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Glossary

AEARC	Atomic Energy Agriculture Research Centre
AFIP:	Armed Forces Institute of Pathology
AFP	Adventure Foundation, Pakistan
AUM	Animal Unit Month
BAP	Biodiversity Action Plan
CBD	Convention on Biological Diversity
CEMB:	Centre of Excellence in Molecular Biology University of the Punjab
CCD	Convention to Combat Desertification and Drought
CGIAR	Consultative Group on International Agricultural Research
CIDA	Canadian International development Agency
CIS	Commonwealth of Independent States
CHM	Clearing House Mechanism
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COP	Conference of Parties
CRI	Cotton Research Institute, Multan
DANIDA	Danish International Development Assistance
EEZ	Exclusive Economic Zone
FCCC	Framework Convention on Climate Change
EPA	Environmental Protection Agency
GATT	General Agreement on Trade and Tariffs
GEF	Global Environment Facility
GMO	Genetically Modified Organism
GoP	Government of Pakistan
GTZ	German Agency for Technical Co-operation
HEJ	Hussain Ebrahim Jamal Research Institute of Chemistry, Karachi
HFIP	Houbara Foundation International Pakistan
IAEA	International Atomic Energy Agency
IARC	International Agricultural Research Council
IBPGRI	International Biotechnology and Plant Genetic Resources Institute
IPM	Integrated Pest Management
IPR	Intellectual Property Rights
IUCN	The World Conservation Union
LEAD	Leadership for Environment and Development
LES	Livestock Experiment Station

MAF	Million Acre Feet
MELGRD	Ministry of Environment, Local Government, and Rural Development
MNVD	Main Nara Valley Drain
NARC	National Agricultural Research Centre
NCCW	National Council for the Conservation of Wildlife
NCS	National Conservation Strategy
NIAB:	Nuclear Institute of Agriculture and Biology
NIBGE	National Institute for Biotechnology and Genetic Engineering
NIH	National Institute of Health
NORAD	The Norwegian Agency for Development Co-operation
NWMC	National Wetland Management Committee
NWFP	North Western Frontier Province
OECD	Organisation for Economic Co-operation and Development
PAAS	Pakistan Association of Advancement of Science
PAEC	Pakistan Atomic Energy Commission
PARC	Pakistan Agricultural Research Council
PCDP	Palas Conservation Development Project
PCSIR	Pakistan Council for Scientific and Industrial Research
PFI	Pakistan Forest Institute, Peshawar
PFRI	Punjab Forestry Research Institute, Gatwala Faisalabad
PGRI	Plant Genetic Resources Institute, Islamabad
PIC	Prior Informed Consent
PINSTECH	Pakistan Institute of Nuclear Science and Technology, Islamabad
PMNH	Pakistan Museum of Natural History
PSF	Pakistan science Foundation
QAU	Quaid-e-Azam University, Islamabad
RBOD	Right Bank Out fall Drain
SBSTTA	Subsidiary Body on Scientific Technical and Technological Advice
SPVC	Sindh Poultry Vaccine Centre, Karachi
TDA	Thall Development Authority
TRIPS	Trade Related Intellectual Property Rights
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organisation
UPOV	International Union for the Protection of New Varieties of Plants
VRI	Veterinary Research Institute, Lahore
WFP	World Food Programme
WHC	World Heritage Convention
WWF	World Wide Fund for Nature

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Pakistan Fact Sheet

<i>Facts</i>	<i>Figures</i>
Total Population	132 million
Annual population growth rate (1997-2015)	2.4 %
Urban population (as % of total)	35.4 %
Total Fertility Rate (1998)	5.0
Literacy Rate—people of 15 years and above (1998)	
Male	58%
Female	29%
Population with access to safe water (% of urban population (1997))	77%
Population with access to health services (% of urban population (1997))	15 %
Population with access to sanitation (% of urban population (1997))	53 %
GDP (1998)	USD 40,010,000,000
GDP: Average annual rate of change (1998)	3.3 %
GNP (1998)	USD 61,451,000,000
Water use (% of total resources (1998))	61 %
Deforestation (% change 1990-1995) (1997)	2.9%

Source: World Development Indicators 2000, World Bank website.

Executive Summary

As a signatory to the Convention on Biological Diversity (CBD), Pakistan is required to submit an annual national report on the status, trends and the threats to the country's rich biological resources. This is the first report to be submitted by the Government of Pakistan (GoP). For this, report a small grant of PAK RS. 450,000 was granted by GEF/UNEP, and the task of preparing it was awarded to LEAD-Pakistan, an NGO that trains mid-career professionals in the fields of environment, leadership and sustainable development.

Biodiversity is ineffectively safeguarded in the existing legislation of the country and is often a secondary topic of discussion in the development sector. It is also felt that the concept is poorly understood, even by those organisations that are directly concerned with its issues. However, the 1992 Rio Summit and the ratification of the CBD have sensitised the GoP to this important and neglected sector. The authors of this document feel that the process that led to the compilation of this report has trained many organisations and individuals on the many issues covered by the CBD.

Pakistan has wide geographic variations, which house a number of distinct ecological zones. Thousands of years of natural resource exploitation by human activity have led to widely modified natural habitats. The 35.4% urbanisation, 2.4% annual population growth rate and changed land use Practices are the causes of this modification. Loss of natural habitats has undergone significant acceleration in recent decades. However, adequate attempts have not been made, so far, to prepare a comprehensive and systematic list of threatened flora, fauna or ecosystems in the country.

Threats to Pakistan's Biodiversity are well understood. They include: habitat loss, industrial pollution, invasive species, the growing demand for natural resources and the lack of adequate training on the subject of Biodiversity. Most of these threats are directly related to an increasing human population. In addition, no systematic work has been carried out on the status and threats to ecosystems, and the effects of global climate change are poorly understood.

Traditional medicines in Pakistan use about 400 plant species. About 85% of these species are collected from the wild while the rest are cultivated. Data on medicinal plants in the wild is scant. The provincial forest departments do auction the rights to collect medicinal plants, but quantities collected are not recorded. The most threatened ecosystems in Pakistan, containing medicinal and aromatic plants, are the temperate Himalayan forests in the upland areas.

Managing an ecosystem holistically by employing conservation policies that include wildlife and forests is unpractised in Pakistan. Hence, wildlife and forests are managed in isolation. The forest management plans of the country reflect the global debate of sustainable forestry against the traditional management. Sustainable forestry is not discussed and forest management plans mainly deal with the sustainable yield of timber and firewood. In the last century, some of Pakistan's natural forests were declared reserve forests by the government and resultantly have been major harbingers of Biodiversity. Unfortunately, the pressures of human population and ineffectual forest management Practices threaten these protected areas. Forest Biodiversity is affected negatively by the introduced exotic species. However, some good initiatives have been taken by forestry departments, which includes the sharing of the forest resources with the local communities and their inclusion in the management of forests. With the financial and technical assistance of the government and Non-Governmental Organisations (NGOs), a number of environmental conservation projects have been implemented and others are to follow. The signs are encouraging.

Until the 1970s, the protection of wildlife came under the then broader mandate of forestry. When legislation for wildlife was drafted, provincial wildlife departments were set up and the two topics were separated. Wildlife management in Pakistan was previously concerned only with game species. However, with the growing realisation that all wild vertebrates possess important values, the scope of wildlife management has been broadened to include predators, songbirds, furbearers and vertebrate pests. Unfortunately though, as wildlife habitat is severely degraded, wildlife populations have suffered significantly. A large number of animals are now on the verge of extinction and fall under various categories of threatened species. However, little research has been done on Pakistan's wildlife and the information on most species is sketchy. Major threats to wild animals include competition with domestic livestock for forage, infrastructure development, and hunting.

Large water bodies in the country support a variety of waterfowl that are both resident and migratory. The extent of wetlands is constantly changing due to the draining of swamps and marshes for cultivation and the creation of new dams for irrigation purposes. Canal irrigation through seepage has also contributed towards increasing land area underwater in the form of water logging. Such areas support a great number of waterfowl, by providing them with an excellent habitat.

Pakistan's coastline of 1,050 km consists of a variety of habitat types, supporting a wide range of animals, of which over 1000 is fish species. Pakistan's marine flora and fauna have not been studied extensively. Hence, detailed information on these species is deficient.

Pakistan's freshwater resources are dominated by the Indus River system, which drains into the Arabian Sea through the Indus Delta. Studies on fauna have identified resident fish and their natural distribution. Indiscriminate and over-fishing is a real threat to Pakistan's native fish of commercial value. Pakistan's fisheries policy deals only with aqua-culture, fishing licenses and auctions of fishing rights, although the rules do cater for the preservation of undersize fish for commercial purposes. The conservation of indigenous species or habitats is not an issue in fisheries policies and laws. Important aquatic mammals like the threatened Indus dolphin are not mentioned in the fisheries laws. Although the Indus dolphin is protected under the Wildlife Act, the fisheries departments regulate fishing in the Indus. The isolation of concerned legislation and government departments is a major threat to the welfare of such species special concern.

Most of Pakistan's population, directly or indirectly, depends on agriculture. The introduction of modern, intensive farming systems, using imported hybrid seed varieties and modern technology has resulted in a situation that could lead to the loss of Pakistan's Biodiversity. These systems are resulting in the replacement of native crops by high-yielding imported varieties, particularly local varieties of vegetables. Presently, no legislation provides protection to indigenous plants. By establishing repositories of clones of agricultural crops, progress has been made at the National Agriculture Research Centre, Islamabad. Livestock research focuses on maximising meat and milk production through cross breeding. Apart from cows, local livestock breeds are not under any immediate threat. The conservation of local breeds however has not been addressed yet. These issues were highlighted when research was being conducted for this first CBD report and it is hoped that accordingly they will be addressed.

Biotechnology is an emerging field that has not yet been fully institutionalised in Pakistan. Efforts are underway to mainstream this discipline into the agricultural and livestock sectors of the country. Pakistan is conscious of the threats of the unregulated spread of genetic material and research. A National Biosafety Committee has therefore been established at the MELGRD, which is responsible for the development of biosafety guidelines.

The fair and equitable sharing of benefits of biological resources, issues of traditional knowledge and indigenous people are important components of the CBD. Despite, earlier legislation providing some forests rights to local communities, a policy statement on the rights

of the traditional people and the sharing of income from natural biological resources does not exist. Pakistan's biological resources are used for economic gains by the government and little benefits accrue to the local community directly. However, projects have been implemented to promote the concepts of community participation and joint management of natural resources. These aim to mobilise the local population to conserve and improve access to biological resources. A review of the existing laws dealing with biological resources, like the Forest Act of 1927, reveals the issue of equitable benefit sharing as perceived by the government. The clash in the perceptions on the usage of natural resources can be highlighted in four cases. These are the *Haqdari* Rights in the Murree hills, forest legislation in Hazara, land rights in the scrub forests of the Salt Range and the Cholistan desert. Hence, the BAP recommends that apart from the government, NGOs as well as local communities should be involved in the management of biological resources. Attention needs to be paid to the issues of sharing benefits. Traditional knowledge needs to be applied wisely, particularly as traditional activities such as hunting urial, killing bears for medicine, unrestricted tree cutting and free grazing have become illegal. Consequently, these have now become a source of conflict between the authorities and the local communities.

The land that now comprises Pakistan has always had a peculiar attraction to invaders from outside. The Central Asian, Turkish, Afghan, Arab, Persian and British invaders not only conquered this land but also lived here for long periods, thus influencing the social culture. They also brought exotic plants and animals that today are fully adapted to and part of the ecosystem. Examples of introductions are the fruit trees by the Mughals, trout by the British, and horses and dates by the Arabs. During the last century, certain plants were imported for their economic value and ability to tolerate arid conditions. Examples include the eucalyptus and mesquite. While debate on the merits of Eucalypti is still inconclusive, mesquite is acknowledged as an invasive weed. Another example is the uncalculated introduction of species into isolated ecosystems e.g. the feral cats in the islands off the Arabian Sea in Balochistan. The fishermen introduced these cats to kill rodents to stop them from destroying the fishing nets. Contrarily, these cats have been destroying the migratory birds' nests and consequently the number of wintering birds has decreased. Eucalyptus is widely grown on farmlands, public forests, linear strips, village surroundings and grazing lands. However, it is known to compete with the local flora for nutrients and outpaces all other species in drawing water from deeper soils.

The development of a core set of indicators is essential to monitor the changes and trends in Biodiversity. Baselines to monitor changes are essential. However, agreement has to be made on whether baselines are to be set at the time of pre industrialisation, the signing of the CBD or at a century ago. Information is available on the status of major ecosystems, as they were a century ago, in district gazetteers prepared by the British during their rule. Some preliminary work on the development of indicators of sustainable development, including Biodiversity has been done by the MELGRD. This is focused on socio-economic, ecological, and sustainable development indicators.

Pakistan has responded fully to most Biodiversity related international conventions such as: The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), The RAMSAR Convention, The Convention on World Heritage, and The Convention to Combat Desertification (CCD), etc. Unfortunately, Pakistan's capacity to enforce and comply with these conventions at the local, national and international levels is inadequate. The required efforts to implement these have not been fully harnessed due to institutional, legal and financial constraints. There is also a strong need to revise national laws, rules and regulations to compliment international obligations. Although the MELGRD is making efforts to implement, the CBD, Pakistan needs to do much more. The poor progress so far can be attributed to inadequate resources and trained work force in the field of Biodiversity, and this was felt strongly during the process of the preparation of this report.

1. Preparation of this Report

This report has been compiled and analysed through an extensive consultative process, involving eleven core experts and technical input from various other individuals and organisations. LEAD-Pakistan provided its office, equipment, Internet facilities and one of its Fellows, who co-ordinated this project. Most of the contributions in the shape of case studies were obtained from LEAD Fellows. Without the input of LEAD-Pakistan, a project of this magnitude could not have been possible in the limited budget and time. Resource persons and vital information was supplied by the MELGRD, through a series of meetings. The information contained in this report has been correlated using the following steps:

- Step I: CBD and UNEP guidelines were downloaded from the Internet and analysed by the principal author at LEAD-Pakistan. Terms of Reference (TORs) were developed and sent to 11 sector experts in fields related to Biodiversity.
- Step II: These sector papers were analysed at LEAD-Pakistan in the light of the guidelines and improved through a number of meetings with all the stakeholders such as LEAD-Pakistan, MELGRD and the experts involved in the drafting of this report.
- Step III: Related experts, mostly LEAD-Pakistan Fellows, were contacted for the preparation of case studies. Concerned organisations were also contacted in this regard.
- Step IV: All collected material, expert papers and case studies were compiled at LEAD to form the National Country Report.
- Step V: A seminar was organised by the MELGRD to analyse and review the contributions made to the report.
- Step VI: The deliberations of the national seminar were incorporated and the report was sent to UNEP for comments. Finally, the comments of UNEP have been incorporated in this report.

A final seminar was held by the MELGRD in collaboration with LEAD-Pakistan in Islamabad. Seventy leading experts, contributors and institutions related to Biodiversity participated. The participants approved the report and gave suggestions for improvement.

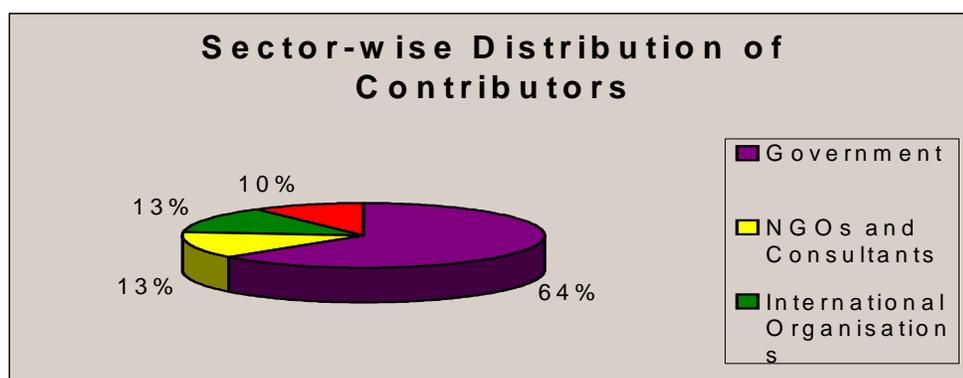
The final report incorporated the decisions of the seminar. The final draft was sent to United Nations Environment Programme (UNEP) and the CBD International Secretariat in Montreal, Canada. This report incorporates the suggestions and comments of these organisations.

Given the very limited financial resources, this task has only been accomplished due to the co-operation of leading experts, the in-house capacity of LEAD-Pakistan and government agencies dealing with the diverse issue of Biodiversity. The subject of Biodiversity is a fundamental subject in the LEAD curriculum. The process of this report has triggered much thinking amongst the country's scientific community. This is on the gaps in the country's commitments to the CBD. This report covers the status, trends and threats of Biodiversity, while the Biodiversity Action Plan (BAP) outlines the strategy on what should be done and how. This report should not be considered as a substitute to the BAP. Efforts have been made not to repeat what is already available in the BAP.

The Core Experts

This report has been prepared using contributions from 11 core experts as given in Appendix H. Syed Mahmood Nasir, Fellow, LEAD-Pakistan, Cohort 5, worked as the co-ordinator and principal author. Individual contributors are mentioned in **Appendix H**. In addition, **Figure 1.1** shows a sector-wise breakdown of the contributors.

Figure 1.1 Sector-wise Distribution of Contributors



1.1 Background

1.1.1 What is Biodiversity?

Biodiversity or biological diversity is defined as:

"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 (CBD 1992)."

Biodiversity is recognised at three levels: the gene, the species and the ecosystem levels. Biodiversity refers to the variety of life on earth. Estimates of the total number of species in the world range from 2 to 100 million. It is estimated that only 1.5 million species have actually been studied.

This report has been prepared to fulfil Pakistan's obligation as a Party to the CBD under Article 26 of the Convention, which states that:

"Each contracting party shall, at intervals to be determined by the Conference of the Parties, present to the Conference of the Parties, reports on measures which it has taken for the implementation of the provisions of this Convention and their effectiveness in meeting the objectives of this Convention."

The second Conference of the Parties (COP) to the Convention, held in November 1995, decided that, "The first national reports by Parties will focus in so far as possible on the measures taken for the implementation of Article 6 of the Convention, General Measures for Conservation and Sustainable Use, as well as the information available in national country studies on biological diversity, using as a guide the annex to this decision."

This report provides a general description of the components of biological diversity in Pakistan, including descriptions of different habitat types, their present condition, important plants and animals, their status, and major threats to these habitats and species. The report also presents an overview of the various strategies, policies, legislation, programmes, and projects initiated before, and as a result of, the signing of the Convention.

1.1.2 The Convention on Biological Diversity

The Convention on Biological Diversity was opened for signature on 5 June 1992 during the United Nations Conference on Environment and Development (UNCED) held in Rio de Janeiro. The Convention entered force on its thirtieth ratification on 29 December 1993. Since then, it has received 176 signatures and 159 ratification. In 1994, the United Nations General Assembly declared 29 December as the International Day for Biological Diversity. The Convention on Biological Diversity was signed by Pakistan on 5 June 1992, and was ratified by the Cabinet on July 26 1994. Through the Convention, Pakistan and other signatory countries are involved in an international partnership to help halt the global loss of biological diversity. The Convention addresses biological diversity at the genetic and ecosystem level, and provides a framework for its conservation and sustainable use.

The overall objectives of the Convention are the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the utilisation of genetic resources.

The Convention was developed in recognition of the environmental, social, cultural and economic value of biological diversity, both now and in the future, and its significant on-going reduction around the world.

1.1.3 Pakistan's Obligations

As a Party to the Convention, Pakistan is obliged to the following general commitments:

- Take general measures for the conservation and sustainable use of biological diversity;
- Identify and monitor components of biological diversity, and activities that have an adverse affect on biological diversity;
- Adopt measures for in-situ conservation, including a system of protected areas, the restoration and rehabilitation of degraded areas, and the development of legislation and other regulatory provisions for the protection of threatened species and their populations;
- Adopt measures for ex-situ conservation, including research on plants, animals, and micro-organisms, and measures for the rehabilitation and reintroduction of threatened species;
- Integrate the consideration of sustainable use of the components of biological diversity into national decision making;

- Adopt measures that act as incentives for the conservation and sustainable use of biological diversity;
- Establish and maintain programmes for scientific and technical education and training in measures for biological diversity conservation. Promote and encourage research and training that contributes to biological diversity conservation;
- Promote understanding of the importance of, and the measures required for, the conservation of biological diversity;
- Ensure environmental impact assessment of projects likely to adversely affect biological diversity with a view to avoiding or minimising adverse impacts;
- Endeavour to facilitate access to genetic resources for environmentally sound measures;
- Facilitate access of other Contracting Parties to technologies relevant to the conservation and sustainable use of biological diversity;
- Facilitate the exchange of information relevant to the conservation and sustainable use of biological diversity;
- Promote international, technical, and scientific co-operation in the field of conservation and the sustainable use of biological diversity;
- Take measures to provide for participation in technical and scientific co-operation;
- Provide financial support and incentives for activities that are intended to achieve the objectives of this convention.

The preparation of the Biodiversity Action Plan by the MELGRD has been the first major step towards the implementation of the CBD. The progress on the COP decisions, the development of indicators of Biodiversity, the clearinghouse Mechanism (CHM), the financial mechanism, Biodiversity related legislation, policies, and the institutional arrangements are discussed in the following sections.

1.1.4 The Biodiversity Action Plan

Pakistan's Biodiversity Action Plan (BAP) provides a brief overview of the status and trends of the nation's Biodiversity. It outlines strategic goals and objectives and proposes a plan of action for the implementation of CBD objectives. Moreover, it discusses the co-ordination arrangements and implementation measures.

The BAP provides a strategy for action on the 13 main components of the CBD, which correspond to the articles of the Convention. For each component, issues relevant to Pakistan have been outlined, and corresponding actions are proposed. A period of one, five and ten years are provided for meeting immediate, short, and long-term goals respectively.

The plan calls for greater collaboration between government agencies, local communities and NGOs to work together as partners in Biodiversity conservation. The overall responsibility for the implementation of the BAP will fall on the MELGRD, which is also the national focal point for the implementation of the CBD.

The BAP has been approved by the government of Pakistan (GOP) and the initial steps for its implementation are being taken. The plan proposes for the establishment of a Biodiversity Secretariat that would be responsible for the co-ordination and implementation of the BAP with all relevant institutions, NGOs, and other stakeholders.

1.1.5 COP Decisions and Pakistan's Response

Pakistan has participated in all four COP meetings. Actions taken by the Government of Pakistan generally comply with the COP decisions. This first country report describes compliance to decisions relating to biotechnology; identification and monitoring, sustainable use; agricultural Biodiversity; the knowledge, innovation and Practices of indigenous people; the issues of benefit sharing and *in-situ* and *ex-situ* conservation of the components of biological diversity. GOP shares information with the CBD Secretariat on the management of the country's Biodiversity.

1.1.6 Indicators of Biodiversity

The COP and Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) guidelines require the first national report to identify indicators that will be used "... for tracking the results of the [Biodiversity] action plan and for monitoring changes in the economy, environment and society."

Article 7 of the CBD stresses the need for monitoring changes in Biodiversity, which are under threat. It also necessitates the identification of activities that have adverse impacts on the Biodiversity. The national report is also required to contain qualitative and quantitative measures of the effectiveness of implementation of projects concerning Biodiversity. The definitions of Biodiversity indicators, targets and other information tools have also been defined in the CBD guidelines, are reproduced below.

Indicators

Indicators of Biodiversity summarise complex and sometimes conflicting information regarding (i) the state of biological resources; (ii) the pressures on Biodiversity; (iii) the impact of these pressures; and (iv) responses to these pressures. Indicators are determined to document the progress toward a particular objective. The performance of an initiative can be assessed against these usually quantitative measures. However, indicators have their own limitations and associated problems, which need to be considered. Examples are:

- ◆ Macro-scale indicators can be too generalised to detect grassroots changes.
- ◆ Most national-level indicators are country-specific.
- ◆ Cause and effect relationships can be too complex to be determined definitively through indicators.

Targets

Targets are often linked to timetables. These are measurable objectives or concrete milestones. In addition, are set out in a planning process. Targets can be quantitative or qualitative. Meeting targets indicates tangible progress in achieving CBD objectives.

Reference points

This category of indicators includes targets, thresholds and baselines. They provide a means for observing and gauging the significance of change.

Thresholds

Thresholds, or standards, are usually limits that serve as an "early warning " function. Crossing such thresholds generally signals the existence of a problem that requires prompt action.

Baselines

Baselines are particularly important reference points since they serve as a "starting line" for measuring change from a certain date or situation. Given the lack of available data, some baselines may need to be postulated (assumed true). Concerning the CBD, two possible baselines can be considered: (i) the pre-industrial state; and (ii) conditions in 1993 (the year the CBD came into force). The use of such baselines could help sketch "pictures" of change in Biodiversity resulting from anthropogenic impacts.

Statistics

Statistics are static, quantitative measures without reference points.

As a first step to identifying and applying indicators on the different components of Biodiversity, there is a need to agree on where baselines are to be set. Fortunately, quality information on pre-industrial ecosystems, flora and fauna of the country is available from the *District Gazetteers* and *Land Administration Manuals* published by the government of British India. Subsequent data is also available, although most of this information is scattered amongst different organisations. The working plans of the Forest Department also contain documented accounts of the taxonomy of the flora and fauna.

The shortage of an adequate number of taxonomists restricts our capacity to undertake the task of monitoring trends and changes in Biodiversity. However, there are still other options available in this area. SUPARCO, the national space agency, has some capacity to monitor changes in ecosystem diversity by using remote sensing, but does not have Biodiversity research as part of its mandate. Similarly, the Pakistan Forest Institute (PFI) and the National Agricultural Research Centre (NARC) also have some facilities for remote sensing that can be oriented to record ecosystem Biodiversity. Realising these inherent shortcomings in Pakistan's capacity to comply with the CBD obligations, the BAP has suggested the appointment of a national centre (or several provincial centres) to co-ordinate Biodiversity identification and monitoring activities.

To establish an indigenous capacity to measure, assess and report on sustainable development, MELGRD held a national workshop in Islamabad on indicators of sustainable development. This was held in collaboration with the Economic and Social Commission for Asia and the Pacific (ESCAP) in 1998. The workshop identified 77 preliminary indicators; related to economic, socio-cultural, ecological/environmental, institutional and political concerns (**Appendix D**). Out of these listed indicators, only one directly deals with Biodiversity i.e. habitat alteration with protected area as a percentage of total land area. The rate of deforestation and the short-run sustained yield/ actual harvest were identified as indicators for forests. No further follow-up action has been done neither is there any institutional arrangement for the purpose.

1.1.7 Clearing House Mechanism

The first meeting of the COP established the clearinghouse Mechanism (CHM). It encourages parties to develop a national capacity for the exchange and dissemination of information on the experiences and lessons gained by the parties in the implementation of the Convention. This mechanism has multiple partners and provides information to all concerned. MELGRD is in the process to establish a CHM, the first meeting/workshop will be held in the MELGRD to assess the needs, identify the institutional framework and evaluate the various options for the establishment of a CHM. As a first step, LEAD-Pakistan placed the CBD report on its website to make it accessible by all interested parties. Comments received were forwarded to the project co-ordinator of this report.

1.1.8 Financial Mechanisms

Pakistan has so far paid USD 22,701 as its membership contribution to the CBD Secretariat. The GEF provided funds for the three-year project, "Maintaining Biodiversity in Pakistan through Rural Community Development," which ended in April 1999. The second phase of this project has commenced with UNDP funding of USD 10.36 million for the Mountain Area Conservation Project (MACP). GEF has also provided USD 10.47 million for the Protected Areas Management project. UNEP has committed USD 0.1 million for a biosafety capacity-building project.

1.1.9 Biodiversity Related Legislation

Like other parts of the world, Biodiversity was given importance only in the early nineties in Pakistan, after the Rio Summit, which highlighted the need to preserve Biodiversity. Consequently, policy or legislation was made that deal directly with this subject. A review of the existing legislation on land, water, soil, air, forests, oceans, etc. reveals that the issues and legislation addressed by the CBD have been undertaken. However, many issues of Biodiversity in this legislation are contrary to the provisions of the conservation, sustainable use and equitable benefit sharing of biological resources. Standards for industrial effluents are not fixed keeping in mind the diverse ecosystems of Pakistan. The forest and tree cutting acts given in **Table 1.1** also focus on the conservation of certain species of economic value (also see Chapter 4 on forest Biodiversity). Wildlife legislation also has been made in isolation from the forest legislation, and that too focuses on game species rather than the whole ecosystem. Even the implementation mechanism for forest and Biodiversity are not effectively co-ordinated in all the provinces. The quarantine laws aim at restricting the import and export of diseases through biological material and not through invasive species or genetically modified organisms. The fisheries legislation given in **Table 1.1** again focuses only on revenues for the state from marketable fish, and not on the aquatic ecosystem including plants and non-fish animals.

Table 1.1: Biodiversity Related Legislation and the Departments/Agencies Responsible for Implementation

General	Executing agency/ department
Environmental Protection Ordinance (1983)	Federal and Provincial EPAs
The Environmental Protection Act (1997)	-do-
The Balochistan, NWFP, Punjab, and Sindh Local Government Ordinance(s) (1979/80)	Provincial local government and rural development departments
Land	
The Punjab Tenancy Act (1887)	Board of Revenue through the district magistrate
The Punjab Land Revenue Act (1887)	-do-
The Sindh Land Revenue Code (Bombay Act 1879)	-do-
Punjab Laws Act (1872)	-do-

Punjab Alienation of Land Act (1913)	-do-
Chos Act (1900)	-do-
The Punjab Pre-emption Act (1913)	-do-
Thall Development Act (1949)	-do-
West Pakistan Land Revenue Act (1967)	-do-
Plant and Forest	
The Cattle Trespass Act (1876)	District magistrates
The Punjab Forest Act (1913)	Forest Department
The Forests Act (1927)	Forest departments of Punjab, NWFP and Balochistan
The NWFP Hazara Forest Act (1936)	Forest Department, NWFP
The Kohat Mazri Control Act (1954)	-do-
The Punjab Plantation and Maintenance of Trees Act (1974)	Forest department, Punjab
The Cutting of Trees Act (1975)	-do-
The NWFP Management of Protected Forests Rules (1975)	Forest department NWFP
The Pakistan Plant Quarantine Act (1976)	Department of Plant Protection GoP
The NWFP Forest Development Corporation Ordinance (1980)	Forest Department, NWFP
Wildlife	
The Sindh Wildlife Protection Ordinance (1972) and Rules (1972)	Wildlife Department, Sindh
The Punjab Wildlife Act (1974) and Rules (1974)	Wildlife Department, Punjab
The Balochistan Wildlife Protection Act (1974) and Rules (1975)	Wildlife Department, Balochistan
The NWFP Wildlife Act (1975) and Rules (1976)	Wildlife Department, NWFP
Islamabad Wildlife Ordinance (1979/80)	Capital Development Authority
Insect Biodiversity	
The West Pakistan Agricultural Pests	Provincial Agricultural Department(s)

Ordinance (1959) and Rules (1960)	
Aquatic Biodiversity	
The West Pakistan Fisheries Ordinance (1961)	Provincial Fisheries Department(s)
Balochistan Sea Fisheries Ordinance (1970) and Rules (1971)	Fisheries Department, Balochistan
The NWFP Fisheries Rules (1976)	Fisheries department, NWFP
Territorial Waters and Maritime Zones Act (1976)	Maritime Security Agency (MINFAL, GoP)
Agriculture and Livestock	
The Prevention of Cruelty to Animals Act 1890 & West Pakistan Prevention of Cruelty to Animals Rules, 1959	Livestock departments
The Glanders and Farcy Act, 1899	Livestock departments
The Dourine Act 1910	Do
The Agriculture Produce Grading and Market Act 1937	Do
West Pakistan South African Horse Sickness Rules, 1959	Do
West Pakistan Union Council (Slaughter House) Rules 1961	Do
The West Pakistan Goats Restriction Ordinance (1959) & West Pakistan Goats Restriction Rules, 1961	Provincial Departments
The Punjab Animals Compound Feeding Stuff Act 1974	Do
Punjab Livestock, Dairy and Poultry Development Board Act 1974	Do
Punjab Meat Control Order 1978	Do
West Pakistan Animals Slaughter Control Act 1963	Do
Pakistan Animal Quarantine Act (1985)	Animal Quarantine Department (GoP)

The diverse research institutes and organisations involved in research (Biodiversity not being the major focus) are given in **Appendix C**. While the projects are given in **Appendix G**. Biodiversity research is scattered in different provincial and federal research institutes. Although quality work is done, there is a lack of co-ordination, and paucity of research funds.

1.1.10 Biodiversity Related Strategies, Policies and Plans

The National Conservation Strategy (NCS), the Forestry Sector Master Plan (FSMP), BAP and the Forest Working Plans¹ **Table 1.2** deal with Biodiversity-related strategies and policies. Although these deal with Biodiversity conservation, the issues were poorly understood at the time these policies and strategies were made. The NCS deals with Biodiversity as a discipline that is a component of various subjects like wildlife, forestry and agriculture. Moreover, Biodiversity has been tackled in a non-integrated way that clearly shows lack of conceptual clarity. The forest working plans are prepared in isolation of wildlife planning or laws and have a specific objective of providing a sustainable yield of wood. Sustainable forestry and Biodiversity has not been debated in the ministries of the federal or provincial departments that deal with forestry. However, the BAP is the first comprehensive attempt by Pakistan on contemporary issues of the CBD.

Table 1.2 List of the Biodiversity Related Strategies, Policies and Plans

• The Pakistan National Conservation Strategy	1992
• The Forestry Sector Master Plan	1985
• The Biodiversity Action Plan	1998
• Forest Working Plans of all the forest divisions In the provinces	-----

The processes that led to the preparation of the legislation and policies are complicated and give little weight to Biodiversity. The implementation by the ministries and departments concerned with these policies is also not well co-ordinated.

1.1.11 Institutional Co-ordination

MELGRD is the focal point for national Biodiversity concerns. Within the MELGRD the Director General, Environment, assisted by a Deputy Secretary and a Section Officer deal with all issues related to the CBD. The policies and programmes of the following federal ministries are crucial to the conservation and sustainable use of biological resources:

- Food and agriculture
- Finance
- Science and technology

The following provincial departments are also involved:

- Agriculture
- Livestock
- Forestry
- Wildlife
- Tourism

¹ *Forest Working Plans* are legally binding management plans that are prepared by provincial forestry departments; these are normally for ten to twenty years. The plans concentrate on the sustainable yield of timber and not on sustainable forestry. (See also Chapter 4 for details)

- Fisheries

MELGRD co-ordinates all the above mentioned concerned ministries and departments through various committees within the ministry. For technical guidance on Biodiversity and related issues a Biodiversity Working Group has been established within the MELGRD, all relevant government departments/ agencies, research institutions and NGOs are represented in this group.

The office of the IGF (Inspector General of Forests) within the MELGRD looks after all policy co-ordination, research and education related to forestry, rangelands and wildlife. Although the concepts of forest biological diversity and the ecosystem approach have not yet been institutionalised. This report is expected to give a fillip to this process. The provincial forest and wildlife departments have a separate hierarchy of officers who have no institutional arrangements for co-ordinated implementation of projects. The NCCW (National Council for the Conservation of Wildlife) is responsible for the formulation and co-ordination of wildlife policies under the MELGRD. The Zoological Survey Department conducts wildlife surveys at the federal level. The Pakistan Forest Institute (PFI) is the primary forestry education and research institute though forestry is also taught as a major subject in the Agriculture University, Faisalabad, and forestry research is conducted at the Punjab Forestry Research Institute, Faisalabad (PFRI). A list of research organisations is given in **Appendix C**.

NGOs like the WWF-Pakistan, IUCN-Pakistan and the Houbara Foundation are involved in conservation and sustainable use projects as detailed in Chapters 3 and 4 of this report and listed in **Appendix G**.

2. Pakistan's Ecological Zones

This section describes Pakistan's main ecological zones, habitat types, and plant species of particular importance. The major threats to Pakistan's plant Biodiversity and these habitats are listed. Actions that have been taken or are proposed for plant Biodiversity conservation are described.

2.1 Introduction

Pakistan is situated at the western end of the South Asian subcontinent. Its flora and fauna have the characteristics of both Palaeartic and Indo-Malayan elements. Climatically, Pakistan is largely arid and semi-arid. However, there are wide geographic, altitudinal, and physiographic variations, from the tropical coast in the south to the high mountains in the north, with altitudinal variation from sea level to about 8000 meters. Annual rainfall ranges from less than 50 mm in arid and semi-arid areas to 2000 mm in moist areas of the Himalayas. The temperature (influenced by the altitude) ranges from below freezing levels in the northern mountains during winter months, to 35-50°C during the summer in the central plains. Based on these variations across the country, a number of distinct ecological zones and habitat types have been classified, although not according to any recognised system of classification. In this regard, Roberts (1977) divided the whole country into 9 major zones, covering eighteen habitat types.

Pakistan is a land of some of the oldest civilisations in the world. Its Practices in the use of natural resources are thousands of years old. Natural habitats have been widely modified by human activities and very few natural forests remain unaltered. The degradation and loss of natural habitats has occurred for thousands of years, but the process has been accelerated in the last few decades due to rapid development activities and population expansion. Recently, with the development of the canal system, an extensive area in the Indus plains has come under the cultivation of agricultural crops after the clearing of forests (including the riverine forests of Punjab and Sindh).

Despite the large-scale modification of natural habitats, many Biodiversity-rich ecosystems are still found. These are described in the following sections.

2.1 Ecosystems of Special Biodiversity Significance

2.1.1 Balochistan Juniper Forests

Balochistan's forests are one of the most extensive and oldest juniper ecosystems of the world. These provide habitats to many unique birds, mammals and species of plants that have a very restricted range of distribution. This extensive open woodland is spread between 2100-3000m. At higher elevations the trees have become stunted and dwarfed and form large prostrate patches on rocks, especially on wind exposed slopes in the Ziarat, Zarghun and Harboi Ranges. Generally, above 2800m juniper trees become more sparse and are gradually replaced by curious hedgehog-like dwarf shrubs.

The main species-*Juniperus excelsa* subspecies *polycarpus*, is a very slow-growing species. Some trees are thousands of years old and suffer from ageing, parasite disease, and impacts of climate change, heavy grazing and deforestation. Several species found in the juniper tract are endemic to Balochistan or extend their distribution to neighbouring areas of Afghanistan

and Iran. The species' restricted range of distribution increases the importance of this ecosystem, making these mountains centres of endemism in the region. Some of these endemic species associated with juniper forests include *Berchemia pakistanica*, *Amygdalus brahuica*, *Cotoneaster afghanica*, *Cotoneaster rechingeri*, *Cerasus rechingeri*, *Spirea brahuica*, *Aitchisonia rosea*, *Gaillonia afghanica*, *G. macrantha*, etc.

Juniper forests include some of the oldest trees of the country. Unfortunately, this national heritage is facing threat from a parasitic disease caused by a small plant - the dwarf mistletoe (*Arceuthobium oxycederi*). This parasite is expanding in the Ziarat juniper tract and it needs immediate attention to protect the ecosystem, which is providing habitat to several endemic species of shrubs and herbs in the forest under growth. **Box 1** gives an account of the status of conservation of the juniper forests.

Box 1: The Juniper Forests of Balochistan²

The juniper forests of Balochistan are among the few representative examples of this species in the world. These forests grow on calcareous soil between 2500 and 3000m in dry cold climates with only 200-300mm rainfall per annum. This makes it a unique ecosystem. Juniper is an extremely slow-growing species and attains only one-inch diameter growth and one cft in 50 years. Ziarat, Zarghoon and Harboi are the best examples of pure juniper stands in Balochistan. The scarcity of water in and around the juniper tract has increased the importance of this species, as it plays a significant role in protecting the land from wind and water erosion. The Biodiversity Action Plan (BAP) of Pakistan describes this important ecosystem as critically threatened and strongly recommends immediate measures to protect and conserve this natural heritage. Overexploitation, changes in land use practices, disease attacks and low germination rates are a few of the major threats to this important species. In Zarghoon Valley alone, 3900 kg of juniper wood is cut down annually for domestic use. The lack of substitute fuel wood or other energy resources is a very big threat to the existence of these forests. If the existing growth rate of the population and juniper forests is assumed mutually compensatory, then the existing reserve stock will suffice for only a few more decades. The dwarf mistletoe (*Arceuthobium oxycedri*) is a serious parasite that is carried and spread via birds, the mistle thrush, and wind. This parasite badly effects the host tree (juniper), resulting in the trees drying, poor growth and retarded seed development. The Pakistan Forest Institute, Peshawar, and the Forest Department of Balochistan to overcome this problem have undertaken a number of efforts. Due to their landscape, physical structure, geological formations, petrified forests and natural water sources, juniper forests have great a potential to attract tourists in other areas besides Ziarat. Properly managed ecotourism in these ecosystems can be an effective means to educate and create awareness among the public and tourists about the importance of this unique species. It can also generate income for the locals, which will ultimately reduce the pressure on these natural resources. The Forest Department is executing an extensive project under the Balochistan Natural Resource Management Project (BNRMP) for the improvement of this unique ecosystem. WWF-Pakistan is also working with the custodian communities to protect this natural heritage. The first phase of this project has been successfully completed in Rodmalazai juniper tract. The second phase is under implementation in the Ziarat juniper ecosystem.

2.1.2 Chilghoza Forests

Chilghoza pine (*Pinus gerardiana*) form forests in the dry northern mountains of the country. It is not widespread. Large-scale deforestation of these forests has already occurred in certain parts of the Northern Areas.

The Chilghoza pines of the Sulaiman range of Balochistan form a unique ecosystem, providing a habitat to endemic mammals like the Sulaiman Markhor, as well as endemic species of plants. On higher elevations, *Juniperus excelsa* subspecies *polycarpus* is the other associated species.

² Case Study prepared by Tahir Rashid Fellow LEAD-Pakistan

2.1.3 Balochistan Subtropical Forests

Most of the land of Balochistan is arid and does not support the growth of large forests. Subtropical broadleaf forests mainly composed of wild pistachio and ash species have very small and scattered populations. Wild pistachio trees (*Pistacia atlantica* subspecies *cabulica* and *Pistacia khinjuk*), a more commonly grown species, is scattered at intervals on lower slopes of hills or along dry watercourses. In some places, it grows gregariously with wild ash (*Fraxinus xanthoxyloides*) forming small patches with open forest in dry watercourses. These receive water during the rainy season. Such examples can be seen near Quetta in Hazarganji-Chiltan National Park and near Zhob. They never form close canopy forests and the under growth is similar to surrounding areas without trees.

In Balochistan, this forest type appears to have been greatly affected by man and his domestic livestock. These open woodlands are located in the northern part of this province, which experiences extremely cold temperatures in winter. Located at the valley bottom, it is easily approachable and subjected to lopping for fuel and fodder. These trees have adapted to frequent natural and human disturbances, and hence have the ability of sprouting after cutting and lopping. In 1994, examples of such drastic cutting were observed in Hazarganji-Chiltan National Park's pistachio and ash woodlands where trees recovered in three years.

These woodlands are severely fragmented and have been reduced to small patches due to the interference of man and nature. In several areas, especially between Loralai and Harnai, the trees appear stunted due to overexploitation. Although these species show a remarkable ability to recover after disturbance and they grow relatively faster than other introduced species, the structure and composition of these forests still has been greatly modified by man throughout the centuries. There are only few remnant representative examples in the province and a detailed inventory of these forest communities is not available. It will be difficult to assess the benefits and losses associated with these communities.

2.1.4 Sub-Tropical Deciduous Forests

The salt range and foothills of the Himalayas support sub-tropical deciduous forests. Himalayan foothill sub-tropical forests are the only habitats for Indo-Malayan elements forming multistoried forests with high species diversity. Some typical examples of such forests can be observed in the Margalla Hills, and the Lehtrar, Panjar and Karot Valleys. These forests are formed by tall trees like *Kydia calycina*, *Pistacia integririma*, *Bombax ceiba*, *Albizia lebbek* *Terminalia belerica*. These are mixed with small and medium-sized trees (e.g. *Acacia catechu*, *Mallotus philipensis*, *Lannea coromandelica*, etc). A large variety of low-growing shrubs, herbs and climbers are also found.

These forests are suffering from land clearing for urban and agricultural expansion, heavy grazing and an increasing demand for fuel wood. The species *Holarrhena pubescens* is known to be extinct in Pakistan, but has been reported in the Margalla Hills subtropical forests. Some rare species associated with these Himalayan subtropical forests include *Pittosporum nepaulense* var *rawalpindiense*, *Engelhardtia colebrookkiana*, *Ficus semicordata* and some orchid species such as *Nervilia gammieana*, *Pecteilis gigantea*, *Eulophia graminea* etc.

Vast amounts of sub-tropical forest have been cut down in the lower Swat Valley, with only small patches of the original vegetation remaining on steep slopes or around graveyards (R.R. Stewart, 1967). Extensive plantations of exotic species like *Eucalyptus spp.* is a growing threat to the natural, indigenous species of flora and fauna

2.1.5 Himalayan Dry and Moist Temperate Forests

Himalayan dry and moist temperate forests are the only tall tree forests and are confined to the high altitudes of the Himalayas and Hindukush Ranges and parts of the Karakorum

Range. According to studies in the Kaghan Valley, potential forest area has declined approximately 50% and major structural changes in forests have occurred in more populated areas (Schickoff 1995). In the Siren Valley, the forest cover has decreased by 45% between 1979 and 1988 (GTZ report 1990). This information is based upon remote sensing data (Landsat MSS and TM). Research in the Karakoram Valleys gives evidence of dramatically increased logging in the past 20 years after the construction of the Karakoram Highway and subsequent link roads (Schickhoff, 1992, and 1993). According to official estimates, the forests of the Northern Areas will disappear within 30 years if the present rate of logging continues (Government of Pakistan, 1992:10). Allan (1986) and Haigh (1991) reported similar forest losses in the valleys of Swat and Dir.

2.1.6 Trans-Himalayan Plateau

High altitude alpine and sub-alpine habitats are the most sensitive habitats subject to heavy grazing pressure, increasing eco-tourism and global warming. These plateau provide a habitat to many endemic species of plants including two of the three CITES Appendix-I species (*Picrorrhiza kurroo* and *Saussurea costus*). The Deosai Plateau is one of the unique habitats in Pakistan providing refuge to the declining population of the Himalayan brown bear (*Ursos arctos*). Tourism has increased in recent years and increasing vehicle traffic is damaging the vegetation through trampling, in addition to causing noise and vehicular emissions. Detailed ecological studies are needed to assess the vegetation and the impact of disturbance. High alpine areas are sensitive to global climate change. Alpine plant species can be used as indicators of natural and human disturbances.

2.1.7 Thorn Forest

The natural tropical thorn forest of the wood plains, lower hills and arid sandy tract (comprising *Salvadora oleoides*, *Prosopis cineraria*, *Tamarix aphylla* and *Caparis decidua*) once formed the bulk of the vegetation of the Punjab's so-called wood-reserves (*rakhs*). After the advent of irrigation, most of the land under these forests was claimed by agriculture, urban colonization and irrigation plantation. At present, the thorn forest community occupies less than 2% of its documented historical record (14,500 km²) and is likely to become vulnerable if existing casual factors continue to operate (Khan, 1994). Two of the three species of these forests, *Prosopis cineraria* and *Tamarix aphylla*, have been selected for arid land afforestation. Whereas the co-dominant associate of this community *Salvadora oleoides*, is specified as an uneconomic wood devoid of any interest (Khan, 1955, 1960, Muhammad and Naz, 1985; Khan and Muhammad, 1987). Its slow growth and the preference for fast-growing species have probably led to its unpopularity and indiscriminate replacement by other trees. This trend is contrary to the historical record, which suggests that it was once a valuable resource in the rural economy. The species now survives or regenerates only on the state-protected arid rangelands on inferior soil and in a degraded state. In these arid areas, it could be considered a biological resource, but even here, *S. oleoides* is being cleared.

In Pakistan, economic incentives have been far more pervasive in overexploiting this community as opposed to conserving it. The incentives to convert these forests into arable land and to plant artificial forests in the irrigated flood plains might have been appropriate, but on the sandy fragile soil, these practices have set up a trend of Desertification. The costs of reversing the processes of Desertification will far exceed any economic benefits from clearing this vegetation in the first place. Since resource exploitation is governed by economic considerations (McNeely, 1988), an approach to conservation is put forward which may alter land use proposals regarding this species. Ecological and ethno-botanical aspects of this neglected species are highlighted in Rakh Khairewala, located in Thal, a largely man-made desert (Ahmad, 1959; Chaudhri and Sheikh, 1960), and makes a stronger case for promoting the cause for its conservation. The species owes its survival here to security provided by the range and livestock departments, but outside this *rakh*, Desertification is proceeding rapidly.

2.1.8 The Balochistan Desert Basin

This is the most important but least explored desert basin of the Balochistan province. It starts from Nishi and goes directly to the Taftan Sandak area via Nok Kundi, Dalbadin, Padag, Yarmach etc. A large tract of loess plains interspersed with barren rocky hills is the prevailing feature of the area. The vegetation is sparse, consisting of small shrubs and clumps of grass. This region is very important especially for herpetofauna. A large number of species of snakes and lizards are unique to this area. Endemic species of viper include *Ericsticophis macmohoni* and lizards of the genus *Phrynocephalus*. Among the lizard family *Teratoscincus scincus*, *Teratoscincus microlepis*, *Crossobemon lumsdeni*, *Eremias scripta*, *Eremias acutirostris*, are characteristic species. Among snakes *Eryx tataricus* and *Lytorhynchus maynardi* are also characteristic species of this desert region.

2.1.9 The Thar Desert

This is a plain of gently undulating sand hills sloping upward gradually to the northeast. Elevation generally is below 500 feet. To the south, the desert blends into a vast salt marsh, the Rann of Kutch. Vegetation is generally sparse, consisting of xerophitic and halophytic shrubs and grasses. *Acacia*, *Prosopis*, *Zizyphus* and *Calotropis* are the characteristic species of the desert region.

The herpetofauna is made up of wide-ranging desert forms. The unique feature of the herpetofauna is the presence of several species characteristic of north central or peninsular India. Here these species are present at the western or northern limit of their distribution. The important species of this region are the tortoises. *Testuda elegans* (CITES Appendix II) is present; among snakes, *Elaphe helenae*; among lizards *Chamaeleo zeylanicus* (CITES Appendix II), *Sitana ponticeriana* and *Agama minor*.

2.1.10 Indus Delta Mangrove

The Indus Delta stretches over an area of some 600,000 hectares on the border between Pakistan and India. A vast complex of river channels and creeks, low-lying sandy islands, mangrove swamps and inter-tidal mudflats cover about 200km of the outer edge of the delta. Recent satellite imagery indicates that about 260,000 ha of the delta is covered with mangroves. The progressive reduction of freshwater flows in the Indus has affected the saltiness in the delta creeks. This puts stress on the mangroves causing stunting and the loss of seedlings. Overgrazing and lopping for fuel wood results in stunted trees in some areas. The survival of the mangrove system is at risk. In addition, domestic and industrial effluents flowing into the ecosystem have also contributed to the degradation of the mangrove ecosystem.

The Indus Delta mangroves are perhaps unique in that they constitute the largest area of arid climate mangroves in the world. They are almost wholly dependent upon freshwater discharges from the River Indus, and a small quantity of freshwater from run-off and domestic and industrial effluents from Karachi. The Indus Delta mangrove ecosystem is dominated by a single species, *Avicennia marina*, which constitutes over 95% of the trees, though a few stands of *Ceriops tagal* and *Aegiceras corniculatum* exist. *Rhizophora mucronata* once used to grow in the Indus Delta but it has since vanished, possibly due to selective overexploitation and degrading conditions. Villagers from many coastal settlements that are scattered throughout the delta, use the mangroves for fuel wood and fodder for their animals. *Avicenna* leaves are excellent fodder for animals and are collected regularly by the villagers.

The Indus Delta is an important fly-over for migratory birds from as far north as Siberia. In fact, it is one of the seven major migration routes in the world. During the winter, millions of waterfowl, including pelicans and flamingos, stop over in the delta for feeding and breeding.

Mammals, jackals and herds of camels can be found on many of the delta's islands. Three species of dolphins can be found swimming in many of its main creeks.

2.2 Threats

All the threats to the Biodiversity in Pakistan ultimately can be attributed to the increase in population. However, the rate of increase in population has been cut to 2.6% in the late 1990s from 3.6% of the 1980s. Urbanisation is on the increase and presently is 4.6%. The policies in context are not sensitive to the ecological considerations. No EIAs are conducted in urban and rural land use planning; resultantly invasion from one land use to the other is common. Protected areas have been declared but the rules for conservation are not fully implemented.

3. Plant Biodiversity

This section describes Pakistan's plant species of particular importance. The major threats to Pakistan's plant Biodiversity are also listed, and actions that have been taken or are proposed for plant Biodiversity conservation are described.

3.1 Introduction

Pakistan has over 5700 species of flowering plants reported in the *Flora of Pakistan* (Nasir and Ali, 1970) with around 400 endemic species and 4 endemic genera (*Douepia*, *Suleimania*, *Spiroseris*, and *Wendelboa*).

The National Herbarium, Islamabad is the federal institution engaged in data collection on the floral diversity of Pakistan with over 100,000 plant specimens stored in primary field data. The National Herbarium has prepared the first account of the *Flora of Pakistan*, an inventory of plant diversity of the country. The National Herbarium has started preparing databases to facilitate scientific research and information exchange with other regional institutions in the country. A database to prioritise medicinal plants for conservation is near completion. This information will be useful to assess the market demand and conservation status of rare plants greatly in demand. This information will be helpful in taking the necessary steps for the cultivation of threatened species to ensure a sustainable supply to markets and to determine research priorities.

3.1 Medicinal Plants

Medicinal plants are a major source of drugs for the treatment of various health disorders. Pakistan has around 6000 species of wild plants (Stewart 1972) out of which about 400-600 are considered to be medicinally important. An estimated 80% of the rural population of Pakistan depends on a traditional medicinal system called *Unani* for their primary healthcare needs, the majority of which uses plants or their active ingredients. See **Box 2** for details of the *Unani* system.

The four ecological regions where medicinal plants are exploited commercially are described below:

3.1.1 Medicinal Plants of Alpine and High Altitude Areas

Most plants of these areas are slow-growing perennials, which require several years of vegetative growth for reproduction by seed. Most of these are classified as threatened or vulnerable. Endangered plant species of this area include *Podophyllum hexandrum*, *Saussurea costus*, *Picrorrhiza kurrooa*, *Aconitum heterophyllum*, and *Corydalis* spp.

3.1.2 Medicinal Plants of Temperate Montane Forest

Common medicinal plants of these areas are *Atropa acuminata*, *Angelica glauca*, *Paeonia emodi*, *Geranium wallichianum*, *Artemisia* spp., *Glycyrrhiza glabra*, and *Ephedra* spp.

3.1.3 Medicinal Plants of Sub-Tropical Foothill Forests

Species found here include *Terminalia* spp., *Mallotus philippensis*, *Phyllanthus embilica*, *Butea monosperma*, etc.

3.1.4 Medicinal Plants of Arid and Semi-Arid Areas

Some important species of medicinal plants of commercial importance like *Artemisia* spp., *Ephedra gerardiana*, *E. procera*, *Bunium persicum*, etc. are found in cold arid habitats. In warm arid areas, species like *Commiphora wightii* are widely distributed.

3.2 Present Status

According to the National Institute of Health (NIH), approximately 400 plant species are used extensively in traditional medicines. The *Tibbi Pharmacopoeia of Pakistan* (a pharmacopoeia of traditional drugs compiled by the Tibbi Board) has listed around 900 single drugs and about 500 compound preparations made of medicinal plants. There are about 27 large herbal manufacturing companies in Pakistan, which produce *Unani* medicines on a commercial scale. The number of herbal medicine manufacturers in the non-organised sector runs into the hundreds. The annual turnover of some large herbal manufacturers is comparable to multinational companies in Pakistan. Traditional healers (around 50,000 in numbers, including homeopaths) serve about 60% of the population, especially those living in the rural areas.

Box 2: The Unani System of Medicine in Pakistan³

Unan is the local name for Greece, and the Unani system is the Greek system of medicine. The great Greek scholars perfected this system and physicians like Aristotle etc. The later empires of the Byzantine however shelved all Greek knowledge and the world was ignorant of its existence during the dark ages of Europe. It was Mamun ur Rasheed, the Abbasid Caliph of Baghdad, who in the eleventh century launched big campaigns to acquire the old Greek works and had them systematically translated in the 12th century AD. This system reached perfection when the Indian knowledge of medicine was added during Mamun's time. The practitioner of Unani medicine is called a Hakim. A Hakim has to pass a four-year course in one of the Tibbia colleges. There are more than 20 reputed Tibbia colleges in Pakistan. Hakims had always enjoyed respect and power in the courts of the kings of India. Hakim Ajmal Khan was the best known Hakim of the last century. His formulations like Ajmaleen were patented in Germany. Hakim Saeed founder chair of the Hamdard Foundation is another renowned Hakim. Due to the work of Hakim Saeed, the World Health Organisation (WHO) recognised the Unani system in the early eighties, when the Government of Pakistan also gave it official status. The GoP set up a Tibbi Council under the Ministry of Health. The council has an elected president and fifteen elected members. A draft law, the Unani Drug Act, has been debated and is likely to be promulgated by July 2000. This law will standardise the formulations and set pharmaceutical standards in packaging etc.

The Unani System of medicine is based on the concept of developing resistance in the human body against disease. It is weak in surgery but quite effective in medicine. Unani medicines are known to have no side effects. A commercial manufacturer of Unani medicine is known as a 'Dawa Khana,' the largest among them being Hamdard. Others are Qarshi, Rehmania, Ajmal etc.

Hakims are available all over Pakistan. Some use branded medicine while others make their own. Most of the formulations are passed down from father to son. However, Hakim Saeed of the Hamdard Foundation, published formulations and set up research laboratories in Karachi. Hamdard also takes up the cultivation of medicinal plants at its research site called Madinatul Hikmet, Karachi. Only a narrow band of other medicinal herbs is cultivated in the private sector.

Since herbs are the main source of Unani medicine, threats to the ecosystems are threats to human health. Due to shortages, the Unani system has also started extracting the active ingredient only. A classic example is the common household traditional medicine for flu - 'Joshanda.' Joshanda is no more available in the market in its original form (a blend of herbs). Instead, only powdered commercial brands are currently available.

³ Source Mr. Kaleemulah Malik, Mymo Dawakhana and Cheap Medical Store Mianwali.

3.2.1 Threatened Medicinal and Aromatic Plants of Pakistan

Tables 3.1 and 3.2 contain the names of plants, which are endangered and vulnerable in Pakistan.

Table 3.1: Endangered Medicinal Plants of Pakistan

Plant	Local name	Annual Consumption (Tons) approx.	Ecological Region
<i>Commiphora wightii</i>	Guggul	25-50	Deserts
<i>Picrorrhiza kurrooa</i>	Katki	10-15	Alpine Himalayas
<i>Podophyllum hexandrum</i>	Bankakri	30-40	Temperate Himalayas
<i>Dioscorea deltoidea</i>	Kanis	30-60	Temperate Himalayas
<i>Paeonia emodi</i>	Mamekh	10-20	Temperate Himalayas
<i>Onosma echioides</i>	Ratanjot	5-10	Cold dry mountain
<i>Polygonum amplexicaule</i>	Anjabar	15-20	Temperate Himalayas
<i>Valeriana wallichii</i>	Mushkbala	30-50	Temperate Himalayas
<i>Aconitum heterophyllum</i>	Atees	4-5	Temperate Himalayas
<i>Rheum emodi</i>	Revand-chini	30-40	Temperate Himalayas, Hindukush
<i>Saussurea costus</i>	Kuth	5-8	Alpine Himalayas
<i>Atropa acuminata</i>	Angoor-shafa	15	Temperate Himalayas

Source: Rafiq, 1998

Table 3.2: Vulnerable Medicinal Plants of Pakistan

Plant	Local name	Consumption/Yr. (Tons) approx.	Ecological Region
<i>Plantago ovata</i>	Isabagol	30-40	Cold arid Hills
<i>Pistacia integerrima</i>	Kakar Singhi	2-3	Sub-tropical Himalayas
<i>Ziziphus sativa</i>	Unab	50-100	Sub-tropical Himalayas
<i>Glycyrriza glabra</i>	Mulathi	200	Hindukush, Karakorum
<i>Artemisia spp.</i>	Afsantin	100-15-	Hindukush, Himalayas
<i>Adiantum capillus-veneris</i>	Parsiyawshan	80-100	Temperate Himalayas
<i>Acorus calamus</i>	Warch or gorbach	20-30	Temperate Himalayas
<i>Mallotus Philippinensis</i>	Kamila	5-10	Sub-tropical Himalayas
<i>Berberis lycium</i>	Dardald	300-400	Hindukush, Himalayas
<i>Colchicum luteum</i>	Suranjan Talkh	5-8	Sub-tropical Himalayas
<i>Citrullus coloyntis</i>	Tumba/Hanzil	40-50	Deserts
<i>Bergenia ciliata</i>	Zakhme-e-Hayat	15-20	Temperate Himalayas

Source: Rafiq, 1998

3.2.2 Conservation

Although adequate data is not available about medicinal plants that require conservation, there is overwhelming agreement among experts in the country that the most threatened ecosystems are the alpine and temperate Himalayan forests in the north of the country. There is also agreement that almost all the forests of Pakistan have been exploited heavily

during the last two decades (including the medicinal plants).

To initiate conservation efforts, Pakistan has established reserve areas, mainly national parks covering about 10% of the total land. Please see chapters 4 and 5 for further details. *Ex-situ* conservation of medicinal and aromatic plant seeds has recently been initiated at the Plant Genetic Resource Institute (PGRI) at NARC in Islamabad, where a special department called the Hakim Mohammad Saeed Chamber has been established.

Pakistan has a number of institutions involved in research and development work on medicinal plants. However, except for a few, the majority are either inadequately equipped or do not have the human and financial resources required for the assigned work. The institutions engaged in research are listed in **Appendix C**.

3.2.3 Conclusion and Recommendations

The regular up-date of data is essential for monitoring the conservation of plant Biodiversity. A single institution should be designated to store and maintain data on Biodiversity for analysis and dissemination.

Reliable inventories of endangered and threatened plant species need to be prepared so that effective step can be taken for their conservation.

The strengthening of institutions to expand and improve the information base is required. Secondly, the development and institutionalisation of systems to monitor the components of Biodiversity is also needed.

For *in-situ* conservation, better management of National Parks and other reserve areas is required.

4. FOREST BIODIVERSITY

This section describes forestry in Pakistan. It includes discussions on forest management, different forest types, threats to Pakistan's forests, and steps that have been taken, or are still needed to protect forests.

4.1 Evolution of Forest Management in Pakistan

Before the British came to the subcontinent, the natural resource base was so vast that there was little need for forest science. However, it was soon realised in the third quarter of the 19th century, that unless forests were protected and managed properly, they would soon diminish. In this regard, German forest scientists like Brandis and Schlich were engaged for the scientific management of forest resources.

Accordingly, silvicultural systems for all forest types were developed with clear management objectives. To fulfil the fuel wood requirements of the railways, irrigated plantations like Changa Manga were established. It was not easy to select the right types of species from amongst the Indian trees and standardise the irrigation system. After independence (1947), some useful irrigated plantations based on the old English system were developed. The hill forests were in good condition.

In fact, a century of management (started in the end of the 19th century) in the hill forests has resulted in forests being exactly as desired by the management system. Forests in Pakistan have the potential of being the harbingers of ecosystem diversity. Most of the landscape of the country has been modified. Living space for Biodiversity and for the natural processes of succession is only available in the areas declared as reserves under the Forest Act of 1927.

The effects on nature by forest management in all the ecosystem types of Pakistan, as well as the dynamics of the effects of the delicate ecosystems to human interference is discussed in the following section.

4.2 Forest Management in Practice

The major objectives of the forest management practices in Pakistan are based on the sustainable yield of timber and firewood rather than on sustainable forestry. Sustainable forestry as perceived by foresters is restricted to the principle that the annual wood harvested from a given forest must not exceed the annual growth gained through photosynthesis. It is also limited to the species that have good commercial value and does not consider the ecosystem as a whole. Whereas, the contemporary concept of sustainable forestry puts emphasis on management of the system as a whole, including forest fauna and micro-organisms. The problems and challenges today are related to the shortage of timber, firewood, grazing lands and competition from other land uses. The focus of forest management remains to manipulate nature by retaining those species that are preferred by foresters. Economic considerations are the prime concern. In other situations, exotic or non-endemic species are being heavily planted outside their natural zones. Working plans regulate Forest management. All such plans consider Biodiversity preservation, climatic issues and the provision of habitat to the fauna. A critical look into these issues reveals that forestry management practices are not employed as constructively as is necessary. Though Pakistan is a member of intergovernmental panels like the IGFF and IPPF (Intergovernmental Panel on Forests); it has not been able to attend its meetings due to other priorities and financial constraints. Therefore, the implementation of IPPF decisions does not find a place in forest

policies. A brief overview of the management of various forest types keeping in view the various articles of the CBD and related conventions is discussed below.

4.2.1 Hill Forests

The primary natural forests were subject to management under various silvicultural systems, including the selection and shelter wood system. The selection system has been applied to all conifer forests, except Chir pine, where the shelter wood system was applied. In the selection system, trees of exploitable diameter are marked for commercial harvesting, while in the shelter wood system felling is carried out by dividing the whole area into periodic blocks and leaving a few seed bearers as mother trees. Rotations for each periodic block were fixed so that a sustainable yield of timber was obtained regularly. The system worked well in the initial stages of the century. Consequently, modified normal forests were created. The rotation period was reduced as the demand for timber increased. The condition of the forests began to deteriorate in the end of the 20th century.

4.2.2 Riverine Forests

The history of the management plans of riverine forests goes back almost 50 years. These plans are designed to convert the primary obhan (*Populus euphratica*) forest into irrigated plantations of *shisham* (mulberry). Neither the need of the local people, nor the feed and habitat requirements of the wild animals that were dependent on these riverine ecosystems have been considered in these management plans. Initially, success was achieved in raising valuable *shisham* and *kiker*, but this system demands expensive input like weeding and irrigation. Huge development works such as flood control engineering structures and water reservoirs were constructed. Therefore, these riverine forests are not receiving the vital flushing floods necessary to sustain the forests. Installing diesel-operated pumps was considered a solution as opposed to bringing the management plans in harmony with nature and the demands of the local peoples. This artificial irrigation technique is not giving the desired results. Particular reference is given to Ghazi Ghat Forest near the famous Ghazi Ghat Bridge. Foresters have not come up with any viable technique to regenerate *shisham* after the felling of the mature crop in areas that no longer receive floodwater. Irrigation engineers have blocked the creeks of the mighty Indus and not a single drop of floodwater now reaches this forest. A similar situation exists in almost all the riverine forests in the country. *Obhan* (*Populus euphratica*) was the traditional tree of the primary riverine system in Pakistan. This is of tremendous economic value to traditional artisans. The lacquered traditional furniture made of *obhan* not only has local market value, but also has export potential.

4.2.3 Scrub Forests⁴

The British preserved large tracts of natural primary forest in the shape of reserved forests. Legal cover to this preservation was given under the Forest Act of 1927. The main objective that led the British to take major steps for forest conservation was to supply fuelwood to the newly created railways and to supply timber to the British Empire. Surprisingly, British legislation especially the Forestry Act, 1927 is the main legal instrument that has helped preserve the natural forests. Ironically, this act is the main target of criticism of environmental NGOs and other decision-makers. However, this act has helped in retaining a major portion of these forests in almost pristine condition. Management practices were subsequently developed to conserve the *Accacia modesta* and *Olea ferruginea* forests. The only change that post-independence foresters have made is that exotic species like eucalyptus are being widely planted. Minerals like coal, bentonite, fire clay and silica sand etc are abundantly available in the forest reserves. These forests are now under threat from mining leases. No definite legal cover is available to minimise the impacts from mining. Fragmentation due to the large-scale construction of roads, etc. is another threat. There is a need to devise strategies to deal with these issues. The rights of grazing and grass cutting

⁴ Please also see section 2.1.7 'Thorn Forest' in Chapter 2 for the descriptive part.

also need to be rationed. This is due to the increase in the human and livestock populations (for details see *Land rights in the Scrub Forests of the Salt Range* in Chapter 12 of this report). These forests are not greatly damaged by the livestock of the local residents, but by the nomadic Bakarwals⁵, the regular winter visitors with their large goatherds. These goats browse the Acacia trees and are the single largest threat to them. The forest department traditionally used to issue grazing permits to the Bakarwals on a heavy fee. A ban on their entry in the districts having scrub forests has been imposed since the late 1980s. This has been done because they cause damage to trees. Yet, the forest department has no control on their entry in the private lands adjoining the state forests. Nevertheless, the fact remains that they do find ways to enter the districts and ultimately the forests. A rational strategy needs to be evolved in consultation with these grazers to meet their requirements as well as the objectives of forest conservation.

4.2.4 Irrigated Plantations

The British rulers raised the original irrigated plantations in the 19th century with the objective of producing fuel for the railways and the steamships sailing the Indus River. After independence, large tracts of land were set aside for plantations in the arid areas. These plantations were raised alongside the development of new barrages and dams. It appears that the purpose of the authorities setting aside these lands was the creation of windbreaks and lowering the subsoil water table. Plantations raised (especially in the Thall area) were a replication of the techniques developed by the British for the initial plantations meant for the supply of wood to the railways. Initially, good results were obtained when the agricultural lands were not developed and abundant water was available for the plantations. The dilemma is that adequate water is no longer available. Moreover, in areas where water logging starts, the plantation trees are the first to die. Shorkot Plantation is a classic example of this. However, biological reclamation has become possible by the introduction of eucalyptus. The role of the irrigated plantations for carbon sequestration, Biodiversity conservation and commercial purposes needs to be ascertained. There is a need to develop strategies for the irrigated plantations to cater to the emerging challenges of the 21st century. Irrigated plantations can play a big role in Biodiversity conservation by meeting the demands for timber and firewood; thus protecting fragile and threatened ecosystems.

4.2.5 Linear Plantations

Good linear plantations were raised, especially in the post-independence period, alongside roads and canals. The objectives of these plantations were amenity, the creation of shelterbelts, and sand dune stabilisation. With no fixed period of crop rotation, there are still many old growth trees, which the foresters term as mature and over mature crop. In every forest division, the emphasis is on removal of the old, dead and dry trees. Old trees are now almost non-existent in the country. This is due to shorter rotation periods in the irrigated plantations and the high prices of timber that lure farmers to sell trees earlier. Many birds roost and nest in the old, dead and dry trees, especially in the canal sides. Those birds that have not adapted to urbanisation are likely to become extinct. Due to scarcity of land, the linear plantations provide an ideal site to plant local species. There is a need to promote activities that can provide livelihoods to the local people without the cutting of trees.

4.2.6 Farm Forestry

Farm forestry and agro-forestry practices are popular in the country. However, the objective of farm forestry should be the mitigation of pressure on the natural forests rather than replacing forestry with farm forestry. The concerns of the articles of the CBD have not been incorporated in farm forestry projects and plans as highlighted in the case study of the farm forestry project in the Punjab (refer to **Box 3**). Local trees, especially those that can be used, need to be promoted instead of eucalyptus.

⁵ Nomadic tribe that keeps mainly hairy goats and descend to the low hills in winter for grazing

Box 3: Farmland Planting in the Punjab Province⁶

Land is being cultivated more intensively and fertilised more frequently. Vegetation is considered weed and is removed to give way to staple crops. Consequently, animals and birds are finding it difficult to find living space. Insects are eliminated by the excessive use of pesticides. With the invention of irrigated agriculture and intensive cropping patterns, the use of pesticides and chemical fertilisers has increased manifold, resulting in vanishing wildlife and the extinction of wild flora. Even the soil and air-based microbial activity has been badly affected. The cultivated area of Punjab is over 11m ha out of 20.63m ha. The green revolution has increased the productivity of the crops many-fold, but due to the heavy reliance on chemical fertilisers and pesticides the biological equilibrium has been disturbed. This needs to be addressed. The options of agro-forestry and social forestry seem to be the answer. The Punjab Forest Department has more than a decade of experience in social forestry practices. Because of these efforts, there are about 17 trees per hectare in the Punjab province. This amount can be doubled as a result of the Punjab Forest Department's experience. The on-going World Bank-funded Punjab Forestry Sector Development Project is already busy in transferring the technology of raising nurseries and planting techniques while supportive agro-forestry research is providing the leadership to implement planting programmes. The social forestry, social range and scrub forest management approach has made it possible to address the problems of stakeholders. Development of woodlots on marginal and sub-marginal lands is a welcome step to providing habitats to wildlife, both macro and microorganisms, in addition to the amelioration of farm economy and the alleviation of rural poverty. Supportive research in the discipline of Biodiversity is essential but not fully covered in the social and farm forestry projects of the Punjab. In central Punjab, *Dalbergia sissoo* (Shisham) is dying in farmlands; this is attributed to the indiscriminate fertilisation and use of pesticides, and to the toxic effects of the unused nutrients. However, enough research has not been undertaken to arrive at definite conclusions.

The farm forestry projects in the Punjab showed that it was mostly market forces and lacks of Biodiversity awareness amongst the foresters and international consultants that resulted in the massive planting of the eucalyptus in the farmlands. This planting had been more prevalent in the northern districts of the province through the USAID Forestry Planning and Development Project. There is a big move against the planting of eucalyptus. The anti-eucalyptus campaign is inspired mainly by the campaign against it in neighbouring India, but no large-scale scientific studies have been conducted on its negative impacts. Influenced by the campaign, the present trend of the farmers in all the districts do not plant eucalyptus, and the sale of eucalyptus saplings from the forest and private nurseries has diminished significantly. There is a need to catalogue the extinct and threatened local trees and encourage their planting. Fortunately, many threatened local trees provide income to farmers by non-destructive exploitation - the fruit of the Lassora and Amla is an example. Others have medicinal value like the pods of Dhak *Butea monosperma* and the fruit of Banafsha.

4.3 Forest Management and Wildlife

Wildlife is an integral part of the forest ecosystem. While managing the forested land, administrative considerations have prevailed on the ecosystem approach in Pakistan. Consequently, the Wildlife Department has been separated from the Forest Department in the provinces of Punjab, NWFP, Sindh and Azad Kashmir, while in Balochistan and the Northern Areas these are managed by a wildlife wing under the forest departments. This separation appears to have isolated the tree from the life dependent on it. All the management plans for the forestry sector are prepared in isolation from the wildlife management plans. Even the staff of the forestry and the wildlife departments has no common formal forum despite working in the same forests. There are no prescriptions in the management plans for the habitat requirements of the fauna. There is a need to harmonise the activities of both departments at all levels. The immediate requirement is to retain some percentage of dead, dry and fallen trees in the forests. Retention of some old and hollow trees is also necessary to eliminate the chances of the extinction of birds that fail to adapt to the intensification of agriculture and forestry practices.

There is an emphasis in our wildlife legislation on game management. Non-game species that are equally important are totally ignored, such as anteaters and some reptiles that are killed due to mere superstition. There is a need to develop strategies to conserve all forms of life.

⁶ Case Study Prepared by Fauzia Bilqis Malik Fellow LEAD- Pakistan

4.4 The Biodiversity Convention, Forestry and Threats to Pakistan's Forests

The three main components of the CBD are the conservation, sustainable use and equitable benefit sharing of biological resources. As a large proportion of Pakistan's Biodiversity resides in forests, this sector has to deal with these three objectives. Reserve forests, especially those declared in the natural ecosystems of the hills, are the only major harbinger of Biodiversity. Unfortunately, these ecosystems are not only under threat due to human population pressure, but also face threats posed by the management practices of forest managers. Mining activities, heavy grazing pressures, and wood theft are some of the major external threats to forest Biodiversity. The large-scale introduction of exotic species, heavy tending operations and a silvicultural system based on commercial considerations are some of the threats posed by resource managers (as discussed in section 4.2 above). Large tracts of land near reserve forests that were left as communal or private property have been brought under intensive agricultural use throughout Pakistan. This and other development activities, such as the road and dam construction, are resulting in the fragmentation of ecosystems. The dangers in these threats should be realised, and strategies devised for the creation of biological corridors.

There is also a need to record indicators for forest Biodiversity, with a baseline that establishes the condition of Biodiversity a century ago. Recording changes at both the ecosystem and the species levels also needs to be undertaken. As mentioned earlier, accounts of the natural environment, as it was a century ago are available in district gazetteers. There is a need to update the syllabus on forestry in colleges, so that developments in Biodiversity research are incorporated in forestry planning and policies. Greater training for foresters in management practices is required, as is dialogue on how to bring forest management in conformity with the CBD in Pakistan.

4.5 Strategies, Policies and Legislation

A number of steps have been taken to direct Pakistan's strategies, policies and legislation toward the conservation of forest Biodiversity.

The Forestry Master Plan was launched in 1992 for a period of 25 years. Its aim is to assist in sustainable forest development and management, supported by long-term goals and objectives for the forestry sector. This was the first document that had long-term vision, and set up long-term goals and objectives for the forestry sector. A number of important projects like the Asian Development Bank and the Dutch-funded Forestry Sector Project in NWFP, and the World Bank-funded Punjab Forestry Development Project are aiming at sustainable forest development through community participation.

The Environmental Protection Ordinance (EPO) of 1983 was the first legislation framed to consider environmental concerns and issues as a whole. This act was followed by the Pakistan Environmental Protection Act (PEPA) of 1997. The National Conservation Strategy was the first comprehensive document that sought to plan development within an environment friendly framework, one that emphasised conservation and the efficient use of natural resources. The NCS focuses on sustainable development. In line with the NCS, the Sarhad Provincial Conservation Strategy (SPCS) has already been completed, while the preparation of conservation strategies for Balochistan and the Northern Areas are in progress.

The timber-harvesting ban imposed in 1992 in the NWFP province, was the first response of the government to increasing large-scale deforestation, thereby providing an excellent opportunity for the rehabilitation of the forest. Although the overall impact of the ban was positive, the Forest Department did not succeed in providing an alternative system of forest

management, and harvesting. Currently, efforts are underway to identify those forest stands, where commercial harvesting can be undertaken on a small scale. Since 1985, an executive order of the Chief Minister of Punjab has put an end to the cutting of trees in the high hills of Murree and Kahuta.

In NWFP, a number of policy initiatives are underway to achieve sustainable forest development through the involvement of all stakeholders in forest management, conservation of Biodiversity and environmental protection. The forest policy has been revised and is in the final stages of approval, while the Forest Act has also been revised to better suit the current demands and trends of natural resource management. The establishment of a forestry commission is also planned. In the same way, necessary notification has been issued for the establishment of Forestry Round Tables where civil society viewpoints and concerns about sustainable natural resource management can be discussed. All these forums should towards broadening the future perspective of forest conservation and management.

4.6 Conservation Projects

Forest Biodiversity includes the ecosystem, the flora and fauna that resides within it, as well as the existing human population. Biodiversity conservation is a complex task requiring efforts on a number of fronts. This includes the initial step of awareness-raising and advocacy, the assessment of the resources and various factors affecting Biodiversity, the formulation of comprehensive strategies and policies, the formulation and implementation of conservation projects, and above all monitoring and evaluation. All these important steps require the active involvement of various stakeholders, including the community, government, NGOs, assisting organisations and donors. These stakeholders play an essential role that contributes to sustainable forestry resource management and conservation.

With the assistance of donors, both the government and NGOs have implemented a number of environmental conservation projects. Although the total number of these conservation projects is large, their descriptions and contribution to conservation efforts is beyond the scope of this assignment. The NCS implementation unit was established in the Ministry of Environment to oversee the implementation and follow-up of the NCS. However, some projects and programmes of direct relevance to Biodiversity are briefly described below.

4.6.1 Environmental Rehabilitation in NWFP and Punjab

This project covers three sites in the upland areas of Pakistan, which is Murree-Kahuta in the Punjab province, and Galiat and Dir Kohistan in the NWFP province. The Government of Pakistan and the Commission of European Communities fund this project, whereas the European Commission, the GoP, along with the IUCN is the direct co-operating agencies for the implementation of the project. The project covers the period from October 1996 to December 2003.

The main objective of the project is to bring a halt to and effect the reversal of the on-going processes of environmental degradation. This will be achieved through integrated measures for natural resource rehabilitation, sustainable socio-economic development, and the sustainable use of natural resources. The project envisages the full involvement of the locals in the management of natural resources, on which they depend. This project addresses six out of fourteen core programme areas recommended by the NCS. These include the integration of population and environment programmes; the support of institutions for common resources; developing and deploying renewable resources; the protection of watersheds; the conservation of Biodiversity, and the maintenance of soils in croplands.

4.6.2 Kalam Integrated Development Project (KIDP)

This is a Swiss-funded multi-sectoral project, dealing with agriculture, forestry, and village development. Its aim is to raise the socio-economic conditions of the local people through sustainable agriculture and forest management. The community has been organised into village and women's organisations. Community participation in resource management is the essential aspect of this project. The project was very effective in motivating the local communities to manage their forests. It promoted off-season vegetables, which provided substantial income to the local people. It ultimately reduced their dependence on harvesting of the natural forest. Similarly, the purchase of royalties by contractors was largely halted, which has also helped in the conservation of natural forests.

4.6.3 Social Forestry Project Malakand/Dir

The Dutch-assisted Social Forestry Project is a pioneering forestry project for the rehabilitation of the denuded hillside of a fragile ecosystem in the district Dir, and Malakand Agency. The project has been very successful in promoting community involvement for natural resource development and conservation. A number of useful tools such as Village Land Use Planning have been developed by this project, and have been adopted by a large number of other forestry projects.

4.6.4 Environmental Rehabilitation Project, Swat, Bunir, and Chitral

This is another important forestry project in the uplands of Pakistan. The project is funded by the Dutch and the World Food Programme (WFP) and aims to control erosion and rehabilitate degraded sites. The project is carrying out a large-scale afforestation programme through community participation, and has been particularly effective in the environmental protection of community and private lands.

4.6.5 Tarbela-Mangla Watershed Management Project

This project has been under implementation for the last 20-25 years, and aims to control erosion and silt deposit control in the Tarbela and Mangla Dams. A participatory approach has been undertaken to raise large-scale plantations. The WFP and the German Agency for Technical Co-operation (GTZ) is the main funding agencies of this project.

4.6.6 Siren Valley Forestry Development Project

The Siren Valley Forestry Development Project is under implementation in the district of Mansehra and is a successor project of the Kaghan Intensive Project. This was operative in the reserved forests of Kaghan Valley for approximately 14 years. The Siren Valley Forestry Development Project is funded by the German and NWFP Governments, and aims to promote sustainable forest management.

4.6.7 Forestry Management Centre (FMC), NWFP

The Forestry Management Centre is a Swiss-funded project that aims to assist the preparation of forestry management plans for all the forests in NWFP by adopting participatory planning. The role of the FMC is a crucial one, as it prepares management plans for important ecosystems in the upper catchment of the country.

4.6.9 Other Projects

Beside these projects, a large number of donor-funded projects are contributing to sustainable forest management and conservation in Pakistan. Examples are the Suketar

Watershed Management Project, the Northern Resource Management Project, and Bhimbar Project in Azad Jammu Kashmir. The Northern Areas Development Project and the Aga Khan Rural Support Programme operates in the Northern Areas. The Mithawan Watershed Management in D.G. Khan and the Forestry Sector Development Project operate in Punjab. The Balochistan Area Development Project is operating in Balochistan, while in Sindh the Forestry Development Project is in operation.

4.7 Recommendations

The following are the recommendations listed during the process of the preparation of this report.

4.7.1 Sustainable Forestry

There is need to develop a strategy aiming at sustainable forestry development by adopting holistic and integrated resource management principles through active community participation. This will require a change in the role of the managers, the active participation of communities and other stakeholders; capacity building; and the sharing of benefits on an equitable basis. Sustainable forest development also demands consistent policies and strategies for achieving both short and long-term goals, in addition to a clear-cut vision, and strong political will to realise the objectives of the policies in true spirit. Decentralisation and devolution also play a crucial role in sustainable forest management. In some provinces, the Forest Department has already started these processes, but donor assistance plays a major role in this process. It is not known that whether these changes will continue once donor support is discontinued.

Indicators are ways to measure or describe criteria and provide a common framework for describing, monitoring, and evaluating progress towards sustainable forest management. This concept is a relatively new initiative in sustainable forest management, and is considered a very useful tool for adjusting forest policy and adopting other measures to sustain forestry. Globally, more than 150 countries are currently participating in international processes aimed at the development and implementation of national level criteria and indicators for sustainable forest management.

In Pakistan, the process of identification and adoption of criteria and indicators has not yet begun. The initiation of this process is crucial due to the tremendous changes in socio-economic and other factors. In the absence of an effective monitoring and evaluation tool, land degradation would reach an irreversible limit. It is hoped that with the implementation of the BAP and the establishment of the Biodiversity Secretariat in the MELGRD this process will find its footing.

4.7.2 Promotion of Non-destructive Uses of Trees

Trees and forest ecosystems have many uses that are economically important, but do not involve cutting. Presently our management plans do not focus on promoting non-destructive uses as tools for conservation. Gums, wild fruits, ecotourism and honey are some uses that need to be focused on in the future plans of forest management. Moreover, the social and environmental services of the forest continue to grow. These include global climatic change, soil conservation, conservation of biological diversity, employment generation and the provision of recreational opportunities.

5 Wildlife Biodiversity

This section describes Pakistan's wildlife, its present status, the major threats to wildlife Biodiversity, and the actions that have been taken or are proposed for its protection.

5.1 Introduction

For the purpose of this report, wildlife includes all vertebrates except fish, domesticated animals and human beings. Other broader definitions of wildlife include all plants and animals in wild ecosystems. Wildlife management is therefore concerned with the abundance and distribution of vertebrate species. Wildlife managers must also manage habitats, including vegetation and invertebrates which are food for, or causes of disease to wildlife.

Wildlife management is the science and art of changing the characteristics and the interaction of habitat, wild animal populations and man in order to achieve specific human goals by means of wildlife resources.

Until recently, most wildlife management has focused on game animals. With the growing realisation that all wild vertebrates possess important values, the scope of wildlife management has been broadened to include predators, songbirds, furbearers and vertebrate pests. **Box 4** gives an account of the steps undertaken for conserving the brown bear - species whose killing holds an economic incentive. **Box 5** gives some detail on the crocodile, whose killing also holds an economic incentive.

Box 4: Protecting the Himalayan Brown Bear in Deosai Plains⁷

Encircled by the Himalayan Mountains and in close proximity to the breathtaking Karakorum Range, the Deosai Plains are a fascinating exhibition of nature and unique wildlife with an average height of 13,000 feet. The Plains are home to the ibex, red fox, golden marmot, wolf, the Ladakh ural, the snow leopard, the Himalayan brown bear, and a number of resident and migratory birds. They make up one of the last frontiers of natural habitat for the Himalayan brown bear (*Ursus arctos*). Having long been a prize kill for poachers and hunters, the brown bear, Pakistan's largest omnivore, is presently on the verge of extinction. Only 27 bears remained in the Deosai plains in 1998. The Deosai National Park was established in 1993 as part of a joint effort between the Himalayan Wildlife Foundation (HWF), the Northern Areas Forestry, Parks and Wildlife Department, and local communities. This was done to secure the survival of the brown bear in the Deosai Plains. These efforts have included involving local communities in the conservation process, co-ordinating with the local administration for the legal establishment of the Deosai National Park, and carrying out surveys and research on the brown bears and other biological resources. The field staff of the HWF conduct surveys at regular intervals to document the movement, behaviour and mortality of the bears. The bears are monitored using the technique of darting. After darting, the animal's vital signs are checked to ensure that no risk to the animal's life has been incurred. Samples of blood, teeth, hair and tissues are taken to get vital biological information about the species.

⁷ Prepared after literature review by Mahpara Raza, LEAD Pakistan consultant

Box 5: Muggers Crocodiles

No recent survey data is available on mugger Crocodiles (*Crocodylus palustris*). This species was considered endangered or very rare in the early 1980s (Groombridge 1982). The most recent survey was conducted by the Zoological Survey of Pakistan during 1997. Five hundred specimens were recorded at Makhi and Baqar Dhand of the Chotiari reservoir. Plans for the winter survey during the 1999-2000 season are underway. The Sindh Wildlife Department recorded One thousand specimens in 1999 in Sanghar district. The species is now considered safe in Sindh. Crocodile recovery has been associated with a conservation project in the Deh Akro no. 2 Taluka Nawabshah. The project began in 1983, and current estimates place the crocodile population at about 2000 (Ahmad 1990). In Balochistan, the widespread killing of crocodiles has threatened the majority of the local populations. Many crocodiles were reported killed in the River Hingol during a period of low water in 1986-1987 (Khan 1989). Principal threats include killing for sale of the hide, killing by fishermen, as well as killing for the collection of specimens for laboratories and museums (Khan 1988).

5.1 Existing Wildlife in Pakistan

The mountainous areas embracing the Himalayan, Karakorum and Hindukush Ranges are rich in fauna and flora, as compared to other parts of the country. These areas provide an excellent habitat for wildlife in the form of alpine grazing land, sub-alpine scrub and temperate forests. These habitats support a variety of wild animals. The areas are difficult for human beings to access; hence, most wildlife is present in reasonable numbers though some are endangered for other reasons. Some of the main wildlife species are the snow leopard, the black and the brown bears, otter, wolf, lynx, Himalayan ibex, Markhor, Bharal, Marco Polo's sheep, Shapu, musk deer, marmots, tragopan and monal pheasants. The snow partridge and snowcock reside at higher elevations. The Rhesus monkey, common langur, red fox, black bear, common leopard, a variety of cats, musk deer (over a limited area), goral, several species of flying squirrels, chakor, partridge and pheasants (koklass, kaleej and cheer) live in the lower elevations. Amongst these the snow leopard, musk deer, Marco Polo's sheep, and the brown bear are endangered. The Tibetan wild ass and the blue sheep populations have been reduced drastically. The cheer pheasant is reported to be extinct from within Pakistan's boundaries, and is included in the *IUCN Red Data Book*. The western horned tarpon was reported to have disappeared from within Pakistani territory, but has now been relocated to Indus Kohistan, although its numbers are low.

The main threats to the population of wild animals in the northern mountainous regions include the competition with domestic livestock for existing natural forage, increasing human interference in the form of cultivation, the construction of roads, and hunting.

The Himalayan foothills and the Potohar region, including the Salt Range and Kala Chitta Range, are covered with scrub forests, which have been reduced to scanty growth in most places. Medium-sized animals like the Punjab urial, barking deer, goral, chinkara, partridges (grey and black), seese and chakor are supported in these habitats. Varieties of songbird faunas also occur in these areas. The urial is prized for its trophy and has been discussed in detail in **Box 6**.

Box 6: The Urial⁸

The urial (*Ovis vignei*) belongs to the sheep family and has a convoluted taxonomy. In Pakistan, three sub-species *Ovis vignei punjabiensis*, *Ovis vignei cycloceros*, and *Ovis vignei vignei* have been identified in the localities of the Salt Range, Bolan Pass, Astore, Baltistan and Gilgit. Since there is no regular systematic census, the exact population of the urial cannot be ascertained. The urial is a very popular game animal. Hunting is the main threat to its population. Development activities such as urbanisation, clearing of forests for agriculture, and the construction of roads and dams are other threats faced by the urial. Illegal lamb capture for selling as pets is one of the major sources of population loss. Competition with domestic livestock that depends on the urial's habitat is another issue that has to be scientifically studied. Predation is no longer a threat since the natural predators like leopards and panthers are almost extinct. While wildlife management and protection is entrusted to separate provincial wildlife departments, there is poor co-ordination between the forest managers and provincial authorities. The urial has been included in schedule III of the Punjab Wildlife Act of 1974. The killing of the animals included in this schedule is prohibited. The Ladakh urial is listed as endangered in the 1996 IUCN Red Data Book and in Appendix I of the CITES list. The Afghan urial is listed in the third schedule of the Balochistan Wildlife Act. The WWF-Pakistan is implementing a project with UNDP funding in the Chakwal district of the Punjab province. It aims involving the local communities in the conservation of the urial.

Vast Indus flood plains have been cleared of natural vegetation to grow crops. Very little wildlife habitat has been left untouched. Only animals like the jackal, mongoose, jungle cat, civet cat, scaly anteater, desert cat and the wild hare occur in these areas. Hog deer is found in riverine tracts. The crop residues and wild growth support reasonable populations of black and grey partridges.

Little vegetative cover, severity of climatic conditions and the great thrust of grazing animals on the deserts have left wild animals in a precarious position. Parts of Thall and Cholistan are now being irrigated, with the situation almost identical to that of the flood plains. Chinkara is the only animal, which can still be found in average numbers in Cholistan, but rarely in Thall. The blackbuck, once plentiful in Cholistan has now been eliminated. However, efforts are being made to reintroduce them back into the country. A small number of blue bulls are found along the Pak-Indian border, and some parts of Cholistan. Grey partridge, species of sand grouse and the Indian courser are the main birds of the area. Peafowl occur in some areas in Cholistan.

The Thar Desert supports a fair population of the Chinkara gazelle. Peacocks are only found in the wild, mainly because of the protection they enjoy in Hindu communities. The wild ass migrates from the Indian part of the Rann of Kutch to the Pakistani part in search of food.

The Houbara bustard is a regular winter visitor to the desert. Visiting diplomats have hunted and reduced their numbers. The great Indian bustard is sporadically sighted. The imperial sandgrouse is another migrant visiting these areas. Grey partridges are frequently sighted. The python is also threatened with extinction.

The Sulaiman and Kirthar Ranges present habitats manifesting unique characteristics. The former supports the straight-horned markhor, chinkara and urial, whereas Sindh ibex, urial, chinkara and common leopard occupy the latter. The straight-horned markhor, which is almost extinct from within settled boundaries of Pakistan, occurs in somewhat fair numbers in the Tribal Areas. The chakor, seese and grey partridge are birds commonly found in the tracts.

The reed beds and tamarisk bushes along the rivers support hog deer and black partridge populations. However, due to occasional heavy floods their numbers have also been reduced. The Indus dolphin, fishing cat, and Eurasian otter are found in the Indus River

⁸ Case Study by Ghulam Ali Awan Lecturer Government College Wazirabad

waters below the Chashma Barrage. The gavial has become extinct in Pakistan. The crocodile is found in small numbers in lower Sindh. Wild boar numbers have increased because of the immunity they enjoy in a Muslim society that forbids its consumption by humans.

The animals found in the south-western mountains of Balochistan are: Sindh ibex, Chiltan markhor, straight horned markhor, wild sheep, leopard, marbled pole cat, Blandford's fox, chinkara, goitered (Grant's) gazelle and the marsh crocodile. The cheetah is believed to be extinct and the Makran bear critically endangered. The Houbara bustard (migratory), sandgrouse, black and grey partridges, and the chakor and seese partridges are also found here. The status, threats and conservation of the Balochistan black bear has been described in detail in **Box 7**. The Chiltan wild goat found in the Balochistan highlands is discussed in **Box 8**.

Irrigated forest plantations have emerged as the prevailing land use practice for the last 100 years. These ideally provide excellent habitat for chinkara, hog deer and blue bull. Forest management does not cater to the needs of these wild animals. This, coupled with the poor implementation of laws has resulted in the extinction of species in the irrigated plantations. Due to habitat disturbances, the ungulates have failed to establish themselves, whereas the partridges have flourished well.

The striped hyena and the wolf are widely distributed in the sparsely populated parts of the country. However, information about them is scanty. Information about carnivores in general is difficult to obtain because of their nocturnal mode of life and high mobility. The black bear and brown bear populations are also not understood completely.

Box 7: The Balochistan Black Bear

The Balochistan black bear (*Ursus thibetanus gedrosianus*) locally known as "Mum" was once widely distributed in most of Balochistan. The Balochistan black bear is sub-species of the Asiatic or Himalayan black bear. It is smaller and specimens from the south manifest short, coarse, rufous brown fur, while those from the north are much darker as compared to the Himalayan black bear. The Balochistan black bear's habitat ranges from Iranian Balochistan to Pakistani Balochistan. According to T.J. Roberts, this species has been reported in the Sulaiman Range, Ziarat, Harnai, Khuzdar, Kharan and the Lasbela Hills, but now it is considered extinct in most of the areas. The major stronghold of the species is now in the Pub Range (Khuzdar Hills) where it is mostly confined to arid sub-tropical thorn forest. Two surveys have been conducted one by WWF-Pakistan in 1993-96 and the other by the Himalayan Jungle Project in 1994, both confirming the presence of the species in the Pub area. The population status is not certain, but local hunters report 8-10 animals still survive in the area. A WWF survey team has also reported scats and footprints of the black Bear in the Sulaiman range in 1998. The bear has been described as endangered in the IUCN Red Data Book. Very little is known about the ecology and biology of the species. The fact that few studies have been undertaken to understand its living patterns also threatens this species' future. It is usually seen in the rainy season from August to November, its food preference is *Olea ferruginea*, Ber (*Zizyphus nummularia*) as well as the starchy rhizomes. It also likes fruits of the dwarf palm, insects and lizards. Mating occurs in October and cubs are born in February. The main threat to the species is its persecution by the locals. Bears are usually killed when they are found predating on goats and their kids. Bears are also killed for the sale of their fur and the collection of fat for medicinal use. The ecological niche of the Balochistan black bear and its food preferences are still not clear and need further in-depth study.

Box 8: Chiltan Wild Goat

The Chiltan wild goat has attracted the attention of wildlife conservationists around the world because it is found only in the highlands of central Balochistan. Despite its global importance, it has not been explored in detail nor has it been identified properly so far. Up until the late seventies it was thought that Chiltan wild goats were confined to three localities i.e., the hill ranges of Chiltan, Murdar, and Kohi Maran in Balochistan. Presently, it is only reported in the Hazarganji-Chiltan

National Park, situated 20km away from Quetta, the capital city of Balochistan province. Ladekker (1913) first described this animal as distinct sub-species, (*Capra falconeri chialtanensis*). Other scientists cited in Roberts (1967) and Schaller (1977) suggested that it might be a hybrid between the straight-horned markhor (*C. falconeri jerdoni*) and the wild goat or a markhor and a domestic goat. Schaller and Khan (1975) and Schaller (1977), however, have studied populations of various species and based on horn morphology concluded that they (*C. falconeri chialtanensis*) are in fact *Capra aegagrus chialtanensis*. It was concluded that it does not merit sub-specific status because intermediate forms exist between this species and a typical wild goat.

The IUCN Red Data Book lists both the Chiltan wild goat and the markhor as 'Vulnerable' (V) (Anon 1988). Initial surveys on the population status of the Chiltan wild goat were made in the early seventies. In November 1970 following some fieldwork, Schaller and Mirza (1970) estimated the population of the Chiltan goat as two hundred in Hazarganji-Chiltan National Park. In the course of developing the management plan, four separate surveys were conducted by WWF-Pakistan during 1996 -1998 and on an average, more than seven hundred animals were counted in these surveys. Basic population and ecological data on the Chiltan wild goat is extremely limited. The present status of scientific knowledge on the Chiltan wild goat is too old and does not reflect the current population and habitat details of the animal. The scientific information on the morphology and biochemistry of the ungulates in general and the Chiltan wild goat in particular is lacking. The existing knowledge on the species does not completely elaborate its identification compared to its relatives. In the past, a few efforts have been undertaken to identify its taxonomy but those were mostly based upon personal communication, observing some body traits, and general observations that do not quantify the required information. Though Schaller (1977) has changed the status of the Chiltan goat, some scientists and local experts still do not agree with his arguments and declare the species to be, in fact, a markhor. Although grazing is prohibited in the National Park, the wildlife authorities must work to totally discourage this activity.

Livestock not only compete with the wildlife, but also are as vector for disease. Keeping in view these important problems, efforts should be mobilised to investigate any remnant population of the species or alternate suitable habitats other than the Hazarganji Chiltan National Park. Then the animals should be reintroduced in those areas and managed appropriately as an alternate viable genome. Keeping in view the importance of the National Park in general and the Chiltan wild goat in particular, the WWF has formulated a management plan for the park. This sub-project of BNRMP funded by the World Bank aims to strengthen the Forest Department's National Park wilderness area management capability. The plan has been approved by the authorities and is to be implemented accordingly so that the area can be managed properly and scientifically.

Birds of prey like the peregrine, cherrug or saker falcons, tawny eagle, imperial and greater spotted eagles, osprey, shikra, and the black-winged kite occur throughout Pakistan but their population statuses are unknown.

Along the shores, there are four species of marine turtles: the ridley, green, leatherback and hawksbill turtle, which are of high economic importance. Due to loss of habitat and human disturbances, their population is also decreasing. About eight species of freshwater turtles are found in Pakistan. Sand lizards, monitors, geckos, agamas, diamond snakes, sand snakes, vipers, cobras, kraits and the famous Indian python constitute the other reptilian fauna (see **Box 9**, "Snakes of Pakistan").

Box 9: Snakes of Pakistan⁹

Pakistan possesses a diversity of snake species belonging to both the Palearctic and Oriental realms. Sixty-five species belonging to seven families have been identified. There is a dearth of scientific studies on Pakistani snakes and amateur herpetologists, mostly expatriates, carried out most of the available reliable studies in the early sixties. Current professional studies of herp fauna of Pakistan in general, and snakes in particular, are lacking. Systematic studies throughout Pakistan would definitely reveal new species and aid conservation efforts (currently there are none). The rat snake is listed in provincial wildlife acts, but no protection is accorded to these or any other snake. Some important snake species of Pakistan include:

- Indian python (*Python molurus molurus*) - This is found in the Indus Delta and around the Indus River in lower Sindh. It is threatened in Pakistan.
- Red-spotted diadem snake (*Sphalerosophis arenarius*) - This is a near endemic colubrid species found in Las Bela, and the Thal desert.
- Maynard's awl-headed snake (*Lytorhynchus maynardi*) - This endemic species is from the Chagi Desert. Illegal capture for export is perhaps the biggest threat to this species.
- Sindh River snakes (*Enhydryis pakistanica*) - This endemic species is found in the Indus Delta.
- Oxus cobra (*Naja naja oxiana*) - This species is listed as threatened in the IUCN Red Data Book.
- Leaf-nosed viper (*Eristicophis macmahoni*) - Found in the deserts of northwestern Balochistan, is near endemic.
- Himalayan pit viper (*Agkistrodon Himalayanus*). This species is endemic to the western Himalayas.

Snakes are mythical creatures. Most people consider all snakes as lethal. A mass awareness programme, aiming at providing scientific information will help in the conservation of snake fauna. There is also a strong need to carry out studies on lifestyles and indigenous knowledge of Jogi (snake charmer) tribes that are scattered throughout Pakistan.

Large water bodies in the country support a variety of waterfowl both resident and migratory. The extent of wetlands is constantly being changed. On one hand, swamps and marshes are being drained to reclaim land, whereas on the other hand, new dams (large water bodies) have been created for irrigation purposes. Canal irrigation through seepage has also contributed towards increasing the land area under water in the form of water logging. Such areas support a great number of waterfowl by providing them with an excellent habitat. The wetlands are one of the most important wintering areas and "green routes" of Asia. The important waterfowl in Pakistan are the ducks (mallard, pintail, shoveler, pochard, gargeny, ruddy shelduck, teals, tufted and gadwall), geese (grey lag, bar-headed), coots, flamingoes, pelicans, spoon bills, storks, ibises, plovers, curlews, sand pipers, snipes, and herons. The marbled teal and white-headed duck have decreased in number and now visit the wetlands infrequently. Among the waterfowl are (resident) gallinules, moorhens and rails, gulls, terns, water cock, grebes, cormorants, egrets, bitterns, and jakanas. The spot-billed lesser whistling teal and the cotton teal are resident ducks. A rich wader fauna visits the coastline during the winter.

Efforts have been made to document the status of wildlife and in some cases, the correct status is known, whereas most of the information about their populations is sketchy. With the strengthening of wildlife organisations in the country more reliable information can be obtained.

⁹ Case Study Prepared by Naeem Ashraf Raja Fellow LEAD- Pakistan

5.2 Areas of Special Concern

The Himalayan moist and dry temperate forests are hot spots for avian species as they contain the largest populations of the endangered western tragopan, and other birds. These areas are also home to wild relatives of livestock such as the Himalayan ibex, the Chiltan and Sulaiman markhor, and the urial sheep. The Indus flood plains are among the world's most important areas for migratory birds.

5.3 Species of Special Concern

5.3.1 Extinct

Though little data is available, there is little reason to believe that Pakistan's biota is exempt from this rapid decline. Within the last 400 years, at least four mammals are known to have disappeared from Pakistan: the tiger (*Panthera tigris*), swamp deer (*Cervus duvauceli*), lion (*Panthera leo*) and the Indian one-horned Rhinoceros (*Rhinoceros unicornis*). Furthermore, four species are also extinct: the Asiatic cheetah (*Acinonyx jubatus venaticus*), the Indian wild ass (*Equus hemionus khur*) and the Hangul (*Cervus elaphus hanglu*) have most likely become extinct in recent decades (Roberts 1977, Khan and Hussain 1985). The fourth species is the Blackbuck (*Antelope cervicapra*) is listed as an extinct species but has been bred in captivity.

5.3.2 Internationally Threatened

The latest *IUCN Red List of Threatened Animals* (IUCN 1996) lists 37 species and 14 sub-species of internationally threatened or near-threatened mammals that are found in Pakistan (**Appendix A**). Of these, two are critically endangered, nine endangered, 11 vulnerable, 23 near-threatened, five data deficient and one is conservation dependent. The critically endangered mammals are the Balochistan black bear (*Ursus tibetanus gedrosianus*) and the Chiltan goat (*Capra aegagrus chiltanensis*). The full list of threatened and near-threatened mammals includes: four species of bats (Chiroptera), two species of primates, three species of dogs (Canidae), three species and two sub-species of cats (Felidae), one species of otter (Mustelidae), and one species and one sub-species of bear (Ursidae). The list also names three species of cetacean, one species and one sub-species of Artiodactyla, one sub-species of Cervid, 11 species and nine sub-species of Bovidae (antelopes, goats, sheep, etc.), one species of pangolin (Manidae), and seven species of Rodentia.

Twenty-five internationally threatened birds (one critically endangered, two endangered, and 22 vulnerable) and 17 internationally near-threatened birds are found in Pakistan (Collar and Andrew 1994, IUCN 1996) (see **Appendix B**). One critically threatened bird is the lesser florican (*Eupodotis indica*).

Ten internationally threatened reptiles occur in Pakistan (three endangered, three vulnerable, three near threatened and one data deficient), but there are no internationally threatened amphibians in Pakistan (IUCN 1996) (see **Appendix A**). The latest *Red Data Book* (IUCN 1996) additionally lists one species of fish, the spiny eel (*Macrogathus aral*) and one species of invertebrate, a butterfly (*Hyles hippophaes*) as data deficient.

5.3.3 Species of National Concern

Lists of internationally threatened species show only the tip of the iceberg. For example, while only 5% of European birds are of global conservation concern, a further 33% have unfavourable conservation statuses in Europe (Tucker and Heath 1994). While there is little data available to demonstrate the decline of species' populations in Pakistan, the accelerating

loss, degradation and fragmentation of habitats clearly imply such declines. Habitat fragmentation isolates the population of a species, exposing them to a higher rate of loss of genetic diversity and a higher risk of extinction (UNEP 1995). A few preliminary attempts have been made to draw up national lists of threatened species. These include a list of some 500 species of plants believed to be nationally rare or threatened (Davis et al. 1986). No comprehensive and systematic list of species of national concern has been compiled for Pakistan. Such a list would include species, which are nationally rare and declining, and those that are nationally rare, and not declining, but otherwise at risk (e.g. from population fluctuations, natural catastrophes, indiscriminate killing, etc.). The list would also include those that are highly localised in distribution and those, which are still widespread and common but are suffering significant decline.

5.4 Protected Area Systems

Land areas set aside specifically for protecting wildlife is not a new concept in Pakistan. The early rulers or *Mirs* often declared certain areas as preserves especially for this purpose so they would have a sufficient supply of game animals for hunting.

The first forest reserves set up under the British period in the mid 1800's, more often than not circumscribed the same areas previously set aside by the *Mirs*. Under the British forest system, habitat was protected and to some degree wildlife itself.

Outside the Indus basin, wildlife has maintained itself due to the remoteness and inaccessibility of the terrain, especially in the northern mountainous, tribal areas. Local chieftains with a passion for hunting often recognised the value of putting certain areas off limits to hunting to allow animal populations to build up.

Thus, coming into the present century there were a number of areas scattered around the country that served to protect wildlife. Except for the reserved or protected forests, few received more than a minimum amount of management and many were unknown.

The passage of the Wildlife Protection Ordinance in 1959 and issuance of the Wildlife Protection Rules in 1960 authorised the establishment of sanctuaries and reserves for game. Wildlife was formally recognised as an important natural heritage.

Following the 1966 and 1967 WWF expeditions in Pakistan to assess the state of the environment, recommendations were made to the Government of Pakistan for the establishment of parks and reserves. The functions of the Wildlife Inquiry Committee, appointed in 1968 included the selection of suitable areas for declaration as national parks or reserves. The committee also made recommendations concerning legislative, administrative and other measures concerning the national parks. It was well-recognised that in order to conserve wildlife, Pakistan needed an extensive network of well-maintained reserves and that this network should include samples of all the various habitats and their associated fauna, including predators such as wolves and leopards. The Wildlife Inquiry Committee completed its work in October 1970 and recommended the establishment of 46 wildlife sanctuaries. These would be devoted to preservation of flora and fauna in its natural state and entrance and other activities would be controlled by permit. Forestry practices were prohibited, as were the collection of grass, firewood, building materials. Five Game Reserves were established and hunting was to be controlled by a special permit system.

The first national park, Lal Suhanra, was formally declared in the Bahawalpur district of Punjab in 1972. The park consists of irrigated forest plantations (20,974 acres), desert branch pond (4780 acres) and Cholistan Desert (51726 acres) for a total of 77480 acres. The park was established to protect existing wildlife and vegetation; reintroduce extirpated species; rehabilitate wildlife habitat; create education/research facilities for local and foreign tourists, and recreational facilities for the local population.

Kirthar National Park achieved its protected status in 1973. Established in the Dadu district of Sindh, this 466,000 acre reserve provides protection for a fine herd of ibex about 60 miles north of Karachi. Other large game species such as Indian gazelle and urial sheep have increased their populations within the park. A management plan has been drawn up for the park with the assistance of the World Conservation Union (IUCN). However, fiscal restraints and other priorities have largely precluded full implementation of the plan.

Khunjerab in northern Hunza, Gilgit Agency, became the third national park in 1975. This area has been successful in providing protection for the Marco Polo's sheep, blue sheep, snow leopard, snowcock, snow partridge and other high mountain species.

National parks in Pakistan have apparently been established primarily for wildlife and not necessarily for their historic or scenic features. The provincial wildlife departments handle their administration. So far, 14 national parks have been declared as follows:

NAME OF THE NATIONAL PARK	AREA (ha)	Year of declaration
Ayubia	1,684	1984
Chinji	6,095	1987
Chitral Gol	7,750	1974
Hazarganji–Chiltan	15,555	1980
Hingol	165,004	1997
Khunjerab	226,913	1975
Kirthar	308,733	1974
Lal Sohanra	37,426	1972
Margalla Hills	17,426	1980
Central Karakorum	13,90,100	1995
Kandrap Shandur	51,200	1993
Deosai Plains	3,58,400	1993
Sheikh Buddin	15,554	1993
Machiara	13,532	1980
Total	37,67,518 Ha	

(Source: WWF-Pakistan and MELGRD)

IUCN Protected Area Classification (I-VI) is given below:

IUCN PROTECTED AREAS CLASSIFICATION

- I. Strict Nature Reserve/Wilderness Area:** Areas of land and/or sea possessing outstanding or representative ecosystems, geological physiological features and/or species, available primarily for scientific research and/or environmental monitoring; or large areas of unmodified or slightly modified land, and/or sea, retaining their natural character and influence, without permanent or significant habitation, which are protected and managed so as to preserve their natural condition.
- II. National Park: Protected Areas Managed Mainly for Ecosystem Conservation and Recreation.** Natural areas of land and/or sea, designated to (a) protect the ecological integrity of one or more ecosystems for this and future generations, (b) exclude exploitation or occupation inimical to the purposes of designation of the area and (c) provide a foundation for spiritual, scientific, educational, recreational and visitor opportunities, all of which must be environmentally and culturally compatible.
- III. Natural Monument: Protected Areas Managed Mainly for Conservation of Special Features.** Areas containing one or more specific natural or natural/ cultural

features which is of outstanding or unique value because of its inherent rarity, representative or aesthetic qualities or cultural significance.

- IV. Habitat/Species Management Area: Protected Areas Managed Mainly for Conservation through Management Intervention.** Areas of land and/ or sea subject to active intervention for management purposes to ensure the maintenance of habitats and/ or to meet the requirements of specific species.
- V. Protected Landscape / Seascape: Protected Areas Managed Mainly for Landscape/ Seascape conservation and recreation.** Areas of land, with coast and sea as appropriate, where the impact of people and nature over time has produced an area of distinct character with significant aesthetic, cultural and/ or ecological value, and often with high biological diversity. Safeguarding the integrity of this traditional interaction is vital to the protection, maintenance and evolution of such an area.
- VI. Managed Resource Protected Area Protected Areas Managed Mainly for the Sustainable Use of Natural Ecosystems.** Areas containing predominantly unmodified natural systems managed to ensure long-term protection and maintenance of biological diversity, while providing at the same time a sustainable flow of natural products and services to meet community needs.

Source: IUCN, 1994. Guidelines for Protected Area Management Categories

In addition to the above mentioned 14 national parks, the provincial governments have listed 99 wildlife sanctuaries (Punjab - 19, Sindh - 35, Northwest Frontier - 6, Balochistan - 15, Northern Areas - 5). In addition, 96 other areas have been designated as game reserves. These govern an additional 4407 square miles of terrain, (Punjab - 19 areas, Sindh - 14 areas, Northwest Frontier - 38 areas, Balochistan - 7 areas, Northern Areas - 9 sites and AJK - 8 sites).

Most of the areas were created to provide habitat protection for animal species commonly referred to as game (hunnable species for sport or meat). Providing protection for these species also offered a measure of security for many lesser known plant species and smaller animal species. Thus, the Government of Pakistan has created a parks and reserves system governing about 9.1 million ha (10.40% of total land area). Although extensive, only a fraction of the network is protected. Game reserves, in particular, which are often in private land, receive minimal protection due to the lack of legal provisions to control land use. Wildlife sanctuaries enjoy better protection, but in practice, legal restrictions are seldom enforced other than to prevent hunting. Most sanctuaries have been designated in reserve forests of commercial value where timber and minor forest products are harvested. Enforcement is better in the national parks. Protected areas have been created haphazardly, often in the absence of any criteria for their selection, and the boundaries drawn with little or no ecological basis. The protected areas system is under review to incorporate a new category of protected areas viz. Biodiversity conservation.

6. Insect Biodiversity

This section describes insect fauna found in Pakistan, the major threats to insect Biodiversity, and measures that have been taken or are proposed for the conservation of insect Biodiversity

6.1 Insect Species in Pakistan

By far the majority of invertebrates in the terrestrial environment are insects. More than 2000 species have been recorded in Pakistan. A few species or groups of insects may occur in extremely large numbers and the biomass of invertebrates in a forest or plateau may be greater than the vertebrate biomass in the same environment. Pakistan has representatives of 13 insect orders.

The orders of Protura, Thysanura and Diplura comprise a small numbers of species that live in the soil or in kitchens or food stores. More than 150 of such species are known to exist in Pakistan.

Grasshoppers and crickets (Orthoptera) form an order having 152 species recorded from Pakistan. Most members of the grasshopper family, Acrididae, live on vegetable matter, but some of the bush cricket families, Tettigoniidae, also eat other insects. Some are large beautiful insects, which can also attract attention via their song.

Earwigs (Dermaptera) form an insect order with many species in Pakistan. These live on the ground where they eat small insects and vegetation. They are most commonly found in dirty kitchens, sewage pipes, food stores, etc.

Dust lice or book lice (Psocoptera) comprise an order of insignificant insects in Pakistan. There are two recorded species from Pakistan. They live beneath the bark of trees and feed on pollen and fungus myceli. A few species live in buildings and cause damage to books and Natural History collections.

Thrips (Thysanoptera) are very small slender insects with two pairs of thread-shaped wings with broad fringes. These live on plants, especially the flowers, ten species of which have been recorded in Pakistan. There are more than 159 species of bugs (Hemiptera) recorded in Pakistan. Lacewings and alderflies (Nemoptera) are two species recorded from Pakistan.

Other insect species recorded in Pakistan include:

- Many species of scorpion flies (Mecoptera)
- 25 species of fleas (Siphonaptera)
- 315 species of butterfly (Lepidoptera) and
- Species of bees, wasps and ants (Hymenoptera)

Other Arthropods found in Pakistan include:

- Species of millipedes (Diplopoda)
- Species of centipedes (Chilopoda)
- 84 species of arachnids (Arachinoidea)
- 225 recorded species of mollusca and 75 of nematodes.

Entomology is taught as a major subject in three agricultural universities: the University of Agriculture, Faisalabad; Sindh Agricultural University, Tando Jam, the University of Agriculture, Peshawar. Entomology's major application is in the plant protection and

community health sectors. Although this subject is of major economic importance for enhancing agricultural productivity, it has not been given the importance it deserves. There are a number of agricultural research stations in Pakistan, but entomologists have inadequate opportunities for advanced research and development in their field. Therefore, the present level of information on insect Biodiversity in Pakistan is very low. Integrated Pest Management (IPM) technologies that ensure reduction in the use of insecticides are applied on a very limited scale.

6.2 Use of Pesticides and Threats to Biodiversity

Since the early 1950s, with the discovery of the insecticide properties of DDT, insecticides have been used excessively for pest control. During this period, due to the spectacular success of chemical control, other control techniques were almost completely ignored. The indiscriminate use of insecticides has adversely affected Biodiversity by killing or eliminating animal species. However, the development of resistance in pests against insecticides; the resurgence of secondary pests; pollution of the environment; and presence of pesticide residues in the food chain; have stimulated renewed interest in alternative methods of pest control. Consequently, the interest in Integrated Pest Management (IPM) has developed.

More than two hundred pesticides including insecticides, acaricides, weedicides, nematocides, rodenticides, etc. are registered in Pakistan. Insecticides that have not been registered are also being imported under generic names. These are creating resistance in insect pests, causing serious environmental problems and posing a serious threat to Biodiversity.

At present, pesticides worth more than Rs.13 billion are imported into Pakistan annually. Most of these pesticides are non-selective toxic chemicals. Ecological and agricultural sustainability has become an essential consideration in Pakistan's agriculture. The indiscriminate use of pesticides has been responsible for a number of problems such as environmental pollution, resistance in pests, and the upsurge of secondary pests due to the elimination of natural enemies.

6.3 IPM Projects in Pakistan

In Pakistan, foreign donor agencies including the World Bank, the Asian Development Bank (ADB), the Food and Agriculture Organisation (FAO) of the United Nations and the Swiss Development Co-operation mostly sponsor Integrated Pest Management (IPM) projects. The major on-going projects are:

- Integrated pest management of sugar pests in Sindh
- Integrated pest management of cotton pests in south Punjab
- Integrated pest management of cotton pests with emphasis on the white fly in Multan Civil Division, Punjab

The Government of Pakistan makes minor contributions for the introduction, research and implementation of IPM projects. The Biodiversity of agro-ecosystems is lower in comparison to less disturbed ecosystems. The use of insecticides further adversely affects Biodiversity by reducing the number and populations of insects, especially those of natural enemies. When pesticides are used indiscriminately natural enemies are the first to be eliminated, resulting in an upsurge of secondary pests disturbing the Biodiversity of the agro-ecosystem.

Of the various methods of pest control, Integrated Pest Management is the best for the conservation of Biodiversity. IPM programmes for a number of crops such as sugarcane,

mango, apple and cotton have been developed in Pakistan. The biological control components of IPM are introduction, conservation, redistribution and augmentation.

In introduction and redistribution, useful and beneficial species are transferred from one area to another. If they become established, they permanently add to the Biodiversity of the agro-ecosystem. They do not eliminate the pest species but bring their populations to sub-economic levels thus enriching the Biodiversity of the ecosystem. **Table 6.1** gives an account of successes achieved in Pakistan by elimination or minimisation of pesticide use and thereby directly contributing to Biodiversity conservation. A number of species have been successfully introduced and redistributed in Pakistan (**Table 6.2** and **Table 6.3**).

In conservation, desirable species (mostly of natural enemies) are protected or encouraged by the judicious use of insecticides and cultural practices or by providing shelter to natural enemies. Therefore, the populations of natural enemies are saved from destruction or elimination. This helps in improving Biodiversity. The natural enemies of the pests of mango, sugarcane and cotton have been conserved for pest control in IPM technologies.

In augmentation, populations of natural enemies are increased by the release of natural enemies at the proper time. This is based on detailed studies on the biology and ecology of the pests and their natural enemies. The addition of useful species at a certain time of the season not only enhances Biodiversity but also provides cheap and safe control of the pests for which otherwise poisonous insecticides would have been used.

In Pakistan, very little effort has been made to study the Biodiversity of agro-ecosystems. The challenge is to conserve or improve it before it is destroyed. Studies on this important aspect of agro-ecosystems should receive priority

Table 6.1: Successes in Biological Control and Integrated Pest Management in Pakistan

		Control Measures	Remarks
Sugarcane	Pyrilla	Conservation of egg parasitoids	Complete control throughout NWFP, aerial spray Was stopped and more than RS. 30 million are being saved every year since 1985. Complete control at Faran Sugar Mills, Tandlianwala Sugar Mills, Habib Sugar Mills etc.
	Borers	Introduction of <i>Cotesia flavipes</i>	Excellent control achieved at Habib Sugar Mills, Faran Sugar Mills, Tandlianawala Sugar Mills, Consolidated Sugar Mills In addition, Bannu Sugar Mills etc.
		Augmentative releases of <i>Trichogramma</i> Mass releases of the egg parasitoids <i>Telenomus dignus</i>	Excellent control achieved at Habib Sugar Mills, Faran Sugar Mills, Jamal Din Wali Sugar Mills, Tandlianawala Sugar Mills, Consolidated Sugar Mills and Bannu Sugar Mills etc.
Mango	Fruit flies and scale insects	Use of pheromone traps, releases of Coccinellid beetles	Excellent control of fruit flies and scale insects
	Mealy bug	By hoeing and ploughing	Good control of mealy bug was achieved.
Apple	Pest Complex	Biological control based IPM	Complete control of woolly aphid, San Jose scale, codling moth, and red spider mites. Number of pesticide sprays considerably reduced.
Cotton	Bollworms	Mass releases of <i>Trichogramma</i> .	Excellent control of Bollworms
	Sucking pests	Conservation of predators	Excellent control of sucking pests

Table 6.2: Natural Enemies Introduced from Other Countries

Crop	Parasitoids	Country of origin	Year	Target pest	Where established	Reference
Maize and Sorghum	<i>Cotesia flavipes</i>	Japan	1962	<i>Chilo partellus</i>	Throughout Pakistan	Mohyuddin (1981)
Apple	<i>Aphelinus mali</i>	Switzerland	1989	<i>Eriosoma lanigerum</i>	Murree, Azad Kashmir,	Qureshi et al., (in press)
			1991-92	<i>E. lanigerum</i>	Malakand Division	Mohyuddin and Qureshi (1992)
	<i>Encarsia perniciosi</i>	USA	1959-60	<i>Quadraspidiotus perniciosus</i>	Murree, Azad Kashmir,	Rehman et al., (1961)
Grape Vines	<i>Leptomastix dactylopii</i>	Texas (USA) and Trinidad	1984-86	<i>Planococcus citri</i>	Quetta valley	

Table 6.3: Successful Redistribution of Natural Pest Enemies in Pakistan

	Natural enemy	Origin	Year	Target Pest	Where Redistributed	Reference
I	SUGARCANE					
	Epiricania melanoleuca	Punjab	1975	Pyrilla perpusilla	NWFP (Peshawar)	
II	APPLE					
	Chilocorus infernalis	Murree	1990	Quadraspidiotus perniciosus	Kalam	Mohyuddin and Qureshi (1992)
	Aphelinus mali	Murree	1991	Eriosoma lanigerum	Swat	Qureshi, et al., (in press)
	Encarsia perniciosi	Murree	1993	Q. perniciosus	Swat	Mohyuddin and Qureshi (1992-93)

7. Marine Biodiversity

This section deals with Pakistan's marine ecosystems. It includes discussions of the present status of marine Biodiversity, major threats, and actions that have been taken or are required for marine Biodiversity conservation.

7.1 Pakistan's Coastline

Pakistan has a 1050 km long coastline, 250 km falling in Sindh province and 800 km in Balochistan. It borders the productive NE Arabian Sea, famous for its upwelling phenomenon. Its Exclusive Economic Zone (EEZ) covers an area of 196,600 sq. km. In addition, the territorial waters cover an area of 24,000 km². The continental shelf of the Sindh coast extends to a distance of 150 km whereas Balochistan only measures 15-40 km. The prevailing direction of the ocean current is clockwise during the southwest monsoon season and anti-clockwise during the northeast monsoon season. The salinity value is generally 36 ppt. Tides are neither very high nor very low, but intermediate; the mean average height is about 10-11 feet. Tides are higher on the eastern side and their velocity is generally between 1-2 knots but can increase to 4 knots in narrow creeks.

The coast is rugged and tectonic in origin as evidenced by the uplifted terraces, headlands and fluted beds. The mud volcanoes present along the shores further support this geographical condition. The coastline is mostly bare desert with unique landforms such as sandy beaches, mud flats, rocky cliffs, headlands, bays, deltas, etc. Brief descriptions of these are given in the following section.

7.1.1 Habitat Types along Pakistan's Coastline

7.1.1.1 Beaches

Sandy beaches are common along Balochistan's shores but rare in Sindh. Well-known beaches in Pakistan include Somniani, Hingol River, Ormara, Pasni, and Gawadar in Balochistan; and Clifton and Hawks Bay in Sindh.

7.1.1.2 Cliffs and Headlands

Rocky shores and cliffs are prevalent in Balochistan. They are generally composed of conglomerates of soft mudstone and sandstone, which are highly susceptible to erosion. Headlands are prominent in Jiwani, Pisukan, Gawadar Rasjaddi and Ormara, and are intervened by low-lying places comprised of alluvial deposits. Irregular cliffs present at Ras Malan are a result of tectonic activity. Several deep-seated faults are also evident. The Sindh coast on the other hand, is very poor in rocky shores. Buleji, Manora Rocky Ledge, Cape Monze, and a few other small sites are present in the extreme western part of the province. The steep cliffs at Cape Monze are a trajectory of Mor and Kirthar Ranges, and are composed of hard limestone.

7.1.1.3 Bays and Lagoons

Bays and lagoons are protected bodies of water surrounded by land having an opening into the sea. In bays, the opening is wide, whereas in lagoons it is very narrow. There are no bays or lagoons along the Sindh coast, but several along the Balochistan coast, such as Gawadar Bay, Ormara Bay and Somniani Bay. Sandy coasts in a curvilinear pattern fringe the

first three mentioned bays, which are slowly being destroyed by erosion. There are only two lagoons in the country, both of which are also located in Balochistan. These are the lagoons of Kalamat Khor and Miani Hor. These harbour dense mangrove vegetation.

7.1.1.4 Mud Flats

Mud flats are gently sloping, unconsolidated inter-tidal parts of estuaries, and are always occupied by marsh vegetation. Tidal flats are the same except that they lack vegetation. The entire Indus Delta and most of the Sindh coast is comprised of mud flats with mangrove vegetation. Mud flats are non-existent in Balochistan except in Gawadar Bay, Kalamat Khor and Miani Hor lagoons.

7.1.1.5 Mud Volcanoes

Mud volcanoes are conical hills or mountains with a crater on top through which they gently emit liquid, mud and gas. They are commonly associated with petroleum deposits; hence, their presence indicates high petroleum potential along the Makran coast. Mud volcanoes generally emit muddy and saline water, but occasionally large masses of rock are violently blown hundreds of feet into the air. The gases that are discharged include methane, ethane and traces of unsaturated hydrocarbons. Mud volcanoes are a common occurrence in Balochistan but are not found in Sindh.

7.1.1.6 Estuaries

Estuaries are coastal embankments that receive substantial freshwater runoff from land, and experience open tidal circulation with the ocean. In other words, estuaries are the mouths of rivers opening into the sea. There are three major estuaries in Pakistan, the largest one being the Indus estuary on the Sindh coast. The other two are the Hingol and Dasht estuaries both located in Balochistan.

7.1.1.7 Deltas

Deltas are an accumulation of sediments at the mouths of rivers where they empty into basins. Deltas consist of three major parts: the delta plain, delta front and prodelta. There are several small deltas at the mouths of seasonal rivers in Balochistan. However, one of the largest deltas in the world, the Indus Delta, is located at the mouth of the Indus River and covers almost the entire coast of Sindh. It forms a remarkably uniform landform with large extensive mud flats intervened by narrow creeks. These are remnants of old, Indus tributaries. The western part of the delta between Phitti Creek and Karachi Harbour is now abandoned, although at one time the Indus River used to flow close to Karachi.

7.2 Important Marine Species and their Status

Species diversity is generally a good measure of the Biodiversity index, but cannot be applied in places such as Pakistan, because the flora and fauna has not been adequately studied and documented. In addition, as Pakistan is not a bio-geographic entity and its borders are confluent with other countries, the rate of endemism is very low. While endemic species do exist in terrestrial flora and fauna, information about endemic marine forms does not exist. Some important groups and species of marine animals are described below.

There are approximately 788 marine fish species in Pakistan's coastal waters (Ahmed, 1998). Large pelagics such as the tuna are common in the waters of Balochistan. The blind Indus dolphin (*Platanista minor*) is a resident of the Indus River and estuary. Palla fish (*Tenalosa*

ilisha), which is considered a delicacy, is an anadromous¹⁰ fish that swims up the Indus River to breed. However, the palla fish can no longer migrate up the Indus River due to the construction of a number of dams. Now it is found up to the Ghulam Mohammad Barrage. This has seriously affected the reproductive potential and distribution pattern of the species.

The green turtle (*Chelonia mydas*) and the olive ridley turtle (*Lepidochelys olivacea*) are both found in Pakistan. Until recently, they were indiscriminately killed on the Makran coast.

Eight species of oysters occur in Pakistan. Squid are abundant, but surprisingly echinoderm populations are very small.

Eight mangrove species were reported to grow in Pakistan until recently, but now only four survive. These are *Avicennia marina*, *Ceriops tagal*, *Aegiceras corniculatum*, and *Rhizophora mucronata* (Saifullah, 1982,1997).

7.3 Major Threats to Marine Ecosystems

The major threats to marine ecosystems in Pakistan include pollution, decreased river flow, urbanisation, and sea level rise (Table 7.1). Marine ecosystems in Sindh face all nine issues mentioned in the table, whereas Balochistan's marine ecosystems face fewer threats. For instance, pollution, urbanisation, and the decreased flow of river water are not problems in Balochistan where the marine environment is presently pristine.

One of the biggest environmental problems in the Indus Delta region is the drastically reduced river discharge caused by the construction of dams further upstream. The discharge is presently around 5 percent of what it used to be before the construction of the dams. This has seriously affected the Biodiversity of the region, especially that of the mangrove forests. Only four out of eight mangrove species now survive, and the total area covered has undergone significant reduction.

The construction of dams has also affected the stocks of palla fish and the Indus dolphin, whose populations have declined significantly. Along with the reduction in the Indus' flow, there has been a sharp reduction in the annual discharge of alluvial sediments. The reduction in sedimentation has had an adverse affect on mangrove populations and other soft bottom biota, and has been responsible for shore erosion, since sediment is no longer deposited along the shoreline.

Urban and industrial pollution is the next serious problem-threatening marine Biodiversity. There are more than 5000 industrial units in Karachi. Approximately 262 million gallons of sewage are generated each day; half is of municipal origin and the other half of industrial origin. Only a fraction of this sewage is treated before being dumped into the sea.

There is significant oil pollution along Pakistan's coastline. According to one estimate, some 90,000 tons of oil find its way to the Pakistani coast each year, due to the clearing of bilge and other oil refuse. Other major pollution sources in Karachi include steel mills, power plants, and refineries. Due to the increased turbidity caused by the discharge of pollutants, the large edible oyster *Crassostrea sp.* is on the verge of extinction.

¹⁰ Fish that ascends rivers from the sea to spawn- *The New Shorter Oxford Dictionary*

Table 7.1: Threats to Marine Ecosystems

Problem/Issue	Management Strategies
Mangrove deterioration <ul style="list-style-type: none"> • Hypersalinity • Overexploitation • Pollution • Soil erosion 	<ul style="list-style-type: none"> • Increased flow of the Indus • Reforestation • Ban on 'Katra¹¹' nets • Regulate harvesting • Strict adherence to NEQs • Assessment of annual loss
Pollution <ul style="list-style-type: none"> • Industrial • Eutrophication • Sewage • Oil • Agriculture • Toxic waste • Thermal • Radioactive 	<ul style="list-style-type: none"> • Pre-treatment of effluents • Monitoring • Clean-up operations • Ship waste processed or eliminated • Multi purpose numerical modelling • Reduction of harmful compounds
Decreased Flow of the Indus <ul style="list-style-type: none"> • Soil erosion • Hypersalinity 	<ul style="list-style-type: none"> • Restoration of flow • Strict adherence to NEQs • Decrease silt deposition
Threats to Biodiversity <ul style="list-style-type: none"> • Disappearance of species • Loss of sanctuaries 	<ul style="list-style-type: none"> • Improved habitat • Reintroduction of extinct species • Marine parks • Eco-tourism
Urbanisation <ul style="list-style-type: none"> • Dredging • Channelisation • Solid wastes 	<ul style="list-style-type: none"> • Regulation of coastal development • Dumping of dredged material far away • Reforestation
Rising sea level <ul style="list-style-type: none"> • Loss of land and biota • Economic losses 	<ul style="list-style-type: none"> • Estimation of accretion and sea-level rise • Conservation of mangroves
Socio-economic aspect <ul style="list-style-type: none"> • Poverty • Illiteracy • Lack of municipal facility 	<ul style="list-style-type: none"> • Socio-economic uplift of fishermen • Education • Alternative livelihoods • Marine parks • Apiculture • Mariculture
Lack of public awareness and people participation	<ul style="list-style-type: none"> • Participation of locals in all coastal matters • Education through mass media
Lack of harmonisation and enforcement of legislation	<ul style="list-style-type: none"> • Central, provincial and local government co-operation • Penalties

Source: Saifullah, S.M. University of Karachi

The over-exploitation of natural resources (e.g. over fishing) also poses a considerable threat to marine Biodiversity. Unsustainable harvesting has resulted in the extinction of certain species, and a significant reduction in the populations of others. Certain crab, oysters and gastropods like *ficus*, *murex*, *tibia*, *bullia* and *olivia* are reported to be disappearing as a result of over-exploitation. Mangrove forests are used as a source of fuel wood and fodder, which has resulted in a decrease in shrimp catch from 25,000 tons to 14,000 tons. Green and olive ridley turtles were also killed indiscriminately in the past, but are now the focus of conservation efforts around Karachi. Over-fishing is a major problem in Pakistan's coastal waters. The Exclusive Economic Zone is frequented with illegal foreign trawlers, poachers and even the licensed trawlers resort to over fishing. Sawfish, hammerheads, sardines and sharks are the fish most affected by this illegal practice. RS. 22 million was accumulated as

¹¹ Fine guage nets that catch small fish

penalties during the year 1998-99 from foreign vessels involved in illegal fishing in the Exclusive Economic Zone of 35 nautical miles.

Box 10: Marine Turtle Conservation¹²

Thousands of years of biological and geographic evolution and manipulation have been unable to significantly alter the process of marine turtle nesting on the beaches of Karachi. Out of the eight species of marine turtles known world-wide in tropical and sub-tropical marine waters, two have been positively identified as nesting and laying on the beaches of Karachi. These are the green turtle (*Chelonia mydas*) and the olive ridley (*Lepidochelys olivacea*). Pakistan is thus amongst the very few major marine turtle nesting grounds in the world. Over-exploitation for commercial purposes has caused the world-wide turtle population to drop to drastically low levels. Like all other species of turtles, the green turtle and the olive ridley are also endangered and are threatened with extinction due to a number of factors. Observations indicate that poaching, predators and human habitation along the beaches are interrupting the turtle's egg laying process and destroying their nests, eggs and hatchlings. According to observations made by the Sindh Wildlife Department, the peak nesting season is from September to November, although turtles come up at lower densities throughout the year. The nesting process takes about three hours. It begins when the turtles come up onto the sandy shore, find a suitable place, dig a body pit and make an egg pit or nest. This is followed by laying of eggs and the pit is covered by sand. Finally, the turtles go back to the sea. It sheds tears during nesting which serves as an important biological process for balancing the salt concentration in the body. About one hundred or more eggs are laid at a time and hatch after forty to sixty days of incubation, sometimes more, depending on temperature and other environmental factors. The hatchlings are very active and instinctively orient themselves towards the sea, but they must walk on firm sand to reach the waves. This is the time when they can be attacked by birds, dogs and other predators. If they survive, they reach maturity after twelve to fifteen years; when they come back to the same beach to lay eggs.

A pioneering step for conservation was taken by the Sindh Wildlife Department, which passed the Protection Ordinance of 1972. The Act declared harassment or hurting an adult or to steal eggs or disturb nests an offence. A pilot project was started with the resources available from the Government of Sindh and WWF Pakistan in 1979. The project was included by the IUCN/WWF in their global protection programme "The Seas Must Live" (1976). The project proposal for the funding of marine turtle research and conservation programmes was forwarded to the IUCN and the WWF and approved in 1980. Since then, the Sindh Wildlife Department has started a protection and research programme for marine turtles. Protection, research and education are the three main components of this project.

Protection and conservation includes beach patrols, and the occasional prosecution of poachers. Conservation includes the transfer of eggs to protected enclosures, where the natural cycle is observed as much as possible. The eggs are buried in the sand at the same depth at which the mother laid them. A wire mesh bearing a serial number for record covers the nest. After hatching, the young turtles are released into the sea. To date, more than 4 million hatchlings have been released into the sea.

After laying eggs, turtles are marked by monel metal tags on both front flippers. Each tag carries "W" as a code for Pakistan with the return address inscribed on the other side. More than 3,000 turtles have been tagged and 513 have been recovered so far. To minimise the mortality rate of hatchlings, the captive rearing of sea turtles has begun, which after emergence, tiny hatchlings are kept in seawater tanks for a few months. Captive rearing or head starting is the practice of raising hatchlings to make them less vulnerable to the predators than the hatchlings growing in the wild. The aim of this practice is to contribute more to a healthy population.

At times, the turtles are examined for diseases and parasites. Leeches of the species *Ozobranchus* are usually found as ecto-parasites attached to their necks, eyes and other soft parts. Besides conservation and research, education of the masses is an important aspect of this project for which publicity material has been produced such as posters, T-shirts, stickers, signboards, information hoarding, greeting cards, brochures and documentary films. Guided tours to the beaches are also organised for students and the public to educate them aware of the conservation of this species and the protection of our natural heritage.

¹² Case Study prepared by Dr. Fehmida Firdaus Sindh Wildlife Department Karachi

7.3.1 Economic Value

Pakistan has a thriving fisheries industry. The annual catch of fish is about 300,000 tons while that of shrimp is 25,000 tons with a cash value (in 1999) of more than US \$ 30 million. Pakistan earns US \$ 120 million annually from the export of marine fish. The fisheries sector provides employment to whole communities, of which exact estimates are not available.

7.3.2 Institutional arrangements

Excessive mismanagement and ineffective policies have created huge problems within this sector. Firstly, too many agencies are laying their claim to the fisheries such as the Ministry of Food, Agriculture and Livestock (MINFAL) which is controlled through the Marine Fisheries Department, and the Fisheries Development Commission. The Fishermen Co-operative Society, Karachi, looks after the fishermen's interest and in 1999 a deal for fishing rights worth USD 460 million with a US company was cancelled by the government on protests from the local fishermen.

8. Freshwater Biodiversity

This section describes Pakistan's freshwater resources, and the species that are dependent on it. The major threats to Pakistan's freshwater Biodiversity are also discussed, as are the conservation measures that have already been taken or are proposed.

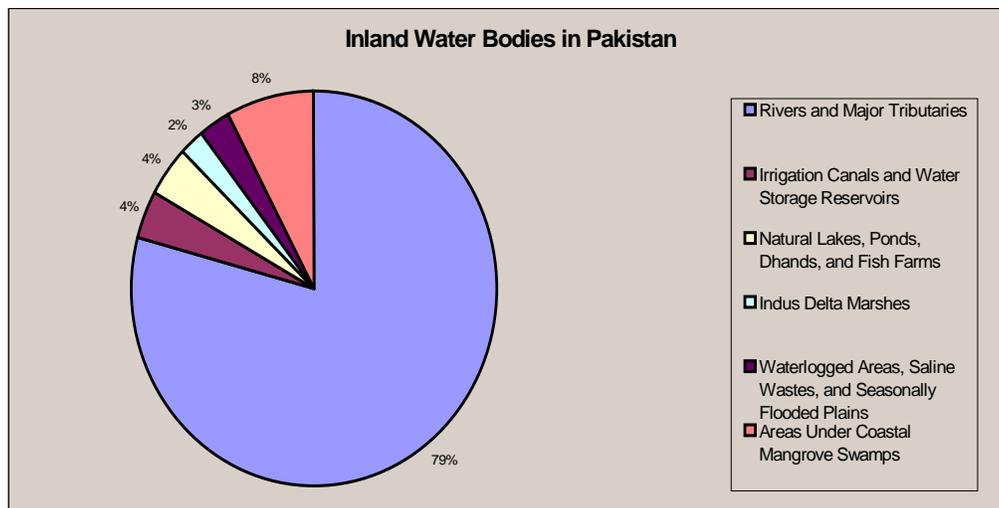
8.1 Pakistan's Freshwater Resources

Pakistan's freshwater resources are dominated by the Indus River system, which serves as a drainage basin for the Himalayas. The Indus originates in western Tibet and enters Pakistan through Baltistan. Its length up to the Arabian Sea is 2,480 km. As the river flows through the Northern Areas, the Shyok, Astor and Gilgit Rivers join the Indus. In the NWFP it is joined by the Kabul River, this has already joined the Swat River. The Indus then flows into Punjab, where the Jhelum, Chenab, Ravi, Beas and Sutlej Rivers join it. These rivers flow through Punjab and converge to form the much larger Indus River, which then flows through Sindh, before draining into the Arabian Sea through the Indus Delta.

Other than the Indus River system, there are some small rivers in Balochistan province such as the Hub River, Gudri River, and the Nal River, all of which drain into the Arabian Sea on the Makran coast. The area of Pakistan covered by inland water bodies is illustrated below in **Figure 8.1**.

Figure 8.1 Inland Water Bodies in Pakistan

Pakistan has one of the world's largest man-made canal irrigation systems, which consists of a number of large dams, barrages, and a network of irrigation canals and waterways. The three largest dams are the Tarbela, Mangla and Hub Dams. These dams have been constructed to regulate river water for hydropower production, and to provide water for



irrigation in Punjab and Sindh. In addition to irrigation canals, a number of link canals connect the rivers. Link canals are used to transfer water from one river to another. In addition to dams, a number of barrages also regulate water flow. Some of the larger barrages are the Chashma, Taunsa, Merala, Rasul, Qadirabad, Guddu and Sukker Barrages.

Pakistan's extensive irrigation system has resulted in a number of problems. Due to bad drainage, about 2.25 million hectares of agricultural land is presently waterlogged. In addition, a significant portion of these waterlogged areas is saline due to minerals that leach from the soil.

Around 200 multi-purpose mini dams have also been built in Rawalpindi, Chakwal, Attock, Sialkot, and Jhelum and Quetta districts to irrigate small areas.

Pakistan has a number of natural lakes: four in the province of Sindh (Manchar, Bakar, Kinjhar and Halijee); two in Balochistan (Patisar and Hina); one in Kaghan Valley (Saiful Malook), two lakes in the Neelum Valley. Several of other in Skardu and other parts of the Northern Areas. All these lakes receive water from springs and streams, and contain sweet to slightly saline water. A number of moderately saline marshy lakes also exist. Lakes in the Salt Range (Punjab) are generally saline, since they are charged by aquifers in mountains with a high salt content.

8.2 Important Species and their Status

Pakistan is at the peripheral zone of the South Asian region. The Trans-Himalayan area has no South Asian fish. There are 68 genera reported from Pakistan, none of which is endemic. Out of these, nine genera are high Asian. Most of the snow carps are restricted to the Trans-Himalayan part of the Indus system and only few come down to the mountain areas when temperature fluctuations in the water occur.

At least 179 species and sub-species of freshwater fish are reported to exist in Pakistan (15 exotics), including representatives from important groups such as loaches, carps, and catfish (including air-breathing catfish).

8.2.1 Aquatic Plants

Groups such as algae, and submerged and other emergent macrophytes have been studied in freshwater environments. None of these plants is reported to be under threat. However, comprehensive information is absent as research material is scarce.

8.2.2 Amphibian Fauna

There are three families of amphibian fauna in Pakistan:

- Bufonidae
- Microhylidae
- Ranidae

Twenty species and 4 sub species i.e. 24 taxa of amphibian fauna (frog and toad) are recorded.

8.2.3 Fish and other Aquatic Organisms

An interesting phenomenon that exists in Pakistan is the temperature-related distribution of fish and other aquatic organisms, distinguishing cold water fish from warm water fish. The different temperature zones are described below:

Rithorn Zone: In this zone the water temperature of the river remains below 20°C, oxygen concentration is always high, flow is fast and the bed is composed of rocks, stones and gravel. Such areas contain cold water fish and other fauna. Most fish found in this region are carnivorous as the primary productivity of these waters is very low, which results in low algal biomass. About 17 fish are known from this zone.

Deosai Plateau: This is an area of rolling country at an elevation above 4000m including parts of the Himalayan and Pamir-Karakorum Ranges. Three fish are found here viz. *Triplophysa stoliczkae*, *Dyptichus maculatus* and *Ptychobarbus conirostris*.

Potamon Zone: In this zone, the water temperature rises over 20°C, the water flow is slow, and the bed is mainly sandy. This zone contains warm water fish. Most parts of Pakistan have elevations lower than 1000 m, and are included in the Potamon Zone. The majority of Pakistan's fish belong to this zone.

A total of 32 fish species and sub-species are known to be endemic to Pakistan.

Pakistan's endemic fish species are not yet recognised as endangered at the national level. However, at least two of threatened species, due to their great commercial importance, may become endangered soon, if steps are not taken to conserve them. One of them is the *Tor putiptora*, which migrates from the flood plains to the Himalayan foothills for breeding, but the construction of the Mangla and Tarbela Dams has blocked its migration. The other species is the *Tenuulosa ilisha*, which requires a 200 km northward run for spawning from the coast in the Indus River. The migration of this fish has been blocked by the construction of the Ghulam Muhammad Barrage and Kotli Barrage (with ineffective fish ladders).

Considerable studies on fish fauna have been carried out in Pakistan to determine their natural distribution. However, a large number of species have not yet been studied in terms of habitat requirement and population. The barrages have physically fragmented the riverine habitat, which is particularly critical for species like the blind Indus dolphin, which is trapped between the barrages of Sindh and the Punjab provinces. During the formulation of this report, it was learnt that two blind dolphins had been strangled to death in the fish ladder of Chashma Barrage in 1997. Ironically, in the records of the Punjab provincial Wildlife Department, its annual dolphin survey does not register the dolphin as being found upstream of the Chashma Barrage.

8.3 Threats to Freshwater Biodiversity

The widespread destruction of habitats due to the burgeoning human population, pervasive poverty and human consumption patterns has quickened the pace of freshwater Biodiversity loss. In this context, aquatic resources have been relatively neglected. Fish and fish products have provided food and employment in the country. Yet, little effort is made for their preservation.

Domestic waste is probably one of the main sources of organic wastes that mostly enter the riverine system untreated, resulting in high loads of waste reaching the rivers especially in urban areas. Refuse also contributes substantial pollution loads to such rivers. There are additionally, large inputs of organic wastes from agriculture-based industries such as poultry farms, tanneries, textile factories, pulp and paper mills, sugar processing, etc. High concentrations of suspended solids are often present in rivers due to land erosion following deforestation and mining operations.

Although fishermen are required to attain licenses issued by the fisheries departments and to declare their catch, over-fishing continues to pose a threat to native fish species of commercial value.

Many small but valuable wetlands were created by seepage from irrigation systems in the Punjab. However, these are threatened by drainage for agricultural land uses. Other wetlands are under pressure, one the reasons being the discharge of saline water into the wetlands.

Thorough research and investigation are imperative to determine the distribution, taxonomic status, and population size and habitat requirements of these species. Once undertaken, this will enable scientists to list species in relation to their degree of vulnerability, and to devise effective conservation programmes for their protection. With continued urbanisation, a research-based programme aimed at establishing sanctuaries to safeguard the young of vulnerable species during fluvial conditions is necessary

The provincial fisheries departments maintain fish seedling nurseries and release millions of seedlings in the rivers and large ponds. The WAPDA fisheries directorate also does the same in the large lakes of the hydropower projects of the country (Tarbela, Mangla Dams etc). This is performed to supplement natural reproduction and to supply private commercial fish farms. However only fishes of commercial value are reared. Many fish seedling nurseries have also been established in the private sector. During the preparation of this report, the importance of diversifying the release of fish was recognised. Hence, it is hoped that with the functioning of the Biodiversity secretariat, this shall be undertaken after thorough studies are completed in this regard.

8.4 Freshwater Biodiversity Conservation

8.4.1 Strategies and Policies

Agricultural policy, as reflected in the eighth five-year plan, addresses a number of issues relevant to freshwater Biodiversity conservation. The fisheries policy, as reflected in the same plan, focuses on aquaculture and does not refer to the conservation of indigenous aquatic Biodiversity.

Fisheries are dealt with by the provincial fisheries departments, which are limited to the development, protection and enhancement of productivity of commercially important fish species. The fisheries departments protect only 20 out of 164 fish species found in Pakistan. The existing regulation of fisheries is divided between the federal and provincial governments. Provincial fisheries legislation focuses on freshwater and estuarine fisheries. The Sindh Fisheries Act of 1973 is the most developed of the provincial legislation. These laws prohibit the destruction of fish by explosives or by poisoning and regulate fishing craft and gear. It also empowers the government to designate any water body as a sanctuary for fish for a specified period. In such sanctuaries, fish can only be caught with a permit.

The lack of clear jurisdiction can lead to the damage of the resource by a competing government agency despite careful management by the ostensible fisheries authority.

8.4.2 Fish Ladders

Fish travel long distances to breed and feed. They move on to warmer waters in the winter and to clearer waters in the monsoon season. A large number of casualties occur while the fish try to cross the barrages and weirs that are constructed on the river systems. At each headwork, one or two fish ladders are constructed to facilitate a safe passage. Detail of this is given in **Table 8.1**.

Table 8.1 Fish Ladders in Pakistan

Barrage	Length Ft	Width Ft	Bottom floor level R.L.	
			Upstream	Downstream
Marala	270	10	800	789
Khanki	198	12	738	726
Qadirabad	356	10	692	674
Trimmu	261	12	481	466
Panjnand	187	13	333	319
Sulemanki	270	12	560	549
Kalabagh	234	12	684	667
Chashma•	428	30	630	608
Taunsa	262	12	438	423

Source Nazir Bhatti, D.G. Fisheries, Punjab

•Personal communication by the Deputy Director Fisheries, Chashma Barrage, where it was also reported for the first time that dolphins occur upstream the Chashma Barrage as well.

Palla (*Tenualosa ilisha*) fish is most affected by the construction of barrages and dams in the Indus River. Previously its range was from the estuaries of the Arabian Sea to the north Punjab up to the Himalayan foothills.

8.4.3 Additional Research Required

The research conducted so far has mainly focused on freshwater fish, with little attention paid to other components of freshwater Biodiversity. Hence, studies confirm that 160 fish species exist in the different freshwater habitats of Pakistan. The geographic distribution of these fish species is also known. However, this list is not final and considerable research is still required. Further research on fish ladders is also required to make them effective for fish species found in Pakistan.

9. Agricultural Biodiversity

This section describes agriculture in Pakistan, including the different crops grown. Problems and threats to Pakistan's agricultural Biodiversity are also discussed, as are the conservation measures that have already been taken or are proposed.

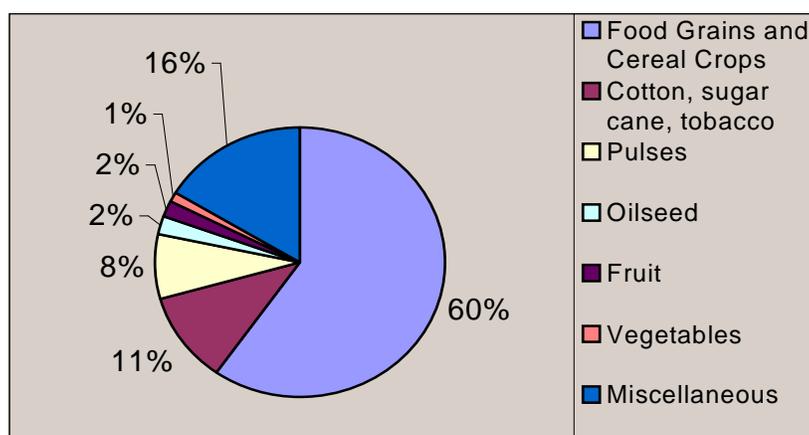
9.1 Agriculture in Pakistan

Pakistan is endowed with a variety of plant species that range from the tropical to the temperate. Rural communities who have relied on genetic Biodiversity to ensure the stability of their food production systems use many of these for food and nutrition. These systems include diverse cropping practices suited to local ecological, social and cultural systems. The agro-ecological diversity of the region has been important in the evolution of diverse farming systems that are built in distinct knowledge systems, which the native farming communities have tried and refined over generations. These farming communities also developed conservation and management strategies to ensure the sustainable use of agricultural resources. Pakistan's main productive areas all lie in the arid zone with average annual rainfall of less than 200 mm. Before the construction of the barrages, irrigated agriculture was practised along the riverbeds. With the extension of the canal irrigation system, Pakistan now produces tropical crops like rice and sugarcane. Before the green revolution, farmers kept their own seed, but it is now almost impossible to find local varieties of seed. HYV seeds, pesticides and chemical fertilisers are now commonly used. This could result in genetic erosion. Resistance of pests to insecticides, particularly cotton, is a dilemma that Pakistan faces.

9.2 Production Systems

The main crops grown in Pakistan include food grains and cereal crops, including wheat, barley, rice, maize, sorghum and millets, cotton, sugarcane, tobacco, pulses, oilseed, fruits, and vegetables (**Figure 9.1**).

Figure 9.1: Agricultural Profile of Pakistan



The two main cropping seasons in Pakistan are *Kharif* (summer) and *Rabi* (winter).

9.3 Crop Genetic Diversity

Pakistan lies in close proximity to the four major centres of Biodiversity.¹⁴ Further, the diversity in agro-climatic regions, crops, agricultural systems and farming cultures make this region rich in agro-Biodiversity. Throughout the ages, the diverse communities have evolved strategies for harnessing local agro-Biodiversity for food security as well as for improved livelihood. A variety of crops, fruits and vegetables are grown in Pakistan. The various native and introduced plant species are listed in **Table 9.1**.

Table 9.1: Crop Genetic Diversity in Pakistan

Plant Group	Native to Pakistan	Introduced to Pakistan
Food Plant	Bread wheat, Rice, Barley, Cowpea, Pigeon pea, Moth bean, Green gram, Horse gram	Maize, Small millet, Sorghum, Pearl millet, Chickpea, Lentil, Field pea
Sugar	Sugarcane	Potato, Sweet potato
Vegetables	Okra, Eggplant, Melon, Cluster bean, French bean, Pumpkin Gourd, Water melon, Bean	Tomato, Carrot, Radish, Cauliflower, Cabbage, Turnip, Bottlegourd
Fibre Plant	Tree cotton, Sunhemp	American cotton
Oilseeds	Indian mustard, Sesame, Safflower, Castor	Groundnut, Soybean, Sunflower, Linseed
Spices and Condiments	Turmeric, Black mustard	Chillies, Coriander, Cumin, Fennel, Mint, Ginger
Fruit Plants	Mango, Citrus, Jujube, Guava, Mulberry, Pomegranate	Apple, Pear, Peach, Plum, Apricot, Strawberry, Grapes, Banana, Papaya, Date palm
Ornamentals	Lotus, Jasmine, Orchids, Rhododendrons	Rose, Dahlia, Marigold, Chrysanthemum, Tuberose, Cacti, Various others

Source: Zahoor, PGRI, NARC Islamabad

This table is indicative of a diversity of cultivated plants. Due to local preferences, there is much variability within each individual species. This is an important base for using agricultural Biodiversity to breed new high yielding varieties resistant to various biotic and abiotic stresses. The identification and conservation of the wild relatives of agricultural crops is a key to Biodiversity conservation as well as a guarantor of food security for the country. The Plant Genetic Resources Institute (PGRI), Islamabad, has collected specimens of the known wild relatives of agricultural crops; the detail is given in **Table 9.2**. There are no projects for the *in-situ* conservation and promotion of cultivation of the wild relatives of these crops.

¹⁴ Hawkes (1983) has described eight centres of biodiversity of cultivated plants. These centres are in China, Indo-Malaya, Central Asia, the Near East, the Mediterranean, Abyssinia, Southern America. These are the centres where maximum plant variability exists or most of the plants have originated in these centres. This diversity of germplasm provides a sustainable basis for food supply and security, which in the future, will become extremely important. The future sustainability of the human race also depends upon these resources.

Table 9.2: Wild Relatives of Crop Plants in Pakistan

Common Name	Scientific Name	Distribution in Pakistan
Wild relative of wheat	<i>Aegilops squarossus</i>	Mountains areas of N Pakistan
	<i>Aegilops triuncialis</i>	Mountains areas of N Pakistan
Wild relative of wheat	<i>Elymus borianum</i>	Endemic to Swat
	<i>Elymus kuramensis</i>	Endemic to Kurram
	<i>Elymus nodosus</i>	Kurram
	<i>Elymus stewarti</i>	Endemic to Kashmir
	<i>Elymus longe aristatus</i>	High alpine areas of Hindukush Himalayas and Karakorum
	<i>Elymus russelii</i>	Endemic to Karakoram
	<i>Elymus jacquemontii</i>	Endemic to Kashmir
Wild relatives of barley	<i>Hordeum bogdanii</i>	Karakoram, Ziarat, and Harboi Range
	<i>Hordeum spontaneum</i>	North Balochistan
	<i>Hordeum murinum</i>	NWFP, Murree Hills
	<i>Oryza coarctata</i>	Indus Delta
	<i>Sorghum nitidum</i>	Hazara and Murree hill tract
	<i>Sorghum halepense</i>	Common weed throughout the country
Wild relatives of millet	<i>Pennisetum flaccidum</i>	High alpine slopes of Karakoram, Himalayas, Hindukush
Wild relative of cotton	<i>Gossypium stocksii</i>	South Sindh
Wild relatives of mustard	<i>Brassica junacea</i>	Western area of Balochistan
	<i>Brassica deflexa</i>	Western part of North Balochistan
Wild relatives of kenaf	<i>Hibiscus caesius</i>	North Punjab, NWFP, Kashmir
	<i>Hibiscus micranthus</i>	Sindh and Balochistan
	<i>Hibiscus lobatus</i>	Salt Range, Kurram Valley, Sindh
Wild relatives of chick pea	<i>Cicer macranthum</i>	Hindukush, -Himalayas,-Karakorum
	<i>Cicer microphyllum</i>	Hindukush, -Himalayas,-Karakorum
Wild relatives of bean	<i>Vigna spp</i>	
Wild relatives of fruits	<i>Pyrus pashia</i>	Temperate Himalayas
	<i>Mallus chitralensis</i>	Chitral
	<i>Prunus prostrata</i>	Temperate Himalayas
Wild almond	<i>Amygdalus brahuicus</i>	North Balochistan
Wild cherry	<i>Cerratus rechingeri</i>	North Balochistan
Wild relatives of grapes	<i>Vitis jacquemontii</i>	Himalayas
Pomegranate	<i>Punica granatum</i>	Foothill Himalayas
Wild relative of olive	<i>Olea ferruginea</i>	Lower hills of North Pakistan

Source: *Flora of Pakistan*

Pakistan has taken steps to preserve varieties of agricultural crops the composition of the germplasm collection stored at the NARC National Gene Bank is given in **Figure 9.2**.

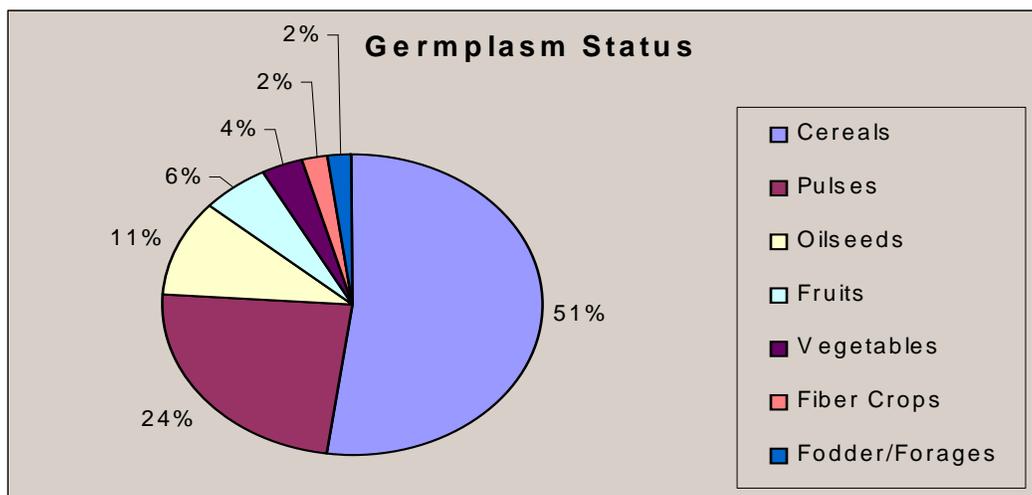


Figure 9.2: Germplasm Composition at the NARC National Gene Bank Pakistan

9.4 Crop Biodiversity

9.4.1 Cereals

Wheat

Wheat is the major food crop of Pakistan grown over an area of 8 million hectares scattered over a wide range of ecological regions. Presently, most of the areas are occupied by improved varieties but local land races still exist in Balochistan, the Northern Areas, Chitral and Kashmir. Variation is not only in plant characteristics like plant height, straw thickness, grain size, colour, and spike density, but in their tolerance to stresses like salinity and drought. The land races of wheat grown in Balochistan are of great importance due to their tolerance to drought and salinity.

Rice

Rice is another important cereal crop. During various surveys, rice germplasm collections were made from 1972-77 and more than 900 cultivars were recorded and collected at the NARC from different areas. Pakistan is considered the origin of the famous Basmati rice, due to its grain length and aroma. Besides Basmati, coarse and glutinous rice is also grown in many areas. Some of the rice cultivars/land races have been reported to be resistant to diseases and pests. In Punjab, where Basmati rice is grown, 100% cultivation is under improved varieties due to the economic value of this cereal crop. In addition to wheat and rice, primitive types of maize, sorghum, finger millet, foxtail millet, buckwheat, barley etc. are grown in Pakistan. Communities in northern Pakistan cultivate different barley races (covered and naked), foxtail, and millet and finger millet races.

9.4.2 Food Legumes

Pulses are grown over an area of 1.48 million hectares and are an important group of food crops providing proteins. Among food legumes, the chickpea, lathyrus, lentil, mung bean, mash bean, pigeon pea, Cowpea and moth bean, broad bean, and the common bean constitute important gene pools of various legumes. Diversity occurs in plant type, days to maturity, pod size, shape, grain colour etc. Some of the germplasm has been identified as resistant to biotic and abiotic stresses. Due to concerted efforts by various research institutes in the country, the release of high yielding varieties in chickpea, lentil, mung and mash has resulted in the erosion of various local races/cultivars from the farmer's field. Due to lesser attention on the pigeon pea, Cowpea, moth bean and the broad bean, the rate of genetic

erosion is comparatively less than conventional food legumes, chickpea, lentil, and mung.

9.4.3 Horticultural Crops

Pakistan lies between two major centres of fruit diversity, the Caucasus Mountains and China. An ancient trade route from China to western Asia and Europe passed through this region. Fruit species from the route were brought here and have been grown for centuries. A wide range of fruit species such as mango, guava, citrus, banana, *Zizyphus (Ber)*, *Eugenia (Jaman)*, apple, peach, plum, apricot, grapes, and nuts like almond and walnut are grown. These possess wide genetic variability in fruit size, shape, colour, maturity time and quality etc. These fruit species have been diversified through human selection over hundreds of years. There are more than 150 clones/local cultivars of apricots grown in the Northern Areas of Pakistan. Wide variation exists in fruit size, shape, colour, taste, seed size, quality of kernel etc. The recent introduction of hybrid varieties of apricots has posed a serious threat of genetic erosion to the local cultivars.

The local pears and peaches are also diverse in terms of fruit size, shape and time to maturity. The grapes grown in Pakistan include land races of *Vitis vinefera*, *V. Jacquemontii* and *V. Parvifolia*. The adaptation pattern of different species varies from the arid dry to the humid regions. *Vitis vinegera* demonstrates great diversity in Skardu, Hunza, and Gilgit. *V. Jacquemontii* is adapted to the high rainfall areas in Swat and Kashmir. The wild species of *V. Parvifolia* are distributed sparsely in the Chickar area of Azad Kashmir.

All the mangoes grown in Pakistan are monoembryonic. More than 150 varieties have been documented. The most famous varieties are Sindri, Malda, Dosaria, Chonsa, Anwar Retole etc. The maturity time of mango varieties varies from early June to late August or early September indicating a wide diversity. Similar patterns of variability exist in citrus, guava, etc. Mango is the most popular fruit in Pakistan; the private sector as well as the government research institutes continuously works to develop better varieties through grafting. The ratio of grafted to the non-grafted local varieties in the fruit markets have shifted. Today, it is rare to find the non-grafted fruit as compared to fifty years ago.

Market demand and non-availability of local seeds are causing genetic erosion in major vegetables like tomatoes, onions, peas, lady fingers, brinjals, cauliflower, carrots, radishes, turnips, etc. The indigenous diversity is still to be found in cucurbits, bitter gourd, spinach, Lufa, and Brassica spp.

9.5 Changes in Food Habits¹⁵ and the Effects on Biodiversity

A review of historical records shows that more than 85 percent of the population of Pakistan a century ago was rural, and dependent on agriculture or livestock for a living. There has been a trend to adopt the urban way of life, and now, though the majority still lives in rural areas, have adopted urban lifestyles. One hundred years ago, two meals were taken daily. The staple food was based on the seasonal availability of food; millet was the staple food. It was taken with *gur* (brown sugar) and butter oil, *sag* (mustard), and *lassi* (yoghurt drink). Meat was eaten on marriages and once a year during the Eid ul Azha festival (See section 12.2 on Religious and Cultural Beliefs). The fruit of the thorn forest tree, called Peelu (*Salvadora oleides*) was the staple food for two months, and entire village communities would go in the bushes to eat the fruit. Today people take three meals daily. As there is not enough butter oil, imported oils are used for cooking. The consumption of white sugar and tea has increased, and Pakistan has the largest per capita consumption of tea in the world. A

¹⁵ The author made a survey of the District Gazetteers of Mianwali, Dera Ghazi Khan, Bahawalpur and the Shahpur districts of the last century (British era) specifically for this section of the report.

huge amount of foreign exchange is spent on the import of oilseeds. Edible oils like Soya and palm oil are imported. Wheat was occasionally eaten a century ago, but now the staple diet of the entire country is based on wheat. This has resulted in efforts to bring more land area under wheat cultivation. The use of chemical fertilisers, pesticides and weedicides has increased consequently, and original ecosystems, flora and fauna though not fully documented appear to be on the verge of extinction. Ninety percent of the farming communities use tractors instead of the traditional bulls for ploughing. Consequently, there is little incentive for farmers to keep draught animal breeds. This shift in lifestyle has been gradual and unplanned, and the western way of life is attractive, so the trend continues. The consumptive pattern is likely to expand with economic development, resulting in environmental degradation and Biodiversity loss. With the launching of the NCS (1992), Pakistan is in a much better situation Vis a Vis environmental awareness than it was a decade ago.

9.6 Threats to Crop Biodiversity

Genetic erosion is taking place in both commercial and traditional crop species. This is due to many reasons like the growing population, the shift to intensive agriculture and the changing agricultural and economic environment. These include the opening of trade boundaries, and the lower economic return for the indigenous varieties.

9.7 The Conservation of Crop Biodiversity

9.7.1 Strategies, Policies, and Legislation

The public sector research infrastructure developed and released more than 700 improved varieties of crops in Pakistan. This was due to the exemption of agriculture from patent laws. The share of the private sector in this field in Pakistan is negligible. This has aided the increase of food grain production since breeders have been able to develop high-yielding and disease-resistant varieties of crops without payment of royalties. Hence, seed is made available to farmers at low prices. A number of federal and provincial agricultural research institutes and universities in Pakistan are working on agricultural Biodiversity issues like conservation, evaluation and utilisation. A list of such institutes is given in **Appendix C**.

The Plant Genetic Resources Institute (PGRI) located at NARC is a federal facility for the conservation of plant genetic resources. At this institute, the germplasm of various crops and their wild relatives are collected and stored in the gene bank at low temperatures and moisture where they remain viable for a longer period. If any material goes out of stock, it is reproduced. This national facility has arrangements for mid-term conservation (10-20 years) and long-term conservation (more than 50 years). The material stored in the gene bank is documented and evaluated for various genetic characteristics.

After characterisation and evaluation, information is supplied to other research institutes. The various discipline-oriented institutes help to evaluate the germplasm for desirable characters. Research on recalcitrant species (where the plants fail to produce seeds or the seeds can not be stored) is still lacking in the country.

The above mentioned on-going Biodiversity conservation project at NARC deals with *ex-situ* conservation. Minimal work has been done on livestock animals. The conservation of livestock animals is mostly concentrated on a few breeds of buffalo and cattle. The on-going activities on the conservation, documentation and evaluation of crop genetic resources are given in the following sections.

9.7.2 Ex-situ Collections

Because of 28 plant collecting expeditions by the scientists of NARC, 18,000 samples of different crops have been collected and conserved at the PGRI.

9.7.3 Documentation

The germplasm collections at the PGRI, Islamabad, are fully documented in a format recommended by the International Biotechnology and Plant Genetic Resources Institute (IBPGRI) and are kept in the form of data books. There are more than 16,000 samples currently present in the gene bank. Out of them about 60 percent have been acquired through expeditions and the remaining have been acquired from other institutes within and outside the country. The passport data of 75 percent of the collected samples has been entered into a database. Most of the donated data is present in electronic form. However, a complete computerised database has not been fully developed. The work on this database is in progress and reports have been designed for the users. The process of cataloguing the collected information is in progress. At present, only passport data of collections is being catalogued. Reports are generated crop wise. Agronomic evaluation information is separately maintained in the form of database files and hand-written data registers, still not integrated with the passport data file. Almost 80 percent of the samples are fully documented.

9.7.4 Evaluation and Characterisation

The evaluation of indigenous land races, primitive cultivars and their wild relatives need to be studied of the entire national germplasm. This evaluation will help to incorporate local desirable traits into the modern cultivars for sustainable agricultural production. It is strongly urged that evaluations be carried out at multiple locations. No systematic characterisation and evaluation work in these botanical gardens has been undertaken so far.

9.7.5 Policies

In order to fulfil its international obligations, Pakistan has become a party to several international agreements and has been actively involved in the discussions in various preparatory meetings on plant Biodiversity. The agreements and conventions include the following:

- 1) Plant Protection Agreement, Rome, 1956.
- 2) International Union for the Protection of New Varieties of Plants, 1961 (UPOV).
- 3) Convention on International Trade in Endangered Species and Wild Flora and Fauna, Washington, D.C. 1973.
- 4) International Technical Conference on Plant Genetic Resources, Leipzig, June 1996.
- 5) World Food Summit, Rome, November 1996.

Pakistan still has to go a long way to frame laws and policies to conserve all its genetic material, the multilateral exchange of material, farmer's rights, etc.

10. Livestock Biodiversity

This section describes livestock diversity; the breeds of cattle, horses, camels, goats and sheep. It also touches on the social and cultural values of livestock in the rural communities of Pakistan. It highlights the need for conservation of the local breeds, which hitherto has been ignored due to commercial considerations.

10.1 Historical Trends in Livestock and Poultry in Pakistan

Domesticated cattle were already in use in the Indus Valley around 4000-5000 BC. Farmers of this region learned livestock improvement through breeding. Their main contribution is the excellent breeds of cows. These cows have been exported to all regions of the world. The cattle of the Indo-Pak subcontinent belong to the family Bovidae, Unlike the European cattle these are humped. Tolerance of extreme climatic conditions and sturdiness are the main qualities of the livestock of Pakistan. There are eight breeds of cows, two of buffalo, twenty-eight breeds of sheep, twenty-five of goat, one of horse, four of camels and three indigenous breeds of poultry. Wild relatives of cattle are not known. The urial is believed to be the wild relative of the sheep. The jungle fowl is believed to be the wild relative of the domestic chicken and is almost extinct. Wild relatives of the buffalo exist in India and Bangladesh.

Table 10.1: Estimated Livestock (Ruminant) Population of Pakistan

Livestock	Population (1995-96, 1000 heads)	Growth Rate (FAO Estimated)	Documented Breeds
Large Ruminants			
Cattle	17,883	2.4	8
Buffaloes	20,214	1.4	2
Camels	1,163	(not available)	4
Small Ruminants			
Sheep	29,789	2.2	28
Goats	45,649	2.7	25

Source: Aslam Malik, Livestock Department, Government of the Punjab

Due to the expansion of the irrigation system in the Punjab, two separate breeds of buffalo, the Nili and the Ravi, have inter-bred so much that they are now classified as one breed. Thoroughbred horses were imported from Britain in the early 20th century and raised in military stud farms. Fifty thousand thoroughbred horses were exported to England during the Second World War.

Pakistan has given the world some excellent breeds of cows. The Sahiwal cow has been exported to many countries and is noted for its large milk productivity. A brief account of the major breeds is given below, while the detailed list is given in **Appendix F**.

10.2 Important breeds of Cattle (*Bos indicus*)

For the past 50 years, cattle have been imported from the Northern Hemisphere. The crossbreeding of local cattle with Holstein-Friesian, Ayrshire, Brown Swiss, Jersey, Guernsey,

red Dane, milking shorthorn, and the Australian Illawara shorthorn has been encouraged at the government level. It is estimated that purebred animals constitute only 20-25 % of the total cattle population. Quality livestock is bred in government and military dairy farms. Artificial insemination facilities for cattle are available in many parts of the country. **Table 10.1** above gives information regarding the status of livestock in Pakistan. The description of some important breeds of cattle is given below:

- **Tharparkar**

Synonyms: Grey Sindhi, White Sindhi, Thari

A relation of this breed is the Cutchi, which originates from Cutch on the northwest border of India and Pakistan. The home of the breed is the Tharparkar district of Hyderabad and even India. This is an arid area and in drought years cattle move to the surrounding regions where they have interbred with Kankrej, red Sindhi, and Gir and Nagori cattle. Its habitat is situated just outside the tropics and is very arid. The rainfall averages 203 mm (8 inches) per annum. These are strongly built, medium-sized animals with comparatively short, straight limbs and good feet. The skin is pigmented and thin, and the hair is fine and short. The coat colour is usually white or grey with a light grey stripe along the top line. In the male, the grey colour may deepen with age, particularly on the face and hindquarters. Black and red-coloured cattle are also seen. The hump is moderately well developed and firm; the dewlap is of medium size; the sheath in the male is semi-pendulous and of moderate length and the naval flap in the female is prominent.

Average weight of male = 950 lbs.

Average weight of female = 890 lbs.

Average milk yield in 300 days 3500 lbs.

This is one of the best dual-purpose work-milk breeds found in Pakistan and the Indian subcontinent. It will milk under very poor feeding conditions and has great powers of endurance and resistance to poor feeding and to drought conditions. Several of these cattle have been exported particularly to Zaire, Iran, Sri Lanka, and the Philippines.

- **Red Sindhi**

Synonyms: Malir, red Karachi, Sindhi

The original breed was founded at Malir outside Karachi, Hyderabad and Lusbella district. In Pakistan, it is believed that this breed is derived from hill-type cattle. It is somewhat similar to the Sahiwal. The home of the breed is now around Karachi, just outside the tropics where the climate is sub-tropical and semi-arid. The red Sindhi is a medium to small animal with a deep compact frame. The coat colour is usually red varying from dark red to dun yellow, often with specks of white on the dewlap and the forehead. The horns are thick at the base and laterally emerge and curve upwards.

Average weight of male = 925 lbs.

Average weight of female = 750 lbs.

Average milk yield in 300 days 4000 lbs.

This species is considered one of the best dairy breeds in Pakistan, though it is occasionally used for light work. It has been exported to India, China, Sri Lanka, Malaysia, Brazil, Mauritius, Thailand, Philippines, Afghanistan, Turkey, Korea, East Africa, USA, Australia, Egypt, Iraq, and Japan.

- **Sahiwal**

This breed originates from district Sahiwal of the Punjab province. The climate of its original habitat is hot and arid. It is a large, heavily built fleshy animal. The coat

colour is varied, although reddish dun is common. Other coat colours are pale reds; dark brown and almost black flecked with white. The head is broad and massive in the male and the ears are of medium size with black hair on the fringes.

Average male weight = 1000-1400 lbs.

Average female weight = 600-950 lbs.

Average milk yield in 300 days is 7000 lbs.

This is the best dairy breed of Pakistan and has been exported to Turkey, Malaysia, and Kenya. In Jamaica, it has been crossed with the Jersey breed to produce the Jamaica Hope breed. In East Africa, it has been widely used to upgrade the small East African Zebu cattle. The Sahiwal breed can also be used for beef and work purposes.

- **Rojhan Bull and Cow**

Rojhan cattle are bred in Bakht Baidar Khan and G.B. Isani. These are small animals with a red and white spotted coat (considerable variation in spot size, tight skin, small and alert ears, small pointed horns, short neck, proportionately large hump, and extended dewlap). Their thin tail usually ends in a white switch. They have a small, tucked up udder. Milk yield is very low. The adult male weighs 300-350 kg and the female 230-280 kg. Male stock is very suitable for draught work in hilly and sub-hilly areas.

- **Kankrej**

This breed is from the districts of Tharparkar and Badin in the Sindh province. It also extends along the Rann of Kutch to the northern part of Gujrat in India. Its small strain is locally named Kutchi or Wadhiari and is found in the Thatta and Sanghar districts of Sindh. The body colour of the Kankrej cattle varies from silver-grey to a darker-grey. Males are darker at the shoulders, hump and hindquarters. The forehead is broad and slightly concave in the centre. The nose is slightly upturned, and the ears are large and pendulous. The horn is strong and lyre-shaped. Females weigh 350-400 kg, have a medium-sized udder and are good milk producers. Kankrej bullocks are prized as fast and powerful draught animals. Adult males weigh 500-650 kg. As both good milk producers and strong workers, Kankrej cattle serve a dual purpose.

10.3 Breeds of Goats (*Capra hircus*) and Sheep (*Ovis aries*)

Goats belong to the family Bovidae and genus *Capra*. The domesticated goat of West Asia is *Capra hircus*. Goat breeds have been documented from various parts of the country, including Azad Kashmir and the Northern Areas. Most are small to medium in size. Some of the breeds carry exactly the same name given to the breeds of sheep found in the same area. Most goats in Pakistan are usually raised for meat and hair production, although some breeds are good milk producers. None of the breeds seems to have been specifically developed as the dairy or meat type, so goats serve as multi-purpose animals, and at a very low level of performance. The teddy goat, imported from Bangladesh, is spread all over Pakistan, and is popular due to its prolific rate of growth, less demand for feed and the easy marketing of mutton. In general, the inadequate availability of feed is the major factor responsible for low productivity. There is a need for a new classification system of goat breeds in this country in order to eliminate some of the names and overlapping of characteristics in the present long list of breeds described in **Appendix F**.

Sheep are reared throughout Pakistan and have a wide range of climatic adaptability - from the desert to the snowy mountains in the north of the country. Sheep are used for wool and mutton. The characteristics and description of the sheep of Pakistan is given in **Appendix F**.

10.4 Horses (*Equus caballus*)

The area now comprising Pakistan had been the route of the Greek, Arab, Persian and Afghan conquerors of India for centuries. All the foreign armies brought horses with them, which were subsequently crossbred extensively, so mixed breed horses are common. Two centuries ago, horse breeding was at its climax in Pakistan and the British colonial rulers frequently sent thousands to Europe for use in wars. In order to meet the increasing demand of the army for heavier horses, (for carriage of heavier weapons) large numbers of European thoroughbreds were imported. These thoroughbreds were crossed with the local breeds. Gradually most of the local breeds have disappeared. Three pure breeds of horses are known from Pakistan.

- **Baluchi**

This breed is indigenous to the Balochistan province but is now also found in Dera Ghazi Khan, Muzaffargarh, Bahawalpur, and the Multan districts. It has also spread to other parts of the country. This breed is easily scared, and therefore is not used by the police and the army. However, it is popular in tent pegging sport, and for horse carts and general riding.

- **Anmol**

This small-sized breed is found in the districts of Attock, Jhang, Mianwali and Faisalabad. It is believed that this breed was imported but has been crossbred. Presently, only a few pure blood animals are available. Others believe that this breed is already extinct. The horses used to play polo in the Gilgit area are believed to be a separate breed.

- **Thoroughbred**

This breed was imported from Britain and reared in the military farms of Sargodha, Sahiwal, and in Faisalabad's remount farms. Large areas of land have been leased to local farmers on the condition that they cross these breeds only with select stallions. This breed is popular for horse races and is a part of the presidential bodyguard. It is also reared in government farms.

10.5 Camels (*Camelus dromedarius*)

Camels are widely used for draught and beef in the country. The breeds are broadly classified as hilly area, plain area and dual-purpose camels.

The hilly area camel is widely used for carrying heavy loads. It is small in size, very hard working and docile. Breeds of this category are the Powinda, Pashin, Brohi and Salt Range. The Powinda and Pashin are found at the Pakistan-Afghanistan border, the Brohi in Balochistan and the Salt Range in Jhelum, Rawalpindi and the Attock districts. The hilly area breeds of camel have adapted to tolerate the cold season.

The plain area camel breeds include species that are found in the canal-irrigated tracts of the Sindh and Punjab provinces. The Thalli and Bahawalpuri breeds are found in the desert areas of Thal and Bahawalpur.

10.6 Poultry

Three breeds of chicken are found in Pakistan. The Aseel in Punjab, Sindh and the NWFP is an expensive breed. It is famous for cock fighting. The naked neck and the Desi breeds are found throughout the country. These are egg layers and a source of meat. With the introduction of poultry farming, imported cheaper white leghorns have almost overtaken the indigenous breeds in the poultry markets. Unlike the imported breeds, the local varieties are not reared in poultry farms. Fayumi is another breed that has been successfully introduced for rearing in households.

10.7 Social and Cultural Values

Cattle have a traditional importance in the culture of Pakistan. The Aryan race that invaded the subcontinent approximately 4000 years ago also brought large herds of cattle. The cow is sacred in the Hindu culture and a large number of sacred cows can be seen in the Thar districts of Sindh where Hindu communities still reside. A study of the evolution of the social development in the subcontinent reveals that the races and castes that exist today were initially categorised according to their profession. The person that rears and breeds cattle is called a *Gujjar*. Hence the caste - Gujjar. Cattle are colloquially called *mal*, which means wealth. So the larger the herd in turn means the higher the social status. Though the old culture is fast disappearing in Pakistan, a glimpse can be seen in the culture of the grazers of Cholistan. Cholistanis still prefer to buy more cattle than land when they have money (See Section 12.5). The local people still work hard and keep verbal records of the pedigrees. However, in the larger part of the country crossbreeds are preferred.

Fairs and exhibitions are held all over the country during the spring season. The horse and cattle show at Lahore and the Sibi Mela in Balochistan are the largest fairs. Horse, dog and oxen races, and pegging competition are held. Competitions simulating water lifting from wells, in which the number of rounds run in a fixed time judges the winner, are also held throughout the country. Pigeons for display and pigeon flight competitions are also popular sport. The winning animal is highly prized.

Eid ul Azha, the Muslim festival in memory of the sacrifice of the prophet Abraham, has a special meaning for the livestock farmers of Pakistan. Most people sacrifice goats, sheep, bulls and cows, camels and a few yaks. Most livestock farmers rear the animals for sale on this festival, and the prices shoot up during the Eid season

10.8 Threats

Pakistan has provided excellent milk breeds to the world in addition to dual-purpose breeds of cattle. These same breeds are now threatened in the country. This is a result of the tremendous cross breeding programmes. The Sahiwal breed is threatened and the red Sindhi is on the verge of extinction. Cross breeding programmes reached a climax in the seventies, when the F1 (first generation of crossbred animals) stock increased milk production tremendously. However, recessive genes surfaced in the F2 (the offspring of the F1 stock) generation, while there was complete chaos in the F3 (the offspring of the F2 stock) generation. The repeated crossbreeding did not serve the purpose of producing maximum milk-producing cattle as exhibited in the poorer quality F3 stock. Initially the Livestock Department motivated the farmers to undertake cross breeding and did the same in the government experimental farms. Upon realising these negative impacts, the government farms stopped crossbreeding. However, farmers still prefer to cross local breeds. The extension and outreach activities of the livestock department are ineffective, so this change in farm practice has not been advocated widely. There is a need for the government to take up this issue and preserve the prized local breeds.

The people of Pakistan prefer buffalo milk over that of the cow. This is due primarily to the latter containing 6-9 percent fat content as compared to 3.5 % fat in the former. Buffalo (*Bubalis bubalis*) milk sells easily and at a 20% higher price in the market. This factor makes cow farming less attractive. The pre-industrial period also had a need for oxen as draught animals, but now tractors have become popular, making oxen redundant. Due to these reasons, the keeping of cows and local breeds is on the decline.¹⁶ The lack of incentives for farmers to conserve the local breeds is the other factor that threatens the local breeds.

10.9 Conservation projects

The Government of Pakistan is conscious of the importance of the conservation of the local breeds of livestock. The local or *desi* breeds of cattle are preserved in the government cattle farms; the detail of these farms is given in **table 10.2**. The case study given in **Box 12** details the activities undertaken for the conservation of the local breeds.

Box 11: The Ghulaman Livestock Experiment Station¹⁷

Unaware of the provisions of the CBD, Dr. Ajmal Jalvi and his team at a remote farm are crusading for the preservation of the livestock breeds of Pakistan. This farm, the Ghulaman Livestock Experiment Station, is located 70 km from Mianwali City. The motivated team in this remote area of the country was addressing global concerns of Biodiversity conservation. Although Pakistan takes pride in providing the world with famous breeds like the Sahiwal, it appears that this breed is likely to become extinct at home. This is due to the encouragement of cross breeding by the GoP in the sixties and seventies. The crossbred F1 generation did increase milk production, but now at the F3 stage the non-descriptor breeds of cattle, with very poor traits has surfaced. The GoP has realised the importance of preserving the local breeds now. However, the farmers still take pains to get their cattle crossed with the Friesian or Jersey cattle of the Northern Hemisphere.

Like others, this farm was established in 1951 by the Thal Development Authority (TDA) and was then called the 'Common Wealth Livestock Development Farm.' This remained with the TDA until 1969. It has since been owned by many departments as shown below:

- ◆ The West Pakistan Agriculture Development Corporation 1969 to 1970
- ◆ The Army Welfare Trust 1970 to 1974
- ◆ The Directorate of Livestock Farms Lahore 1974 to 1978
- ◆ The Pak- Iran Joint Agro Livestock Complex 1978 to 1979
- ◆ The Directorate of Livestock Farms Lahore 1979 to date

Since the farm has been under different administrations over the last half-century, its objectives and styles of management have been inconsistent. It was only in 1984 that a defined scheme for this farm was approved. According to this scheme, the farm was to maintain strength of the following breeds:

Nili Ravi buffaloes	250	Teddy goat	2000
Sahiwal cows	400	Thalli sheep	200

¹⁶ Personal interview with Dr. Hasan Aziz Javed, Director Livestock, Livestock Department, Government of the Punjab, Lahore.

¹⁷ Case study based on site visit by LEAD-Pakistan team comprising Dr Aslam Malik and Syed Mahmood Nasir to the Livestock farm Kallurkot. Persons contacted were Dr. M. Ajmal Jalvi, Farm Superintendent, Dr. M. Fayyaz, Veterinary Officer. LEAD-Pakistan expresses its gratitude for the courtesy extended by the farm management and the entire staff.

Box 12: The Ghulaman Livestock Experiment Station (continued)

Again under a new policy all the Sahiwal Cows were shifted to the nearby livestock farm of Kallurkot, and the revised sanctioned strength was fixed as under:

Nili Ravi	250	Teddy Goat	500
Cross-Bred	50	Thalli Sheep	500

The objective of management remained mainly to preserve the quality local breeds, provide breeding services and issue superior germplasm to the farmers. The farm has an area of 10273 acres out of which 30 % is leased out for cultivation to outsiders. This leasing is done to earn revenues, since the farm has to show revenues to the provincial finance department. Twenty-five percent of the area is under canal irrigation, while less than ten percent is used as rain-fed grazing land. The farm has been successful in maintaining more than the sanctioned strength of adult livestock. Milk production, fertility and mortality percentages are also satisfactory. This shows that the farm is in safe hands. The daily production of the farm is 1000 litres, fifty percent of which is sold to Nestle and the rest is sold in the market at Kallurkot. Since 1991, the farm has supplied the following stock to private farmers:

Breeding stock sold:

Nili Ravi Bulls	71	Crossbred Cows	81
Thalli sheep and Teddy goats	4112		

Culled Stock sold

Nili Ravi Buffaloes	1052	Crossbred cows	198
Thalli sheep and Teddy goats	2795		

The lessees (204 in number) of the farmland also maintain a good number of livestock issued by the farm; 550 crossbred, 220 Sahiwal and 150 local bred cows. Anyone can buy the farm livestock through open auctions held 4-5 times a year. Applications for the breeding stock however are processed and approved by the director at Lahore, and stock is sold at fixed prices. The annual income of the farm averages Rs. 10.4 million while the annual expenditure is Rs. 10.25 million.

Dr. Fayyaz, the young veterinarian, works devotedly and knows what it means to preserve a breed. He also knows how difficult it is to develop a new breed and laments the lack of breeding policies. He travels to far off private and government farms from his own expense. Such young scientists who take interest in this important task need patronage. If a breed is preserved, it shall be useful to the entire world.

The GoP is also conscious of the need for preserving local poultry breeds. A four-year project (1999-2004) titled "Selection and Breeding of the Indigenous Poultry Breeds in Punjab" has been launched with a total cost of Rs. 8 million. The project envisages the procurement of local poultry breeds and rearing them scientifically. Final objective is to redistribute vaccinated poultry. The project also intends to find and encourage the Kashmiri *desi* breed.¹⁸

The Agricultural Census Bureau of the federal government conducts the census of agricultural crops and livestock every ten years. However, the livestock scientists working in the field¹⁹ do not agree with the accuracy of the federal reports. The Livestock Department Punjab has therefore started its own census programme, since without accurate census figures of the breeds no effective conservation programmes can succeed.

¹⁸ UNEP has observed that the draft report did not mention the status of the Kashmiri Deshi breed of poultry. This breed is reported to be the carrier of Rani Khet disease but is not affected itself. The author contacted the scientists at the VRI (Veterinary Research Institute, Lahore). After a thorough search, the VRI scientists have requested that available information on this breed should be provided and the Livestock Department shall focus on this breed for conservation and research.

¹⁹ Personal interview by the authors (Dr. Aslam Malik and Syed Mahmood Nasir). Livestock scientists contacted were: Dr. Saeed Ahmed, Deputy Director, Veterinary Research Institute, Lahore, Dr. Hasan Aziz, Director Livestock, Lahore, Dr. Sajjad Zaheer Malik Director Planning and Evaluation, Livestock Department, Lahore, Dr. Muhammad Fayyaz and Dr. Ajmal Alvi of the Government Livestock Farm Ghulaman district Bhakkar.

Table 10.2 List of Institutions working for the conservation of the local breeds of cattle in Pakistan (livestock and dairy farms)

Province	Name of farm	Location	
Punjab	Livestock Experiment Station (LES) Bahadarnagar	Okara	
	LES Qadirabad	Sahiwal	
	LES Chak Katora	Bahawalpur	
	LES Jehangirabad	Khanewal	
	LES Fazilpur	Rajanpur	
	LES Khushab	Khushab	
	LES Kherimurat	Attock	
	LES Khairawala	Layyah	
	LES Haroonabad	Bahawalnagar	
	LES Khizerabad	Sargodha	
	LES Bhuinke	Kasur	
	LES Dera Chahal	Lahore	
	LES Rakh Ghulaman	Bhakkar	
	LES Kallurkot	Bhakkar	
	LES 205 T.D.A.	Bhakkar	
	LES Rakh Mahni	Bhakkar	
	LES Jajitpur	Bahawalpur	
	Leased Farms in Punjab	Allah Dad Cattle Farm no. 1	Khanewal
Allah Dad Cattle Farm no. 2		Khanewal	
Shergrah Grantee Farm		Okara	
Shah Jewana Farm		Jhang	
Kot Amir Shah Farm		Jhang	
Kalabagh Farm		Mianwali	
Massan Farm		Sargodha	
Balochistan	Government Dairy Farm	Khuzdar	
	Government Dairy Farm	Kohlu	
	Government Dairy Farm	Pishin	
	Government Dairy Farm	Mastung	
	Government Dairy Farm	Quetta	
	Beef Production Centre	Sibi	
	Bhagnari Cattle Farm	Usta Muhammad	
	Red Sidhi Cattle Farm	Hub	
Sindh	LES Nabisar Road	Tharparkar	
	LES Malir	Karachi	
	Red Sindhi Cattle Breeding Farm	Tando Mohammad Khan, Hyderabad	
	Kundi Buffalo Farm	Rohri, District Sukkur	
	Kamori Goat Farm Khudabad	Dadu	
NWFP	Cattle Breeding and Dairy Farm Harchand	Charsadda	
	Jaba Sheep Farm	Mansehra	
	Livestock Development and Research Farm Surezai	Peshawar	

11. Genetic Biodiversity

Pakistan is a country with diverse geographic and climatic conditions. High mountains, deserts, plateau, rivers, oceans and fertile plains are all present in the country. Still there are some remote areas in this country, which have not yet been spoiled by the evils of environmental pollution. These regions are likely to have unique indigenous microbes.

11.1 Conservation and Institutional Arrangements

In Pakistan, MELGRD serves as the focal point for developing biosafety guidelines. It has set up a National Biosafety Committee. The National Institute for Biotechnology and Genetic Engineering (NIBGE) has also prepared a document outlining the basic principles for the "code of conduct" for research projects related to recombinant organisms, genetically modified organisms, (GMOs) and other areas of biotechnology research.

In Pakistan, work in the area of strategies, policies or legislation in this field is confined to a few institutes. These are listed below in **Table 11.1** along with some of the major projects presently underway.

Table 11.1: Institutions Involved in Genetic Engineering and Biotechnology in Pakistan

<i>Agriculture</i>	
Tissue Culture	Agriculture University Faisalabad, HEJ Research Institute of Chemistry (University of Karachi), Botany Department of Punjab University (Lahore), University of Peshawar, PFRI (Gatwala Faisalabad), NARC (Islamabad)
Bio-fertilisers	NARC (Islamabad), NIBGE, (Faisalabad)
Transgenic Crops	NIAB, (Faisalabad), CMB Punjab University. (Lahore) CRI, Cotton Research Institute (Multan)
<i>Environment</i>	
Pesticides	HEJ (Karachi), PCSIR (Lahore)
Air Pollution	NIBGE (Faisalabad), PCSIR (Lahore)
Toxic Effluents of Industries	PINSTECH (Islamabad), Cell and Molecular Biology Laboratory Department of Zoology Punjab University (Lahore), NIBGE (Faisalabad), PCSIR (Lahore), Centre for Molecular Genetics, Karachi University
<i>Industry</i>	
Fermentation	PCSIR (Lahore), NIBGE (Faisalabad)
Bio fuel	Biology Department QAU (Islamabad), NIBGE (Faisalabad), PCSIR (Lahore)
<i>Health</i>	
Diagnostics	Dr. A.Q. Khan Research Laboratories (Islamabad), NIBGE (Faisalabad), AFIP (Rawalpindi), Aga Khan University (Karachi)
Human Population Genetics	CEMB Punjab University (Lahore)
Human Genome Diversity	Dr. A.Q. Khan Research Laboratories (Islamabad)
<i>Animal</i>	
Livestock	NARC (Islamabad)
Vaccines	NIH (Islamabad), HEJ (Karachi), SPVC (Karachi), VRI (Lahore)

(Please see Glossary for abbreviations)

The Nuclear Institute of Agriculture and Biology (NIAB) and the Cotton Research Institute (CRI) are the premier institutes that develop new varieties of pest-resistant cotton and wheat. Before the recommendation of release of new varieties, extensive field trials are done at the research facilities and then at the adaptive research demonstration plots of the provincial agriculture departments. Success has been achieved in tissue culture technology

especially in the potato crop at the NARC. Some private tissue culture companies have also entered the market. The Punjab Forestry Research Institute (PFRI), Gatwala, has also established tissue culture facilities for tree crops. The new technology of Essential Micro-organisms (EM) started in the early nineties. And has now been applied at the farm level. The NARC has extracted biofertilisers from algae like Azolla. The HEJ Institute of Chemistry, Karachi and the PCSIR laboratories, Lahore, has had successes in extracting and marketing pesticides derived from Neem. The National Institute of Health (NIH), Islamabad, and the Veterinary Research Institute (VRI) have made Pakistan self sufficient in most of the vaccines for common diseases including snake bites.

It is important to emphasise that one specific area that has been ignored in Pakistan is microbial diversity. Microbes significantly exceed plants and animals in both number and diversity. Their diversity is reflected by the multitude of ecological habitats they occupy. This ecological distribution is a clear indication of their metabolic diversity and adaptability. Historically the cataloguing and documentation of Biodiversity has focused on flora and fauna. Therefore, microbes have largely been ignored, or at best relegated to a secondary position. This has happened despite the fact that the role of microbes in the production of fermented foods dates back to prehistoric times. It is believed that this role has spanned a period of eight millennia. The few thousand microbes that have been discovered, identified and catalogued represent only a fraction of what is believed to be present.

11.2 Threats

Revolutionary breakthroughs in genetic engineering during the last two decades have enormously increased the ability of scientists to manipulate genetic material. This is clearly reflected in the development of Transgenic crops and animals. Such genetically modified organisms (GMOs) and living modified organisms (LMOs) do have enormous economic potential but also raise serious issues related to biosafety and environmental imbalance. The hazards of accidental release of modified organisms can have unpredictable consequences. There could be epidemics for humans, livestock or plants. In a developing country like Pakistan, these problems can become unmanageable. Alternately, the accidental release of modified organisms can also cause the complete extirpation of vulnerable creatures including man. Genetically modified food, is food prepared from genetically modified seeds. Although, sale of this type of food for consumption has been allowed in the West, strong objections and controversy continues regarding its use. Monsanto, a US Company, tried to establish its activities in Pakistan, but due to strong lobbying by the environmental the programme has been shelved for the time being. The release of such microbes and plants into the environment needs to be seriously monitored and continuously debated.

In view of the foregoing, it is obvious why the conservation of microbial diversity should be an integral part of a national bio-conservation strategy. In terms of the review of the implementation of the CBD, it is important to pay attention to the issues related to microbial diversity. At present, there is no national centre for the preservation and collection of microbes in Pakistan. This extremely important initiative merits special attention.

A great deal of emphasis has been laid on the need to establish a strong regulatory system for the control of possible risks associated with the use and release of LMOs. However, very little attention has been paid to developing legislation or policies on biosafety guidelines in this area in Pakistan.

11.3 Conservation Projects

The document currently available on this subject is the *Voluntary Code of Conduct for the Release of Organisms into the Environment* prepared by the National Institute of Biotechnology and Genetic Engineering (NIBGE), Faisalabad. A committee has been constituted by the MELGRD to draft biosafety guidelines in genetic engineering and

biotechnology. The National Biosafety Expert Committee (NBEC) has recently given its conceptual approval to the guidelines. The guidelines propose a three-tier system to meet this biosafety requirement, i.e. the implementation of biosafety practices in genetic engineering and biotechnological work. The institutional biosafety convention has been proposed to implement and supervise low-risk elements. The Ministerial Biosafety Committee (MBC) deals with medium-risk elements and the National Biosafety Committee deals with high-risk elements. The guidelines also explain the policies, powers, functions and the responsibilities of the three committees. Standard forms are to be used by the three committees for the collection of necessary information.

11.4 Trade Related Intellectual Property Rights

The World Trade Organisation (WTO) includes the multi-trade agreement, the Trade-Related Aspects of Intellectual Property Rights (TRIPS). Members of the WTO are free to determine the appropriate methods of implementing the provisions of the TRIPS agreement within their own legal system and practice. This agreement establishes a minimum standard of intellectual property protection. The TRIPS agreement requires the member states of the WTO to provide protection to plants either by patent or by an effective *sui generis* system or any combination thereof. Each country is free to decide on the form of protection i.e. plant breeder's right or plant patent right. There is a ban on double protection for the same variety.

With the strengthening and widening of the *Intellectual Property Rights* (IPR) regime, the instances of attempts in industrialised countries to patent material based on traditional knowledge and genetic strains derived from other countries is increasing. This has led the Consultative Group on International Agricultural Research (CGIAR) to call for a moratorium on IPR claims on seeds held in trust in gene banks. This was done at their International Agricultural Research Centres such as the (IRRI), (ICARDA), (ICRISAT) located at Los Banos – Philippines, Aleppo-Syria, and Hyderabad – India respectively. Other materials, whose properties have not been fully understood, such as *Neem* and *turmeric*, have been grown in Pakistan for centuries. In recent years, these plants have been subject to IPR claims in industrialised countries. Even plant material of well-established geographical identities, such as Basmati rice grown and developed in Pakistan, has been subject to IPR claims. These rules prevent, among other things, the use of an old well-known name for a new variety, or a name similar to that recognised name.

11.5 Protection of Varieties through Patented Genes

The protection of the variety of plants by a Plant Variety Protection system is as important as the patent of genes. The practical implication of patented varieties is that these varieties cannot freely be used as a gene source for commercial breeding. This may lead to a monopolisation of a certain variety-type (e.g. insect resistant), which may harm the community and farmer, as well as discourage competition between companies. Licensing and patenting is being finalised in Pakistan, when the rules for licensing will be notified. Such a license may be granted if the exploitation of the variety is in the interest of the public, and the variety or the invention (the gene) represents important technological progress. The patent holder is in that case also entitled to get a license for the variety in order to insert genes and exploit the possible resulting, dependent variety. Although this regulation gives some comfort for breeders, but it is still uncertain whether such a compulsory license will ever be granted. If that is the case, whether it will be in time to have any commercial profit. Moreover, it would have been better to obtain the license during the breeding and selection process, before the release of the variety. One must consider the special case of self-reproducing, living plants, which function as a carrier for the inserted gene(s). It is in the interest of society to have a balanced system between the rights of the patent holder and the importance of free competition in order to avoid monopolisation. The exclusive rights of the

patent holder can be restricted by the creation of a Breeder's Exemption from the Plant Breeders' Rights. This means that without the consent of the patent holder, the patented variety can be used as a source for commercial breeding. However, with the obligation to pay a reasonable royalty if the resulting variety, is commercially exploited. The patenting of plant and plant varieties is not very common in Pakistan. With the recent development of the utilisation of plants without the Prior Informed Consent (PIC) of Pakistan, the plant and plant product patenting has created awareness among researchers. The HEJ Institute of Chemistry, Karachi, holds a patent on a pesticide composition based on *Neem (Azadirachta indica)*. The Plant Genetic Resources Institute has submitted a case for the patenting of 18 medicinal plants to safeguard and protect the valuable properties of Pakistan's indigenous plants.

12. Equitable Benefit Sharing of Biological Resources

This section deals with the policy, legal and implementation aspects of the equitable sharing of benefits from Pakistan's biological resources. It is supported with case studies on biological resource usage and steps that have been taken or are required, and projects that are underway.

12.1 Pakistan's Responses

An important component of the CBD is that of the equitable benefit sharing of biological resources. Part C of Article 10 requires each Contracting Party to protect and encourage the customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements; to support local populations in developing and implementing remedial actions in degraded areas where biological diversity has been reduced.

This aspect of the CBD has not yet been adequately addressed in Pakistan. However, The BAP has touched on this issue by stating that NGOs should be involved in the conservation of protected areas involved in the process. Unfortunately, the equitable benefit sharing of biological resources has not been dealt with directly. References in existing laws on land, forestry, fisheries and wildlife do give an idea of the understanding of the state on the equitable benefit sharing of biological resources. However, there is no direct policy statement on this.

The implied response of Pakistan to this component of the CBD can be obtained from the projects that have emphasised community participation and mobilisation, and the joint management of natural resources and empowerment. There is no project on the promotion of the traditional use of biological resources. Some initiatives, however, have been taken to promote income sharing from biological resources and provide income to the local communities. This is in the shape of an ecotourism project by the Adventure Foundation of Pakistan for the blind dolphins (See **Box 13** for details). NGOs like SUNGI²⁰ have been advocating that the revenues earned by the state from forest harvesting in the high hills should be shared with the local population.

12.2 Administration of Land, Water, Air, Forests and the Oceans

The Mughal King Akbar made the first piece of land legislation in the sixteenth century for India; it forms the basis for all subsequent legislation of Pakistan. All land was considered, as state owned, of which there were two categories of users: the landowner and the tiller. Parcels of land were then allotted by orders of the royal court called *firmans*. The property owner had to pay a tax or revenue in exchange of the benefits obtained. The British colonial rulers followed Akbar's land administration and made certain legislation. The land tax was

²⁰ SUNGI is a NGO with headquarters in Islamabad, and concentrates on the equitable distribution of benefits from natural resources. It is an advocacy NGO. Its main area of operation is the forests of Abbottabad civil division, NWFP. It has also played an active role in ensuring that the local people receive fair compensation for their lands acquired for the construction of the Ghazi Barotha Hydropower Project.

again treated as a rent payable to the crown. Pakistan adopted the Land Revenue Act of 1887 in the shape of the West Pakistan Land Revenue Act 1967. This act is applicable in all provinces, except the tribal areas. Under this Act, title to land, tenancy and lease, land revenue, assessment of land value etc are addressed. The colonial rulers awarded large parcels of land as fiefs (called *jagirs*) to powerful locals who promised allegiance or as reward. Nevertheless, through land reforms, the Jagirdari system is vanishing. Forest settlement that declares forests as reserves is made under the Forest Act, 1927. Rights of the local people in the forests like grazing, grass cutting, rights to water, etc. are settled and legal. The rights once acquired are non-transferable except by inheritance. The Land Revenue Act also governs the land under the rivers.

21The fisheries sector is controlled by a host of departments and agencies under the Fisheries Act 1961 and the Maritime Act 1976. These include the ministry of Food, Agriculture and Livestock (MINFAL) Islamabad that controls fisheries business through the Marine Fisheries Department (MFD) Karachi, the Karachi Fish Harbour Authority (KFHA) and the Korangi Fish Harbour Authority (KoFHA), though located in Karachi are controlled by different departments. The former is controlled by the Sind provincial government and the latter by the MINFAL. The Fishermen Co-operative Society (FCS) Karachi, a non-governmental organisation looks after the interests of the fishermen engaged in the marine sector only. The post of the fisheries Development Commissioner was created to handle the fisheries development work. The provincial fisheries departments handle fisheries business in the fresh waters of the respective provinces under the fisheries laws (given in table 1.1). Their activities include auction of fishing rights, except for the breeding season. Establishment of hatcheries and release of fish fingerlings is also a part of their duties. The departments also encourage commercial fish farming in the private sector. The present situation is that every possible pond, lake and marshes are auctioned to collect revenues. The Water and Power Development Authority (WAPDA) an autonomous organisation however handles the same duties in the fresh water dams of Tarbela, Mangla, Warsak and Hub dams. Issues of Biodiversity like introduction of exotics, non-fish aquatic fauna as dolphins are no priority of the fisheries departments. The traditional fishermen communities called Mohannas (who know no other skill for a living) before the advent of fisheries legislation were relatively more free. Now they cannot fish in their traditional fishing waters; they have to work for the fish contractors. Fish contractors usually pay in advance in the shape of commodities (mostly food) and deduct the amounts from the catch of each Mohanna on daily basis during the fishing season. This misery can be judged from the case study "The Cycle of Despair" Box 12.

Traditional natural resource management systems have declined with the advent of state-controlled protected areas and the creation of centralised management agencies. Although many rural communities have developed specialised, area-specific systems of use and conservation, current laws recognise few of these systems. On the other hand, many traditional activities have become illegal and are now sources of conflict between the authorities and local communities. The case study given in **Box 12** regarding Manchar Lake highlights this concern.

Box 12: The Cycle of Despair²²

"Why you are coming after every two months," remarked the woman from the boat. Though visitors are warmly welcomed in rural Sindh, the fishermen community of Manchar Lake has become sick of visitors. As we met the woman named Lal Khatoon in the boat, she said that the golden days of Manchar have passed when a thousand tons of fish were caught. Now the colour and taste of fish has changed. "The former Chief Minister Abdullah Shah had introduced the new seed of fish in the lake but that also does not give any fruitful result," says Lal Khatoon. According to her, almost each house of the area is in debt. They also purchase grocery items on credit at high rates. The shops are also located in boats. Women have very little for entertainment. They meet in the evening on the boats and chit-chat, and sometimes they sing folk songs. Men arrange chicken fights for entertainment. In marriages, boats are

²¹ Source: article by Latif Baloch dated June 15, 2000 in Daily Dawn.

²² Personal interview by Nasir Ali Panhwar Fellow LEAD-Pakistan, conducted for the preparation of this report.

decorated. A huge amount of money is taken as a loan from the contractor and is spent on marriages. Having huge feasts in marriages is a matter of prestige. Once an indebted person comes in the control of the contractor he never gets rid of the debt and remains in the vicious circle of poverty and the credit remains for generations.

"We also go to our spiritual leader Pir Mattal Shah who lives in the lake," says Lal Khatoon. Lal Khatoon prays to Allah that Chandan Main Nara Valley Drain (MNVD) i.e. outfall of the Right Bank Outfall Project (RBOD), which has spoiled the lake, should be stopped immediately.

The Right Bank Outfall Drain Project (RBOD) is a long-term project. It aims to drain out saline water on the Right Bank of the Indus River. Under the Right Bank Master Plan, developed by M/s. Mott Macdonald, WAPDA has undertaken drainage works on a priority basis that includes the construction of the link canal. This canal would dispose off the effluent from the RBOD into the River Indus. Presently, this effluent is disposed of in Manchar Lake through the MNV drain. The Main Nara Valley Drain has been further widened and remodelled to drain saline water. The RBOD has direct outfall in Manchar, which has not only affected life around and in the lake, but has also disturbed the heritage of Sindh. Under the project, the drain is being constructed to eliminate the outfall in the Indus River, which would again play havoc with the downstream population. This is because there is serious and unprecedented water scarcity in the Indus River due to upstream dams. More than 40,000 people from the vicinity of Manchar Lake have migrated due to loss of their livelihood. This perhaps is the worst migration due to environmental degradation in Pakistan.

Box 13: Conserving the Indus River Dolphins through Boat Safaris²³

The blind Indus dolphin is an internationally threatened mammal. Almost impenetrable barrages have carved up its home range. It has virtually no room to move along the great span of the river. This river was once its home territory. The waters of the Indus are polluted by human activity as it runs its tremendous course to the ocean. The dolphin has to compete with man for the fish that forms an essential part of its diet. Occasionally the river dolphin is trapped in fishing nets, which can mean death for the mammal. As is the case in many developing countries, there are limited financial resources to conserve this rare animal.

The Indus River dolphin is a very unusual kind of cetacean. A century of living in the turbid waters of the Indus has meant that its eyes are no longer needed. It has developed a sophisticated sonar system known as echolocation that it uses to steer with and hunt underwater. The current population of the river dolphin is thought to be 500. Its habitat is now confined to the area between two barrages, the Guddu and Taunsa Barrages, on the Indus.²⁴ A relative of the Indus River dolphin, the Ganges dolphin closely resembles it, but is, in fact, a distinct species. Other river dolphins include the Amazon River dolphin and the Yangtze River dolphin, all of which are distinct species. The closest known interaction of the river dolphin with humans is with the Indus Boat people, the Mohannas, who have lived on this river for centuries. The Mohannas too know no home other than the Indus, for they are truly boat people. Their houseboats drift silently up and down the river all year long using only sails and oars to propel them. The boat people are fishermen, who rely on the fishing contract issued by the government to harvest farmed fish on the reservoirs of the Indus barrages and dams. Poverty and neglect imperil the Mohanna's non-invasive way of life, and they suffer from poor health, education and low-income status.

The river dolphin has been featured in the folklore of the boat people, mostly as a benign and harmless creature. Now these two gentle life forms are thrown together into an awkward coexistence as they compete for food and space on the river.

Caught in this impasse of neutrality, the fishermen do not proactively conserve the dolphin, although they are keenly tuned into the behaviour and whereabouts of the dolphin in the river. The Adventure Foundation of Pakistan (AFP), a non-commercial venture, has initiated the Indus boat safari to raise

²³ Case Study by Mehjabeen Habib Fellow LEAD Pakistan

²⁴ Although prior to this report, the dolphin was reported only between the two barrages, during interviews for this report with the Deputy Director Fisheries, Chashma, it was learnt that this species also occurs upstream of the Chashma Barrage. Through the LEAD-Pakistan network, this fact was reported to the concerned agencies. The process of this report also highlighted that organisations like the Directorate of Fisheries, WAPDA should be on the panels that deal with biodiversity as they have rich first hand information.

awareness about this ecosystem and its unique inhabitants. The boat safari offers outsiders the chance to live on traditional Mohanna boats, drifting down the Indus with the fishermen to see the dolphin at close quarters and understand this unique animal. The project is aimed at developing an ecotourism product that protects the threatened Indus dolphin by involving the Mohannas to become the protectors of the dolphin. Conservationists in Pakistan are aware of some of the commercialised dolphin viewing tours operating in the world that have resulted in dubious impacts on both human and dolphin interactions. There have been cases when invasive tourist practices like feeding and swimming with the dolphins has been hazardous to both the animal and man. The AFP promotes dolphin viewing as a non-invasive activity, based on the traditional practices of the Mohannas. The closest that the visitors may get to the Indus dolphin is to listen to the continuous vocalisation of the dolphin with a hydrophone placed in the water.

A small co-operative society of the boat people manages and benefits from the proceeds of the ecotourism activity. The AFP is providing technical guidance to the boat people, helping to upgrade their boats, improve safety for visitors and equip individuals to become certified Indus guides. The AFP also helps promote this new activity in the country and in the world by using its close alliances with conservation NGOs such as the WWF, IUCN and the government. As it establishes itself, the boat safari is an incentive and a reward for the boat people to conserve the unique dolphin with minimum disturbance. It also encourages them to value their own traditional way of life and helps promote the off season activities of the Mohannas by refining and marketing their traditional handicrafts, such as basketry and embroidery. In the national context, the government has declared the territory of the Indus River dolphin a protected area. The habitat of the river dolphin is classified as the second most critically threatened ecosystem of Pakistan. The boat safari represents an essential link in the chain to help save the dolphin. As the primary interaction between the animal and the human, the project is a grassroots initiative to enable the boat people to become the protectors of the blind Indus River dolphin.

12.3 Religious and Cultural Beliefs

Ninety-seven percent of the population of Pakistan is Muslim. Like the western religions, Islamic teachings consider all creatures and resources a gift of God to man. Man being the best of God's creation is his *Major domo* (*chief servant*) on earth. The conquest of all God's creation is also believed to be within the control of man. Quranic verses frequently count the blessings of God; like fresh meat under the sea, fruits and livestock for food etc. Islamic teachings also warn against the wasteful utilisation of resources. There are many references in the Quran to the variety of life on earth, that it is subject to continuous change and that man knows only a fraction of what is created at any given time (Surah Yasin and Anaam). The holy Prophet Muhammad while leading war campaigns strongly banned cutting of trees in the conquered lands. Islam was spread in the land that now comprises Pakistan through the Sufi saints. These mystic Sufis are equally respected by all religions of the subcontinent. The Sufis' teachings are in harmony with nature, never taking/ wasting from the environment more than what is needed. The Sufis are known for their love of wildlife and wilderness. In fact, as shown in the case study of Kallar Kahar (**Box 14**) the Sufis in fact are the only force that has saved some of the wildlife from extinction. Zakat, a tax (2.5%) on the assets, is compulsory to be paid to the needy. Similarly, the sacrificial animals at Eid ul Azha act as incentive to the livestock breeders (See Chapter 10). Hunting is not disallowed in Islam and resultantly wildlife is at risk as guns are easily available. Green trees bow before God according to the Quranic teachings, but in Pakistan the tremendous increase in population makes people cut more and more; the rich for more wealth and the poor for a living. The Forest Departments in their regular tree planting campaigns (twice a year, spring and monsoon) frequently use the Quranic verses and teachings of the Prophet for planting trees. This strategy has given good results, though the increased price of wood is also a big incentive to the tree farmers.

Box 14: The Peacocks of Kallar Kahar and a Sufi Saint - the Unofficial Conservator of Nature²⁵

Kallar Kahar is a beautiful picnic resort in the heart of the Salt Range, some 130 km south of Islamabad. Peacocks and a historical lake surrounded by small hills are its peculiar features. The beauty of this lake was acknowledged in 1540 AD by Emperor Babar, the first Mughal king of India. He stopped here with his troops en route to conquer Delhi, and even mentions its beauty in his biography 'Tuzk e Babari'. This area is also known for the Sufi shrine of two grandsons of Syed Qadir Jilani of Baghdad (11 AD). This shrine is locally called Hazrat Hoo Bahu. Flocks of peacocks roam freely in this area. They spend time in the hills for feeding and breeding, but occasionally come close to the shrine. This site is unique in Pakistan, as the people do not catch or even disturb the peacocks. Had there been no shrine, it is certain that there would be no peafowl, as the locals believe. The Sufi saint has stated that whoever attempts to catch the peafowl will go blind. Peafowl are a popular and expensive cage bird in Pakistan and are considered a status symbol. A pair sells for Rs.5-15, 000 in the market. This price is lucrative enough for people to ensnare the birds from Kallar Kahar, but nobody dares to do it. The poorer people of the area turn down even requests for a pair from influential people in high offices and power.

The Sufi saint has conserved the peafowl by his spiritual powers. They have in fact multiplied and have reached Choa Saidan Shah a small town 40-km away where another Sufi saint is buried. Flocks of geese roam freely near the shrine of Choa town. Even in Choa Saidan Shah nobody dares touch the peafowl, as it is believed that these belong to the Saint, and whoever snares them shall be cursed.

The Sufi saints are known for love of wildlife and the wilderness. In fact, they have acted as the unofficial conservators of forests. In this case, they have proven more effective than any law of the country.

The local people had been using the natural resources for ages. The otter is one example of an animal that was traditionally captured from the wild by the traditional fishermen, trained and used in fishing. But due to intensification of fishing the otter which once was a friend of the fishermen is now considered a pest that eats commercially valuable fish, Box 15 elaborates this.

Box 15: From Pet to Pest a Story of the Otters²⁶

There are two species of otters in Pakistan the Common otter *Lutra lutra* and the Smooth Coated *Lutra perspicillata*. Both compete with man for food and had been kept as pet in the past to assist the fishing tribes trap fish. The story of the decline of the otter population and change of its status from pet to pest with no conservation projects is very serious.

The Common otter formerly occurred throughout all the Himalayan river systems, extending in summer to small mountain torrents as high as 3500m. It had been hunted extensively for its expensive fur. It has also come in conflict with government programmes to develop trout fisheries in the north. Resultantly it has become rare in even more accessible regions such as the Kaghan, Swat and lower Chitral valleys. Roberts 1997 reports that skins of the Himalayan otter reach the fur shops of Peshawar and Rawalpindi from Jhelum and Neelum valleys of Azad Kashmir as well as Hazara districts. However, most furriers admit that they have been receiving much smaller numbers in recent years. Hess believes that killing of otters by guards of the trout hatcheries as well as local hunters, is a more serious threat than the fur trade. In

²⁵ Based on personal visit by Syed Mahmood Nasir LEAD-Pakistan Fellow to Kallar Kahar for this report. Moreover, reference to the book locally available '*Ghaus Ul Azam Key Sahibzaday*' by M. Mustafa. There are many other shrines of Sufi saints all over Pakistan and each has a similar story. There is a need to catalogue all such cases and use them as a tool for conservation.

²⁶ Research conducted specifically for this report by Syed Mahmood Nasir Fellow LEAD- Pakistan cohort 5

Jughur Trout hatchery he saw four stuffed otters on display during 1984 and 1985 and a fifth specimen killed in 1983 near Singur, upstream of Chitral town.

The smooth coated otter is a species of the plains found throughout the lower Indus up to the outer foothills of the Punjab. It will frequently enter man made canal systems as well inundation storage reservoirs, swamps and lakes, often situated at a distance from the rivers. It has become comparatively rare largely because of increased human settlements on riverbanks and reduction of habitat due to barrages. It has been hunted for its skin and the professional fishing tribes of Sindh still trap the young and train them to assist in catching fish. Nowadays every sizeable lake in the country is leased to fish contractors by various government departments. Due to tremendous increase in fish prices, the fish contractors destroy any otter that they encounter, in order to eliminate competition for fishing stocks. Roberts 1997 quotes J. A. Murray (1884) who when writing about Sindh describes clusters of boats which formed the fishing villages on the Indus. Here one could see as many as twenty to thirty tame otters (*L. perspicillata*) tethered by the waist, some lying basking in the sun and others playing with children in the sand. Today such a sight is rare.

With the advent of the nation state and legislation, there is an apparent conflict on the usage of the natural resources between the traditional local population and the state. The conflicting perceptions of the traditional users of natural resources and the authorities of the state are elaborated upon in the following sections.

12.4 The *Haqdari*²⁷ System in the Hill Forests of Murree and Kahuta²⁸

In 1868, the hill forests of Murree and Kahuta near the capital city of Islamabad were richly populated with a diversity of flora and fauna. The human and cattle populations at the time were very low, and the requirements of timber and grazing were met without any hindrance. Thereafter, both the human and livestock populations increased. Giving them rights for grazing and timber in return for their assured co-operation in preventing incendiary fires regulated the rights and concessions of the villagers. This was sanctioned in 1886 by a decree from the British rulers of India. These rights included a free grant of three mature coniferous trees every five years to each individual. Whereas the forests have remained stationary, the population increased from 8413 households (in 1913) to 30,000 households (in 1952) and 130,000 households (in 1997). Proportionately the livestock heads have also increased. This increase in livestock has resulted in the extermination of the majority of broad-leaved species for which no rules were framed.

At the time when this right was admitted, available records show that only 1680 trees were required under this decree in 1868. Presently the forests can provide only 2000 to 3000 dead and dry trees against an annual demand of 26,000 by the right holders. Thus, the Forest Department is able to supply trees to 5 % of the registered right holders. Section 23 of the Forest Act of 1927 prohibits the transfer of rights in any way, except by inheritance. Yet, this clause is unable to mitigate the pressure on the forests. This is because the human population in Murree and Kahuta has increased tremendously over the last fifty years. The monetary value of trees granted as *haqdari* to the local population is Rs. 30 million annually.

The burden on the forests has been partly reduced due to the increased use of *liquefied petroleum gas* (LPG) and kerosene oil in the area since the early eighties. To further mitigate

²⁷ *Haqdari* is a legal term that means the right of the local inhabitants of the Murree and Kahuta hilly areas. This right is for trees to be used for personal purposes such as house construction or repairs, etc. The sale of trees is prohibited.

²⁸ Case study prepared by Shabbir Ahmed, Conservator of Forests, Murree Kahuta Development Authority and Syed Mahmood Nasir, Fellow, LEAD-Pakistan, Cohort 5, specifically for this country report.

the pressure on the hill forests, the Forest Department is also supplying 1200 metric tons of firewood at subsidised rates from the irrigated plantations of Mianwali and Gujrat. However, the pressure on timber is increasing and the forests can no longer bear the weight of an increase in population. There is a need to reduce *haqdari* pressure by reducing the rights, if not outright cancelling them. The entire local population no longer avails the concessions granted 100 years back, since many are away in their jobs down country and others use modern construction materials like cement and reinforced cement concrete (RCC). These concessions have now mostly been commercialised and most of the land, either full or part thereof, has been sold to immigrants from down country and estate developers. The new settlers legally cannot enjoy the legal right of *haqdari* due to the provision in the Forest Act of 1927, which prohibits the transfer of rights except via inheritance.

These mountains are the watersheds of Punjab's major water reservoirs, and simultaneously the water recharge zones for down country aquifers. The excessive exercise of grazing and timber rights and the development of housing colonies on communal lands have threatened the complete collapse of the ecosystem. There is a need to put a halt to this situation and regulate these rights in the changed scenario. Politically, the democratic government is not in a position to eliminate the *haqdari* rights nor are the people willing to do so. A major intervention is required to break the impasse and find a win-win solution to this environmental flashpoint. Until now, no solution has been attempted. The imposition of a ban on the felling of green trees as discussed in Chapter 4 is the only exception.

12.5 Distribution of Benefits in the High Hill Forests of NWFP

Most of the high hill forests of Pakistan are located in the NWFP. These are productive forests with commercial, social and protective roles. The local communities are highly dependent on various products from forest resources. The distribution of rights and privileges play a greater role in the conservation and development of the forests. In the NWFP, these rights are based on the tenure system. There are three category of forests: reserved, protected, and *guzara*.

Reserved forests are government-owned and provide minimum rights and privileges to the local communities. Although locals do not have the rights of free grazing, firewood collection, and timber, unofficially they receive these benefits. However, they are not entitled to any share from the commercial sale of trees. This situation hinders the co-operation of the local communities and discourages them from the sustainable development of resources. Realising this crucial issue, the Forest Department is working for the joint management of the forest. This is through the Siren Valley Project. Under this project, the local communities will be entitled to firewood, fodder and timber for the construction of houses. The communities' will in turn, play a more active role in forest protection and development. In this regard, the Forest Department has made a change in the Forest Act by including community participation. This concept is in its initial stages, but has enlisted the greater support of the community for forest protection. If adopted on a large scale, it will be a good step towards the equitable distribution of benefits, and will lead towards sustainable forest management.

The second category of forests is the *guzara* forests in Hazara district. These forests are privately owned, where the government receives 20% of the commercial sale proceeds from tree harvesting operations. The owners receive the remaining 80% of the revenue. In this category, the non-right holders can collect firewood, and fodder, but are not entitled to any share in the royalties. This type of arrangement requires adjustments since it is skewed. The joint forest management strategy can also work in this system.

In the Malakand division of NWFP, the forests have been declared *protected forests*. These forests belong to the government, but the locals have rights. They are allowed to graze

animals, collect firewood, other minor forest produce and obtain timber for the construction of houses. They are entitled to a 60% share in the commercial sale of trees. The future distribution of royalty shares is undertaken amongst the tribes based on prevailing rules and regulations. Although this is an effective system, locals do not feel responsible for forest protection. In order to involve the local community in forest management and protection, a number of initiatives were taken by the Kalam Integrated Development Project. These include the preparation of participatory management plans, the formation of forest protection committees, the training of locals in the environmentally friendly scientific harvesting of trees. This also includes the elimination of outsiders (timber mafia)²⁹ in the purchase and over-harvesting of their forests.

12.6 Equitable Benefit Sharing among Traditional Grazers of the Cholistan Desert

Cholistan is a vast tract of hot desert land locally known as Rohi. It extends over an area of 6,600,000 acres which was transferred to the Forest Department and was declared a protected forest under the Forest Act of 1927. The general land marks like *tobas* (earthen, makeshift ponds) and old routes demarcate one block from another.

The traditional local grazers called *rohillas* lead a life that revolves around the rearing of cattle. They spend time in the desert when there are rains. Rainwater is collected in the *tobas*. A few underground tanks have been constructed to store water. The locals acquired the art of building ponds and tanks elders' centuries ago. This art is now dying since the government and other agencies have taken over this role.

The rangelands of Cholistan are depleted due to the injudicious use of the areas, coupled with frequent droughts. The average forage production of the area is 150 lbs. per acre. The total carrying capacity of the area under grazing at present is 687,400 Animal Unit Months (AUM) with a grazing capacity of 8 acres per AUM. The area can provide feed for 140,000 AUM (which is the present number of livestock grazing in Cholistan) for a period of 5 months.

Cholistanis have customary rights to graze any number of livestock owned by them by paying an annual grazing fee. This is normally a nominal fee called *tirni* collected by the Forest Department. The average annual revenue collected by the government amounts to Rs. 600,000 (**Table 12.1**). Cholistanis earn their income from the sale of cattle, and animal by-products such as milk, butter, oil, wool, camel hair, and the animal hides of sheep, and goatskins. The Forest Department auctions bones of dead animals annually.

Table 12.1: Rates of Grazing Fee in Cholistan

Animal Type	<i>Tirni</i> (Rs./animal/annum)
Sheep	3
Goat	3
Cow	6
Buffalo	12
Camel	18

²⁹ The timber mafia is a term used in Pakistan for influential persons who illegally log and market timber. Due to their power and influence they cannot be apprehended.

12.5.1 Differences between the Traditional People and the Forest Department

Cholistan has a population of more than 50,000 people. The majority of this population consists of Muslims called *Rohilas* and the minority of Hindus called *Marwaris*. They live in small hamlets and their main profession is the grazing of livestock. Traditionally each tribe and clan has control over their *tobas* and other watering points. Arranged marriages within and between the clans largely depend on the ownership of *tobas* and grazing lands, but with the advent of the government agencies, this custom is dwindling. Animals of one particular area or village may move to another area and vice versa by mutual arrangements for grazing. Local communities still accept ownership of the land according to their traditional system, and each tribe respects the grazing rights of their neighbours. However, the Forest Department, deals with the entire tract as a protected forest and there have been instances of the department triggering disputes between the clans by giving temporary ownership of *tobas* to outsiders. The pattern of grazing is nomadic. Animals and the grazers keep on moving from one place to another in search of water. Grazers and their livestock enter Cholistan with the first rain shower, usually in the middle of July. Grasses spring to life during these showers and the *tobas* fill. In a good rain year, Cholistan bustles with activity until the rainwater dries up by January/February. By January, Cholistanis move to their villages, where each family digs up unlined, temporary wells to use the rainwater soaked in the upper layers of the soil.

There are no recorded rights of grazing in the government records over the area of Cholistan except for the *Kharoolas*. The case of harvesting of Khar (see **Box 16**) highlights the need to educate the traditional people and the government regarding natural resource usage. This is necessary in order to bring these perceptions in accordance with the requirements of the CBD. The Cholistanis have divided the areas between the tribes for organised grazing. While arranging marriages between the tribes, the traditional rights of grazing and access to water ponds are taken into consideration. The Forest Department had been issuing *superdnamas*, which locally means temporary custody for the ponds constructed by the Forest Department. The *superdnama* issued by the Forest Department come into force whenever new agricultural lands are available for allotment by the extension of the canal irrigation system.

Box 16: Harvesting of Naturally Growing Khar³⁰

Khar (*Haloxylon recurvum*) is a perennial plant that can be observed all over Cholistan. It breeds through seeds and coppice. Seedlings sprout in the late monsoon season and reach a height of 2-3 feet by the winter. Khar was traditionally auctioned by the Nawabs of the former state of Bahawalpur. This is done by the Forest Department upon the accession of the state to Pakistan in 1952. Rights were granted to the local people for the collection of Khar. These rights state that no outsider shall be employed for its harvest and that the purchaser shall pay half the harvest to the locals as a collection fee. Khar is cut and burned in pits and the solid product called Chowa is used as a raw material in the caustic soda soap industry. The ecological impact of this harvest on the desert ecosystem has not been fully studied. Due to the overexploitation of this vital biological resource of the Cholistan desert, the soil is exposed to erosion and the habitat of wild animals, e.g. foxes and hares, is disturbed. The natural process of plant succession is also brought to a halt. The regeneration of fodder plants like Jand and Ber is also on the decline in areas where Khar has been exploited.

12.7 Status of Right Holders in the Scrub Forests of The Salt Range

The scrub forests of the Salt Range of Potohar are spread around Rawalpindi, Jhelum, Attock, Chakwal and Khushab districts of the Punjab Province. These forests were mostly no man's lands at the start of the century. Exceptions were small tracts used for rain-fed agriculture by the local population.

³⁰ Case study by Javeed Kausar Conservator of Forests, Punjab Forest department

These scrub forests were the harbingers of vast floral, faunal and ecosystem diversity. Records show that the District Magistrate of Shahpur gave rewards for the killing of pythons, lions and tigers until the end of the 19th Century. Realising the importance of these forests, the British rulers of India made settlements under forest laws in 1902. The rights of grazing, grass cutting and the collection of firewood for domestic use were granted. Private ownership of land was also established. Large tracts of lands were set aside as communal grazing lands while the rest of the areas were declared as reserve forests where grazing or any other intervention was not allowed. Forest laws were vigorously implemented in the reserves. Until the landscape favoured grazing in the communal lands, there was little conflict between the local population and the forest authorities.

After over a century of free grazing in the communal lands, land degradation has resulted, and the pressure is now shifting to the reserve forests. Mining activity and large scale nomadic grazing by the Bakarwals have also had adverse effects on the reserves. In a major portion of the forests, grazing rights were granted upon the payment of a fee. The browsing of goats and camels was not allowed in any of the forests. However, in practice, goats and camels freely graze and browse in these forests. The management plans for these forests have been prepared and implemented. Although a 10-year rotational grazing system was allowed in some forests classified as protected forests, this was not implemented in practice. The Forest Department earns substantial revenues through the sale of grass and by the issuance of grass cutting permits to non-right holders. Those villages that were granted free rights to collect firewood for domestic use continue to enjoy these rights.

The tremendous increase in the human and livestock populations of the Salt Range areas has brought the forests to such a stage that the Forest Department has now devised a forest management strategy that involves the local population. This is being achieved by the range and scrub component of the Punjab Forest Sector Development Project. The social mobilisation of the communities is in progress and it is hoped that most of the forests shall be utilised in a sustainable way without adversely affecting the scrub forest ecosystem and productivity. However, this is a difficult task and only time will tell if the Forest Department has improved or further deteriorated the forest resources, by introducing community participation into forest management.

12.8 Conservation Projects Involving Local Communities

A number of projects have been undertaken that seek to enlist the participation and support of the local communities in conservation. The objectives, achievements and some specifics of the project are elaborated upon in the following sections. A list of Biodiversity related projects in Pakistan are available in **Appendix G**.

12.8.1 Protected Areas Management Project

The Protected Areas Management Project (PAMP) seeks to strengthen the management of three National Parks of Pakistan. The objective of the project is to enhance the conservation of Biodiversity in these protected areas by integrating them with their local and regional socio-economic environment. This will involve implementation of a community-based management model for the national parks. An appropriately targeted environmental education initiative and upgrading the existing park-related infrastructure and management capacity is part of the project strategies. The strategy also includes mitigating the environmentally degrading processes in each protected area and its environs. This is achieved through the development of management plans and strategies.

The Hingol, Chitral Gol, and Machiara National Parks were selected for this project because of their ecological importance and the degree to which Biodiversity was threatened within them. The investment plan of these areas was submitted to the GEF Council, which has been

approved for a funding of USD 10.8 million. The project has been approved by the Government of Pakistan.

12.8.2 Sustainable Resource Use in Bar Valley

The Bar Valley is situated in the Northern Areas of Pakistan. The valley is characteristic of a high altitude, low rainfall, arid mountain ecosystem. The area offers a wide range of habitats for a variety of flora and fauna. The main tree species are juniper, willow, ash, and birch. The Himalayan ibex and snow leopard are among the important resident wildlife species.

By the late 1980s, the locals threatened the natural resources of Bar Valley because of population pressure, the expansion of agriculture and livestock, habitat degradation and subsistence hunting of the ibex. The population of the Siberian ibex was nearing extinction while the snow leopard was also being poisoned to protect domestic goats and sheep. WWF-Pakistan's Bar Valley project was initiated in this area to protect the natural resources of the area, particularly the Himalayan ibex and the snow leopard. The objectives of the project were as follows:

- Conservation of natural resources, especially the wildlife population and their habitat.
- Sustainable use of wildlife species, especially the ibex for enhancing the local economy, and to create new sources of income generation e.g., promotion of ecotourism and the trophy hunting of ibex.
- Capacity building of local activities for community mobilisation and management issues related to good record keeping and accounts management of CBOs.
- Awareness raising of the public regarding environmental conservation.
- Capacity-building of local guides to promote eco-friendly trekking and tourism.

Under this project, the following achievements were made:

- The conservation of ibex for sustainable use
- The replenishment of depleting habitats
- The establishment of a village committee elected by the locals to:
 - a) Guard against illegal hunting of the ibex and other wildlife species
 - b) Undertake development activities as planned by the project

12.8.3 Torghar Conservation Project (TCP)

The Torghar Conservation Project (TCP) ranks as one of the first sustainable use initiatives in the country. The TCP was started by a group of volunteers to stem the illegal markhor and urial hunting that had resulted in the dwindling of the two species in the Torghar Hills region. The project was run informally until 1994 when a NGO called the Society for Torghar Environmental Protection (STEP) was formed to administer the project. The NGOs and the government as a tool for conservation have accepted the concept of using trophy hunting as a tool for wildlife conservation. The dynamics of this tool are described in **Box 17**.

Box 17: Trophy Hunting in Pakistan-an Important Tool for Conservation³¹

In Pakistan as in almost all of the developing countries where many of the large mammals are threatened with extinction, both government and non-government conservation organisations now endorse trophy hunting as a pragmatic management tool for conservation. For many years, limited trophy hunting has been practised in the provinces of Balochistan, NWFP, and Sindh as well as in the Northern Areas of Pakistan.

In the Torghar Mountains of northern Balochistan, trophy hunting has been used as a management tool for the conservation of the internationally threatened Sulaiman markhor (*Capra falconeri jerdoni*) and Afghan Urial (*Ovis vignei cycloceros*). These were at the verge of extinction when the project, Society for Torghar Environmental Protection (STEP) began in 1985. Currently, Torghar boasts the largest populations of both of these important species. The proceeds from the limited trophy hunt have been used in the development activities of the area, thus establishing a clear link between conservation and development for the tribal people of the area.

Parallel to the STEP initiative, WWF-Pakistan introduced a sustainable trophy-hunting project in Bar Valley, Gilgit. The revenue generated by trophy hunting of the Himalayan ibex is shared with the local communities and the government with a 75% and 25% share respectively. The IUCN project "Maintaining Biodiversity in Pakistan through Rural Community Development" began in January 1995. It covers Chitral in the NWFP and the Northern Areas. Trophy hunting is one of the important components of this project. Resource management plans are prepared with the participation of the local communities and where the population of the Himalayan ibex (*Capra ibex*) can sustain it, trophy hunting is conducted. The proceeds are shared between the communities and the government. This has led to a sense of ownership of wild resources. Similar approaches have been adopted for the Himalayan ibex in a WWF project in Bar Valley.

Trophy hunting has also been carried out in Chitral for the conservation of the flare-horned Markhor (*Capra falconeri falconeri*). In Sindh, trophy hunting has been used for conserving the Sindh wild goat (*Capra aegagrus*) and the chinkara gazelle (*Gazella gazella*).

At the 10th Conference of the Parties of CITES held in Harare, Zimbabwe, in 1997, an annual quota of six sport hunted markhor trophies from Pakistan was approved. The main arguments used by the Pakistani delegation at COP-10 were that Pakistan is actively promoting community-based management of wildlife resources. It was also argued that the financial proceeds from trophy hunts would go directly to participating communities as an incentive. In 1998, the federal government allocated this quota to Balochistan and NWFP. In the absence of a clear mechanism to manage this quota, this project is currently on hold.

Although trophy hunting has been accepted as an important tool in conservation outside of protected areas, a clear policy and associated legislation and regulations are needed to implement it. Pakistan must develop a transparent and well-defined policy with appropriate incentives to encourage the use of this important tool to reduce poaching and conserve natural heritage.

12.8.4 Palas Area Conservation Project, Kohistan, NWFP

This project aims to protect and conserve Biodiversity, particularly the endangered western tragopan, in the valley of Palas. Due to remoteness and inaccessibility, the habitat is healthy and supports a large number of plants and animals. With the help of the community, efforts are being made to keep this important habitat free from commercial harvesting. The communities also help to identify and promote alternate sources of income from this forest. This is in the shape of medicinal plants, mushrooms and other minor forest produce. Similarly, in other adjacent areas, sustainable forest management and utilisation techniques are demonstrated to reduce the dependency on the protected areas.

12.8.5 Maintaining Biodiversity in Pakistan with Rural Communities

This project has recently been concluded in the Northern mountainous region of Pakistan. Its principal objective was to demonstrate how the conservation of Pakistan's Biodiversity could

³¹ Case Study by Naeem Ashraf Raja Fellow LEAD Pakistan

be enhanced. This was achieved by providing the rural communities with the technical skills to manage natural resources for sustainable use. In addition, derive income from trophy hunting, ecotourism, and the marketing of medicinal herbs, etc. Village Management Plans prepared by the communities is the main tools for the conservation of Biodiversity for sustainable use and community development.

12.8.6 Mountain Areas Conservancy Project (MACP)

The Mountains Areas Conservancy Project (MACP) is funded by the Global Environmental Facility (GEF) for the total cost of US\$ 10.35 million. The MACP will be implemented in northern mountains of Pakistan in four project areas called "Conservancies," covering an area of 16,000 sq. km.

The MACP aims at protecting the rich ecological landscapes and Biodiversity of the Karakoram, Hindu Kush and Western Himalayan mountain ranges of Northern Pakistan. It comprises a package of interventions to address the underlying causes of Biodiversity loss in the region. The principal focus is on empowering local communities to manage Biodiversity, making them accountable for the quality of resource stewardship. Share of communities and government in the revenues from trophy hunting would be 75% and 25%, respectively. Proceeds from trophy hunting and other sustainable use initiatives will be deposited in the communities' fund.

Seven major components of the MACP include: Local planning and management, conservation education and awareness, local monitoring, eco-development, sustainable use demonstrations, policy, legal and institutional development and financial mechanism-conservancy fund.

13. Other Biodiversity Related International Conventions

This section discusses international Biodiversity related conventions that Pakistan is a signatory to, other than the CBD.

13.1 Pakistan's Compliance with International Treaties and Conventions

The Government of Pakistan is a Party to a number of international treaties/conventions related to nature conservation. These conventions and focal points in Pakistan are as under:

- | | |
|-------------------------------------------------------------------------------------------|--------|
| • Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) | NCCW |
| • Convention on the Conservation of Migratory Species of Wild Fauna (CMS) | NCCW |
| • Convention on Wetlands of International Importance (Ramsar) | NCCW |
| • Framework Convention on Climate Change (FCCC) | MELGRD |
| • World Heritage Convention (WHC) | NCCW |
| • CBD | MELGRD |
| • CCD | MELGRD |
| • FCCC | MELGRD |
| • CITES | MELGRD |
| • CMS | NCCW |

Details on the implementation of some of the conventions are given in the following sections.

13.2 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

This convention was signed in Washington on March 3, 1973. Pakistan became a party on April 20, 1976. More than 130 countries have acceded to it so far.

13.1.1 Obligation of the Parties

- To prevent trade in specimens of species included in Appendix I, II, and III of CITES except in accordance with the provisions of the Convention.
- To take appropriate measures to enforce the provisions of the Convention and to prohibit trade in the specimens in violation thereof. In case any violation has already taken place, the main provisions of the Convention are:
 - To penalise and take possession of such specimens.
 - To proceed to return the specimens to the country of origin.
 - To prepare periodic reports on CITES implementations for submission to the Secretariat of the Convention.

The endangered species have been categorised in three different appendices in accordance with their global status. Appendix-I lists critically endangered species with trade potential for scientific, research and breeding purposes only. The species of fauna which are found in Pakistan and are listed in CITES Appendix-I include the snow leopard, Marco Polo sheep, black and brown bears, peregrine falcon, the Houbara bustard, the monitor lizard and marine turtles. The species of fauna listed in Appendix-I are protected because they are listed in provincial legislation for legal cover. Hunting and export on a commercial basis is not permitted. The trade policy circulated by the Ministry of Commerce also reflects the commitment of the Government of Pakistan by listing CITES species in such a category that prohibits their export. An example is the Houbara bustard, an important bird whose arrival in winter also brings foreign dignitaries and at times controversies for its conservation (see **Box 18** on the Houbara bustard for details).

Appendix-II of CITES includes species which are not critically endangered, but whose free trade may cause their eventual inclusion in Appendix-I. The Government of Pakistan generally discourages the trade of birds listed in CITES appendices. However, a limited number included in CITES Appendix-II are permitted for export. Such species of fauna in Pakistan include the saker falcon, Indian cobra, mongoose, etc. A few floral species found in Pakistan are also listed in CITES Appendix-II such as the katki and Indian nard. The Government of Pakistan is permitting the export of saker falcons in limited numbers. These falcons are exported to the Gulf for use in falconry. However, such exports are permitted only to the dignitaries or state guests. The permitted floral species of Appendix-II are collected on a commercial basis mainly for medicinal purposes, but their trade outside the country is not permitted keeping in view CITES obligations.

Box 18: Houbara Bustard³²

The Houbara bustard (*Chlamydotis undulata*) - a member of the bustard family, is a migratory bird, which visits Pakistan during the winter season, from mid-September until April. Its breeding grounds are the expansive slopes stretching across the Central Independent States. There are also a few records of its breeding in the Kharan and Chaghi districts of Balochistan. Each year before the onset of the winter season and before the hoary winds from the tundra engulf the region, the Houbara migrates to the warm wintering sites in the south. It enters Pakistan along two main routes: down the Kurram Valley, and secondly, via the Chagi-Kharan area, fanning out into the Dera Ghazi Khan civil division, Kirthar and Jhimpher in the west and the Tharparker tracts in the east. Recent studies show a decline in the populations of Houbara in all the wintering areas of the Houbara in Pakistan.

The Houbara was initially listed as a threatened species and was later taken out of the threatened category by the GOP under the influence of the Foreign office. The reason for this being, its extensive range and distribution, which does not meet the requirements of a species having threatened status as outlined in IUCN's criteria.

Although the Houbara is legally protected in Pakistan, (it is in the Third Schedule of all three provincial wildlife acts-Balochistan, NWFP and Punjab), it cannot be hunted or captured under any circumstances. However, every winter, foreign hunters, mostly from Middle Eastern countries, are allowed to hunt them. Thus, the Houbara instead of being an issue of wildlife conservation enters the shady domain of politics, foreign affairs and bureaucracy.

The Houbara Foundation International, Pakistan (HFIP) a non-governmental organisation is engaged in conserving the population of the Houbara bustard. It claims that the Houbara bustard is a victim of illegal hunting by locals and foreigners, and that its population is under constant pressure. The HFIP is striving for the conservation of the Houbara population (both the migratory and the resident variety) through its sustainable harvesting in collaboration with local communities. They have also started educational and awareness programmes to restore the degraded habitat. The HFIP has undertaken a number of projects dealing with the Houbara bustard. There is a dire need to ensure the implementation of law to protect the Houbara from illegal hunting. In addition, there is room to strengthen sustainable use programmes that can be run in the Houbara wintering areas providing the local communities living in and around the Houbara habitat are given sufficient incentives to maintain the populations.

Appendix-III includes species, which may be common in one country, but at the same time endangered in another. One example of such a species is the rose-ringed parakeet. Its population is so common in Pakistan that it is considered a pest of fruit and crops. On the recommendations of the Zoological Survey Department, the scientific authority for CITES in Pakistan, a quota for the export of rose-ringed parakeets was fixed at 30,000 for the year 1998.

In order to fulfil the obligations of CITES and to protect the natural wealth of the country, the GoP has imposed a moratorium on the commercial trade of mammals, reptiles, and protected birds. This ban will continue until the year 2001 and if required an extension will be reconsidered. A number of traders are interested in the export of freshwater turtles to China and other countries of Asia. Since most of the freshwater turtle species are listed in the CITES Appendices, the commercial export is not permitted despite the Ministry of Commerce's recommendations to allow such exports.

The import of CITES-listed species is only permitted if admissible under regulations. It is being reported that *Shahtoosh*, a fine quality woollen shawl which is made from the wool of the Tibetan antelope, a CITES Appendix-I species, is being traded through Pakistan. Tibetan antelope found in China are being poached for their high priced wool. The shawls are manufactured in Indian-held Kashmir.

Pakistan submitted a proposal to the 10th Conference of Parties of CITES held in Harare, Zimbabwe in 1997 that called for the allocation of an export quota of six hunted markhor

³² Case Study by Naeem Ashraf Raja Fellow LEAD Pakistan

trophies. The markhor is listed in CITES Appendix-I. The quota was approved to give an incentive to the communities involved in nature conservation.

13.3 The Convention on the Conservation of Migratory Species of Wild Animals (CMS)

The member countries of the CMS are obliged to take the following measures to conserve migratory species and their habitat:

- Adopt strict protection measures for migratory species that have been categorised as endangered;
- Conclude agreements for the conservation and management of migratory species that have an unfavourable conservation status or would benefit significantly from international co-operation;
- Undertake joint research activities.

Migratory species are listed in two appendices. Appendix-I of the CMS lists the species that are in danger of extinction throughout or in a significant proportion of their range. On the one hand, the Siberian crane and the white-headed duck are both protected under provincial legislation, while on the other hand, the Wildlife Department has taken certain measures for their conservation. The Siberian crane is a passage migrant in Pakistan. It stops over while migrating towards its wintering habitat in India (Bharatpur) and its breeding grounds in the Central Asian States. Since its population is so small, it is rarely observed in Pakistan. The white-headed duck is near extinction. The Uchali Complex (with three wetlands i.e. Uchali, Khabeki and Jhalar Lakes) in the Soan Valley of Punjab has been designated as a Ramsar site for the protection of this globally endangered species. Still the population is on the decline due to other ecological factors.

Appendix-II of the CMS includes a list of migratory species that could attain a conservation status only if the implementation of international co-operative agreements is ensured. The species included in Appendix-II are not necessarily threatened with extinction, but would potentially benefit from international conservation efforts, e.g. see **Box 19** on the Siberian crane.

Keeping in view the alarming status of the Siberian crane, the CMS has encouraged the range states to sign MOUs concerning conservation measures. Seven member countries, including Pakistan, have signed MOUs in 1993 to help save this species from extinction.

Box 19: Siberian Crane

The Siberian crane (*Grus leucogeranus*) is listed as endangered in the IUCN Red Data Book as well as in BirdLife International's Birds to Watch 2 - The World List of Threatened Birds. The Siberian crane breeds in Siberia and winters in China, Iran and India. Three flocks are recognised: the western flock wintering in Iran, the eastern flock wintering in China and the central flock wintering in India after passing through Afghanistan and Pakistan. In India, the wintering population has declined from 125 in the 1960s to 2 birds in 1998.

The passage of the Siberian crane through Pakistan is still a mystery. Whatever evidence we have of its passage in the Kurram Area of the NWFP and northern Balochistan is from hearsay only. Lack of any concrete evidence on the species' migration route through Pakistan adds to the threats faced by the species. The main threats to the species are:

- Heavy hunting and capture along the important migration routes in Afghanistan and Pakistan.
- The drying up and disturbance of important wetlands which act as migration staging sites.

Awareness programmes about the importance of the crane have been taken up by WWF-Pakistan in addition to carrying out studies of its migration routes.

13.4 Convention on Wetlands of International Importance (RAMSAR)

The Convention on Wetlands was signed in February 1971 in the Iranian coastal city of Ramsar and came into force in December 1975. It was initially adopted for the conservation of wetlands of international importance, especially as waterfowl habitats. Pakistan was amongst the pioneer parties of the Convention. To date, 121 countries have ratified it. Member countries promote wetland conservation by adopting the following measures:

- Nominating specific sites to the List of Wetlands of International Importance that will then be continually monitored to ensure that they retain their specific ecological characteristics.
- Promoting the wise use of all wetlands within their territory.
- Promoting the training of wetland managers.
- Consulting each other particularly in the case of shared wetlands, water systems or resources such as migratory water birds.
- Creating and managing wetland reserves.

Pakistan had initially designated nine Ramsar sites, which the Ramsar Bureau monitored. After the Monitoring Mission Report (1990), the list was revised and new sites replaced the three which did not comply with Ramsar criteria. Now there are eight Ramsar sites in Pakistan which are listed below:

	Name of site	Area (Ha)
1.	Uchali Complex including Uchali, Khabeki and Jhalar Lakes	942
2.	Taunsa Barrage.	6567
3.	Chashma Barrage	33084
4.	Drigh Lake	164
5.	Haleji Lake	1704
6.	Kinjhar Lake	13468
7.	Tanda Dam	405
8.	Thanedar Wala	4047
	Total Area:	60381

In addition, eleven more potential wetlands (all in Sindh) have been identified. These await declaration as Ramsar Sites.

There is no legal instrument that can be invoked exclusively for the wetland habitats or Ramsar Convention in Pakistan. However, designated Ramsar sites have protected status under provincial wildlife laws. There have been bottlenecks in the implementation of the Ramsar Convention, which are partly due to weak co-ordination amongst the implementing agencies. To cover the problem of co-ordination, the National Wetland Management Committee (NWMC) was set up in 1996.

13.5 International and National Obligations on Banned Pesticides and Chemicals

In many developing countries like Pakistan, pesticides that have been banned, or have had their use restricted in the western countries, are still being used as these countries provide unrestricted markets for such outdated and harmful pesticides. For example DDT and BHC have been banned in the USA and most of Europe and are still being used in many developing countries including Pakistan. It is time that immediate, necessary preventive and legal measures are taken to ban the use of such pesticides, which are extremely detrimental to human health and the environment.

In Pakistan, pesticides worth about Rs. 13 billion are imported annually. About 70-80% of these is used on cotton. Most of the insecticides currently used are non-selective toxic chemicals. These cause serious environmental problems. Ecological and agricultural sustainability has become an essential consideration in present day agriculture. Moreover, the indiscriminate use of pesticides is creating a number of problems such as environmental pollution, resistance in pests, and an upsurge in secondary pests because of the elimination of natural enemies. Pesticides also increase the cost of crop production. They are hazardous for human beings and animals.

The following insecticide groups are widely used in Pakistan. The pests have acquired resistance against these:

- Cypermethrin
- Monocrotophos
- Methamidophos
- Chlorpyrifos
- Endosulphon
- Prophenophos
- Thiodicarb
- Cyfluthrin

Pakistan is a signatory to a number of UN conventions on hazardous pesticides and chemicals. The ministry of food and agriculture and the MELGRD are the designated focal points to deal with these issues in Pakistan. Pesticides are being sold by a large number of multinationals that have little experience or interest in IPM. The objective of these companies is to sell pesticides, like other products, whereas the pest control process is a highly technical matter that should be handled by those companies who have credibility in pest science. The Pakistan Agricultural Pesticides Association, mostly dominated by multinational companies, is making an effort to monitor pesticide resistance.

Neem based pesticides are now available in Pakistan but have not yet been accepted widely by the farmers.

14. Introduced/ Invasive Species

This section discusses the problems that have been encountered due to the introduction of invasive plant and animal species in Pakistan.

14.1 Introduction

Biological invasion by alien introduced species is one of the major threats to the native biological diversity of a region. The impact of invasive species on the native species is immense and irreversible on a global scale. Climate change, environmental pollution and habitat degradation are encouraging intentional and unintentional introductions to establish themselves in modified habitats.

The scope and cost of biological invasion is global and enormous, both in ecological and economic terms. Invasive species are found in all taxonomic groups including viruses, fungi, mosses, ferns, higher plants, invertebrates, amphibians, reptiles, birds and mammals. They have invaded and affected native biota in virtually every ecosystem of the earth. The ecological cost is the irretrievable loss of native species and ecosystems. The economic costs run into billions of dollars spent to control arable weeds, insect pests and pathogens.

A comprehensive legal and institutional framework is required to deal with this issue to effectively control the flow of alien species. There is very little awareness among the general public and government sector about the magnitude and economic costs of the problem.

Brief definitions of some important terms frequently used with reference to invasive species are given in the *IUCN Guidelines for the Prevention of Biodiversity Loss Due to Biological Invasion* are given below:

"Native species" (indigenous) means a species, subspecies, or lower taxon occurring within its natural range and dispersal potential (i.e. within the range it occupies naturally or could occupy without the direct or indirect introduction or care by humans).

"Alien species" (non-native, non-indigenous, foreign, exotic) means a species, subspecies, or lower taxon occurring outside of its natural range and dispersal potential (outside the range it occupies naturally or could not occupy without direct or indirect introduction or care by humans). This term includes any part, gametes, or propagules of such species that might survive and subsequently reproduce.

"Invasive species" means an alien species which has become established in natural or semi-natural ecosystems or habitats, is an agent of change that threatens native or biological diversity. Although the BAP deals with the issues of invasive species, However there is poor understanding of these issues in Pakistan. It is hoped that this report will be a guideline to Biodiversity related decision-makers to address the issues through projects. However, it will take time to fully integrate this issue into the existing legislation and policies.

14.2 Introduced Eucalyptus Species

Eucalyptus is native to Australia and was introduced in Pakistan almost one hundred years ago. There are more than 600 species of eucalyptus. Four namely *Eucalyptus camaldulensis*, *Eucalyptus citriodora*, *Eucalyptus terricornis* and *Eucalyptus microtheca*, have adapted to local conditions. However, only *Eucalyptus camaldulensis* is widely grown on farmlands for

commercial purposes. *Eucalyptus camaldulensis* belongs to family Myrtaceae and is now widespread in the problem soils of Pakistan. Many exotic eucalyptuses were tried and introduced in irrigated plantations as well as linear land strips. *Eucalyptus camaldulensis* is fully established in Pakistan and is widely grown on farmlands and in public forests. In addition, seeds profusely every year. It partly sheds leaves and is an evergreen broad-leaf. It is a non-legume nitrogen-fixer and substantially improves the sterile, waterlogged, and saline/alkaline soils. It grows in a wide range of climates and soil types, and has environmental value due to its evergreen characteristics.

Eucalyptus has established itself in Pakistan and can be seen everywhere from the mountains to the seacoast. Although it does not occupy a large area, eucalyptus is found everywhere in Pakistan except the high hills. It is found in areas such as marginal and sub-marginal farmlands, scrub forests, Pabbi Hills, Salt Range, Thar and Cholistan Desert, piedmont tract of the Salt Range and the Sulaiman Range. Additionally, it is found in the plains of Punjab, Sindh, NWFP and Balochistan. Eucalyptus can be seen growing and contributing to conservation, good air, and the production of honey and soil environment. This is done because eucalyptus firewood now sells, thereby mitigating the pressure on the local firewood species. Despite the claims of the anti-eucalyptus campaigners, birds roost and nest on this tree, and the honeybees flock to collect its nectar.

This species is also found in the linear land strips and village surroundings and grazing lands. Most of the man-made irrigated plantations have sizeable areas under *Eucalyptus camaldulensis*. At least 7.7 million cf. of eucalyptus biomass was estimated in 1992 (FSMP, 1992). The Sindh province alone has 6,000 ha of land under this species.

There is lot of controversy surrounding the monoculture of *Eucalyptus camaldulensis*. For example, in Malakand, lower Swat Valley, and Siren Valley, natural vegetation has been totally replaced by eucalyptus plantations. Natural vegetation can not grow under eucalyptus. Consequently, the natural habitat will be totally degraded, and wildlife normally seen around indigenous plant species in the area will disappear.

Eucalyptus camaldulensis has fully adapted to the edapho-climatic conditions of Pakistan. Even in piedmont soils like the one prevailing in the Jauharabad Plantation, regeneration from seed has been observed.³³ It has an excellent coppicing power and ratoon³⁴ cropping can be practised for pulp and small timber.

14.2.1 Allelopathic³⁵ Affects

Experiments at Punjab Forestry Research Institute (PFRI) Faisalabad (Fauzia, 1992 and Rafique, 1993) have confirmed that *Eucalyptus camaldulensis* has no adverse allelopathic affect on wheat crop. However, it competes for moisture, nutrients and light and must be properly planted in farmlands.

14.2.2 Ecological Impact

Eucalyptus is believed to compete with local flora for nutrients and outpaces all other in drawing water from deeper soils, resulting in the drying up of the subsoil water table. Still, more data that is scientific is required on this issue.

³³ Personal observations by the author.

³⁴ Sprouting of plants from stumps after the tree is cut, this is used as a tool for regeneration of tree crops.

³⁵ Plants produce certain chemicals that inhibit others from growing near them.

14.3 Invasive Mesquite

The mesquite *Prosopis juliflora* locally called *valayati jand* or *Kabuli kiker* is indigenous to the west tropical and sub-tropical North and South America (N.P. Mohan Punjab Forest Records 1940). It is well adapted in its native habitat to low rainfall and arid conditions. In Jamaica it is described as an admirable tree often attaining a height of 40 to 60 feet, growing in gravelly soil and in situations where it does not rain for months. This species was introduced to Hawaii in 1828 and since then has spread from the seacoast up to an elevation of 2000 feet. It has also been successfully introduced in Australia and South Africa.

Available records show that the mesquite was introduced initially in the Indo-Pak subcontinent in Sindh to act as a sand binder in 1878. It has reproduced naturally over the Miani plain near Hyderabad through seed distribution by goats. It did well in Balochistan, the Pabbi Hills in the Punjab and near Peshawar in the early years of its introduction. In the canal irrigated areas the mesquite has assumed the role of an invader, particularly in the irrigated plantations of Punjab and Sindh. It grows naturally in the Pabbi hills, the Salt Range, the piedmont area, the mining wastes, plains, riverine forest area, waste agricultural lands, saline and waterlogged areas, the desert, the Sulaiman Range. It is found on almost all the linear land strips like highways, canals, and railway tracks. Sizeable areas of the Makran coast of Balochistan are home to the mesquite. The poor rural masses enjoy its free harvest for their domestic energy needs, as it is considered as a weed. The forestry departments spend huge amounts on mesquite eradication whenever new plantations are established.

Two species of mesquite (*Prosopis juliflora* and *P. glandulosa*), as well as five varieties were introduced in the country. These were the arid country form introduced in 1912 from Mexico, the Mexican tree form introduced in 1912, the Australian form introduced in 1915, the Peruvian form introduced in 1915 and the Argentine form introduced in 1916. However, the majority of the varieties now encountered in the country are bushy forms. The PFI, Peshawar, has been successful in identifying and raising tree varieties of mesquite. This variety promises good quick green cover in the arid country.

14.3.1 Environmental Impact

Mesquite has occupied a niche by replacing the local flora. Some wildlife is known to prefer mesquite plantations for refuge. The unprecedented increase in the population of the wild boar after 1947 was partly attributed to the mesquite. Ecological studies on its effects on the local flora that it has replaced and its effects on the ecosystem have not been detailed.

14.4 Invasive Paper Mulberry

Paper mulberry (*Broussonetia papyfera*) is a fast growing Southeast Asian species that has naturalised widely in the country. Records show that it was introduced in northern India (Saharanpur) in 1880. Parker in his *Forest flora for the Punjab, 1915*, feared it would become common in the sub-Himalayan tract and the irrigated plantations. He also reports its spread in Lahore and Shahdara Plantation in the first quarter of the twentieth century. Today it is one of the major weeds of all the irrigated plantations, and neglected spots and is suppressing the growth of trees (Khan and Rizwanullah, 1981), even in areas not reported earlier (Khan and Adil, 1994). It was planted on a large scale in the new capital Islamabad in the fifties but today is a menace. Allergies and choking of sewerage lines in the urban set-up are attributed to the paper mulberry. The strategy of regeneration, both vegetative and by seeds plays an important role in its invasion (Khan, Amin U. and Rizwanullah, 1988). Birds disperse its fruit (which ripens in June). Additionally, it also sends root suckers, thus forming layers around the mother plant. (Khan, Rashid and Adil, 1994).

14.5 Fauji Khagga as an Invasive Species³⁶

Bagarius bagarius locally called Fauji Khagga is a kind of catfish, often called the 'freshwater shark' due to its voracious habits and ugly shape. It inhabits the freshwaters of South Asian countries like Pakistan, Nepal, India, Bangladesh, China, Thailand, Malaysia and Indonesia.

The records of Chashma Barrage landings and arrivals in the fish markets of the Punjab show that the population of this fish has increased significantly during 1990-1996. There is a general belief that this is an invasive species, and that it entered Pakistan's rivers after the 1992 floods. However, this is not the case and it is only the sudden rise in its population. This could be due to some ecological disturbance. This sudden increase has made some naturalists think that it is an invader.

The catches from all the rivers, especially at the Chashma Barrage, contained very big fish ranging from 40 – 65 kg in weight. The autopsy of the fish stomach showed that each fish had preyed upon several dozens of fish of all kinds, inflicting heavy losses to other fish populations. During the years 1997-98 and 1998-99, the fish population of the Khagga was greatly reduced at Chashma due to the reduction in water supply and the draining of the water from the barrage reservoir for repair purposes. Hence, the reservoir became almost dry and consequently, the downstream area of the barrage became waterless. The fish moved further downstream and the catches at Chashma became negligible during the years 1997-98. The total weight of Fauji Khagga sold in the Lahore markets was 71 tons, which dropped to 9 tons in 1998-99 (Bhatti, 1999).

14.6 Introduced Cats in Islands of the Arabian Sea³⁷

As one sails south of the small Balochi coastal town of Pasni, after about three hours an island with serene blue seas all around becomes visible. The island is locally known as Haptalar and is located some 16 miles from the town of Pasni.

Though the island is not easily accessible and is uninhabited, fishermen from nearby coastal towns like Shah Bandar in Sindh, visit the island seasonally to catch fish, lobsters and oysters. Owing to the negligible human interference and the difficult terrain, a large number of birds used to migrate from the colder regions and spend their winters here. Older fishermen recall that they used to collect a large number of eggs from the islands during the winters. Two rather smaller sandy beaches on the islands also provide a hospitable environment for marine turtles.

Though there are no large mammals on the island, there was a large rodent population that used to destroy the fishing nets of the fishermen. A couple of decades ago, these fishermen brought some cats from the coastal areas to control the rodents. Now these cats have no natural predator on the island and have played havoc with the migratory birds by attacking their nests, destroying eggs and eating up their young ones, hence drastically cutting the number of wintering birds. The cats also dig out pits on the sandy beaches made by turtles and destroy their eggs. The cats, over the years have adapted to the new environment. They have become completely wild, known to even attack the fishermen.

14.7 Exotic Fish Species

About 15 fish species have been introduced in Pakistan. Out of these species, swordtails, guppies and goldfish have been imported for ornamental purposes, although gambusia was

³⁶ Prepared by Dr. Nazir Bhatti, Director General, Fisheries, Government of Punjab, especially for this report

³⁷ Adapted from the article in *The Dawn* by Baghwan Das

brought for mosquito control. Two species of trout referred to as semi-exotics were introduced for sport fishing. The three Tilapia species were imported to culture in the saline waters of the waterlogged areas. The common carp (*Cyprinus carpio*) and three Chinese species viz., the silver carp, grass carp and bighead carp were imported by the Punjab Fisheries Department to enhance fish yield per unit area.

With exotic species, it has been observed that these fish have proven effective in achieving the targets for which they were introduced into the freshwater ecosystem of Pakistan. The trout have bred very successfully in the hilly regions. Since the brown trout cannot tolerate higher temperatures, the Punjab Fisheries Department has introduced it into the Murree Hills. Three species of Tilapia (*Oreochromis aureus*, *O. niloticus*, and *O. mossambicus*) are well established in the saline waters of Okara, Bahawalnagar, Bahawalpur and Rahim Yar Khan. The Tilapia fish is internationally known as the 'aquatic chicken' and is relished everywhere in the world. Generally, its size does not grow to more than 200-300 gms, but in Pakistan, this species has been known to grow upto 2-3 kg. This fish has become very popular due to its delicious taste. It is best suitable for culture in saline waters. Tilapia can thrive well, even in half seawater concentrations. The common carp is another fish, which is cosmopolitan, and is found everywhere. This fish has the quality to survive even in adverse aquatic conditions. It can feed on any kind of food present in the water, and breeds naturally in small confined waters. It can breed more than once a year depending upon the temperature of the water. The fish grows to a good size in a year and can survive even in unattended fishponds. The three Chinese carps (*Ctenopharyngodon idellus*, *Hypophthalmichthys molitrix*, and *Aristichthys nobilis*) have surprisingly helped in enhancing the fish yield per unit area. The grass carp that feeds on macro vegetation like buffalo dung has a high growth rate, even more than that in its native China. In Pakistan, this fish lives very amicably with the indigenous culturable species (*Catla catla*, *Labeo rohita* and *Cirrhina mrigala*). Likewise, the silver carp and bighead carp also grow to a very big size, even more than our own culturable species. The average annual weight attained respectively by our culturable species for *Catla catla* is 2-3 kg, *Labeo rohita* (not available) and 1.0 to 1.5 kg for *Cirrhina mrigala*. The grass carp grows to about 2-3 kg, the silver carp is 4-5 kg, and the bighead is 4-5 kg. There has been a significant increase in our yield per unit area because we put all these fish together in our ponds (composite culture, polyculture) where they reside peacefully.

The mosquito fish (*Gambusia affinis*) has been used as an ornamental fish more than it has been used for the control of mosquitoes. Its population size has significantly reduced, perhaps due to the degradation of its habitat.

14.7.1 Impacts of Exotic Fish

Until now, apart from three species, viz., the common carp, Tilapia and silver carp, no detrimental effects have been manifest on our local fish. The common carp is a pond breeder, sometimes breeding twice a year, and has the habit of burrowing at the bottom of and along the dikes of ponds. This makes the water muddy and turbid. Consequently, the gills of all cultured fishes are choked and the process of photosynthesis is retarded. Moreover, its prolific breeding results in a large increase in its population that feeds at the cost of other desired fish. The Tilapia, a prolific breeder, competes for space with others' and its own spawn. Hence, the productivity of the fishpond is reduced.

The third species observed to have affected other indigenous fish is *Catla catla*. It is known to greatly affect the silver carp. Although *Catla catla* feeds on aquatic organisms and the silver carp feeds on aquatic plants, the latter is responsible for the reduction of the population of the former. A reason for this may be the silver carp's active filtering of the maximum quantity of aquatic plants, thus disrupting the food chain for the production of aquatic organisms, as they need to feed on the plants. **Table 14.1** gives information on the exotic fish found in Pakistan.

Freshwater Fish Species with Decreasing Populations

1. *Sisor rhabdophorus*
2. *Labeo calbasu*
3. *Barbodes sarana*
4. *Rita rita*
5. *Notopterus chitala*
6. *Notopterus notopterus*
7. *Tor putitora*
8. *Tenualosa ilisha*

Table 14.1: Exotic Fish in Pakistan

Common Name	Scientific Name
Brown trout	<i>Salmo trutta fario</i> (Walbaum)
Rainbow trout	<i>Oncorhynchus mykiss</i> (Linnaeus)
Grass carp	<i>Ctenopharyngodon idellus</i> (C. and V.)
Silver carp	<i>Hypophthalmichthys molitrix</i>
Bighead carp	<i>Aristichthys nobilis</i> (C. and V.)
Common carp	<i>Cyprinus carpio</i> Linnaeus
Tilapia	<i>Oreochromis aureus</i> (Steind.)
Tilapia	<i>Oreochromis niloticus</i> (Linnaeus)
Tilapia	<i>Oreochromis mossambicus</i> (Peters)
Gold fish	<i>Carassius auratus</i> (Linnaeus)
Guppy	<i>Poecilia reticulata</i> (Peters)
Gambusia fish	<i>Gambusia affinis</i> (Baird and Girard)
Black Mollie	<i>Poecilia latipinna</i> (Le Sever)
Swordtail	<i>Xiphophorus helleri</i> (Heckel)
Swordtail	<i>Xiphophorus variatus</i> (Heckel)

Source: Dr. Nazir Bhatti, Director General, Fisheries, Government of Punjab

15. Arrangements for Cross Boundary Movement of Biological Material

This section discusses the present arrangements and restrictions on the movement of biological resources into and out of Pakistan.

In order to check the movement of biological resources across international boundaries, Pakistan has 2 laws, the Pakistan Animal Quarantine Act 1985 and the Pakistan Plant Quarantine Act 1976. These acts regulate the import and export of plants and animals at the main entry and exit points of the country. This arrangement is discussed in the following sections.

15.1 Quarantine Laws and Status of Implementation

The Quarantine Department, attached with the Ministry of Food, Agriculture and Livestock, has been charged with the pest prevention mission to protect agriculture, the environment and citizens from the damaging effects of plant and animal pests. The Government of Pakistan has legislation regarding animal quarantine to prevent the illegal introduction of animals and to limit the spread of pests and diseases. The Plant Protection Department under the Ministry of Food and Agriculture regulates the import and export of plants and plant material. All plant material intended for export has to be certified by the Plant Protection Department.

The check on movement of biological material is made through two separate departments, which do not have a mechanism for co-ordination. The quarantine laws have a limited scope. Examples of this are that the checklist concerns diseased organisms only and there is no check on the introduction of invasive species. There is also a need to revise the laws encompassing the linkages between animal, plant and biosafety issues.

15.2 Activities of the Quarantine Department

The department is responsible for the regulation of the import, export and quarantine of animals and animal products in order to prevent the introduction or spread of diseases.

The department provides Central Certification Service to the importers and exporters of animals and animal products. The department promotes a uniform standard through examinations and tests that meet international trade requirements, and is responsible for the prevention of the unauthorised import and export of animals and animal products.

Under the Constitution, the federal government is responsible for the statutory authorities and related regulations governing the inspection and transportation of animals and animal products for import and export. Furthermore, it is responsible for the issuance of Health Certificates and the formulation of regulations designed to prevent the introduction and dissemination of diseases of foreign origin.

As a member of the WTO, and as an international obligation, it is obligatory to maintain a quarantine service to safeguard human health, livestock, and the industry of Pakistan and foreign countries from communicable diseases.

Every "point of entry" and "point of exit" has to be guarded to prevent the introduction or spread of diseases. Therefore, the department has office-cum-microbiology laboratories located in Karachi, Lahore, Peshawar, Quetta, Islamabad and Multan as per clause J of Section 2 of the Pakistan Animal Quarantine (Import and Export of Animals and Animal Products) Act, 1985.

There is one officer at each station, performing three types of duties:

- Duties as a "Head Office"
- Research Officer of the laboratory
- Powers, duties and functions of Quarantine Officer which are laid down in Sec – 6 of the Pakistan Animal Quarantine Act, 1985

The department handles all kinds of animals which include birds, cold-blooded creatures, creatures by means of which any disease may be carried or transmitted, crustaceans, fish, quadrupeds which are not mammals, and mammals (except man and animal products).³⁸

On an average, the department handles more than 12,000 cases annually of import and export of animals, birds and animal products. The department earns Rs .2,000 million per annum from Health Certificate fees. The export value of animals, birds and animal products total Rs. 4744 million subsequent to clinical and laboratory examinations carried out by the Animal Quarantine Department.

15.3 Activities of the Plant Protection Department

The "Destructive Insects and Pests Act, 1914" was enacted by the former British Indian government for preventing the introduction and spread of exotic pests and diseases which could be destructive to field crops, horticulture, floriculture and forests. The government of Pakistan in 1951 adapted this Act with slight modification and finally the " Pakistan Plant Quarantine Act, 1976" was enacted. This enactment was done keeping in view Pakistan's obligations FAO "Plant Protection Convention 1951". The Pakistan Plant Quarantine Rules, 1967 were also made under the Act of 1967. The Plant Protection Department under the federal ministry of food agriculture and co-operatives looks after this subject. No import or export of plant material is allowed without a legal certificate of its being disease free. The ports of import and export of biological material have been identified as Karachi Harbour, Karachi airport, Lahore airport, Lahore railway station, Wagah border, Jamrud land border (Peshawar), Peshawar airport, Chaman land border, Quetta airport or any other authorised Land, air or sea routes declared by the Director Plant Protection Department. A plant quarantine officer is posted at these points of entry and the officers of Pakistan Customs are empowered to check plant material upon import or export. No person is allowed to import or export plant material except with the permission of the director. In addition, the Plant quarantine officer is empowered to inspect and destroy or release after treatment plant material if it is suspected of contamination. Import restrictions have been imposed by the government for Potato, Rubber, sugarcane, tobacco, citrus, coffee, banana, groundnut, maize, tea, allium spp. and cotton.

³⁸ An animal product is anything originating or made, in whole or in part from any animal or from carcasses and any other substance of animal origin, which is specified by the federal government by notification in the official Gazette.

APPENDICES

Appendix A: Internationally Threatened Animals in Pakistan

Source: Dr. Aleem Chaudhry, Director General, Wildlife, Lahore

MAMMALIA

CHIROPTERA

RHINOLOPHIDAE

Rhinolophus blasii **L/nt**

VESPERTILIONIDAE

Eptesicus nasutus **V/A2c**

Nyctalus leisleri **L/nt**

Nyctalus montanus **L/nt**

PRIMATES

CERCOPITHECIDAE

Rhesus Macaque *Macaca mulatta* **L/nt**

Kashmir Grey Langur *Semnopithecus entellus* **L/nt**

CARNIVORA

CANIDAE

Bengal Fox *Vulpes bengalensis* **DD**

Blandford's Fox *Vulpes cana* **DD**

Corsac Fox *Vulpes corsac* **DD**

FELIDAE

Cheetah *Acinonyx jubatus* **V/A1d+2d, C1**

Pakistan Sand Cat *Felis margarita scheffeli* **L/nt**

Red Manul *Otocolobus manul ferrugineous* **L/nt**

Fishing Cat *Prionailurus viverrinus* **L/nt**

Snow Leopard *Uncia uncia* **E/C2a**

MUSTELIDAE

Smooth-coated Otter (Smooth Otter) *Lutra perspicillata* **V/A2cd**

URSIDAE

Asiatic Black Bear *Ursus thibetanus* **V/A1cd**

Balochistan Bear *Ursus thibetanus gedrosianus* **CE/B1+ 2abc,**

C2a

CETACEA

DELPHINIDAE

Indo-Pacific Hump-backed Dolphin *Sousa chinensis* **DD**

PHOCOENIDAE

Finless Porpoise *Neophocaena phocaenoides* **DD**

PLATANISTIDAE

Indus River Dolphin *Platanista minor* **E/A1acd, B1+2abcde**

ARTIODACTYLA

MOSCHIDAE

Musk deer *Moschus chrysogaster* **L/nt**

Himalayan Musk deer *Moschus chrysogaster leucogaster* **L/nt**

CERVIDAE

Hog Deer *Axis porcinus porcinus* **L/nt**

BOVIDAE

- Blackbuck *Antelope cervicapra* **V/A1c**
 Nilgai *Boselaphus tragocamelus* **L/cd**
 Wild Goat *Capra aegagrus* **V/A2cde**
 Sindh Ibex *Capra aegagrus blythi* **V/A2cde**
 Chiltan Goat *Capra aegagrus chiltanensis* **CE/C2b**
 Markhor *Capra falconeri* **E/A2cde**
 Flare-horned Markhor *Capra falconeri falconeri* **E/C2a**
 Straight-horned Markhor *Capra falconeri megaceros* **E/C2a**
 Chinkhara *Gazella bennetti* **L/cd**
 Goitred Gazelle *Gazella subgutturosa* **L/nt**
 Himalayan Goral *Naemorhedus goral* **L/nt**
 Western Himalayan Goral *Naemorhedus goral bedfordi* **L/nt**
 Argali *Ovis ammon* **V/A2cde**
 Marco Polo Argali *Ovis ammon polii* **V/A2de, C1**
 Afghan Urial *Ovis vignei cycloceros* **V/C1**
 Punjab Urial *Ovis vignei punjabensis* **E/A1cde, C1+2a**
 Ladakh Urial *Ovis orientalis vignei* **E/A2cde, C1+2a**
 Blue Sheep *Pseudois nayaur* **L/nt**
Pseudois nayaur nayaur **L/nt**

PHOLIDOTA**MANIDAE**

- Indian Pangolin *Manis crassicaudata* **L/nt**

RODENTIA**SCIURUDAE**

- Small Kashmir Flying Squirrel *Eoglaucomys fimbriatus* **L/nt**
 Woolly Flying Squirrel *Eupetaurus cinereus* **E/A2ce, B1+2cd,**

C2a

- Long-tailed Marmot *Marmota caudata* **L/nt**

MURIDAE

- Alticola albicauda* **L/nt**
Calomyschus hotsoni **E/B1+2c**
 Grey Hamster *Cricetulus migratorius* **L/nt**

MYOXIDAE

- Forest Dormouse *Dryomys nitedula* **L/nt**

AVES**PELICANIFORMES****PELICANIDAE**

- Dalmatian Pelican *Pelicanus crispus* **V/C2a**

ANHINGIDAE

- Oriental Darter *Anhinga melanogaster* **L/nt**

CICONIFORMES**CICONIIDAE**

- Asian Openbill *Anastomus oscitans* **L/nt**
 Painted Stork *Mycteria leucocephala* **L/nt**

THRESKIORNITHIDAE

- Red-naped Ibis *Pseudibis papillosa* **L/nt**
 Black-naped Ibis *Threskiornis melanocephalus* **L/nt**

PHOENICOPTERIDAE

- Lesser Flamingo *Phoenicopterus minor* **L/nt**

ANSERIFORMES**ANATIDAE**

- Lesser White-fronted Goose *Anser erythropus* **V/A1acd**
 Ferruginous Duck *Aythya nyroca* **V/A1acd**
 Marbled Teal *Marmaronetta angustirostris* **V/A2c**
 White-headed Duck *Oxyura leucocephala* **V/A2e**

FALCONIFORMES

ACCIPITRIDAE

- Cinereous Vulture *Aegypius monachus* **L/nt**
- Greater Spotted Eagle *Aquila clanga* **V/C2a**
- Imperial Eagle *Aquila heliaca* **V/C2a**
- Pallid Harrier *Circus macrourus* **L/nt**
- White-rumped Vulture *Gyps bengalensis* **L/nt**
- White-tailed Eagle *Haliaeetus albicilla* **L/nt**
- Pallas's Sea-eagle *Haliaeetus leucoryphus* **V/C1+2b**
- Red-Headed Vulture *Sarcogyps calvus* **L/nt**

FALCONIDAE

- Red-necked Falcon *Falco chicquera* **L/nt**
- Lesser Kestrel *Falco naumanni* **V/A1ace**

GALLIFORMES

PHASIANIDAE

- Cheer Pheasant *Catreus wallichii* **V/C2a**
- Western Tragopan *Tragopan melanocephalus* **V/C1+2a**

GRUIFORMES

GRUIDAE

- Siberian Crane *Grus leucogeranus* **E/A2cd**

OTIDIDAE

- Great Indian Bustard *Ardeotis nigriceps* **E/C2b**
- Lesser Florican *Eupodotis indica* **CE/A1a**
- Little bustard *Tetrax tetrax* **L/nt**

CHARADRIIFORMES

CHARADRIIDAE

- Sociable Lapwing *Vanellus gregarius* **V/A1ac, C1+2a**

SCOLOPACIDAE

- Wood Snipe *Gallinago nemoricola* **V/C2a**

LARIDAE

- Black-bellied Tern *Sterna acuticauda* **V/C1**

RHYNCOPIDAE

- Indian Skimmer *Rhynchops albicollis* **V/C1+2a**

COLUMBIFORMES

COLUMBIDAE

- Pale-backed Pigeon *Columba eversmanni* **V/A1a**

PICIFORMES

INDICATORIDAE

- Yellow-rumped Honey guide *Indicator xanthnotus* **L/nt**

PASSERIFORMES

MUSCICAPIDAE

- Long-billed Bush Warbler *Bradypterus major* **V/C2a**
- Bristled Grass-Warbler *Chaetornis striatus* **V/A1c, C1+2a**
- Jerdon's Babbler *Chrysomma altirostre* **V/A1c**
- Kashmir Flycatcher *Ficedula subrubra* **V/B1+2c**
- Tytler's Leaf-warbler *Phylloscopus tytleri* **L/nt**
- Rufous-vented Prinia *Prinia burnesii* **V/A1c**
- White-browed Bushchat *Saxicola macrorhyncha* **V/A1ac,**

C1+2a

AEGITHALIDAE

- White-throated Tit *Aegithalos niveogularis* **L/nt**

FRINGILLIDAE

- Orange Bullfinch *Pyrrhula aurantiaca* **L/nt**

REPTILIA

CROCODYLIA

CROCODYLIDAE

Mugger *Crocodylus palustris* **V/A1a, C2a**

GAVIALIDAE

Gharial *Gavialis gangeticus* **E/C2a**

SERPENTES

BOIDAE

Indian Python *Python molurus* **L/nt**

ELAPHIDAE

Central Asian Cobra *Naja oxiana* **DD**

TESTUDINES

CHELONIIDAE

Green Turtle *Chelonia mydas* **E/A1abd**

Olive Ridley Turtle *Lepidochelys olivacea* **E/A1abd**

EMYDIDAE

Spotted Pond Turtle *Geoclemys hamiltonii* **L/nt**

Crowned River Turtle *Hardella thurjii* **L/nt**

TESTUDINIDAE

Central Asian Tortoise *Testudo horsfieldii*

TRONYCHIDAE

Narrow-headed Softshell Turtle *Chitra indica* **V/A1cd**

ACTINOPTERYGII

SYNBRANCHIFORMES

MASTACEMBELIDAE

Spiny Eel *Macrogathus aral* **DD**

INSECTA

LEPIDOPTERA

SPHINGIDAE

Hyles hippophaes **DD**

Appendix B: Internationally Threatened Birds in Pakistan

Source: Dr. Aleem Chaudhry, Director General, Wildlife, Lahore

	Status (breeding /non-br.)	Habitat codes	Threat codes	IUCN threat status codes
Endangered				
Siberian Crane <i>Grus leucogeranus</i>	N	W	12	A2b,c ; C1; D2
Vulnerable				
Dalmatian pelican <i>Pelecanus crispus</i>	N	W	1235	C2a
White-headed duck <i>Oxyura leucocephala</i>	N	W	1256	A2d
Lesser White-fronted Goose <i>Anser erythropus</i>	N	SWA	012	A1a,b,c
Marbled Teal <i>marmoronetta angustirostris</i>	B	W	125	A2b
Ferruginous Duck <i>Aythya nyroca</i>	N	W	12	A1a,b,c
Pallas's Sea-eagle <i>Haliaeetus leucoryphus</i>	B	GW	135	C1;C2b
Greater Spotted Eagle <i>Aquila clanga</i>	B	FW	13	C2a
Imperial Eagle <i>Aquila heliaca</i>	N	FG	12357	C2a
Lesser Kestrel <i>Falco naumanni</i>	N	FSVGA	15	A1a,b,d
Western Tragopan <i>Tragopan melanocephalus</i>	B	F	1	C1;C2a
Cheer Pheasant <i>Catreus wallichii</i>	B	FSG	12	C2a
Sociable Lapwing <i>Vanellus gregarius</i>	N	GW	158	A1a,b;C1;C2a
Black-bellied Tern <i>Sterna acuticauda</i>	B	W	128	C1
Indian Skimmer <i>Rhynchops albicollis</i>	B	W	1	C1;C2a
Pale-backed Pigeon <i>Columba eversmanni</i>	N	GDA	0	A1a
White-browed Bushchat <i>Saxicola macrorhyncha</i>	B	SD	1	A1a,b;C1;C2a
Jerdon's Babbler <i>Chrysomma altirostre</i>	B	GW	1	Alb
Rufous-vented Prinia <i>Prinia burnesii</i>	B	SGW	1	Alb
Long-billed Bush-warbler <i>Bradypterus major</i>	B	FSA	1	C2a
Bristled Grass-warbler <i>Chaetornis striatus</i>	B	SGWA	1	A1b;C1;C2a
Kashmir flycatcher <i>Ficedula subrubra</i>	B	F	1	B1+2c

Habitat codes

F = All forest and woodland types; S = scrub; G = grassland; W = wetlands including littoral habitats; D = desert; A = agricultural areas

Threat codes

0 = unknown; 1 = loss or alteration of habitat; 2 = hunting, persecution, egg-collecting (subsistence); 3 = disturbance (by humans, stock); 5 = pollution, pesticides, poisoning (accidental); 6 = introduced; 7 = trade, egg-collecting (commercial); 8 = natural causes (exacerbated by other influences)

IUCN status codes: see Collar et al. p.16-18

Appendix C: Biodiversity Related Research Institutions in Pakistan

Agricultural Biodiversity Research Institutes in Pakistan

- 1) Agricultural Research Institute, Sariab, Quetta
- 2) Agricultural Research Institute, Tandojam
- 3) Agricultural Research Institute, Tarnab, Peshawar
- 4) University of Agriculture, Faisalabad
- 5) Agriculture University, Peshawar
- 6) Agriculture University, Tandojam
- 7) Animal Sciences Institute, NARC, -Islamabad
- 8) University for Arid Agriculture , Rawalpindi
- 9) Arid Zone Research Institute, Quetta (with four substations)
- 10) Ayub Agricultural Research Institute, Faisalabad
- 11) Bahauddin Zakria University, Multan
- 12) Cereal Crop Research Institute, Pirsabak, Nowshera
- 13) Cotton Research Institute, Multan
- 14) Cotton Research Institute, Sakrand
- 15) Crop Sciences Institute, NARC, -Islamabad
- 16) Fodder Research Institute, Sargodha
- 17) Pakistan Forest Institute, Peshawar
- 18) Islamia University, Bahawalpur
- 19) Livestock Research Institute, Bahadar Nagar
- 20) Maize, Sorghum and Millet Institute, Sahiwal
- 21) Nuclear Institute of Agriculture and Biology, Faisalabad
- 22) Nuclear Institute for Agricultural, Tandojam
- 23) Pakistan Museum of National History, Islamabad
- 24) Plant Genetic Resources Institute, NARC, Islamabad
- 25) Rice Research Institute, Dokari
- 26) Rice Research Institute, Kala Shah Kaku
- 27) University of the Peshawar
- 28) University of the Punjab, Lahore

Medicinal Plants Research in Pakistan

Phytochemistry

Chemistry and Pharmacology Departments of Various Universities.
International Centre for Chemical Sciences, HEJ Research Institute of Chemistry, University of Karachi, Karachi.
Pakistan Council of Scientific and Industrial Research (PCSIR) Laboratories, Peshawar, Pakistan.

Taxonomy, Collection, Herbarium

Botany Departments of Various Universities.
Hamdard University, Karachi (to a very limited extent research).
Herbarium, University of Karachi, Karachi.
National Agricultural Research Centre (NARC) (Plant Genetic Research Centre and National Herbarium), Islamabad.
Pakistan Forest Institute, Peshawar
Pakistan Museum of Natural History, Islamabad

Pharmacology

Hamdard University, Karachi.
HEJ Research Institute of Chemistry, University of Karachi, Karachi.
National Institute of Health, Islamabad.
Pharmacology and Pharmacognosy Departments of the University of the Punjab, Karachi
university, Gomal university and Peshawar university .
The Aga Khan Medical University, Karachi.
University of Agriculture, Faisalabad (veterinary)

Standardisation, Quality Control and Safety Assurance of Plant-Based Drugs

Hamdard University, Karachi.
Pharmacy Faculty, University of Karachi, Karachi.
HEJ Research Institute of Chemistry, University of Karachi, Karachi.

Medicinal Plants Cultivation

Experimental Farms of the Pakistan Agricultural Research Council.
Hamdard University, Madinatul Hikmah Campus, Karachi.
Pakistan Forest Institute, Peshawar.
Some Small Farms in Private Sector.

Propagation, Tissue-Culture

National Agriculture Research Centre, Islamabad
Department of Botany, University of Peshawar
HEJ Research Institute of Chemistry, University of Karachi
NIBGE, Faisalabad
PCSIR, Karachi

Ethanobotany, Database, Pharmacoeopia

Baital Hikmah Research Institute, Hamdard University, Karachi
Department of Botany, Quaid-e-Azam University, Islamabad
Department of Botany, University of Balochistan, Quetta
Department of Botany, University of Peshawar
Pakistan Forest Institute, Peshawar
Pakistan Museum of Natural History, Islamabad

Appendix D: List of Indicators

Environmental Indicators

Issue OF Concern	Driving Force Indicators	State Indicators	Response Indicators
Air Quality			Reduction in the emissions of SO _x and NO _x abatement equipment of stationary sources
Water Availability	Household Consumption of water/ Capita in urban areas		Households with access to portable water
Water quality	Industrial/ Municipal Discharges into freshwater bodies		
Toxic Chemicals and Hazardous waste	Use of fertilisers- Use of agricultural pesticides – Generation of hazardous waste-Emissions of organic compound		
Urban Environmental Issues	Rate of Growth of Urban Population		
Urbanisation	Rural/Urban migration		
Traffic	Transport fuel consumption per capita- Traffic density	Percentage of urban population exposed to concentration of SO ₂ particulate, Ozone, CO and Lead	Regulation on emission and noise levels
Waste	Solid waste generated per capita(m ³ /year)		Municipal Waste Disposal(t/capita)
Energy Resources	Annual energy consumption per capita		Expenditures on energy efficiency and alternative energy
Forest	Deforestation rate		
Biodiversity	Short run sustained yield/ actual harvest		Protected Area as % of total land Area
Desertification	Land Use Change (km ²)		Area of Land Reclaimed

Economic Indicators

Driving Force Indicators	State indicators	Response Indicators
GDP per capita	Environmental/Adjusted Net Domestic product	
Net Investment Share in GDP	Share of Manufactured Goods in Total Merchandise Export	
Sum of Export and Import as a percentage of GDP	Proven Mineral Resource	
Annual Energy Consumption	Proven Fossil Fuel/Energy Resources	
Share of Natural Resource Intensive Energy in Manufacture Value Added	Energy Resources	
Net Resource Transfer/GNP	Intensity of material used Share of manufacturing value added in GDP	Environmental Protection Expenditure as Percentage of GDP
Total Overseas Development Assistance Given or Recovered as a Percentage of GNP		Amount of New and Additional Funding for Sustainable Development
Capital Goods Imports	Share of Renewable Energy Resource	
Foreign Direct Investment	Debt/GNP, Debt Service/Export, Share of Environmentally Sound Capital Good Import, Saving as Percentage of GDP	Technical Co-operative Grants

Social Indicators

Poverty	Income, assets, unemployment, labor force participation rates, education level of labor rates, self-employment by level of education
Demographic Dynamics	Population growth rate, fertility rates, mortality rates, life expectancy, population density
Education and training	Primary school enrolment rate, secondary school enrolment rate
Human health	Doctor-population ratio, hospital-bed ratio, nurse-population ratio, LHV-population ratio, life expectancy rates, drinking water, immunisation, contraceptive prevalence rate
Capacity building	Number of skilled persons by sex

Institutional Indicators

Management	Decision-making level, field-specific job ratio, distribution of resources, dissemination of information through database, integrated decision-making, ratio of environment-related staff i.e. scientist, engineers, lawyers and other professionals.
Capacity-building	Capacity of existing sustainable development institutions
Monitoring and Evaluation	Gaps identification, number of remedial measures, mandated EIA procedure, set up NEQs for air, water and soil, number of measuring laboratories

Appendix E: Fifty Drugs Discovered from Ethnobotanical Leads

Source: Dr. Iqbal Chaudhry, Professor, HEJ institute of Chemistry

Drug	Medical Use	Plant	Family
Ajmalin	Heart arrhythmia	<i>Rauwolfia</i> sp.	Apocynaceae
Aspirin	Analgesic, inflammation	<i>Filipendula ulmaria</i>	Rosaceae
Atropine	Ophthalmology	<i>Atropa belladonna</i>	solanaceae
Benzoine	Oral disinfectant	<i>Styrax tonkinensis</i>	Styracaceae
Caffeine	Stimulant	<i>Camellia sinensis</i>	Theaceae
Camphor	Rheumatic Pain	<i>Cinnamomum camphora</i>	Lauraceae
Cascara	Purgative	<i>Rhamnus purshiana</i>	Rhamnaceae
Cocaine	Ophthalmologic anaesthetic	<i>Erythroxylum coca</i>	Erythroxylaceae
Codeine	Analgesic, antitussive	<i>Papaver somniferum</i>	Papaveraeae
Colchicine	Gout	<i>Colchicum autumnale</i>	Liliaceae
Demecolcine	Leukemia, lymphomata	<i>Colchicum autumnale</i>	Liliaceae
Deserpidine	Hypertension	<i>Rauwolfia canescens</i>	Apocynaceae
Dicoumarol	Thrombosis	<i>Melilotus officinalis</i>	Fabaceae
Digitoxin	Atrial fibrillation	<i>Digitalis purpurea</i>	Scrophulariaceae
Digoxin	Atrial fibrillation	<i>Digitalis purpurea</i>	Scrophulariaceae
Emetine	Amoebic dysentery	<i>Cephaelis ipecachuanha</i>	Rubiaceae
Ephedrine	Bronchodilator	<i>Ephedra sinica</i>	Ephedraceae
Eugenol	Toothache	<i>Syzygium aromaticum</i>	Myrtaceae
Gallotannins	Hemorrhoid suppository	<i>Hamamelis virginiana</i>	Hamamelidaceae
Hyoscyamine	Anticholinergic	<i>Hyoscyamus niger</i>	solanaceae
Ipecac	Emetic	<i>Cephaelis ipecacuanha</i>	Rubiaceae
Ipratropium	Bronchodilator	<i>Hyoscyamus niger</i>	Solanaceae
Morphine	Analgesic	<i>Papver somniferum</i>	Papaveraceae
Noscapine	Antitussive	<i>Papver somniferum</i>	Papaveraceae
Papain	Attenuates mucus	<i>Carica papaya</i>	Cariaceae
Papaverine	Antispasmodic	<i>Papaver somniferum</i>	Papaveraceae
Physotigmine	Glaucoma	<i>Physostigma venenosum</i>	Fabaceae
Picrotoxin	Barbiturate antidote	<i>Anamirta cocculus</i>	Menispermaceae
Pilocarpine	Glaucoma	<i>Pilocarpus jaborandi</i>	Rutaceae
Podophyllotoxin	Condylomata acuminata	<i>Podophyllum peltatum</i>	Berberidaceae
Proscillaridin	Cardiac malfunction	<i>Drimia maritima</i>	Liliaceae
Protoveratrine	Hypertension	<i>Veratrum album</i>	Liliaceae
Pseudoephedrine	Rhinitis	<i>Ephedra sinica</i>	Ephedraceae
Psoralen	Vitiligo	<i>Psoralea corylifolia</i>	Fabaceae
Quinidine	Cardiac arrhythmia	<i>Cinchona pubescens</i>	Rubiaceae

Quinine	Malaria prophylaxis	<i>Cinchona pubescens</i>	Rubiaceae
Rescinnamine	Hypertension	<i>Rauvolfia serpentina</i>	Apocynaceae
Reserpine	Hypertension	<i>Rauvolfia serpentina</i>	Apocynaceae
Sennoside A,B	Laxative	<i>Cassia angustifolia</i>	Caesalpiniaceae
Scopolamine	Motion sickness	<i>Datura stramonium</i>	Solanaceae
Stigmasterol	Steroidal precursor	<i>Physostigma venenosum</i>	Fabaceae
Strophanthin	Congestive heart failure	<i>Strophanthus gratus</i>	Apocynaceae
Teniposide	Bladder neoplasms	<i>Podophyllum peltatum</i>	Berberidaceae
THC	Antiemetic	<i>Cannabis sativa</i>	Cannabaceae
Theophylline	Diuretic, asthma	<i>Camellia sinensis</i>	Theaceae
Toxiferine	Surgery, relaxant	<i>Strychnos guianensis</i>	Loganiaceae
Tubocurarine	Muscle relaxant	<i>Chondrodendron tomentosum</i>	Menispermaceae
Vinblastine	Hodgkin's disease	<i>Catharanthus roseus</i>	Apocynaceae
Vincristine	Pediatric leukemia	<i>Catharanthus roseus</i>	Apocynaceae
Xanthotoxin	Vitiligo	<i>Ammi majus</i>	Apiaceae

Appendix F: Breeds of Livestock of Pakistan

Breeds of Livestock, Horses

BREED	RANGE
Buffalo	
Kundi	Sindh
Nili-Ravi	Punjab
Cattle	
Bhagnari	Eastern Balochistan
Cholistani	Southern Punjab
Dajal	Balochistan
Dhanni	Punjab
Lohani	Punjab
Hissar	Sindh
Kankrej	Sindh
Red Sindhi	Sindh and southern Balochistan
Rojhan	Punjab
Sahiwal	Punjab
Tharparkar	Sindh
Yak	
Yak (<i>Bos grunniens</i>)	Northern Areas
Goats	
Baltistani	Northern Areas
Barbari	Sindh
Beetal	Punjab
Beiari	Azad Kashmir
Buchi	Azad Kashmir
Chappar	Sindh
Damani	NWFP
Dera Din Panah	Punjab
Gaddi	NWFP
Jattal	Punjab
Kaghani	NWFP
Kajli	Punjab-Sindh
Kamori	Sindh
Khurasani	Balochistan
Lehri	Sindh
Nachi	Southern Punjab
Pak Angora	-
Salt Range	Northern Punjab
Shurri	NWFP
Sindh Desi	Sindh

Sheep

Bagh-dale	-
Balkhi	NWFP
Baltistani	Northern Areas
Baluchi	South-western Punjab
Bibrik	Balochistan
Cholistan	Punjab
Damani	NWFP
Dumbi	Sindh and Balochistan
Gojal	Sindh and Balochistan
Hallenjoo	Sindh
Harnai	Balochistan
Hashnagri	NWFP
Hissar dale	-
Jhala wani	Sindh
Kacchi	Sindh
Kaghani	NWFP
Kail	Azad Kashmir
Kajli	Punjab
Khetrani	Balochistan
Khiljloo	Balochistan
Kohal Ghizer	Balochistan
Kooka	Sindh
Lam Kanni	Punjab
Latti	Punjab
Lohi	Punjab
Michni	Punjab-NWFP
Pahari	Punjab
Pakwasi	-
Pak Karakul	-
Poonchi	Azad Kashmir
Rakhsani	Balochistan
Sarawani	Balochistan
Sipli	Punjab
Thalli	Punjab
Tirhai	NWFP
Waziri	NWFP
Kali	NWFP and Balochistan

Description of Breeds of Sheep

Kail

Kail sheep are from the Neelum and Lipa Valleys in the Azad Kashmir area. They are medium-sized animals. The mostly white sheep are called Pachhi, while some have black or brown heads with black or brown circles around the eyes and ears. These are called Surmiali. Their ears are medium-sized with a growth of curly hair on them in some animals. Kail sheep have a convex face, Roman nose, and open nostrils. The males are horned, with broad shoulders and well-developed quarters. The tail is 15-20 cm long. The live weight of adult males is 41 kg, and that of adult females is 32 kg. Wool yield per head is 2.25-kg annum. Kails are used for both meat and wool.

Kali

Kali sheep are from the Mikkyal area of Kotli district in Azad Kashmir. These sheep are medium-sized and have a compact body, straight back, and broad shoulders. Their ears are 10-15 cm long and legs are medium and stout. Males are generally horned. The tail is thin, about 15-20 cm long, and covered with wool. Males weigh 35 kg, and females weigh 30 kg. Wool yield per head is 1.5-kg annum. Kali sheep are raised for mutton and wool.

Poonchi

Poonchi sheep are from Abbaspur, Aliabad, Kelar, Kahuta and the surrounding areas of Poonch District in Azad Kashmir. Poonchi sheep are compact and medium-sized. They are mostly completely white, but small percentages have black or brown head and legs, or patches of black or brown on the body. Head and ears are medium-sized. Males are horned. The tail measures 15-20 cm. Adult males and females weigh 37 and 30 kg respectively. Wool yield per head is 2-kg annum. These sheep are raised for mutton and wool.

Damani

Damani sheep are from the Dera Ismail Khan district and part of Bannu district in the NWFP. Damani sheep are compact, medium-sized sheep. The body coat is white, and the head is fawn, brown or black and the legs are usually white, but can be camel-coloured. The ears are small and stubby. A small percentage of animals have a bottle like appendage hanging down below the neck, locally called *larki*. The belly is somewhat pendulous, and the udder is well developed with long teats. The tail is small. Adult males and females weigh 33 and 26 kg respectively. Wool yield per head is 1.5-kg annum. In addition to mutton, Damani sheep are also a source of milk. Their milk production is 120 litres per lactation in nearly 100 days.

Kaghani

This breed has been named after the Kaghan Valley and its home tract includes Abbottabad, Mansehra and parts of Mardan and Peshawar districts in the NWFP. Kaghani sheep generally winter in the plains, moving as far east as Jhelum district in the Punjab, but as spring approaches they go back up to the alpine ranges of the Kaghan valley. These sheep are small to medium in size. They can either be completely white or have red, tan, grey or black heads and ears. The head is small, nose slightly convex and ears medium, with a broad base and pointed tips. The neck is short, belly tucked up, with legs often covered with wool. Males are horned. The live weight of adult males and females is 28 and 22 kg respectively. Wool is dense and curly; yield per head is 1.5-kg annum. A number of Kaghani sheep have some degree of Rambouillet blood, resulting in better quality wool.

Sipli

This breed is from the irrigated area of Bahawalnagar district and the adjoining area of Bahawalpur district in Punjab. They are medium-sized animals with a white body, and head, face, and ears of white or light brown. The head is medium-sized, the nose flat, and the ears about 15 cm long. The tail is long. The live weight of an adult male and female is 40 and 34 kg respectively. Wool yield per head is 5.6-kg annum. Sipli sheep are raised mainly for wool.

Thalli

This breed is from the Thal desert, which is considered its home tract. However, Thalli sheep are now found extensively in Mianwali, Muzaffargarh, Multan and parts of Jhang and Sargodha district in Punjab. Thalli sheep have two strains: one with a small head and long ears, and the other with a large head and short ears. Those with short ears have comparatively larger bodies. In contrast, the strain with long ears has smaller but stout legs. Despite this variation, both strains fall within the range of medium-sized animals. The body is generally white with a black or brown head. Occasionally animals are black with a white spot. Legs below the knees/hocks are spotted black. They have a slight Roman nose and small tail. Adult males and females weigh 32 and 27 kg respectively. Wool yield per head is 1.5-kg annum. The mean daily milk yield is 0.7 litres during a 100-day lactation period. Thalli sheep are considered sturdy animals and are raised for mutton and wool.

Kachhi

Kachhi sheep are found in Tharparkar, Sanghar, the Mirpurkhas district and the adjoining areas of the Rann of Kutch and Sindh. They are medium-sized animals that have a white body and tan or black face. The neck and legs are also tan or black. Ears are either small or tubular. An adventitious ear at the upper edge of the normal ear is common. They have a prominent Roman nose. Both males and females are polled. Fleshy appendages are sometimes seen hanging under the throat. The tail is short.

Goats

Baltistani

This breed is found in the Baltistan district of the Northern Areas. The body colour is black with white patches of varying sizes. The small head is black with short horns in both males and females. They resemble teddy goats but are taller in stature. Adult males and females weigh 29 and 25 kg respectively. Milk yield is almost 100 litres per lactation. These goats are raised for mutton, milk, hair and manure.

Beiari

Beiari goats are from Kotli district and adjoining parts of the Mirpur district of Azad Kashmir. This breed is reported to have originated as a result of a cross between the Beetal and Sindhi goats. These shorthaired goats are all white or grey, or have white or grey patches. The body is compact. Ears are long and drooping. The horns grow upwards and backwards. Adult males and females weigh 25 and 20 kg respectively. The udder is well developed, and milk yield is 135 litres in 150 days. About 30 percent of births are twins. This breed is raised for meat and milk.

Buchi

These goats are found in parts of Kotli, Muzaffarabad, and Poonch districts of Azad Kashmir. Buchi goats are black or grey. They have a massive head with a Roman nose, and very small ears. Both males and females have horns. The udder is medium-sized. Milk production is 90 litres in a 150-day lactation. Adult males and females weigh 30 and 22 kg respectively. These goats have 12-15 cm long hair and the yield is 800 g per head each year. Buchi bucks are kept for crossbreeding with the Labri breed (long ears) to produce Shurri goats (with medium ears), since long ears can get entangled with thorny bushes or injured from frost in winter.

Desi

The home tract of this goat is in parts of Mirpur, Potohar and Kotli districts in Azad Kashmir. Desi goats are slim black goats covered with 8-10 cm long hair. Their head is massive, ears are medium and hair is present on the chin. Horns are spiralled in males and smooth in females. Twin births are rare. Adult males and females weigh 23 and 19 kg respectively. Milk yield is 80 litres in 150 days. Hair yield is 600 g per head annually. These goats are raised for meat and hair.

Jarakheil

These goats are from the Chilas Valley in Diamir district in the Northern Areas and parts adjacent to Hazara district and Azad Kashmir. They are usually black with white patches, but in rare cases, brown goats with white patches are also seen. They have a well-developed body with long hair and large drooping ears with white patches and large horns. The udder and teats remain hidden in their long hair. Adult males and females weigh 52 and 45 kg respectively. Milk yield is 135 litres per 100-day lactation. These goats are raised for mutton, hair, milk and manure.

Beetal

Beetal goats are found in almost all the irrigated areas of the Punjab, including the districts Jhelum, Gujrat, Mandi Bahauddin, Sialkot, Gujranwala, Lahore, Sheikhpura, Faisalabad, Sargodha, Jhang, Multan, Sahiwal and Okara. Their colour is golden brown or red, spotted with white or black patches. The body is compact and well developed. The head is massive and broad, nose Roman, and ears long, broad, and pendulous. Spiralled horns are long in males and shorter in females. They have long stout legs and a short tail. The udder is well developed and the teats are long. Adult males and females weigh 46 and 37 kg respectively. Milk yield is 290 litres per lactation of 130 days. More than 50 percent of births are twin or triplets. Having smooth coats, they are not generally clipped. Beetal males are raised especially as sacrificial animals for slaughter on Eid-ul-Azha.

Dera Din Panah

District Muzaffargarh and Multan in Punjab province are the home tracts of this breed. They are named after a town of the same name in Muzaffargarh district. These goats are black and hairy with a large well-developed body, large head with a Roman nose, hair on the chin and long broad ears. Cartilaginous appendages on the sides of the neck are found in some animals. Horns are thick and long with two to three spiralled curves. The tail is medium and covered with short rough hair. The udder and teats are well developed and milk yield is 245 litres in a 135-day lactation. Adult males and females weigh 45 and 40 kg respectively. Hair yield is 1200 g per head annually. Twin births are common. These goats are raised for meat, milk and hair production.

Hairy Goat

This goat comes from the Dera Ghazi Khan district in Punjab. These goats are white, small to medium-sized, and hairy. Adult males and females weigh 29 and 24 kg respectively. Milk yield is 60 litres in a 90-day lactation period. Hair yield is 3000 g per head annually. These goats are raised for meat and hair.

Kalji (Pahari)

Kalji goats are from the Dera Ghazi Khan district of Punjab and the Loralai district of Balochistan. They are usually black, but sometimes white, brown, or grey. Their muscular body is covered with long hair. The head is small, ears erect and pointed, and horns thin. White or brown hairstreaks run from the base of the horns to the muzzle. The udder is medium and milk yield is 120 litres in 120 days. Hair yield is 800 g per head annually. Adult males and females weigh 30 and 25 kg respectively. Twins are rare. Kalji goats are raised for meat, milk and hair.

Burgi (Bagitoori)

This breed is found in parts of Hyderabad, Badin and Mirpurkhas. Burgi goats are white-coloured, hairy animals. They have a medium head with spirally twisted horns rising in an upright position and floppy medium ears. Adult males and females weigh 30 and 25 kg respectively. Hair yield is 600 g per head annum. These goats are raised for meat and hair.

Chappar (Kohistani or Jabli)

This breed originates from the southwestern mountain ranges of Sindh and the adjoining hilly parts of Balochistan, hence the name Chappar, Kohistani or Jabli. Chappar goats are all black, white, or spotted with black and white, and they are hairy. The head is small with an evident forelock, with ears that are small to medium. Both males and females are horned with blunt ends. The tail is nearly 18 cm long. Adult males and females weigh 26 and 22 kg respectively. Milk yield is 90 litres in a 120-day lactation. Hair yield is 600 g per head annually. Chappar goats are raised for meat and hair production.

Jattan (Dhattan)

This breed is named after the camel raising tribe of Jats in Sindh. Jattan goats are found in the irrigated areas of Mirpurkhas district bordering the Thar Desert. Their colour can be fawn, red or black. This is a large-sized breed with long legs. The medium drooping ears are white and splashed with fawn, red or black. Males have a black ring around the base of the neck. Males and females are both horned. The udder is well developed. Milk yield is 225 litres in a 130-day lactation period. Adult males and females weigh 50 and 42 kg respectively. Jattan goats are raised mainly for milk.

AppendixG: Biodiversity Related Projects in Pakistan

PROJECT	EXECUTOR	DONOR	DURATION
Protection of Biodiversity in the Jhangar Valley, Chakwal	WWF-Pakistan	----	5 Years
Sea Weed Fauna of Karachi and Balochistan	Office of Naval Research (ONR) USA/University Grants Commission	ONR (USA)	Two years (Nov. 97-Nov. 99)
Conservation of Mountain Ecosystem with Focus on Moist Temperate Forests and Associated Endangered Fauna in Selected Areas of Northern Pakistan	WWF-Pakistan	WWF-Pakistan	4 Months
Wildlife Protection of Juniper Forest Conservation, Torshor Zarghoon Valley	WWF-Pakistan	WWF-Pakistan	1 Year
Environmental Toxicology Institute	PARC, Ministry of Food, Agriculture and Livestock, Government of Pakistan, Islamabad/UNIDO, Vienna Austria	DANIDA, Royal Government of Denmark	Five years, starting January 1998
Plant Genetic Resources Institute of Pakistan	PARC	Government of Pakistan	Continuous
Conservation and Use of Animal Genetic Resources in Asia and the Pacific	FAO/12 countries in Asia and the Pacific	Government of Pakistan	1995-1998 (3 years)

Conservation And Sustained Management Of Dry Temperate Forest Ecosystem In Chitral, North West Pakistan (Bhombrette)	WWF-Pakistan	WWF-Pakistan	8 Months
Conservation and Sustained Management of Forest Ecosystem in The Gumrat Valley of Dir Kohistan, North West Pakistan	WWF-Pakistan	WWF-Pakistan	8 Months
Ecological Resource Survey For Developing a Sustainable Biodiversity Project with Community Participation in Kalat District	WWF-Pakistan	WWF-Pakistan	4 Months
Ecological Studies Of Game Areas In Balochistan.	WWF-Pakistan	WWF-Pakistan	4 Months
Conservation Of Chalgoza Forest Ecosystem, Suleiman Range (Balochistan)	WWF-Pakistan	CIDA, GoP, WWF-International, UK, Germany, USAID	5 Years
Conservation Of Mangrove Forest In The Coastal Areas Of Sindh And Balochistan	WWF-Pakistan	WWF-Netherlands	5 Years
Surveys, Management Planning And Proposals For Azad Jammu And Kashmir	WWF-Pakistan	WWF-International	On-Going
Support Strategy For Protected Areas Network In Pakistan	WWF-Pakistan	WWF-International	On-Going
Botanical Projects (working to produce a <i>Red Book on Vascular Flora, Field Guide on the Flora of Pakistan</i> , and <i>Glossary of Medicinal Plants</i>)	Quaid-e-Azam University/The Herbarium of Pakistan Museum of Natural History	Self	3-4 years
Vertebrate Pest Management	PARC	Government of Pakistan/ NARC	Continuous

Pilot Studies To Determine The Feasibility Of Protecting The Freshwater Network In Malakand Division Through Partnership With Other NGOs And Concerned Government Agencies	WWF-Pakistan	WWF-Pakistan	1 Year
Conservation Of Cranes In The North West Frontier Province Of Pakistan	WWF-Pakistan	WWF-Pakistan	2 Years
1. Promotion of Private Community Game Reserves 2. Palas Conservation Development Project	NWFP Wildlife Department/Birdlife International-WWF-Pakistan (PCDP)	European Community and Govt. of NWFP (PCDP)	5 years
Study on Shrimp and Fish Nursery Ground in Mangrove Areas of Indus Delta	Marine Reference Collection & Resource Centre, University of Karachi/Coastal Forest Division, Sindh Forest Department	World Bank	2 years
Lungh Lake Rest House		WWF-Pakistan	-----
Conservation Of Wetlands In Pakistan		WWF-Netherlands	On-Going
Survey Of Important Habitats Of Urial And Suleiman Markhor In Quetta District- Takatu And Zarghoon Mountain Ranges (Balochistan)		WWF-Pakistan	1 Year
To Asses The Status Of Falcons And Falconry In Afghanistan		WWF-Pakistan	6 Months
Potentials Of Owls As Agents For Controlling Rats And Mice Populations In Cultivations		WWF-Pakistan	2 Years

Feasibility Of The Restoration Of Vegetation Of Cholistan Desert As Natural Habitat Of Houbara Bustard And Other Wildlife Species		WWF-Pakistan	2 Years
Conservation Of Endangered Flora Of Cholistan Desert By Accelerating Their Germination And Growth		WWF-Pakistan	---
A Preliminary Study in Zooplankton in Coastal Lagoon and Inland Bay of South-western Coast including part of Indus Delta	Marine Reference Collection and Resource Centre, University of Karachi/University Grants Commission	United States Office of Naval Research Project	1 year
Management Of Hazarganji Chiltan National Park	WWF-Pakistan	World Bank	5 Years
Herbal Medicinal and Aromatic Plants in Baltistan	Baltistan Health and Education Foundation/UNEP-GEF	UNEP-GEF	1 year pilot phase
Protection And Sustainable Use Of Wildlife Species In Ghulkin Village, Northern Areas	WWF-Pakistan	WWF-Pakistan	2 Years
Chromosomal and Taxonomic Studies in the Family Liliaceae	Department of Botany, University of Karachi	University of Karachi (most likely to fund)	1 year
Improvement of Sunflower and other Oilcrops	ABI, NARC	NARC, Government of Pakistan	Continuous
Preliminary Filed Survey Of Houbara Bustard South Western Afghanistan		WWF-Pakistan	4 Months
Ecology Of The Francolins In Relation To Agriculture In Pakistan		WWF-Pakistan	2 Years

Studies on the Distribution, Population Dynamics and Status of Vertebrate Mangrove Fauna of Balochistan Coast	Zoological Survey Department/Pakistan Agricultural Research Council	April 92-December 96	PARC (GoP)
Survey of the Wintering Waterbirds on the Makran and Karachi Coasts	Zoological Survey Department	ZSD	
Conservation of Mangrove Forest Ecosystem	WWF-Pakistan/Balochistan Forest Department	WWF-International	----
Maintaining Biodiversity in Pakistan with Rural Community Development	IUCN-Pakistan/GoP/GoNWFP	UNDP/GEF	3 year pilot project started in 1995
Taxonomic Studies On The Snakes Of NWFP	WWF-Pakistan	WWF-Pakistan	1 Year
Mountain Areas Conservancy Project	GoP, GoNWFP, NAs Administration, IUCN, WWF, AKRSP, HWP	GEF/UNDP/GoP	1999-2006
Biodiversity Action Plan and Protected Areas Management Project	IUCN-P/WWF-P/GoP	1996-1998	GEF/WB
Pakistan Environment Programme	IUCN-Pakistan/GoP	1994-1999	CIDA
Ecological Studies Of Avifauna In The Naltar Valley, Northern Pakistan	WWF-Pakistan	WWF-Pakistan	1 Year
Regional/District Conservation Strategies	IUCN-P/Government	Ongoing	SDC, NORAD, Dutch Government
The Management Of Punjab Urial (<i>Ovis Vignei</i>) In The Salt Range, Districts Chakwal And Jhelum	WWF-Pakistan	WWF-Pakistan	6 Months

Conservation Of Migratory Birds In Chitral (NWFP)	WWF-Pakistan	WWF-Sweden and WWF-International	On-Going
Himalayan Wildlife Project	-----	UNDP/GEF. SGP	1996-1998
Sustainable Resource Use In Bar Valley, PSD-21	WWF-Pakistan	WWF-UK, WWF-International/UK	3 Years
Removal of Heavy Metals from Industrial Effluents Using Various Biosorbents	Environmental Biotechnology Division, NIBGE	3 years	NIBGE
Ethnobotanical Studies And Vegetation Analysis Of Selected PA Of AJK	WWF-Pakistan	WWF-Pakistan	1 Year
Herpetology of Pakistan	Pakistan Museum of Natural History/Florida Museum of Natural History, ZSD, Karachi	-----	1989-1992
Measurement of Methane Emission from Rice Fields	Environmental Biotechnology Division, NIBGE	NIBGE	4 years
Biodiversity of Methane Utilising Bacteria (Methano-trophs) in Pakistan	Environmental Biotechnology Division, NIBGE	NIBGE	3 years
Aquatic Baseline Study and Review of Possible Impacts on Aquatic Life	Pakistan Museum of Natural History	Norconsult International	1997-98
Detection of Genetic Material (DNA) Damaging Agents in the Environment	Environmental Biotechnology Division, NIBGE	NIBGE	3 years

Molecular Biology of Indigenous Biosurfactant (BS) Producing Bacterial Strains	Environmental Biotechnology Division, NIBGE	NIBGE	3 years
Preservation of Microbial Biodiversity for the Sustainable Development	Environmental Biotechnology Division, NIBGE	GEF	4 years
Root Causes Of Biodiversity Loss In The Mangrove Ecosystems	WWF-Pakistan	GEF	1 Year
Production of Citric Acid and Xylitol from Agro-industrial Wastes	Biofuels Division, NIBGE	GEF	4 years
Structural Adjustment And The Environment	WWF-Pakistan	WWF-USA	1 Year
Biotechnology of Extremophiles	Biotechnology for Minerals and Fossil Fuels, NIBGE/PAEC	1996-2002	PAEC
Sustainable Cotton	WWF-Pakistan	WWF-International	2 Years
Heavy Metals/ Radionuclide Immobilisation by Biosorption on Microbial Biomass	PAEC	PAEC	1995-2000
Bioprocessing of Zinc-Lead Duddar Ore	PAEC	PAEC	1996-2002
Bioprocessing Sulphitic Ores of Pakistan	PAEC	1995-2002	PAEC and Saindak Metals (Pvt.) Ltd. Quetta
Production of Ethanol from Agro-industrial Wastes	Biofuels Division, NIBGE	MIST, Government of Pakistan	8 years from 1987

Fossil Fuel Technology	PAEC	PAEC	1995-2000
Bioleaching of Non-Sulfidic Ores by Acidophilic Heterotrophs	PAEC	PAEC	1997-2000
Sustainable Development Indicators- A Southern Perspective	WWF-Pakistan	WWF-UK	1 Year
Production of Methane from Agro-industrial wastes	Biofuels Division, NIBGE	PAEC, Habib Sugar Mills Ltd.	6 years from 1990
Support to the Development and Implementation of a National Biosafety Mechanism	NIBGE/ MELGRD/UNEP	UNEP/NIBGE	1998 – and for 18 months
Use of Biofertilisation to Enhance Agricultural Production	NIBGE	GoP/IAEA/ICGEB	Initiated in 1990
Biodetoxification of Effluent from Textile Industry	NIBGE/Crescent Textile Mills	NIBGE/CTM	5 years
Biodetoxification of a Pharmaceutical Industry Effluent Containing High Concentration of Phenols	NIBGE/ENVIRON	NIBGE	3 years (96-98)
People And Plants, Conservation And Training In Applied Ethnobotany	WWF-Pakistan	WWF-International	3 Years
Biodetoxification of Effluent from Antibiotic Producing Pharmaceutical Industry	NIBGE/ Pharmagen Beximco Lahore	NIBGE/ Pharmagen Beximco, Lahore	2 years
Biotechnological Solution of Liquid Effluent from Leather Industry	NIBGE/PSF	NIBGE/PSF	3 years

Biosorption Based Process for Removal of Heavy Metals From Industrial Water Waters	NIBGE/ Kazakhstan- Pakistan Joint Commission	NIBGE/Kazakhstan- Pakistan Joint Commission	2 years
Biology and Biogeography of Butterflies of Northern Areas of Pakistan	Pakistan Museum of Natural History, University of Oxford	N.S.F., USA and Oxford University	5 years (continued since July 93)
Small Mammals of Pakistan	Pakistan Museum of Natural History/Florida Museum of Natural History	US, Fish and Wildlife Services	7 years, continues since July 1993
Zoogeographical Studies of the Flies of Medical Importance of Pakistan	Pakistan Museum of Natural History/ Monobusho International Scientific Research, Japan	Monobusho International Scientific Research, Japan	3 years
Birds and Butterflies as Bioindicators in Mountain Habitats of Pakistan (to be started)	Pakistan Museum of Natural History	Government of Germany	3 years
Biodegradation of Petroleum Using Indigenous Bacteria and Applying Biosurfactants Produced by these Bacteria	NIBGE	NIBGE	5 years (1995-2000)
Biodiversity and Biogeographical study of the Fauna of Pakistan with Special Reference to Nature and Natural Resource		PMNH	continuous
Conservation And Community Development At Tato Village (Fairy Meadows), Northern Areas	WWF-Pakistan	WWF-Pakistan	6 Months
Expedition of Houbara bustard in D.G. Khan to survey its population		HFIP	Completed 1996
Population density of Houbara bustard in Cholistan Desert		HFIP	2 years (1996-97)

Expedition to Nag Valley, Balochistan to study breeding potential of Houbara bustard and reasons for its decline		HFIP	2 years (1997-99)
Captive management of Houbara bustard in Houbara Research and Rehabilitation Centre (HRRC), Rahim Yar Khan		HFIP	2 years (1997-98)
Aerial broadcast of seeds of desert plants in Cholistan		HFIP	1 year 1998
Aerial broadcast of seeds of desert plants in Cholistan		HFIP	1 year 1999
Rearing of Houbara chicks in Houbara Research Rehabilitation and Breeding Centre, Nag Valley (1999).		HFIP	1 year 1999
Ongoing Projects of the HFIP			
Establishment of Houbara Research and Rehabilitation Centre in Nag Valley.		HFIP	
Survey of Houbara bustard in Kharan, Chagai (Balochistan), D.G. Khan, Rahim Yar Khan and Bahawalpur.		HFIP	
Rehabilitation of Houbara bustard in Nag Valley.		HFIP	
Release of Houbara in its breeding and wintering grounds in Pakistan (Nag Valley and Cholistan respectively) using transmitters (December 1999 and March 2000).		HFIP	

Appendix H: List of Contributors

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