Forest genetic resources and management in Nepal – status, needs, challenges and actions required

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Introduction

Nepal is located between 26°22' and 30°27' N. latitudes, and 80°04' and 88°12' E. longitudes, and occupies a total area of 147181 km^2. The average length of the country is 885 km from east to west and the width varies from 145 to 241 km, with a mean of 193 km north to south. Hills and high mountains cover about 86% of the total land area and the remaining 14% are the flatlands of the Terai, which is less than 300 m in elevation. Altitude varies from some 60 m above sea level in the Terai to Mount Everest (Sagarmatha) at 8848 m, the highest point in the world.

Nepal has a population of 23.2 million, 48.5% of which lives in the Terai, 44.2% in the mid-hills and 7.3% in the mountains. The 2001 census indicates an average population growth rate of 2.27%, highest in the Terai and lowest in the Mountains

Biological resources and diversity

Nepal's location in the centre of the Himalayan Range places the country in the transitional zone between the eastern and western Himalayas. Nepal's rich biodiversity is a reflection of this unique geographical position as well as its altitudinal and climatic variations. It incorporates Palaearctic and Indo-Malayan biogeographical regions and major floristic provinces of Asia, creating unique and rich diversity of life. Although comprising only 0.09% of global land area, Nepal possesses a disproportionately large diversity of flora and fauna at genetic, species and ecosystem levels.

Floral diversity

Nepal is ranked at 10th and 31st position in Asia and the world respectively for its flowering plant diversity. On a world scale, Nepal represents 2.7% of angiosperms and 5.1% of gymnosperms. Altogether 342 plant species and 160 animals have been reported as being endemic to Nepal, out of which there are 246 endemic species of flowering plants.

A number of plant species are listed under various CITES appendices –15 species of vascular plants (one species of angiosperm i.e. *Saussurea lappa*, in Appendix I; one species of pteridophytes, two species of gymnosperm and five species of angiosperm in Appendix II; three species of gymnosperms and three species of angiosperm in Appendix III).

Genetic Diversity

Genetic diversity is the basis of heritable variation within and between populations of organisms. Ultimately, this diversity resides in the variations in sequences of the four-nucleotide base pairs, which constitute the genetic code. Farmers have used genetic diversity for thousands of years in agriculture. Hundreds of plant and wild animal species

have been domesticated and bred for desirable characteristics such as size, disease resistance, taste and productivity. Modern breeders also take advantage of genetic diversity.

Until recently, genetic diversity was only given consideration amongst domesticated species and populations held in zoos and botanical gardens. However because of habitat destruction and degradation the number of plant and animal species is decreasing and their genetic diversity is threatened, and conservation of genetic diversity has become a major issue today. Molecular techniques and screening of genes is being applied for the preservation of wild species. Hence, knowledge of how much genetic variation exists within a species, how variation is partitioned between and within populations, and where the species has its centres of diversity is fundamental to applied conservation.

Knowledge of the genetic diversity of plants in Nepal is poor. Its complex vertical topography acts to resist gene flow across the landscape. The very few studies that have been done using modern techniques include analysis of the genetic diversity in rice using Rubisco; restriction fragment length polymorphism, DNA fingerprinting using random amplified polymorphic DNA, and DNA amplification using polymerase chain reaction.

Organisation relevant for FGR

Ministry of Forest and Soil Conservation (MFSC)

The overall responsibility for implementing the Nepal Biodiversity Strategy (NBS) will lie with the MFSC, which is the focal point of and the lead ministry for the Convention on Biological Diversity (CBD). The relevant ministries and departments are responsible for implementation of their sectoral biodiversity plans. The Nepal Biodiversity Coordination Committee (NBCC) facilitates inter-sectoral coordination during NBS implementation and oversee monitoring and evaluation. The minister of Ministry of Forest and Soil Conservation (MFSC), the lead ministry for the CBD, chairs the NBCC and the secretary of the MFSC is the member secretary of the NBCC. Other members include representatives from the each of the relevant government ministries, the private sector, civil society and major donors-12 to 15 members in all. The National Biodiversity Unit (NBU) under the Environment Division of MFSC acts as the secretariat for the NBCC and serves as the forum for information exchange between government agencies, NGOs and the private sector during implementation of the NBS. The NBU also prepares status reports to be submitted to the secretariat of the CBD at five-year intervals. The NBCC is to establish five sub-committees to address the five Biodiversity Themes identified in the CBD, namely: forest biodiversity-including protected area ecosystems and species (*in situ* and *ex situ*), agricultural biodiversity, sustainable use of biological resources, genetic resources and bio-security

Department of Forests – The objective of the Department is protection, management and utilization of the national forest to enhance the country's economy as well as to develop the forest by scientific forest management and technology, including carrying out afforestation at the government level and through wider public participation for ecological balance. Nepal is well known for its greenery. The biodiversity present in the forests are of international importance both in view of the number of globally threatened wildlife and floral elements as well as the diversity of ecosystems represented within these areas. A total of 118 ecosystems, 75 vegetation and 35 forest types have been identified. Nearly 60% of the forests in the 18 districts have been classified as protection forest and can complement

biodiversity conservation. The Department of Forests has the responsibility to look after the national forests that are not under the protected area system.

Involvement of the local people in the management of forest has profound impact on the conservation of biodiversity. It has been proven by community forestry practices in Nepal. So far, 1 491 314 households are involved in the management of 1 082 165 ha community forest. They are concerned about maintaining a whole range of useful plants within their community forests other than fuel wood and timber, and therefore the natural diversity of community forests is maintained.

Basically, the Tree Improvement and Silviculture Unit (TISU) of the Department is involved in FGR activities. Some of its relevant activities are as listed in Table 1.

Table 1. Breeding seedling orchards (BSO), seed production areas (SPA) and trial plots established by the Tree Improvement and Silviculture Unit, Department of Forests, Nepal.

Species	**Category**	**Family #**	**Location**
Dalbergia sissoo	Progeny Trial	35	Tilkane, Chitwan
	Intermediate BSO	84	Sauraha, ,,
		48	Hathausa, Kapilbastu
		70	Dharan, Sunsari
		54	Kohalpur, Banke
	Provenience Trial	4 Prov.	Maheshpur, Siraha
	Infusion Trial	84	Krishnapur, Kanchanpur
Leucaena leucocephala	Simple SPA		Tilkane, Chitwan
			Sauraha
	Simple BSO		Hathausa, Kapilbastu
Aesandra butyracea	Intermediate BSO	40	Banstari, Palpa
		50	Lendanda, Makwanpur
Choerospondias axillaris	Intermediate BSO	25	Thankot, Kathmandu
		30	Ranipauwa, Nuwakot
Emblica officinalis	Intermediate BSO	25	Pumdi, Kaski
		25	Tilkane, Chitwan
Bauhinia Purpurea	Intermediate BSO	32	,,
Bauhinia variegata	Intermediate BSO	42	Majhitar, Dhading
Albizia lebbek	Intermediate BSO	36	Tilkane, Chitwan
Dalbergia latifolia	Simple BSO	140	,,
Michelia champaca	Intermediate BSO	40	Thankot, Kathmandu
Ficus semicordata	Simple BSO	21	Kalika, Kaski
Artocarpus lakoocha	Intermediate BSO	45	Maheshpur, Siraha
Artocarpus spp. (Latahar)	Intermediate BSO	63	Jalthal, Jhapa
Gmelina arborea	Intermediate BSO	55	Lalbandi, Sarlahi
Cinnamomum tamala	Intermediate BSO	36	Bhalam, Kaski
Anthocephalus kadamba	Intermediate BSO	76	Lalbandi, Sarlahi

Department of National Parks and Wildlife Conservation – The primary objectives of the Department are to conserve the country's major representative ecosystems, unique natural and cultural heritage, and give protection to the valuable and endangered wildlife species. It also encourages scientific research for the preservation of wild genetic diversity.

The Department's present priority is focused on participatory management of biodiversity conservation through partnerships with conservation and development organisations, stakeholders and local people. Specific activities of the Department are to:

- conserve endangered species
- practice scientific management of habitat for wildlife species
- establish buffer zones in and around parks and reserve to reduce biotic pressure
- regulate eco-tourism to improve socio-economic condition of local communities and increase conservation awareness through conservation education programs.

A complete list of protected areas of Nepal is presented in Appendix 1.

Department of Forest Research and Survey (DFRS) – To contribute to conservation, management and utilization of forest resources of Nepal through improved technologies and updated forest resource information base is the objective of the Department. The Tree Improvement Section is one of the six sections of the Department's Research Division and is fully committed to undertake the research activities in order to contribute to meeting the overall objective of the Department. Further it is responsible for designing and planning iree improvement research for important tree species in enhancing the genetic base of the species. The DFRS in collaboration with various research institutions will continue to conduct flora and fauna inventories and research on biodiversity assessment and monitoring. The research activities of the section can broadly be placed within the following programme areas.

- Both *in situ* and *ex situ* conservation of most valuable tree species
- Tree domestication
- Enhance productivity through genetically superior mother trees
- Gathering of sparse genotype of valuable species at a place so as to broaden their genetic base.

Department of Plant Resources (DPR) – The Department is providing services in the field of research and development of plant resources in Nepal. Ever since its establishment, many of its activities have concentrated on:

- Conducting detailed survey and collection of plant resources and preservation of the specimens in the National Herbarium.
- Maintenance of botanical gardens in various parts of the country.
- Conducting chemical and biological researches with an aim to optimize utilization of medicinal, aromatic and other plant resources.
- Conducting biotechnology research to improve the plants of economic value.
- Developing agro-technology on plants and providing services to the farmers on techniques of commercial cultivation of important medicinal and economic plants.
- Providing training and garden services.
- Disseminating information through publications on various aspects of researches carried on Nepalese plant resources.

The compilation of a comprehensive list of the flora of Nepal is a very important task. The DPR has published 32 books and booklets about local and regional flora. The National Herbarium and Plant Laboratories of Godavari under the DPR, which was established during 1960-61, has initiated the Flora of Nepal programme (DPR-MFSC 1997). The DPR has established seven district offices for the development of plant resources activities at district level. The MFSC, Tribhuvan University and Royal Nepal Academy of Science and Technology have signed an agreement to produce a comprehensive list of the flora of Nepal.

Ministry of Environment, Science and Technology (MEST)

The Ministry also plays an important role in the long-term implementation of biodiversity conservation in Nepal through the application of the Environment Protection Act 1996 and Regulations 1997. The rigorous application of environmental impact assessment (EIA) will be essential for eliminating and mitigating potential threats to biodiversity arising from development projects. MEST needs to put more emphasis on enforcement of mitigation measures as prescribed in the EIA reports and monitoring such activities, and taking action against those violating the prevailing laws.

Non-Governmental Organisations

The King Mahendra Trust for Nature Conservation, IUCN-Nepal, the Mountain Institute, WWF-Nepal and ICIMOD are NGOs active in the implementation of integrated conservation and development projects and in other specific areas.

Universities and research institutes

The Institutes of Science and Technology, Forestry, Agriculture and Animal Sciences of Tribhuvan University (TU), the Royal Nepal Academy for Science and Technology, and Nepal Agriculture Research Council, have supported the research and implementation of biodiversity conservation programmes. The TU has published several papers on the subject. There are several dissertations from TU dealing with local flora, ecology and biodiversity. Foreign institutions actively involved in the Flora of Nepal Programme include the British Museum in London, the Tokyo University and the Royal Botanical Garden of Edinburgh. The centres, such as musk deer research at Godavari and the Central Zoo, to some extent, will serve as *ex situ* centres for the conservation of endangered fauna. The Botanical Garden and Conservatories will serve as *in situ* and *ex situ* centres for plant conservation. Organisations relevant to FGR, in Nepal are presented in Appendix 2.

National coordination mechanism for biodiversity conservation

Parliamentary Committee on Natural Resources and Environment

The powers and functions of the committee include the evaluation of the policies and programmes, resource mobilisation and administration in collaboration with the Ministries of Water Resources, Land Reform and Management, Agriculture, Forest and Soil Conservation, and relevant departments and agencies under these ministries.

Environment Protection Council

The Environment Protection Council (EPC) was first established in 1992 and carried out several important activities during its first two years. Acting on the initiative of the EPC, the government has ratified the Convention on Biological Diversity and the Convention on

Climate Change, and acceded to the Vienna Convention on the Protection of Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer. Furthermore, on the EPC's initiative, vehicular emission standards have been developed and, to some extent, are being enforced. The Environment Protection Act, 1996, recognised the EPC and provided for its establishment as a statutory body.

Local authorities

District Development Committee (DDC) is the apex body of local government in each district. Other local bodies are Village Development Committee (VDC) and Municipality. There are 75 DDCs, 3912 VDCs and 58 Municipalities at local level where activities for the protection of indigenous knowledge, innovations and practices usually begin.

Biodiversity Coordinator

The Biodiversity Coordinator is the head of the NBU and serves as manager under the supervision of the chief of the Environment Division, to work on the implementation process.

National Policies relevant for FGR conservation and management

The Constitution of the Kingdom of Nepal 1990

Article 26 of the Constitution of the Kingdom of Nepal 1990 has adopted various state policies. Out of 16 policies mentioned in the Constitution, the following sections relate to forest resources:

Sub article (3): The state shall pursue the policy of mobilising the nation's natural resources and heritage in a useful and profitable manner suitable to the national welfare.

Sub article (4): The state shall accord priority to check effects on the environment that might result from physical development activities, and to protect the environment by increasing public awareness about clean environment, and shall also make special arrangements for the protection of rare wildlife, forest and vegetation.

The Master Plan for the Forestry Sector Nepal 1988

The Master Plan for the Forestry Sector (MPFS) Nepal 1988 has set some long-term objectives and identified primary programmes. One of the five long-term objectives is to preserve ecosystems and genetic sources. Likewise one of the six primary programmes is ecosystem and genetic resource conservation.

The Tenth Plan (2002-2007)

The broad goal of the Tenth Plan of Nepal is to reduce poverty from 38% to 32% by the end of the plan. It has prioritised the forestry programmes into three categories as P1, P2 and P3. Half a dozen programmes including community forestry are placed under P1 whereas only three including genetics and biodiversity conservation are under P2. The major quantitative targets are: to maintain country's forest cover by 40%; to work out on registration of biological resources in the context of WTO; to establish at least five gene banks of non-timber forest products; record keeping of country's biological diversity; to frame National Bio-safety Framework in 12 customs; to form 2500 community forest user groups; and to prepare essential policy and laws to protect biological diversity, environment and human health from adverse effects caused by Living Modified Organisms (LMOs)/ Genetically Modified Organisms (GMOs) to comply with International Trade Emission Treaty along with the production of high-valued medicinal plants.

Nepal Biodiversity Strategy 2002

The Nepal Biodiversity Strategy (NBS) is a commitment by His Majesty's Government and the people of Nepal for protection and wise use of the biologically diverse resources of the country, the protection of ecological processes and systems, and the equitable sharing of all ensuing benefits on a sustainable basis, for the benefit of the people and to honour obligations under the CBD.

The NBS is intended to serve as a guide to all government organisations, the private sector and civil society. It sets objectives for the protection of biological diversity in Nepal and identifies or restates government policy on natural resources and their diversity.

The outcomes of the NBS will be a stronger political commitment, an information management system, enhanced human and institutional capacity, clear policies and legislation, detailed action plans, heightened public awareness and an effective monitoring and evaluation process.

Other rules and regulations

- Ecosystems and genetic resources are protected *in situ* within the Protected Area (PA) system of Nepal. The Department of National Parks and Wildlife Conservation has the mandate to administrate and manage the PAs guided by the following legislations and regulations:
  a) Aquatic Animals Protection Act 1961
  b) National Parks and Wildlife Conservation Act 1973
  c) Himalayan National Park Regulations 1979
  d) Buffer Zone Management Regulations 1996, and Buffer Zone Management Guidelines 1999

- Forest Act 1992 and Forest regulations 1995 empowers the government to delineate any part of national forest that has a special environmental, scientific or cultural importance as a protected forest.

- Nepal has prepared a 20-year Agriculture Perspective Plan (APP 1995) covering all aspects of agriculture development, including agrobiodiversity conservation.

- National Conservation Strategy (HMG/IUCN 1988) highlights the necessities of establishing appropriate policies, regulations and management approaches to ensure suitable extraction of medicinal plants or non-timber forest products. Similarly Nepal Environment Policy and Action Plan advocates forestry research should address the utilisation of lesser-known forest products.

Updates and happenings

- Nepal's Biodiversity and the World Trade Organisation (WTO) – Nepal has formally entered into the WTO in April 2004. In the aftermath of the entry it has posed several threats and challenges to Nepal's biodiversity. The primary effect or risk would be in loosing the right of the Nepalese farmers in owning the species biodiversity protected by them. Secondly, such happenings could increase due to lack of its registration. Similarly traditional medical system based on ethno-botanical uses of various plants in most of the rural areas of the country will be seriously affected in the coming days so that the poor and weak people could not afford high cost modern medicines.

Moreover Nepalese traditional knowledge, skill and biological resources will mischievously be registered in the name of foreign companies. Instead of disclosing medicinal plants in open market system of WTO, the investment opportunities provided to local people with a long-term policy will be a dexterity to keep the foreigners away from it. In order to conserve and promote natural resources like medicinal plants, collaboration between government, local communities and private sector is essential (Anon. 2004).

- Record keeping of biological diversity of the country – It is a prerequisite for Nepal, which has already entered into WTO and for implementation of Nepal Biodiversity Strategy. The MFSC has approved three types of forms for record keeping purposes. Biological resource registration has become essential to hold the Intellectual Property Rights and Patent Rights and, to prevent the genetic sources from the claim by others.

- Nepal is a signatory state of the Cartahena Protocol on Bio-safety – The Protocol is to control international trafficking of Living Modified Organisms (LMOs)/Genetically Modified Organisms (GMOs), in order to minimise the risk on human health, biological diversity and environment.

- As indicated by NBS 2002, there is a provision of District Biodiversity Coordination Committee (DBCC) to implement biodiversity activities at local level. As of now, only 10 such committees have been formed out of 29 proposed for first phase.

- National Bio-safety Committee – chaired by the Secretary, MFSC. The Chief, Environment Division of MFSC is the secretary of this committee, and the members are the representatives from commercial, tourism and other related sectors.

- Agriculture policy 2061 has recognised Gene Bank establishment and promotion of in situ conservation, establishment of Participatory Biodiversity Park for biodiversity conservation.

- A draft bill for Genetic Resources (Access, Use, and Benefit Sharing) Act has been prepared. The bill includes, *inter alia*, ownership and registration of genetic resources and substances, benefit sharing, use of and access to it, establishment of National Genetic Resource Conservation Authority, and provision of case investigation and penalty.

- Government has announced three new policies, which are: Working Policy on Wildlife Farming, Breeding and Research, 2003; Domesticated Elephant Management Policy, 2060 (2003) and Working Procedure for the Implementation of the Policy with regard to the Handover of the Management of National Parks, Wildlife Reserves and Conservation Areas to Non-governmental Organizations or Other Organizations as stated in the Paragraph 50 of the Budget Speech of FY 2060/61 (2003/04)

Happenings in forestry seed trade

There are five regional seed centres under the TISU of Forests Department, which are primarily involved in the production and distribution of quality forest tree seeds. The Nepal Agroforestry Seed Cooperative Limited (NAFSCOL) in Kaski, and Kavre Seed Cooperative in Kavre district, are in operation through the technical and financial support of TISU after it initiated decentralized seed supply since 1995. Although the actual demand of seeds is not very clear, estimates and literatures indicate an annual demand of about 12 000 kg, of which about 10% is from TISU, about 30% from the seed cooperatives, 30% from private seed dealers, and the remaining 30% from local collection (DOF 2004).

Ongoing Activities

The Department of Forest Research and Survey has been undertaking the following activities which are relevant to FGR conservation and management:

- Management of a seed production area of *Eucalyptus camaldulensis* at Tarahara Research Site in Eastern Nepal for four years. The area is 1 ha and seedlings were from the seeds collected from phenotypically superior mother trees of Sagarnath Plantation Area.
- Establishment of an intermediate-level breeding seedling orchard (BSO) of Lapsi (*Choerospondias axillaris*) in a central hill district to produce genetically improved seeds. Lapsi is a very popular species in the hills of Nepal due to its income generating capacity. Its fruit is extensively used in making local pickle and sweetmeats. The objectives are:
    (a) Establish a seed bank of improved families for sustainable supply of genetically improved *C. axillaris* seeds,
    (b) Test and demonstrate appropriate technology to produce improved female seedlings by vegetative means,
    (c) Conserve genetic variation of *C. axillaris* that can be used in future breeding cycle and maximize production of fruits from a unit tree, and
    (d) Identify the variety and source of species with higher ratio of flesh and seed for increased income.
- For this, out of 4000 seedlings produced in polypots at the Department's Nursery from the seeds collected from different mother trees distributed in 5 districts, a total of 2000 seedlings have been grafted by taking the scions from selected superior mother trees from different populations.
- Training on methods of vegetative propagation for nurserymen of the department and concerned Community Forest User Group members.
- Planning on *in situ* conservation programme of Bijaysal (*Pterocarpus marsupium*) in the Department's Butwal Research Site located in a central Terai district.

Species conservation strategy

In the process of conserving the genetic constitution (flora) of the country, efforts have been made both locally and internationally. Appendix 3 listed the details of the species under various categories. Under the Forest Act 1993 Article 70, His Majesty's' Government of Nepal (HMGN) has notified following restrictions since 12 February 2001:

- Ban on collection, use, sale, distribution, transportation and export of the following medicinal herbs: *Dactylorhiza hatagirea* (Pancha ounle), *Juglans regia* bark (Okhar ko bokara (Walnut)), *Picrorhiza scrophulariflroa* (Kutaki (Gentian);

- Ban on export outside the country, except the processed product with permission of Department of Forests:

1. *Nardostachys grandiflora*	Jatamansi	Spikenard
2. *Rauwolfia sepentina* Serpentina	Serpagandha	
3. *Cinnnamimum glausecens*	Sugandhakokila	
4. *Valeriana wallichi*	Sugandhawal	Indian Valerin
5. Lichen species	Jhyau	
6. Rock exude	Shilajeet	
7. *Abies spectabilis*	Talispatra	Fir
8. *Taxes wallichiana*	Loth Salla	Himalayan Yew
9. *Cordyceps sinensis*	Yarsa gomba	

- Ban on transportation, export, felling for commercial purpose

1. *Michaelia champaca*	Champ	
2. *Acacia catechu*	Khayer	Cutch tree
3. *Shorea robusta*	Sal	
4. *Bombax malabaricum*	Simal	Silk cotton tree
5. *Dpterocarpus marsupium*	Satisal	
6. *Dalbergia latifolia*	Bijayasal	
7. *Juglans* sp. (Only of National Forest)	Okhar	Walnut tree

- Similarly HMGN is attempting *in situ* gene pool conservation of Bijaysal (*Pterocarpus marsupium*) through tree improvement programmes as the availability of this tree is decreasing in its habitat in the western Terai/ Bhabar mixed hardwood forests. Similarly, the government is also trying to conserve *ex situ* the gene pool of Satisal (*Dalbergia latifolia*), which has been categorised as a vulnerable species by IUCN and protected by HMGN.

- *In situ* conservation of threatened and endemic plants in Protected Areas (PAs) and adjoining areas – The PAs have served as effective *in situ* conservation of medicinal, food, timber and other threatened plants and their wild relatives. A few examples include different *Rhododendron* spp.; *Tetracentron sinense*, an endangered species in Makalu Barun National Park; *Larix himalaica*, a threatened species in Langtang National Park; a good population of *D. latifolia*, a threatened and vulnerable timber plant in Parsa Wildlife Reserve; *P. marsupium*, a threatened and highly vulnerable medicinal plant in Royal Suklanphanta Wildlife Reserve; *Gnetum montanum*, an endangered species in Royal Chitwan National Park and in Seduwa in the low lying Arun valley in Makalu Barun National Park.

Suggestions/Ideas for new FGR related initiatives

Nepal: Action Plan for forest genetics resources (FGR)

Documentation of ongoing activities: What is going-on on the FGR in the country?

- Sharing and documenting FGR advancement between the Department of Forest Research and Survey (DFRS), Department of Wildlife and National Parks (DWLNP), Department of Plant Resources (DPR), Tree Improvement and Silviculture Unit (TISU) and other NGOs.

- Informing all the FGR stakeholders of the AFORGEN.

Operationalising FGR activities at national and subject matter level

- Develop and establish a committee at the strategic level to discuss FGR advances at the national level.
- Develop executive committee to plan, assess and monitor the advancement of FGR.
- Develop executive sub committee to document and extend at appropriate (national and International) level and media. Executive Committee (national level) to meet once every six months.

References

Anonymous. 2004. Nepal's Biodiversity and the World Trade Organization. Environmental Justice, Vol.2, No.2

DFRS. 2004. Annual Report. Department of Forest Research and Survey.

DNPWC. 2004. Annual Report. Department of National Parks and Wildlife Conservation

DOF. 2004. Breeding Seedling Orchard. Tree Improvement and Silviculture Unit.

DPR. 2004. Plant Resources, An occasional Publication. Department of Plant Resources.

EPC. 1993. Nepal Environment Policy and Action Plan. Environment Protection Council, HMG Nepal.

HMGN. 1989. Master Plan for the Forestry Sector of Nepal,1988. Ministry of Forest and Soil Conservation

HMGN. 1990. The Constitution of the Kingdom of Nepal 1990.

HMGN. 1992. Forest Act 1992. Nepal Law Book Management Committee, Kathmandu

HMGN. 2002. Nepal Biodiversity Strategy. Ministry of Forest and Soil Conservation.

MFSC, 2004. Bulletin. Ministry of Forest and Soil Conservation

MFSC, 2005. Bulletin. Ministry of Forest and Soil Conservation

NPC, 2002. The Tenth Plan (2002-2007) of Nepal. National Planning Commission.

Tamrakar, PR. 2003. Status of forest genetic resources conservation and management in Nepal. In the proceedings of the Asia Pacific Forest Genetic Resources Programme Inception Workshop. International Plant Genetic Resources Institute, Malaysia.

Appendix 1. Nepal's National Parks, Wildlife Reserves, Hunting Reserve, Conservation Areas and Buffer Zones

Name of Parks	Gazetted	Area (sq.km)
National Parks		
Royal Chitwan National Park (World Heritage Site 1984)	1973	932
Langtang National Park	1976	1710
Rara National Park	1976	106
Sagarmatha National Park (World Heritage Site 1979)	1976	1148
Shey-Phoksundo National Park	1984	3555
Khaptad National Park	1984	225
Royal Bardia National Park	1984	968
Makalu-Barun National Park	1991	1500
Shivapuri National Park	2002	144
Total		**10288**
Wildlife Reserves		
Royal Suklaphanta Wildlife Reserves	1976	305
Koshi Tappu Wildlife Reserves (Ramsar Site 1987)	1976	175
Parsa Wildlife Reserves	1984	499
Total		**979**
Hunting Reserve		
Dhorpatan Hunting Reserve	1987	1325
Total		**1325**
Conservation Area		
Annapurna Conservation Area	1992	7629
Kanchanjunga Conservation Area	1997	2035
Manasulu Conservation Area	1998	1663
Total		**11327**
Buffer Zones		
Royal Chitwan National Park	1996	750
Royal Bardia National Park	1996	328
Langtang National Park	1998	420
Shey-Phoksundo National Park	1998	449
Makalu-Barun National Park	1999	830
Sagarmatha National Park	2002	275
Royal Suklaphanta Wildlife Reserves	2004	243.5
Koshi Tappu Wildlife Reserves	2004	173
Total		**3468.5**

Source: DNPWC (2004)

- The Protected Areas of Nepal covers a total of 27387.5 sq. km. or 18.60% of the country's total land.
- Sagarmatha National Park and Royal Chitwan National Park are listed in World Heritage Site in 1979 and 1984 respectively, and Koshi Tappu Wildlife Reserve, Bishajari Tal, Jagadishpur Reservoir and Ghodaghodi Tal are listed in Ramsar Site in 1987 and 2003 (last three) respectively.

Appendix 2. Institutions related to forest genetic resources in Nepal

Government Organisations

Parliamentary Committee on Natural Resources and Environment
Environment Protection Council
Ministry of Forest and Soil Conservation

- National Biodiversity Coordination Committee
- National Bio-safety Committee
- Environment Division
- Thematic sub-committees
- National Biodiversity Unit
- Biodiversity Coordinator

Ministry of Agriculture - District Agriculture Offices
Ministry of Environment, Science & Technology
Ministry of Local Development
Department of Forests

- Tree Improvement and Silviculture Unit
- District Forest Offices
- Community Forest User Groups

Department of National Parks and Wildlife Conservation

- National Park Offices
- Wildlife Reserve Offices
- Hunting Reserve Office
- Buffer Zones

Department of Forest Research and Survey - Tree Improvement Section
Department of Plant Resources

- District Plant Resource Offices
- Royal Botanical Garden

District Biodiversity Coordination Committee

- District Development Committees
- Municipalities
- Village Development Committees

Autonomous, Bilateral and I/NGO

Tribhuvan University

- Institute of Science & Technology
- Institute of Forestry
- Institute of Agriculture & Animal Sciences

Royal Nepal Academy for Science and Technology
Nepal Agriculture Research Council
Conservation Area Projects

- Annapurna CAP
- Manaslu CAP
- Kanchanjungha CAP

King Mahendra Trust for Nature Conservation
WWF- Nepal
IUCN-Nepal
ICIMOD
UNDP
The Mountain Institute

Appendix 3. Endangered and threatened species of Nepal

A. Plants of Nepal listed in CITES

Convention on International Trade of Endangered Species (CITES) listed 15 species of plants in Nepal:

- **Species threatened with extinction** *Saussurea lappa*

- **Species not yet threatened with extinction, but which could become endangered if trade is not controlled**

Ceropegia	[Milkworts, 7 species in Nepal]
Cyatheaceae	[tree ferns, CHECK how many species??]
Cycadaceae	[cycads, one species in Nepal?? CHECK]
Dioscorea deltoidea	
Orchidaceae	[orchids, over 300 species in Nepal]
Podophyllum hexandrum	[may apple]
Rauvolfia serpentina	
Taxus baccata subsp. *Wallichiana*	

- **Species identified by any party as being subject to regulation in that country and which require international co-operation to control trade**

Cycas pectinata	[Himalayan cycad]
Gnetum montanum	
Meconopsis regia	
Podocarpus neriifolius	
Talauma hodgsonii	
Tetracentron sinense	

B. IUCN identified threatened species of Nepal

- ***Non-endemic threatened plants***

Sixty species of non-endemic plants are regarded as threatened (Shrestha and Joshi 1996)

Name	Family	IUCN category
Allium przewalskianum	Amarylidaceae	V
Choerospondias axillaries	Anacardiaceae	R
Pistacia chinensis subsp. integerrina	Anacardiaceae	R
Alstonia neriifolia	Apocynaceae	R
Alstonia scholaris	Apocynaceae	R
Beaumontia grandiflora	Apocynaceae	V
Rauvolfia serpentina	Apocynaceae	E
Arisaema utile	Araceae	I
Helwingia himalaica	Araliceae	I
Hoya arnottiana	Asclepiadaceae	K
Tylophora belostemma	Asclepiadaceae	Ex?
Podophyllum hexandrum	Berberidaceae	V
Alnus nitida	Betulaceae	R
Oroxylum indicum	Bignoniaceae	V
Maharanga bicolor	Boraginaceae	K
Maharanga emodi	Boraginaceae	K
Crateva unilocularis	Capparaceae	R

Megacarpaea polyandra	Cruciferae	V
Cycas pectinata	Cycadaceae	E
Dioscorea deltoidea	Dioscoreaceae	T
Dioscorea prazeri	Dioscoreaceae	T
Elaeocarpus sphaericus	Elaeocarpaceae	V
Lithocarpus fenestrata	Fagaceae	K
Swertia chirayita	Gentianaceae	V
Gnetum montanum	Gnetaceae	E
Acacia catechu	Fabaceae	T
Butea monosperma	Fabaceae	E
Dalbergia latifolia	Fabaceae	V
Gloriosa superba	Liliaceae	R
Lillium wallichianum	Liliaceae	R
Paris polyphylla	Liliaceae	V
Magnolia globosa	Magnoliaceae	R
Michelia champaca	Magnoliaceae	E
Michelia kisopa	Magnoliaceae	E
Talauma hodgsonii	Magnoliaceae	E
Olea ferruginea	Oleaceae	R
Paeonia emodi	Paeoniaceae	R
Calamus acanthospathus	Palmae	E
Calamus latifolius	Palmae	E
Calamus leptospadix	Palmae	E
Wallichia densiflora	Palmae	R
Passiflora napalensis	Passifloraceae	E
Larix griffithiana	Pinaceae	R
Larix himalaica	Pinaceae	K
Ceratostigma ulicinum	Plumbaginaceae	R
Podocarpus neriifolius	Podocarpaceae	E
Hydrobryum griffithii	Podostemaceae	R
Rheum nobile	Polygonaceae	R
Helicia nilagirica	Proteaceae	R
Aconitum ferox	Ranunculaceae	T
Aconitum gammiei	Ranunculaceae	R
Aconitum heterophyllum	Ranunculaceae	R
Aconitum laciniatum	Ranunculaceae	T
Aconitum spicatum	Ranunculaceae	T
Prunus carmesina	Rosaceae	R
Bergenia ciliata	Saxifragaceae	T
Picrorhiza scrophulariifolia	Scrophulariaceae	V
Tetracentron sinense	Tetracentraceae	R
Ulmus wallichiana	Ulmaceae	R
Nardostachys grandiflora	Valerianaceae	V

Threatened medicinal plants of Nepal (due to over-collection)

Acontium heterophyllum	'Bikh', subalpine and alpine zones
Aconitum spicatum	'Bikh', subalpine and alpine zones
Acorus calamus	'Bojo', temperate zone
Dactylorhiza hatagirea	'Panch Aunle', subalpine and alpine zones
Ephedra gerardiana	'Somlata', subalpine and alpine zones
Gentiana kurrooa	??
Nardostachys grandiflora (syn. jatamansi)	'Jatamansi', subalpine and alpine zones
Paris polyphylla	'Satuwa', temperate zone
Picrorhiza kurroa	'Kutki', temperate zone
Piper longum	'Pipla', tropical and subtropical zones
Podophyllum hexandrum (syn. emodi)	??
Potentilla fulgens	'Bajradanti', temperate zone

Rauvolfia serpentina	'Sarpagandha', tropical and subtropical zones
Rheum australe (syn. emodi)	'Padamchal, subalpine and alpine zones
Rheum nobile	??
Swertia chirayita	'Chiraito', temperate zone
Terminalia chebula	'Harro', tropical and subtropical zones
Terminalia bellirica	'Barro', tropical and subtropical zones
Valeriana wallichii	'Sugandawal', temperate zone
Zanthoxylum armatum	'Timur', tropical and subtropical zones

Invasive plants of Nepal

Ageratum conzoides	
Amaranthus viridis	
Amaranthus spinosus	
Bidens pilosa	
Cassia tora	
Cassia sophera	
Eupatorium adenophorum	slash and burn areas, subtropical and temperate regions
Eupatorium odoratum	disturbed areas in tropical and subtropical regions
Lantana camara	disturbed areas in tropical and subtropical regions
Mikania micrantha	
Eichhornia crassipes	'water hyacinth', tropical and subtropical water ways

Where, Ex. = Extinct, E= Endangered, T= Threatened, R= Rare, V= Vulnerable, I= Intermediate, K= Insufficiently Known