the transfer of environmentally sound technologies, form the foundations for partnerships among signatory countries. At the same time, the CBD recognizes the sovereignty of countries over their own natural resources, stressing however, the responsibility of each country to ensure the long-term conservation and management of genetic resources in their national territories.

Although many articles of the CBD apply to forest ecosystems, the Convention itself does not make specific mention of forests. Discussions on the conservation of forest biological diversity within the CBD first started at the Second Meeting of the Conference of Parties (COP-2, 1995). A preliminary assessment of the status and trends and identification of options for the conservation and sustainable use of forest biological diversity was carried out under the CBD in 1999. The information from the survey was used in the first Global Biodiversity Outlook, compiled by CBD in 2001. COP-4 (2000) identified forest biological diversity as one of the five thematic areas to be addressed within the CBD and established an Ad Hoc Expert Group to further develop the programme. An expanded programme of work on forest biological diversity, adopted in COP-6 in 2002 (Decision VI/22)[193].

The goals, objectives and activities of the work programme on forest biological diversity, in line with that of other sectors of concern to the CBD, include three programme elements: (i) conservation, sustainable use and benefit sharing; (ii) institutional and socio-economic enabling environment; and (iii) knowledge, assessment and monitoring. More specifically, the forest biological diversity programme includes mention of in situ and ex situ conservation and sustainable resource use; and the need to assess the adequacy and efficacy of existing protected area networks, to establish additional protected area networks, and to facilitate the participation of local and indigenous communities in protected area management. It stresses the need to include forest biological diversity considerations in

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[192] http://www.fao.org/ag/cgrfa/itpgr.htm

[193] http://www.biodiv.org/programmes/areas/forest/default.asp

programmes related to forest resource assessments, forest fires, climate change and pollution abatement, and to link action to the CBD work programme on invasive alien species.

While recognizing the importance of international and regional activities, COP-6 stressed that implementation of the forest biological diversity work programme, for which new and additional financial resources were considered necessary, should be based on national priorities and needs, in line with the basic principles of the CBD. It emphasized the need for the Secretariat of CBD and parties to it, to cooperate with UNFF[194], CPF[195] and their partners to ensure streamlining of common objectives contained in national forest programmes and national biological diversity strategies and action plans. It requested that FAO, in collaboration with international and national partners, continue to coordinate work to define and clarify common forest-related concepts, terms and definitions as a prerequisite for such harmonization of efforts.

The United Nations Framework Convention on Climate Change

The stated objective of the UNFCCC and related legal instruments adopted by its Conference of the Parties, is to achieve, in accordance with the relevant provisions of the Convention, "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system, within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner". The text of the Convention was adopted at the UN Headquarters in May 1992, and it entered into force in March 1994; the convention has been ratified by 188 countries (February 2003)[196].

The Kyoto Protocol (KP) to the UNFCCC, which refers to binding limitations on greenhouse gases for the developed nations, was adopted at the 3rd Session of the Conference of the Parties in December 1997. The Protocol entered into force in February 2005[197]. Noting the weak scientific basis of the KP, the IPCC, at the request of the Subsidiary Body on Scientific and Technical Advice to the UNFCCC (SBSTA) prepared a report examining the scientific and technical state of understanding of carbon sequestration in land use, land-use change and forestry activities ("Special Report on Land use, Land-Use Change and Forestry", June 2002)198. In agreement with this report, forests will be considered as carbon sinks under the CDM (Article 12). However, Article 3.3. of the KP limits the consideration of forestry to, "the net changes in GHG emissions by sources and removals by sinks resulting from direct human-induced land-use change and forestry activities through afforestation, reforestation and deforestation"; it thus excludes forest conservation and sustainable forest management practices.

The United Nations Convention to Combat Desertification

Following UNCED, the UN General Assembly set up an Inter-Governmental Committee to prepare a legally binding instrument to address the problem of desertification, with a view to stopping or mitigating the effects of land degradation in arid, semi-arid and dry sub-humid areas resulting from climatic variations and human activities. The resulting agreement, the United Nations Convention to Combat Desertification (UNCCD), entered into force in December 1996199. In October 2002, the Second Assembly of the Global Environment Facility (GEF), in line with recommendations of the World Summit on Sustainable Development, WSSD (South Africa August-September 2002)200,

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[194] http://www.un.org/esa/forests/

[195] http://www.un.org/esa/forests/cpf.html

[196] http://unfccc.int/resource/convkp.html

[197] http://unfccc.int/kyoto_protocol/items/2830.php

[198] http://www.grida.no/climate/ipcc/land_use/index.htm

[199] http://www.unccd.int/main.php

[200] www.johannesburgsummit.org/

adopted a decision to designate land degradation as its fifth focal area, and to establish the GEF as a financial mechanism of the UNCCD (see section below for additional information on GEF).

Regional Implementation Annexes to the UNCCD provide details on how to prepare and carry out national, sub-regional and regional action programmes within its framework.

The Global Environment Facility

The Global Environment Facility (GEF), was established in 1991 to, "help developing countries fund projects and programs that protect the global environment". GEF is the designated financial mechanism for international agreements on biological diversity, climate change and persistent organic pollutants. GEF also supports projects that combat desertification and protect international waters and the ozone layer[201]. The World Bank, UNEP and UNDP act as implementing agencies for the GEF.

The Convention on International Trade in Endangered Species of Wild Fauna and Flora

CITES is an international agreement between governments, to which governments adhere voluntarily[202]. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES presently has 169 Parties. The Convention works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species. The species covered by CITES are listed in three Appendices, according to the degree of protection they need[203].

3. DISCUSSION AND POLICY MAKING FORA

See also Section 1 of the present Annex, regarding FAO Statutory Bodies: the ***Committee on Forestry***; the ***Commission on Genetic Resources for Food and Agriculture***; FAO ***Regional Forestry Commissions***; and FAO ***Technical Statutory Bodies***.

The Inter-Governmental Panel, the Inter-Governmental Forum and the United Nations Forum on Forests

Following UNCED, the Inter-Governmental Panel on Forests (IPF;1995-97) and the Inter-Governmental Forum on Forests (IFF; 1997-2000), were established under the auspices of the United Nations Commission on Sustainable Development (UNCSD), to facilitate and strengthen policy discussions on forestry issues[204]. Their successor-arrangement, the United Nations Forum on Forests (UNFF), was established in October 2000 as a subsidiary body under the UN Economic and Social Council (ECOSOC) to, "promote the management, conservation and sustainable development of all types of forests and to strengthen long-term political commitment to this end…based on the Rio Declaration, the Forest Principles, Chapter 11 of Agenda 21 and the outcome of the IPF/IFF Processes and other key milestones of international forest policy." The UNFF is composed of all States which are members of the UN and its Specialized Agencies, and meets in annual sessions.

Even though forest genetic resources were not explicitly included on the agenda of any of these fora, related issues regarding the management and sustainable development of all types of forests were, and continue to be, discussed. In this regard, IPF recognized that sustainably managed forests play a

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[201] http://www.gefweb.org/

[202] http://www.cites.org/eng/disc/what.shtml

[203] http://www.cites.org/eng/app/index.shtml

[204] http://www.un.org/esa/forests/; http://www.un.org/esa/forests/about-history.html

valuable part in conserving biological diversity, as reflected in the large number of proposals for action that either directly or indirectly address this issue (see Section, "International Action and Institutions Involved" for a summary of the IPF/IFF proposals for action of relevance to forest biological diversity and the management of forest genetic resources).

The Informal Interagency Task Force on Forests, the Collaborative Partnership on Forests

The ITFF was established in 1995 and was in 2001 was succeeded by the CPF[205]. The objectives of the dialogue these mechanisms support is to underpin the work of the UNFF and Member Countries and enhance cooperation and coordination on forest issues for the promotion of sustainable management of all types of forests. Work includes, *i.a.* efforts to help streamline of forest-related international reporting and forest-related definition. A Sourcebook on Funding for sustainable forest management (available on-line) has also been developed[206] [207].

CPF is a voluntary partnership that receives guidance from UNFF rather than an implementing agency. CPF members operate individually under their own mandates, work programmes and budgets, which are approved by their respective governing bodies. CPF members, individually and as a group, act as catalysts in countries to help implement sustainable forest management. They and other international and bilateral organizations can provide assistance and technical support, help raise awareness of needs, advise on strategies and help build capacity and partnerships. The mechanism of CPF helps ensure that actions of its partners are mutually reinforcing.

[205] The CPF includes representatives of: FAO (Chair), UNFF (Secretariat) UNDP, UNEP, WB, ITTO, CIFOR, ICRAF, IUFRO, IUCN and Secretariats of CBD, UNCCC, UNCCD, GEF. See: http://www.fao.org/forestry/site/cpf/en/

[206] http://www.fao.org/forestry/site/8015/en/

[207] http://www.fao.org/forestry/site/cpf/en/, http://www.fao.org/forestry/site/8015/en/

APPENDIX 2

GUIDING PRINCIPLES USED AS A BASIS FOR PRIORITY SETTING IN REGIONAL,SUB-REGIONAL, ECO-REGIONAL WORKSHOPS ON FOREST GENETIC RESOURCES

Source: "FAO Draft Technical Guidelines Identification and Definition of National Priorities" (FAO 1999)[208]

Identification of target species according to perceived value and attributes/uses

The first step in defining a regional/sub-regional forest genetic resources action programme will be to list ***priority species targeted for action*** (incl. provenances of special value), and to assess the nature of the value attached to them.

Relative priorities for action within any one country will be determined by countries concerned, by balancing socio-economic, environmental and cultural values assessed in the light of susceptibility or likelihood of loss or degradation of genetic resources of target species. Sub-regional and regional priorities will, in addition, take into account common interests and commonality of priority species and activities; and possibilities to complement action through assigning regional and sub-regional lead organizations for given species and/or activities.

Value of target species

Regarding target species, Namkoong (1986) described genetic management for three groups of species:

1. Species of current socio-economic importance;
2. Species with clear potential or future value;
3. Species of unknown value given present knowledge and technology.

Species in (1) are likely to be already included in selection and breeding programmes, or at least anticipated to be included in such programmes in the near future. These may range from programmes which involve systematic testing, evaluation and breeding for different kinds of gene effects for a range of objectives, in several different geographical areas; to those in which more simple systems of mass-selection are used and applied. In regard to (2), the main need will be to clarify the nature and patterns of genetic variation. Progress in this regard can be achieved through genecological exploration, followed by provenance testing to pin-point useful, diverse or unique populations and their specific characteristics. These studies can be supported, when required, by the use of genetic markers to determine corresponding molecular level genetic variation. An indication should be given on whether the species is, (i) indigenous; or (ii) introduced. In regard to (3), into which a large majority of forest tree species falls, the concept of "improvement for human use" is not usually applicable, and the continued existence of samples of populations of such species may be the only management objective. Species which are endemic or endangered at species or population level, but which are not of present-day social or economic value, will fall into this category.

Uses and attributes of target species

In the case of categories (1), (2), and when possible also (3), it is suggested that indication be given of the main actual or potential uses or attributes of priority (target) species:

- (ti) timber production;

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[208] Also used as a basis for agreement on priority setting in the regional, sub-regional and eco-regional forest genetic resources workshops organized in collaboration with FAO and IPGRI/Bioversity International.

- (po) posts, poles, roundwood;
- (pu) pulp and paper
- (wo) fuelwood, charcoal;
- (nw) non-wood products (gums, resins, oils, tannins, medicines, dyes...);
- (fo) food;
- (fd) fodder;
- (sh) shade, shelter;
- (ag) agroforestry systems;
- (co) soil and water conservation;
- (am) amenity, aesthetic, ethical values;
- (xx) other (to be specified).

It would be desirable to have a balance of categories of species (1-3), covering a range of end uses as described above, which are targeted for action by each country.

It is proposed to gather data regarding the value, attributes and uses in a table such as the one shown below, prepared as an example for the Sahelian dry zone Africa Workshop in 1998.

Table 1. Value and attributes/uses of target species, to be filled in by country: example of possible scenario

Species	Value code	Present, future or potential use											
		ti	po	wo	nw	pu	fo	fd	sh	ag	co	am	xx
Acacia karroo	2				X			X					
Eucalyptus camaldulensis	1			X								X	
Faidherbia albida	1						X		X				

Management and occurrence of target species

In order to prioritize among target species, information will be needed on their present occurrence, on-going programmes and projects in which they are included, and actual or potential threats to their genetic resources.

Management and present location of genetic resources of target species

The following repositories of genetic resources should be considered (see also Palmberg-Lerche 1998):

(a) Protected Areas, National Parks (managed with the principle of full protection and minimum intervention by man), in which the target species is a component of a protected ecosystem;

(b) Conservation stands in situ, ex situ (managed for the explicit purpose of conservation of genetic resources of the specified target species). In case of ex situ conservation stands, size, and number of provenances included in each separate stand should be specified.

(c) Forest Reserves, managed forests, in which special attention is given to genetic conservation of target species in defined compartments. These forests include naturally regenerated forests; and plantations (specify if local or introduced provenances used in plantations, if known);

(d) Village woodlots, farmers' fields, windbreaks, homesteads (specify if local or introduced provenances used in plantations, if known);

(e) Field experiments, selection and breeding programmes (specify number of provenances, families, clones).

In order to estimate present status, quantified information should be given in regard to the above, providing factual information (f) or estimates (e) of the number of individuals in each category, per major ecological zone (to be specified/briefly described), as follows:

< 100 individuals
between 100 and 500 individuals
between 500 and 1 000 individuals
between 1 000 and 10 000 individuals
> 10 000 individuals.

Levels of security and threats to target species

Table 2 lists silvicultural methods and management strategies, with special reference to maintaining, conserving or enhancing the genetic resources of given species or species found in given, specified areas. However, management and intensive intervention by man usually concerns only a small proportion of the forest estate, and is likely to be limited to a relatively small number of species and populations, notably those included in intensive silvicultural, or tree planting and tree improvement programmes. In many cases the only basis for evaluating general trends and conservation status is to estimate, in general terms, the intensity of use as related to variation in diversity of the resource and size of occurrence of individual species and populations. In these cases, estimates should be given of the number of individuals in each of the below management/use categories, in each major ecological or geographic zone (to be specified/briefly described).

Table 2. Management and location of genetic resources, by type of site and species: example of possible scenario

Species/area type	**Reserve, national park**	**Stands *in situ ex situ***	**Managed natural stands**	**Managed planted stands**	**Farmers' fields, homesteads**	**Experiments, field trials**
Spp. 1, zone A	< 100					
Spp. 1, zone B					>500(est)	
Spp. 1, zone C		*Ex situ* 20				
Spp. 2, zone B			<1000*			
Spp. 2, zone D						5 provenances

(a) Protected (in protected areas, parks, nature reserves);

(b) Managed for protective purposes (soil and water conservation, shade/shelter);

(c) Managed for productive purposes (wood, non-wood products);

(d) Managed for grazing/browse;

(e) Unmanaged use and harvesting;

(f) Unmanaged grazing/browse (domestic animals, wildlife);

(g) Threatened by wildfires, biotic/abiotic factors (pests, diseases, floods, pollution);

(h) Threatened by clearing for agriculture, pasture;

(i) Threatened by overgrazing;

(j) Threatened by infrastructure development (dams, mining, urban expansion);

(k) Other (specify).

Level of protection/security should be estimated or quantified on a scale of 1 to 5:

1. Implementation/enforcement of regulations probable, and regulations scientifically sound (for use/management categories (a)-(d) above); or threat mild/occasional (categories (e)-(j) above);

2, 3, 4. Intermediate between 1 and 5;

5. Implementation/enforcement of regulations unlikely; or threat severe with high probability of genetic degradation or loss.

The above information can be summarized in Table format (see Table 3 on next page).

Synthesis: Identification of priority species

Based on the above evaluation, species in need of immediate action among the target species originally specified can be pin-pointed, reducing the original list to those in need of most urgent attention.

If, for example, a given target species occurs in large managed forest areas, in each major ecological zone specified, implying 1 000 to 10 000 individuals in each, and the enforcement of management is satisfactory, this potential target species - while it may be socially, economically and/or environmentally of top importance - will not be in need of immediate intervention and action; only monitoring of the situation, over time, will be needed.

If a given potential target species, while under some threat of depletion in parts of its range, is the focus of on-going selection and breeding activities, and occurs in seed stands, comprehensive clone banks and field trials in satisfactory numbers, again, the situation should be monitored but the species may not be of top priority in an action plan.

On the other hand, if the number of individuals in outlying populations of a given potential target species has been reduced to, say <100, and the populations are subject to un-managed grazing and firewood collection, serious consideration should be given for the inclusion of this species and/or given populations in an intensive action programme to safeguard the genetic resources under threat through conservation, management, or systematic inclusion of threatened populations in selection and breeding programmes and populations.

Operational Needs in Priority Species

Once the listing of possible target species has been narrowed down to focus on a list of top priority species (based on value, status and threats), operational needs should be specified. It is suggested that the following categories be used:

Taxonomic exploration;
Genecological exploration;
Collection of reproductive materials for testing;
Testing/evaluation (field trials at provenance, progeny, clonal levels);
Conservation and genetic management in situ;
Collection for conservation ex situ;
Conservation ex situ;
Selection and breeding;
Research on phenology, breeding systems, flowering/fruiting;
Research on silviculture, management.

Priority should be given to relevant operations, as applicable, on a proposed scale of 1-5:

- Priority 1: Top priority, action should start with immediate effect;
- Priorities 2-4: Intermediate between 1 and 5;
- Priority 5: Action should start within coming 10-year period.

Table 3. Example of reporting on levels of security/management, by species

Columns a-l (continued below<->)	**(a)**	**(b)**	**(c)**	**(d)**	**(e)**	**(f)**	**(g)**	**(h)**	**(i)**	**(j)**	**(k)**	**(l)**
Species (by ecogeographic zone)	Protected in protected areas	Managed for:			Unmanaged:		Threats and causes for possible loss					Overall Degree of Security
		Soil, water conservation	used for production of wood, n/w goods	Grazing, browse	Used for production of wood, n/w goods	Used for grazing, browse	Environmental factors	Deforestation	Over-grazing	Development of infrastructure	Other reasons	
Species1 zone A			<100 trees				>1000 trees					1
Species1 zone B	1000 trees								1000 trees			2
Species2 zone B	< 100				< 100				< 100 trees			5
							.....etc.					