First National Report
Of
Pakistan
to the
Convention on Biological Diversity

Ministry of Environment
Government of Pakistan

Contents

Foreword

Biodiversity is a vast subject that encompasses and cross cuts along many disciplines. These disciplines include forestry, fisheries, livestock, bio-technology, agriculture, tourism, wildlife, marine and freshwater ecosystems etc. that traditionally work to fulfil their respective goals and objectives. These goals and objectives by default aim at maximizing production and benefits. However with a better understanding of the science of biological diversity the importance for its conservation and sustainable use has been widely recognized. This recognition received a political significance after the Rio Earth Summit of 1992. In a scenario when every sector is tuned to work in its own sphere of duty it becomes all the more difficult to make the relevant organization to make a paradigmatic shift for conservation rather than production. An example is the fisheries sector that aims to increase commercial fish production while the subject of biodiversity calls for conservation of all aquatic life and aquatic habitats. Similar is the situation in other disciplines like agriculture and forestry. This book aims to bring together all the scientific knowledge on biological diversity, synch it with the existing ground situation in Pakistan and create awareness and capacity to deal with the provisions of the CBD. I would specially mention the valuable contribution of Dr. Ashraf Poswal for his contributions in the chapter on Alien Invasive Species that incorporates the state of the art techniques for biological control of aquatic weeds.

The First National report was completed with the help of a number of resource persons and the experts. Due to unavoidable reasons, the report could not be published although the un-published copy had been the main reference material with all concerned. Thanks are due to all involved in every stage of the process for their time, valuable comments and suggestions. An extensive consultative process was adopted by involving all the national experts and institutions to prepare these reports. The consultative process can be termed a success because experts from all over Pakistan contributed, came together on one platform and attended the workshops held to review the drafts. This report has incorporated initiatives taken so far in the form of case studies and has facilitated the initiation of new research.

I would like to thank authors and co-ordinator of the First National Report Syed Mahmood Nasir and Rizwan Irshad of the Biodiversity Directorate for the preparation of this report in present form. The list of contributors is quite long and it would be injustice to mention just a few here. I would like to appreciate the contributions from Dr. Abdul Aleem Chaudhry and Umeed Khalid, Kalimullah Shirazi, Dr Anwar Nasim and Mehnaz Ajmal, Dr. S.M. Saifullah, Dr. Nasim Akhter, Dr. Zahoor Ahmad, Dr. Rashid Anwar and Dr. Syed Azhar Hasan,

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Acronyms

ABS	Access and Benefit Sharing
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
CDM	Clean Development Mechanism
CFC	Chloro-floro-carbon
CFT	Cubic Feet
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
EPA	Environmental Protection Agency
GATT	General Agreement on Trade and Tariffs
GEF	Global Environment Facility
GHG	Green House Gase
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
ITPGRFA	International Treaty on Plant genetic Resources for Food and Agriculture
IMO	International Maritime Organization
IPM	Integrated Pest Management
IPR	Intellectual Property Rights
IPO	Intellectual Property Organization
IUCN	The World Conservation Union
LEAD	Leadership for Environment and Development
LES	Livestock Experiment Station
MAF	Million Acre Feet
MOE	Ministry of Environment
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
ODS	Ozone Depleting Substances
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
UNFCCC	Framework Convention on Climate Change
UNPOV	International Union for the Protection of New Varieties of Plants
VRI	Veterinary Research Institute, Lahore
WFP	World Food Programme
WHC	World Heritage Convention
WIPO	World Intellectual Property organization
WWF	World Wide Fund for Nature
WCMC	World Conservation Monitoring Centre
CIFOR	Center for International Forestry Research
WRI	World Resource Institute

Pakistan Fact Sheet[1]

The Islamic Republic of Pakistan emerged on the map of the world as an independent sovereign state on 14th August 1947, as a result of the division of former British India. It lies between 23-35 to 37- 05 north latitude and 60-50 to 77- 50 east longitude touching the Hindukush Mountains in the north and extending from the Pamirs to the Arabian Sea. It is bounded by Iran in the west, Afghanistan in the north-west, India in the east and south east and Arabian Sea in the south. There is a common border with China alongside Gilgit and Baltistan in the north.

Pakistan covers 796,095 sq.km with a population of 132[2].35 million according to population census 1998. It is divided into four provinces: Sindh, Punjab, North West Frontier Province and Balochistan. It consists of such physical regions as a) the western offshoots of Himalayas which cover its northern and north western parts of which the highest peak K-2 rises to 8611 meters above sea level; b) the Balochistan Plateau c) The Potohar Plateau and Salt Range and d) The Indus plain, the most fertile and densely populated area of the country getting its sustenance from the Indus River and its tributaries.

Religiously Pakistan is an Islamic country where 96.28 % of population prays towards Makkah. Christians are 1.95 % of the population whereas Hindus are 1.60 % and schedule Hindus represent 0.25 %. Qadiyanis have relatively small community with only 0.22 % representing the new religion. Others are 0.07 % which includes Sikhs and other religious communities.

Climatically, Pakistan enjoys a considerable measure of variety. North and north western high mountainous ranges are extremely cold in winter while the summer months of April to September are very pleasant. The plains of the Indus valley are extremely hot in summer with a cold and dry weather in winter. The coastal strip in the South has a moderate climate. There is a general deficiency of rainfall. In the plains annual average ranges from 16 centimeters in the northern parts of lower Indus plain to 120 centimeters in the Himalayan region. Rains are monsoonal in origin and fall late in summers. Due to the rainfall and high diurnal range of temperature, humidity is comparatively low. Only the coastal strip has high humidity. The country has an agricultural economy with a network of canals irrigating a major part of its cultivated land. Wheat, cotton, rice, millet and sugar cane are the major crops. Among fruits: mangos, oranges, bananas and apples are grown in abundance in different parts of the country. The main natural resources are natural gas, coal, salt and iron. The country has an expanding industry. Cotton, textiles, sugar, cement, and chemicals play an important role in its economy. It is fed by vast hydroelectric power.

Urdu is the national language and is used as a medium of understanding throughout the country. Pakistan is culturally divided into four bilingual provinces. Punjabi is spoken in the Punjab, Sindhi in Sindh, Pashto in NWFP, and Balochi in Balochistan. The country comprises of a vast area that was the great center of ancient civilizations of the world. Its historical sites beginning with stone-age to Twentieth Century A.D are a mirror of the life of its people who are by nature simple, virile, hospitable and hard working. Ancient sites excavated in Taxila, Harappa, and Moenjodaro speak volumes for Pakistan rich cultural background dating back to 3,000 B.C.

[1] Source: www.pakistan.gov.pk

[2] according to the latest reports the population is 160 million

Chapter 1: Introduction

As a signatory to the Convention on Biological Diversity (CBD), Pakistan is obliged to fulfil its obligations and take appropriate measures at the policy and implementation levels. Biological diversity is an overarching subject that encompasses the natural and physical sciences as well as the social sciences when it talks about the equitable benefit sharing and traditional knowledge. In order to address the obligations under the Convention on Biological Diversity sensitizing the organizations that deal with its various thematic areas is necessary, since both the practitioners and researchers are scattered in different organizations and governments. A paradigm shift is needed to address the call of the CBD in every sphere of developmental activity in order to achieve the three aims of the CBD i.e. conservation, sustainable use and equitable benefit sharing. The Ministry of Environment has established the Biodiversity Directorate so as to effectively address the CBD issues, it is expected that with this action a strong foundation has been laid for Biodiversity conservation in Pakistan.

Biodiversity is partially safeguarded in the existing legislation of the country and has been a secondary topic of discussion in the development sector. However, in the recent years it has gained importance and there exists a better understanding in the governmental and non-governmental circles. It is also felt that the concept in its real sense 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 Government of Pakistan to this important and neglected sector. The authors of this document feel that the process that led to the compilation of the three National Reports has trained many organisations and individuals on many issues covered by the CBD.

Pakistan has wide geographic variations and houses 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, 1.86 % annual population growth rate (source: National Institute of Pakistan studies 2006 data) 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 700 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 scanty. The provincial forest departments 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 not practised 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 has yet to be understood and institutionalized and assimilated in the forest management at the provincial level. The existing 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 department, which include 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 other donors 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 in all the provinces except Balochistan. 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. 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 (990 km, measured as a straight line) 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 required.

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 of 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 data were being collected for the 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 MOE, which is responsible for the licensing of the commercial release of GMOs under the Biosafety Rules 2005.

The fair and equitable sharing of benefits of biological resources, issues of traditional knowledge and indigenous people are important components of the CBD and are not widely understood in the context of the relevant articles of the CBD (8 (j) and Article 15), the gap in understanding can be vouched after having a look at BAP's section on ABS. BAP was prepared in 1998 and the sections on ABS reflect the capacity of that time. . Earlier legislation did provide some usufruct rights to local communities in the forest areas but the issue of access and benefits sharing have yet to be fully institutionalized in the policy and legislation. The Biodiversity Working Group established in the Ministry has drafted the Biodiversity rules that are in the draft stage. Pakistan's biological resources are used for economic gains by the industries yet little benefits accrue to the local communities as a fair share from the profits in lieu of their traditional knowledge. However, many 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 Eucalyptous is still inconclusive. Mesquite is also 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 MOE. 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, 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 MOE is making efforts to implement the CBD, Pakistan needs to do much more.

What is Biodiversity?

Biodiversity or biological diversity refers to the diversity of all forms of life on earth and the CBD has defined it 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. According to the CBD website the biodiversity we see today is the fruit of billions of years of evolution, shaped by natural processes and, increasingly, by the influence of humans. It forms the web of life of which we are an integral part and upon which we so fully depend'.

This diversity is often understood in terms of the wide variety of plants, animals and micro organisms. So far, about 1.75 million species have been identified, mostly small creatures such as insects.

Scientists reckon that there are actually about 13 million species, though estimates range from 3 to 100 million. It is estimated that only 1.5 million species have actually been studied.

Biodiversity also includes genetic differences within each species - for example, between varieties of crops and breeds of livestock. Chromosomes, genes, and DNA-the building blocks of life-determine the uniqueness of each individual and each species. Another aspect of biodiversity is the variety of ecosystems such as those that occur in deserts, forests, wetlands, mountains, lakes, rivers, and agricultural landscapes. In each ecosystem, living creatures, including humans, form a community, interacting with one another and with the air, water, and soil around them. It is the combination of life forms and their interactions with each other and with the rest of the environment that has made Earth a uniquely habitable place for humans. Biodiversity provides a large number of goods and services that sustain our lives.

This book 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. It 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.

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 into force on its thirtieth ratification on 29 December 1993. Since then, it has received 168 signatures and 190 ratifications. In 1994, the United Nations General Assembly declared May 22nd 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 during 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.

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 MOE has been the first major step towards the implementation of the CBD.

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 MOE, 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.

Clearing House Mechanism

Establishment of the clearing House Mechanism (CHM) is provided under Article 18(3) of the Convention. 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. Efforts are under way to establish the CHM in Pakistan, however, the web page of the Ministry of Environment in general and NCS more specifically is playing the role of CHM.

Financial Mechanisms

Pakistan pays approximately US $ 5741 as its annual 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 US $ 10.36 million for the Mountain Area Conservation Project (MACP). GEF has also provided USD 10.47 million for the Protected Areas Management project The Pakistan Wetlands project is the latest of the GEF funded projects costing 3 m US$ that aims the conservation and wise use of some selected wetlands of Pakistan.

Biodiversity Related Legislation

Like other parts of the world, Biodiversity as a distinct discipline attracted importance in the post Rio era. The Pakistan Environment Policy 2005 has a section on biodiversity. A review of the existing legislation on land, water, soil, air, forests, oceans, etc. reveals that the issues and legislation addressed by the CBD are addressed in one way or the other specifically conservation. However, many issues of Biodiversity conservation in the pre Rio legislation appear in conflict with the principles of conservation, sustainable use and equitable benefit sharing of biological resources as envisaged in the CBD; 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 while ignoring other species (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: Legislation and the Departments 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 respective district governments
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-
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 Governments
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 Ordinance (1959) and Rules (1960)	Provincial Agricultural Department(s)
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)
Bio-Safety	
The Bio-Safety Rules 2005	Pakistan Environmental Protection Agency

Biodiversity Related Strategies, Policies and Plans

The National Conservation Strategy (NCS), the Forestry Sector Master Plan (FSMP), BAP and the Forest Working Plans[3] **Table 1.2** deals 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, fisheries, taxonomy, 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. 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

Strategy / policy	Year
The Pakistan National Conservation Strategy1992	1992
The Forestry Sector Master Plan 1985	1985
The Biodiversity Action Plan1998	1998
The Pakistan Environmental Policy 2005	2005
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.

Institutional Co-ordination

Ministry of Environment is the focal point for National Biodiversity Concerns. Within the Ministry the Inspector General of Forests **IGF** assisted by a Director Biodiversity and a Technical Officer (Biodiversity) 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 and Livestock
Finance
Science and technology
Ministry of Labour and Manpower
Ministry of ports and Shipping
Ministry of Culture and Sports
Intellectual Property Organization, Cabinet Division
The following provincial departments are also directly involved:
Agriculture
Livestock
Planning and Development
Forestry
Wildlife
Tourism
Fisheries

Ministry of Environment co-ordinates with all these ministries and departments. For technical guidance on Biodiversity and related issues a Biodiversity Working Group **BWG** has been established within the Ministry of Environment (MoE), all relevant government departments/ agencies, research institutions and NGOs are represented in this group. Earlier, due to the lack of capacity and fewer members of BWG, effective guidance and meaningful developments could not be made by the Group. The slow progress was also partly due to the fact that the Group started its work by addressing the complex issue of ABS legislation. Recently, the composition of the BWG has been revised so as to

[3] *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)

include maximum sectors in the changed scenario. This book is expected to give a fillup to the process of addressing the wider issues in all sectors holistically. The provincial forest and wildlife departments have a separate hierarchy of officers who have no institutional arrangements for co-ordinated implementation of biodiversity related projects. National Council for the Conservation of Wildlife (NCCW) is responsible for the formulation and co-ordination of wildlife policies under the Federal Ministry of Environment. 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).

The diverse research institutes and organisations involved in research (Biodiversity not being the major focus) are given in **Appendix C**. 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

Chapter 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.

Introduction

Pakistan is situated at the western end of the South Asian subcontinent. Its flora and fauna have the characteristics of both Palaearctic 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^{o}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. 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 the Punjab and Sindh).Despite the large-scale modification of natural habitats, a few primary / pristine ecosystems are still found. These are described in the following sections.

Ecosystems of Special Biodiversity Significance

Balochistan Juniper Forests

Balochistan 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 sparser and are gradually replaced by curious hedgehog-like dwarf shrubs.

The main species-*Juniperus excela* subspecies *polycarpos,* 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 oxycederii*). 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 Balochistan[4]

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 cubic foot in 50 years. Ziarat, Zarghun 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 Zarghun 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 have undertaken a number of efforts to overcome this problem. 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. They are threatened from not only human activities but also a disease for which no effective remedy has been identified. A medium sized GEF project for the conservation of the juniper forests has recently been launched. The government has also arranged the supply of natural gas through pipelines to ease the pressure on juniper wood.

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 *polycarpos* is the other associated species. Similarly, the chilghoza forest ecosystem of Balochistan has been identified as a high priority area for conservation. Projects for the Chilghoza forests are also in pipeline. The Zoological Survey Department is also implementing a project for survey of animals at the species level.

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

[4] Case Study prepared by Tahir Rashid Fellow LEAD-Pakistan

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 have 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 availabletherefore it is difficult to assess the benefits and losses associated with these communities.

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 multi-storeyed 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 integrrima, Bombax ceiba, Albizzia lebbek Terminalia belerica.* These are mixed with small and medium-sized trees (e.g. *Acacia catechu, Mallotus philipensis, Lannea coromendelica, 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* once considered to be extinct in Pakistan, has been reported in the Margalla Hills subtropical forests. Some rare species associated with the 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 (Stewart, 1967). Extensive plantations of exotic species like *Eucalyptus spp.* is a growing threat to the natural, indigenous species of flora and fauna

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 changes in species composition have occurred in more populated areas (Schickoff 1995). In the Siren Valley, the forest cover has also decreased between 1979 and 1988 (GTZ report 1990). This information is based upon remote sensing data (Landsat MSS and TM). Research in the Karakorum Valleys gives evidence of dramatically increased logging in the past 20 years after the construction of the Karakorum Highway and subsequent link roads (Schickoff, 1992, and 1993).

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 plateaux 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.

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 km^2) 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 associates of this community *Salvadora oleodies*, 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 make 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.

The area harbours the endemic subspecies of wild sheep the Punjab Urial (*Ovis vignei punjabensis*).

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 Nokundi, 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 cold blooded animals: lizards and snakes. 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 Phrynocephalu*s*. 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.

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 xerophytes and halophytic shrubs and grasses. *Acacia*, *Prosopis*, *Zizyphu*s and *Calotropis* are the characteristic species of the desert region.

The cold blooded fauna (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 *Chemaeleo zeylanicus* (CITES Appendix II), *Sitana ponticeriana* and *Agama minor*.

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 are 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. Avicennia 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 including 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.

Threats [5]

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; the trend in population increase is 1.86 % in 2006. Urbanisation is on the increase and with its problems of ecological footprints is threatening the ecosystems. The policies in context are not sensitive to the ecological considerations. Few 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 face setbacks at the implementation level.

[5] Pakistan Museum of Natural History, 1997, *Biodiversity of Pakistan,* Pakistan Museum of Natural History, Islamabad

Chapter 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.

Introduction

Pakistan has over 6000 species of flowering plants reported in the *Flora of Pakistan* [6] with around 400 endemic species and 4 endemic genera. 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. Karachi University, the NARC Herbarium and other research and development organizations are engaged in developing mechanisms for floral taxonomic surveys. The Pakistan Museum of Natural History has launched a Biodiversity Network Program that is available on the World Wide Web. This information will be useful to assess the market demand and conservation status of rare plants greatly in demand. Such networks 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. Some private organizations (Hamdard Laboratories, Qarshi Foundation etc) are also instrumental in cultivating rare medicinal plants in their gardens.

The Pakistan Museum of Natural History and the National Herbarium at the National Agricultural Research Council undertake surveys of flora and fauna in the country; however, no standard reporting format on the status and trends on species composition is available on a regular basis. A project to compile the Flora of Pakistan is on-going at Botany Department University of Karachi. Botany Departments of all the Universities survey the natural areas in the sphere of their jurisdiction. Some individual scientists are also active in this field. Efforts are under way for the establishment of the National Botanical Garden at National Institute of Health. Chak Shahzad Islamabad, it is hoped that the establishment of such Botanical Garden will be a major breakthrough for the systematic floral surveys in the country.

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 700 are considered to be medicinally important[7]. An estimated 80% of the rural population of Pakistan depends on a traditional medicinal system called Tibb-e-*Unani* for their primary healthcare needs, the majority of which uses plants or their active ingredients. See **Box 2** for details of the Tibb-e-Unani system.

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

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, Saussaurea costus, Picrorrhiza kurrooa, Aconitum heterphyllum,* and *Corydalis* spp.

Medicinal Plants of Temperate Montane Forest

Common medicinal plants of these areas are *Atropa acuminata*, *Angelica glauca*, *Paeonia emodi*,

[6] Nasir, E. and Ali, S.I., 1969-1989, *Flora of Pakistan*, Nos. 1-190, Department of Botany, University of Karachi and PARC, Islamabad, Shinwari et al. 2006

7 Shinwari, Z.K.; Watanabe, T.; Rehman, M. & Yoshikawa, T. 2006, A Pictorial guide to Medicinal Plants of Pakistan. Publisher: Kohat University of Science & Technology, Kohat, NWFP, Pakistan. Pp. 492

Geranium wallichianum, *Artemisia* spp., *Glycyrrhiza glabra*, and *Ephedra* spp.

Medicinal Plants of Sub-Tropical Foothill Forests

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

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 known to be present.

Status of the distribution of medicinal plants

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. The Drugs Control and Traditional Medicines Division of National Institute of Health in collaboration of Hamdard University and World Health Organization has published Monographs of Unani Medicines, Vol-1, which contains more than 300 monographs of single medicinal plants. There are about 30 large herbal and around 100 manufacturing companies in Pakistan, which produce *Unani* and Homoeopathic medicines on a commercial scale. The number of herbal and Homoeopathic medicine manufacturers in the non-organised sector runs into the hundreds. The annual sale of Herbal medicines was around 6 billion rupees. The annual turnover of some large herbal manufacturers is comparable to multinational companies in Pakistan. Traditional healers (around 100,000 in numbers, including hakims and homeopaths and around 300 vaids) serve about 60% of the population, especially those living in the rural areas.

Table 3.1: Endangered Medicinal Plants of Pakistan

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

Source: Rafiq, 1998

Box 2: The Unani System of Medicine in Pakistan

The Unani System of medicine locally identified as Tibb-e-Unani may be traced to that system of Greek medicine which was developed during the Arab civilization. The Greek scholars like Hippocrates and Galen perfected this system. 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. By the time the Arabs had penetrated into the Byzantine and Persian Empires, Greek science had for centuries ceased to be a living force. Unani system of medicine which flourished on the fundamental concept of humors, found its support from the Arabs who developed it many fold. 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 A.D. This system reached to perfection when the Indian knowledge of medicine was added during Mamun's time. In addition to the translators, the Muslim physicians who are esteemed due to their long lasting works include Ibn Sina, Al-Razi, Al-Tab-ari, Ibn Nafis and many others. The practitioner of Unani medicine is called a Hakim. A Hakim has to pass a five year course in one of the recognized Tibbia Eastern Medicine / Unani Medicine colleges to secure the degree of B.E.M.S. Hakim had always enjoyed respect and authority 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 Mohammed Said, founder chairman of the Hamdard Foundation Pakistan was another renowned Hakim. Due to the work of Hakim Said, the World Health Organization (WHO) recognized the Unani system in the early eighties, when the Government of Pakistan (GoP) 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 soon. This law will help standardize the formulations and set pharmaceutical standards in quality control, packaging etc.

The Unani System of medicine is based on the concept of developing resistance in the human body against disease. Therapeutics comprises: Regimental, Dietotherapy, Pharmacotherapy and Surgery. Unani medicines are known to have no side effects. A commercial manufacturer of Unani medicine is known as a 'Dawa Khana' (Laboratories), the largest among them being Hamdard. Others are Qarshi, Rehmania, Ajmal etc.

Hakims are rendering services all over Pakistan. Some use branded medicines while others make their own. Most of the formulations are passed down from father to son. However, Hakim Said of the Hamdard Foundation Pakistan published formulations (in Hamdard Pharmacopoeia) and set up research laboratories in Karachi. Hamdard University also takes up the cultivation of medicinal plants at its research site called Madinat al-Hikmah in Karachi. Only a narrow band of other medicinal herbs is cultivated in the private sector institutes.

Since herbs are the main source of Unani medicines, threats to the ecosystems are threats to human health. Due to shortages, the Unani system has also started extracting the active ingredient / extracts. 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 commonly available.

Threatened Medicinal and Aromatic Plants of Pakistan

A few preliminary attempts have been made to draw up national lists of threatened species, including a list of more than 700 plant species believed to be nationally rare or threatened, 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; those which are nationally rare, not declining, but otherwise at risk e.g. from population fluctuations, natural catastrophes, persecution, etc.; those which are highly localized in distribution; and those which are still widespread and common but suffering significant decline. Tables 3.1(above) and 3.2 contain the names of plants, which are endangered and vulnerable in Pakistan.

Table 3.2: Vulnerable Medicinal Plants of Pakistan

Plant	Local name	Consumption/Yr. (Tons) approx.	Ecological Region

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

Source: Rafiq, 1998

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.

No specific national target in accordance with the 2010 target has been established but more than 20,000 accessions related to agricultural biodiversity have been preserved in ex-situ collections. As there are no comprehensive lists of threatened plant species this target has not been addressed in the official plans.

Protected Area (PA) planning includes the assessment of rare / endangered / threatened plant species. All development projects related to natural habitats have to undertake EIAs that report on the conservation status of plant species.

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.**

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. Lists of internationally threatened species hardly reflect the ground situation. While there are little data available to demonstrate the decline of species' populations in Pakistan, the accelerating loss and fragmentation of natural habitats clearly implies such a decline is occurring. Habitat fragmentation isolates populations, exposing species to a higher rate of genetic loss and to a greater risk of extinction.

So far as plant species are concerned very little has been done to protect the threatened species. There are few reports available which have indicated the conservation status of some plant species. Chaudhry and Qureshi (1987) reported 709 species as threatened. These studies are primarily based on the herbarium material only. Oldfield et al (1998) reported only two endangered trees from Pakistan. These reports contain merely preliminary data and have no categorization based on the criteria laid down by IUCN i.e. Extinct (Ex), Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Lower Risk (LR), Data Deficient (DD) and Not Evaluated (NE). In fact, earlier works of listing threatened species of plants is either fragmentary or out dated and lying with different agencies which need to be re-evaluated and updated. The use of these earlier lists as a conservation tool is limited by the fact that the status of many species remains unclear, particularly of threatened species. It is therefore, very important to have a comprehensive survey of the important vegetation zones particularly of national parks, to evaluate the conservation status of different endangered species. It is important to prepare National Red Data lists of threatened plant species based on recent IUCN categories. Such lists would include species which are nationally rare and declining; those which are nationally rare, not declining, but otherwise at risk e.g. from population fluctuations, natural catastrophes, persecution, etc.; those which are highly localized in distribution; and those which are still widespread and common but suffering significant decline.

Chapter 4: FOREST BIODIVERSITY

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

Evolution of Forest Management in Pakistan[8]

Before the British came to the subcontinent, the natural resource base was so vast that there was little need for forest science[9]. 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 due to the hard work of the pioneer foresters of the sub-continent who selected the right species from amongst the Indian trees and standardized the irrigation system that the foresdt related needs of the communities were accomplished. After independence (1947), some useful irrigated plantations based on the old English system were developed. 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. Resultantly there are hardly any primary forests left. 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 the components of forest 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.

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. On the other hand management of the system as a whole is the hallmark of the concept of sustainable forestry. This includes iforest 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 of 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 UNFF (United Nations Forum on forests) yet lot has to be done in making efforts to streamline forest management in accordance with the voluntary provisions of the UNFF. 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.

Hill Forests

The primary natural forests were subjected to management under various silvicultural systems, including the selection and shelter wood system. The selection system has been applied to all conifer

[8] Nasir, Syed Mahmood, 1996, Making Forestry Practices Sustainable, The NEWS, Islamabad, October 26

[9] Agarwala, V.P., 1988, *Forests in India.* Calcutta: Oxford Publishing

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 thus the condition of the forests began to deteriorate in the end of the 20th century.

Riverine Forests

The history of the management plans of riverine forests goes back to almost 50 years. These plans are designed to convert the primary obhan (*Populus euphratica)* forest into irrigated plantations of *shisham*. 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 them. 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 receives 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.

Scrub Forests[10]

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 fuel wood 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 *Acacia modesta* and *Olea ferrugnea* 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 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 Bakarwals[11], the regular winter visitors with their large goatherds. These goats browse 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. The forest department doeas not have any control on their entry in the private lands adjoining the state forests. Nevertheless, the fact remains that they do

[10] Please also see section 2.1.7 'Thorn Forest' in Chapter 2 for the descriptive part.
[11] Nomadic tribe that keeps mainly hairy goats and descends to the low hills in winter for grazing

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.

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.

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 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.

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. 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.

Box 3: Farmland Planting in the Punjab Province[12]

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 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 micro organisms, 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 reduced 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 Lassora and Amla are examples. Others have medicinal value like the pods of Dhak *Butea monosperma.*

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 as others has to deal with these three objectives. Reserve forests, especially those declared in the natural ecosystems of the hills, are the major harbingers 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. One of the reasons attributed to the present system of forest management in Pakistan is the lack of sensitivity to harmonize forest related definitions; most definitions are assumptive, Appendix I gives an overview of the CBD forest related definitions.

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

[12] Case Study Prepared by Fauzia Bilqis Malik Fellow LEAD- Pakistan

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.

Strategies, Polices 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.

Pakistan's first National Environment Policy 2005 has been promulgated, wherein forests and forest ecosystems are treated as integral components of the green environment. The Policy provides guidelines and action plans for the conservation of forest biodiversity in all eco-zones of Pakistan. The draft National Forest Policy has also been prepared after a broad-based stakeholders' consultation. The overriding principle of the Forest Policy is to conserve forest ecosystems and ensure sustainable use. The Forest Policy stresses implementation of forest management plans based on ecosystem approach, and protecting relict natural forests. It seeks that commercial forestry should be practiced to the maximum on private woodlands (agro-forestry) and natural forests be protected for environmental services and Non Timber Forest Products (NTFP). Commercial harvesting of forest has been banned in Pakistan since 1992 after the devastating floods.

Under the Millennium Development Goals, Pakistan intends to extend its forest cover from existing 4.8 percent to 6.0 percent by 2015 i.e. more than one million hectares of new land is to be brought under forest cover. This target will be achieved through provincial forestry programmes. Respective action plans, programmes and projects of the provinces are under development, which have a common goal of restoring, conserving and promoting forests.

Ministry of Environment is sponsoring mega-scale watershed management programmes with the objectives of conserving and building forest biodiversity of catchment areas of Tarbela and Mangla reservoirs. In addition, several projects are under implementation to promote irrigated forests of the Punjab and Sindh provinces. On farmlands, Government of Pakistan, as a matter of its policy, is promoting native tree species preferably in appropriate proportions to ensure maximum species diversity. Dry land and desert forest diversity is being treated as a crosscutting subject where objectives of CBD and UNCCD integrate. A nation-wide programme on combating desertification and sustainable land management has been approved by the Global Environment Facility GEF wherein conservation of dry land biodiversity is a major component. Federal government and provincial governments are vigorously implementing programmes to conserve forest biodiversity of protected areas including four national parks namely Hingol (Balochistan), Chitral Gol, Ayubia (NWFP), Machhiara (Kashmir), and four conservancies in NWFP and Northern Areas.

The National Forestry Program facility (NFP) has been initiated with the support of FAO, this is a three year program and includes a component of Forestry Vision 2020, this activity will include in depth analysis of the global processes including the program of work on forest biological diversity for implementation in Pakistan.

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 (NCS) 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 large-scale deforestation, thereby providing an excellent opportunity for the rehabilitation of the forest. 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, while the NWFP Forest Act 2000 has also been promulgated. The NWFP has formally established a Forestry Commission, a Forest Roundtable and the Joint Forest Management Committees. All these fora aim towards broadening the future perspective of forest conservation and management.

Recommendations

The following are the recommendations listed during the process of the preparation of the National Reports:

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.

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, and conservation of biological diversity, employment generation and the provision of recreational opportunities.

Other issues

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 dialogues on how to bring forest management in conformity with the CBD in Pakistan.

Chapter 5: Wildlife Biodiversity

Introduction:

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.

A lot has been done for the conservation of wildlife since the creation of separate Wildlife Departments; 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 Plains

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 urial, 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 reportedly 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 conducted surveys at regular intervals to document the movement, behaviour and mortality of the bears. The bears were monitored using the technique of darting. After darting, the animal's vital signs were 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. As a result of these efforts a management plan for the Deosai National Park has been prepared and is in the process of implementation.

Traditionally the forest department also looked after the game animals; however in the 1970s the growing concerns on conservation issues led the government to create separate wildlife departments. Presently all the provinces except Balochistan have separate Wildlife Departments. While the NCCW National Council for the Conservation of Wildlife looks after the wildlife related issues at the federal level, it also liaises with the international organization and deals with CITES, Ramsar and the Convention on Migratory Species CMS.

Existing Wildlife in Pakistan

The mountainous areas embracing the Himalayas, 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.

Box 5: Mugger Crocodiles

The Mugger Crocodile (*Crocodylus palustris*), also called the Iranian, Marsh, or Persian Crocodile (in Persian Gandu), was widely distributed in the Indian subcontinent and the surrounding countries (India, Pakistan; in Pakistan's coastal regions of the Makran and delta marshlands of Sindh it is known as the Indus Crocodile, however they do exist in parts of Bangladesh, and parts of Nepal and Iran). The name Mugger comes from its name Magar Macchh in the Hindi language. The scientific name of the mugger crocodile means "of the marshes". According to IUCN's Crocodile Specialist Group (2006)13 the species is regarded as vulnerable (VU A1a, C2a v2.3), however according to Javed et al (2005)14, the species is considered as endangered, exterminated in most of its range, rare in Iran and near extinction in Pakistan.

No recent extensive survey data is available on mugger Crocodiles (*Crocodylus palustris*). This species was considered endangered or very rare in the early 1980s (Groombridge 1982)[15]. 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 Chotiiari reservoir. 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 population. 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).

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, wolf, black and the brown bears, otter, lynx, Himalayan ibex, markhor, bharal (blue sheep), Marco Polo's sheep, shapu, marmots, tragopan and monal pheasant. The snow partridge and snow cock 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 in Indus Kohistan, although its numbers are low.

Table 5.1: Species Richness and Endemics for Major Plant and Animal Groups [16]

Taxa	Total Reported in Pakistan	Endemic	Threatened
Mammals	174	6	20
Birds	668	?	25
Reptiles	177	13	6
Amphibians	22	9	1
Fish (freshwater)	198	29	1
Fish (marine)	788	-	5
Echinoderms	25	-	2
Mollusks (Marine)	769	-	8

13 Crocodile Specialist Group (1996). Crocodylus palustris. 2006 IUCN Red List of Threatened Species. IUCN 2006

14 Javed H. I., Rehman H. and S. Fakhri 2005. On the status of Marsh Crocodile in Pakistan, Records, Zoological Survey of Pakistan, Vol. XVI pp 40-45

15 Groombridge, B. (1982). I.U.C.N. Amphibia-Reptilia Red Data Book. Part 1. Testudines, Crocodylia, Rhynchocephalia. I.U.C.N. Publ., Gland, Switzerland

[16] Source: Third National Report- Pakistan

Taxa	Total Reported in Pakistan	Endemic	Threatened
Crustaceans (Marine)	287	-	6
Annelids (Marine)	101	-	1
Insects	>5000	-	-
Angiosperms	5700	380	?
Gymnosperms	21	-	?
Pteridophytes	189	-	?
Algae	775	20	?
Fungi	>4500	2	?

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, Indian Wolf, partridges (grey and black), seesee and chakor are supported in these habitats. Varieties of songbird fauna also occur in these areas. The urial is prized for its trophy and has been discussed in detail in **Box 6**.

Box 6: The Urial[17]

The urial (*Ovis vignei punjabiensis*) 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. Recently a scientific study aimed at analysing the critical factors responsible for persistence of Punjab Urial in the Salt Range was conducted and according to the estimates, there are still approximately 1000 heads surviving in the area. 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 animal. 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 2003 IUCN Red listing and in Appendix I of the CITES list. The Afghan urial is listed in the third schedule of the Balochistan Wildlife Act.

There a few private game reserves in the Punjab and Sindh where the Urial population is vibrant. The Nawab of Kalabagh has a history of conserving the Urial in an area of approximately 10,000 Acres in district Mianwali. Due to a satisfactory population the Punjab Wildlife Department has started a programme of trophy hunting in the Chumbi Surla Game Reserve and Kalabagh.

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 deserts are gradually being brought under irrigation, 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

[17] Case Study by Ghulam Ali Awan, Quaid-i-Azam University, Islamabad

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 occurs in some areas in Cholistan.

The Thar Desert supports a fair population of the Chinkara gazelle, while the peacocks are found in the wild, mainly because of the protection they enjoy due to the religious beliefs of the local Hindu communities. The Houbara bustard is a regular winter visitor to the desert. The great Indian bustard is sporadically sighted. The imperial sand grouse is another migrant visiting these areas. Grey partridges are frequently sighted. The python is also threatened with extinction.

Box 7: The Indian Wolf[18]

In Pakistan two subspecies of wolf are reported. *Capis lupus pallipes* and *Canis lupus chanco*. However there is little morphological difference between the two subspecies (Roberts 1997)

This species is considerably smaller than those found in sub-arctic regions of the northern hemisphere. A large male weighs 24 kg. There is little colour variation and it is usually greyish fawn in colour. The face is greyer having a mixture of black and white hair, being blacker on the forehead with predominantly white and fawn hair around the eyes. Short bushy tail which barely reaches the hocks and is black-tipped with black predominant on the dorsal surface The subspecies *C. l. chanco* occurs in all mountainous regions from Balochistan up to Chitral, Gilgit, and Baltistan in the north. It is also found in Deosai National Park, areas of Karabos, Bubind, and Sadpara. Extremely rare throughout the Indus Plains and survives mainly in the desert regions such as Cholistan and Tharparkar, where the subspecies *C.l. pellipes* exists. In Balochistan its range appears to extend over the whole province from the Makran coast to Zhob. Due to the decline in habitat quality and prey base, wolf is considered as an enemy species, as it is a threat for herds of goat and sheep. Habitat of the animal is degraded due to change in land-use patterns and fragmentation, increasing human interference through developmental activities, decrease in the quality of habitat due to forest clearing, and hunting. It has almost disappeared from Khirthar National Park and Thar. National status of Indian wolf, according to a recent assessment is *Endangered*. According to the estimates by wildlife officers and field biologists, approximately 300 individuals are expected in the territory of Pakistan which is split into 3-4 subpopulations.

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, seesee 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 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 and large quantity of food available to them.

The animals found in the south-western mountains of Balochistan are: Sindh ibex, Chiltan markhor, straight horned markhor, wild sheep, Indian Wolf, 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), sand grouse, black and grey partridges, and the chakor and seesee partridges are also found here. The status, threats and

[18] Sheikh, K.M. & Molur, S. 2005. (Eds.) "Status and Red List of Pakistan's Mammals" Based on Pakistan's Conservation Assessment and Management Plan for Mammals. 344 pp. IUCN, Pakistan

conservation of the Balochistan black bear has been described in detail in **Box 8**. The Chiltan wild goat found in the Balochistan highlands is discussed in **Box 9**.

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.

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Box 8:The Balochistan Black Bear[19]

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 Roberts (1997), 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 6-9 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 critically endangered in the IUCN Red Data Book according to the recent assessment made in 2003. 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. 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.

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

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 status is 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 10,** "Snakes of Pakistan").

[19] Case study by Tahir Rasheed Fellow LEAD Pakistan

Box 9: 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. 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 the Chiltan wild goat `as least concern' (IUCN Red List of Pakistan's Mammals 2003). 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 behaviour 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 workout its taxonomic status 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.

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 shell duck, teals, tufted and gadwall), geese (grey lag, bar-headed), coots, flamingos, 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 jacanas. The spot-billed lesser whistling teal and the cotton teal are resident ducks. A rich wader fauna visits the coastline during the winter.

Box 10: Snakes of Pakistan[20]

Pakistan possesses a diversity of snake species belonging to both the Palaearctic 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 Lasbela, 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 snake (*Enhydris 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 north-western 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.

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.

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.

Species of Special Concern

Only four species of mammals are endemic to Pakistan. Two species i.e. Woolly Flying Squirrel *(Eupetaurus cinereus*) and Indus Dolphin (*Platanista minor*) were declared as an Endangered (EN) at the recent attempt on mammalian red listing for Pakistan. Two endemic sub-species are the Balochistan Black Bear (*Ursus thibetanus gedrosianus*) declared as Critically Endangered (CR) and the Punjab Urial (*Ovis vignei punjabensis*) as Endangered.

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

[20] Case Study Prepared by Naeem Ashraf Raja Fellow LEAD- Pakistan

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)* which is listed as an extinct species but has been bred in captivity. Cheer Pheasant (*Catreus wallichii*) is another example of recent extinction of a pheasant species in the wild. Though many efforts were made at different appropriate locations to re-introduce the bird, yet viable population of re-introduced birds could not be established. According to a behavioural study on captive flock of cheer pheasants[21], it was found that the bird exhibits a number of survival elements that promise success of reintroduction.

Internationally Threatened

The latest *IUCN Red List of Threatened Animals* (IUCN 1996) lists 44 species and sub-species of internationally threatened or near-threatened mammals that are found in Pakistan (**Appendix A**). Of these, 12 are critically endangered, 12 endangered, 20 vulnerable, 31 near-threatened, 39 data deficient and status of few taxa is still not evaluated. 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 (*Macrognathus aral*) and one species of invertebrate, a butterfly (*Hyles hippophaes*) as data deficient.

Species of National Concern

Lists of internationally threatened species show only the tip of the iceberg. 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. IUCN Pakistan in collaboration with the Ministry of Environment regularly compiles the Red list of mammals and fresh water biodiversity by calling consultative meetings of the experts.

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

[21] 'Some studies on the Biology of captive Cheer Pheasant in Pakistan' M.Phil Thesis by Rizwan Irshad

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, snow cock, 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
Central Karakorum National Park	1390100	1995
Chinji	6,095	1987
Chitral Gol	7,750	1974

Deosai Plains	3,58,400	1993
Ghmot	27394	2004
Hazarganji–Chiltan	15,555	1980
Hingol	165,004	1997
Kandrap Shandur	51,200	1993
Khunjerab	226,913	1975
Kirthar	308,733	1974
Lal Sohanra	37,426	1972
Lulusar	75058	2003
Machiara	13,532	1980
Margalla Hills	17,426	1980
Pir Lasura	5625	2003
Saifulmaluk	12026	2003
Sheikh Buddin	15,554	1993

(Source: NCCW)

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 19 national parks, the provincial governments have listed 99 wildlife sanctuaries (Punjab - 37, Sindh - 35, Northwest Frontier - 6, Balochistan 14, Northern Areas – 5, federal territory 1). In addition, 97 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 - 8 areas, Northern Areas - 9 sites and AJK - 8 sites, federal territory - 1).

The list of Ramsar Sites in Pakistan is given in chapter 8. Most of the areas were created to provide habitat protection for animal species commonly referred to as game (hunt-able 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 12% 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.

Chapter 6: Insect Biodiversity

Insect Species in Pakistan

By far the majority of invertebrates in the terrestrial environment are insects. A review of the available literature shows that the subject of insect taxonomy has yet to receive its due attention; this is reflected by contradicting figures on the number of species found in Pakistan. Souhail, 2007 quotes more than 5000[22] species, in other references the figure is 2000. 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 (Dermoptera) 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 the country. There are more than 159 species of bugs (Hemiptera) recorded in Pakistan. Two species of Lacewings and alderflies (Nemoptera) are also recorded.

Other insect species recorded in Pakistan include:

- Many species of scorpion flies (Mecoptera)
- 25 species of fleas (Siphonaptera)
- 400 species of butterfly (Lepidoptera) and
- 50 species of Termites

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.

[22] Souhail et al March 2007, International conference on Biodiversity as Renewable resource of Pakistan, University of Arid Agriculture.

Use of Pesticides and Threats to Biodiversity[23]

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, nematicides, rodenticides, etc. are registered in Pakistan. 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.

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. NARC and CABI Bioscience as well as some other firms are implementing many IPM projects in Pakistan. The major on-going projects are:

- Integrated pest management (IPM) 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 has made a lot of efforts for the introduction, research and implementation of IPM projects. Since 2004, Pakistan has committed US$7.7 million in public funds to integrate IPM into public policy, university curricula, provincial extension services and research and development. Projects at both national and provincial level are well on their way to using Farmer Field Schools to train 167 000 farmers in IPM over five years.

In Farmer Field Schools, farmers and facilitators spend one morning in a week during the cropping season in a typical field, observing insect behaviour and plant growth rates. Farmers see that beneficial insects often devour pests, and when this is happening, pesticide is not needed. Farmers, even illiterate ones, gain confidence and begin relying on their own judgement, even in the face of intense pressure from government agents and pesticide sellers to spray frequently and without reference to field ecology. According to Dr Iftikar Ahmad, Head of the National IPM Programme, farmers now are using less pesticide: "Our national data show a dramatic decline in pesticide use in Pakistan. Farmers are making more profit and a government study shows a 10 percent increase in cotton production thanks to IPM." Additional benefits included lower exposure to highly hazardous insecticides, especially for the women who pick most of the cotton by hand. The FAO-EU project supported local women physicians to monitor blood samples from women picking cotton; without IPM, their blood enzyme levels were dangerously reduced for more than a month after field work. With IPM, this did not occur.

The Biodiversity of agro-ecosystems is lower in comparison to less disturbed ecosystems. The use of

[23] Mohyuddin, A.I., 1981, A Review of Biological Control of Insect and Weed Pests in Pakistan, *Proceedings of the 2nd Pakistan Congress on Zoology*, Tandojam, 26-27 December 31-79.

Mohyuddin, A.I., 1989, Report on the Consultancy Visits to Malakand Division for Survey of Fruit and vegetable Pests and Diseases, Malakand Fruit and Vegetable Development Project, Saidu Sharif, Swat.

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 are indicated in **Table 6.2** and **Table 6.3**.

In augmentation, populations of natural enemies are increased by their release at 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

Crop	Pest	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 in areas at Faran Sugar Mills, Tandlianwala Sugar Mills, Jamal Din Wali Sugar Mills, Habib Sugar Mills etc.
	Borers	Introduction of *Cotesia flavipese* Augmentative releases of Trichogramma	Excellent control achieved at Habib Sugar Mills, Faran Sugar Mills, Jamal Din Wali Sugar Mills, Tandlianawala Sugar Mills, Consolidated Sugar Mills. In addition, Bannu Sugar Mills etc.
		Mass releases of eggs of the parasitoids *Telenomusdignus*	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, release 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 *Trichogramma*.	Excellent control of Bollworms
	Sucking pests	Conservation of predators	Excellent control of sucking pests

In conservation, desirable species (natural enemies) are protected or encouraged by the judicious use of insecticides and cultural practices or by providing them shelter. 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.

Table 6.2: Natural Enemies Introduced from Other Countries

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

Chapter 7: Marine Biodiversity

Pakistan's Coastline

Pakistan has a coastline that stretches to over 1050 km, (990 Km measured as a straight line) along the Arabian Sea. It comprises two distinct units, the passive margin of Sindh; and the active margin of the Balochistan coast (Figure 1). The coastal and offshore geology of Pakistan tectonically exhibits both active and passive margin features. The Balochistan coast is active whereas the Sindh coast and Indus deltaic area and offshore Indus basin is geologically passive. The Sindh and Balochistan coasts have different climatic conditions, geographical location and socio- economic factors. The Sindh coast can be further divided into two parts, namely the Indus deltaic coast and the Karachi coast. The coast in the vicinity of Karachi, which is approximately a 70 km stretch, is relatively well developed as compared to the rest of the coast.

The coast of Pakistan consists of sandy beaches located in Sindh and separated by rocky protruding points from each other. The rivers are the predominant source of sediment to the sandy beaches. The Balochistan coast is drained by seasonal rivers Hingol, Basol, Shadi Khor and Dasht. Flash floods are frequent and even during scanty rains, there is erosion of top soil from the uncovered hillsides and muddy banks. The eroded material is deposited along the coast at the mouth of the rivers. The Balochistan coastal region has cliffs, occasionally with rocky headlands, and a number of sandy beaches with shifting sand dunes. The coastal regions of Balochistan consist of coastal lagoons with scanty mangrove patches. The coastal Sindh consist of 17 major and minor creeks in the Indus Delta, which is dominated by mangrove forests.

The Sindh coastal region is located between the Indian borders along Sir Creek on the east to Hub River Bank on the west (320 km). The Indus River drains into the entire lower plain of Sindh. The Indus delta is the most prominent feature of the Sindh coast. The sediments are subjected to coastal dynamic processes, such as tides, winds, waves and currents, leading to accretion and erosion of the Indus deltaic coast. The coastal morphology is characterized by a network of tidal creeks and a number of small islands with sparse mangrove vegetation, mud banks, swamps and lagoons formed as a result of changes in river courses. The present delta covers an area of about 160,000 hectares and is characterized by 17 major creeks and innumerable minor creeks (Fig-7.1), mud flats and fringing mangroves. The delta supports wetlands rich in nature and culture, and also nurtures the largest area of arid climate mangroves receiving an average annual rainfall about 200 mm. Twenty seven percent of this land is under water in the form of creeks and watercourses. These watercourses intervene into the island, these are calm and protected water, and are flushed daily by tides up to 3 meters.

The coast of Karachi is situated between the Cape Monze, a high cliff projecting into the Arabian Sea and the Korangi creek. The coastline of Karachi metropolitan is about 70 km long. It is generally oriented NW-SE. On the western side it is bounded by the Hub River and on the east by the mangrove swamps and creeks of the Port Qasim area. The Layari and Malir rivers are the seasonal streams which flow during South West monsoon. The rain water from Karachi and its adjoining area drains in the Arabian Sea. The prominent feature of Karachi coast is shallow and raised beaches, marine terraces and dune fields. Four major inlets, Manora Channel (Karachi harbour), Korangi creek, Phitti creek, and Khuddi creek, invigorate the coastline. A small crescent shaped sand bar exists at the mouth of the Korangi creek. The shore terraces and sea cliffs are to the west of Hawks bay area. The Cape Monze beach is an example of raised beaches along the coast of Karachi. The eastern coast has tidal creeks with mangrove and mud flats. In the region the seabed is generally smooth. The bed slope has a low gradient and is in the order of 1/500 to 1/1000.

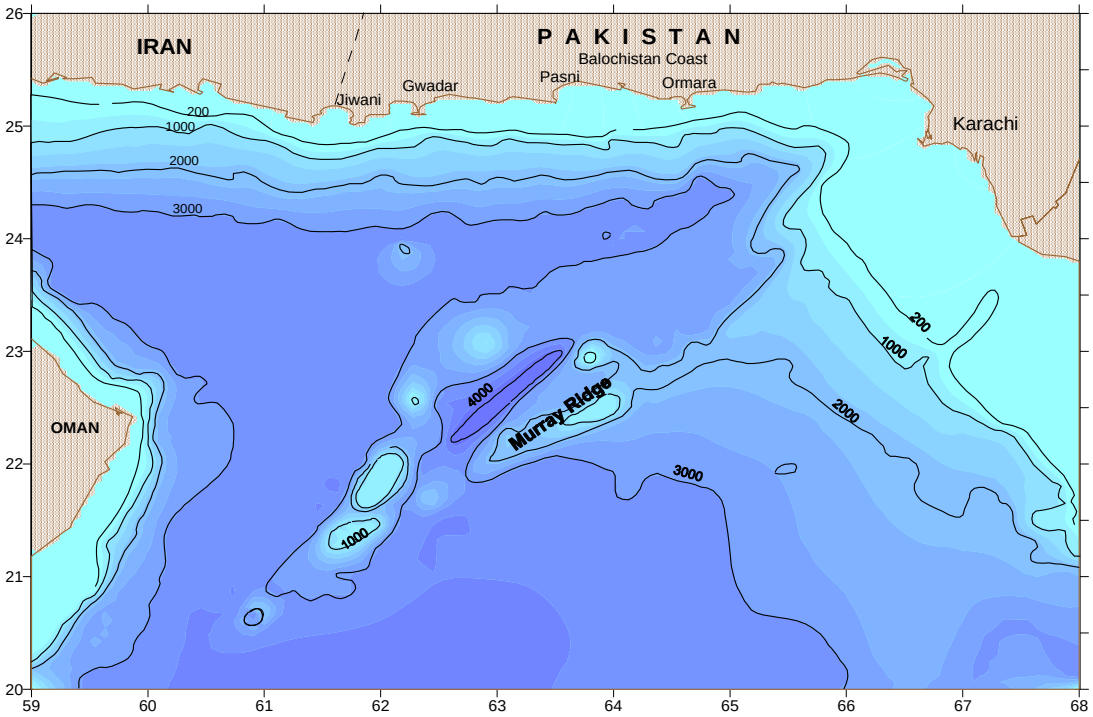

Figure-7.1: Coastal and offshore areas of Pakistan source: NIO

The coast west of Manora breakwater to Buleji consists of sand beaches, (Manora, Sands spit and Hawks bay) rocky protruding points separate these beaches from each other. From Buleji to Cape Monze the coast consists of hard conglomerate and shale cliffs. Beyond Hawks Bay towards west up to the Cape Monze, the unconsolidated sandy clays are exposed to coastal weathering and erosion. The rivers are the predominant sources of sediment to the sandy beaches during the rainy periods. The Clifton beach is largely composed of dark, grey silt material with minute flakes of mica. Further east of Clifton there are agglomerations of Ghizri hills. The coastal areas of Karachi are densely populated. The beaches of Karachi attracting large number of people are a source of recreation for the local inhabitants.

The present Indus delta is located at the head of the Arabian Sea, between Korangi Creek and the Runn of Kutch. The Indus River is the world's sixth largest river; it drains into the north-eastern Arabian Sea forming a large delta. The river discharges nutrient rich sediment load that has a great influence on the marine life of the Indus Estuary and the near shore areas. During the prehistoric times i.e., 5000-6000 years B.C. the delta has protruded 150 km at the rate of 30 m/year to the present position. Fan shaped deltaic complex spread over an area of about 30,000 sq. km. The deltaic complex is comprised of abandoned, active and sub aqueous parts of the delta and river flood plains. With the changes in the river discharge, the present active delta has consequently shrunk to a small triangular area of about 120 sq km stretches in the vicinity of Keti Bandar. The whole area presents a peculiar geomorphology of mud banks, swamps, lagoons and sand dunes. The soil cover in the deltaic area is of drift type made up of altered material transported by rivers. The Indus delta has been found changing its fluvial characteristics due to damming upstream, which has reduced river borne sediments. This has resulted in drying up of the estuaries and has induced sea encroachment further inland.

The Balochistan coast extends from the mouth of the Hub River in the east to the middle of Gwadar Bay in the west and stretches over a distance of about 660 km. The Balochistan coast along Makran and Lasbella districts is an arid coast, owing to scanty rainfall and highly saline soil. The Balochistan coast has almost entirely desert like condition with only 150-mm/year of rainfall. This region has cliffs mingled with rocky headlands and a number of sandy beaches with shifting sand dunes. The region of creeks and coastal lagoon is marshy with scanty mangrove patches.

Principal geomorphic features of the Balochistan/Makran coast are cliffs, headlands, and mud volcanoes. Rocks exposed along the coast are the assemblages of sandstone, shale and mudstone. The mountains are composed of bare rocky limestone or conglomerate, with the exception of some upper highlands with a little or no vegetation. The coastline faces considerable erosion. Owing to shortage of promontories and sheltered areas, most of the littoral material is lost to the sea. Spectacular mud volcanoes are found in several locations along the Makran coast where gas-charged water escapes to the surface.

The prominent coastal areas of Pakistan can be classified as:

Tidal lagoons (a) Miani Hor (b) Kalmat Khor

Sheltered Bays a) Hawks Bay, b) Gadani Bay,
c) Sonmiani Bay, d) Ormara Bay (east and west),
e) Pasni Bay, f) Gwadar Bay (east and west),
g) Gwatar Bay

Seasonal Rivers a) Hub River b) Basol River c) Hingol River
d) Shadi Kaur, e) Dasht River, f) Porali River,
g) Windar River

Other coastal features of Sindh and Makran coast include small-inhabited and uninhabited islands

Geologically offshore the Balochistan coast has a sub-duction plate as a result the coast is reportedly rising. Due to seismic activity the Balochistan coast has been experiencing minor earthquakes. Epicentres of these earthquakes occur along the Balochistan offshore areas. This tectonic activity has produced many mud volcanoes along the coast as a result gas charged water escapes to the surface opening of the volcanoes. The Makran coastal belt extends 50-100 km inland from the coast. It is formed of thick moderately deformed mid-Miocene to mid-Pliocene basin plain, slope and shelf sediments. In addition, as a result of recent uplift, under-formed upper Pliocene and quaternary sediments occur in places near the coast.

Important Marine Species and their Status

The information on taxonomic assessment of marine fauna and flora is discrete and not readily available. A large number of coastal species had been identified and yet but the work done so far is inadequate to cover the entire range of biodiversity in Pakistan's marine areas. The studies done so far cover the species diversity of the rocky, muddy and sandy shores. According to the reports available, gastropods dominate the rocky shore fauna followed by decapods crustaceans and polycheate worms. A list of the fauna of the beaches of Pakistan is available as a supplement prepared by the Zoological Survey of Pakistan (1973).

The wetlands of Pakistan along Sindh and Balochistan coasts, harbour mangrove ecosystems rich in biodiversity. The wetlands are of great ecological and economic significance. There is substantial information available on the mangroves of Pakistan. Over 48 species of macro fauna were reported from mangrove forests along the coast of Pakistan. The fauna consist of several species of crabs, polychaetes, molluscs etc.

A number of workshops have been organized by the Government agencies like Sindh Wildlife Department and other organizations including NGOs on protection and promotion of Mangrove forests on the coastal areas. 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. However, 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*), considered

to be a delicacy, is an anadromous[24] fish that swims up the Indus River to breed. However, it can no longer migrate up the Indus River due to the construction of a number of dams, 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)*.

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 from this area.

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

Table 7.1: Threats to Marine Ecosystem

Problem/Issue	Management Strategies
Mangrove deterioration • Hyper salinity • Overexploitation • Pollution • Soil erosion	Increased flow of the Indus • Reforestation • Ban on 'Katra[25]' nets • Regulate harvesting • Strict adherence to NEQs • Assessment of annual loss
Pollution • Industrial • Eutrophication • Sewage • Oil • Agriculture • Toxic waste • Thermal • Radioactive	• 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 • Soil erosion • Hyper salinity	• Restoration of flow • Strict adherence to NEQs • Decrease silt deposition
Threats to Biodiversity • Disappearance of species • Loss of sanctuaries	• Improved habitat • Reintroduction of extinct species • Marine parks • Eco-tourism
Urbanisation • Dredging • Channelisation • Solid wastes	• Regulation of coastal development • Dumping of dredged material far away • Reforestation
Rising sea level • Loss of land and biota • Economic losses	• Estimation of accretion and sea-level rise • Conservation of mangroves
Socio-economic aspect • Poverty • Illiteracy • Lack of municipal facility	• Socio-economic uplift of fishermen • Education • Alternative livelihoods • Marine parks • Apiculture • Mariculture
Lack of public awareness and people participation	• Participation of locals in all coastal matters • Education through mass media
Lack of harmonisation and enforcement of legislation	• Central, provincial and local government co-operation • Penalties

Source: Saifullah, S.M. University of Karachi

The mass transport of chemicals within sediments is affected by the physical structure of the sediments (particle size, shape, density, cohesion, bed roughness, porosity, and stratification), the current regime, and shear stress of the overlying water on the sediments, bio-irrigation, and bio-turbation. Benthic animals move particles and water vertically, and larger animals move more sediment and pump more water. Benthic animals transport contaminants to the overlying water by mixing sediments vertically and by irrigating their burrows. The marine fauna can also increase the sediment burden of contaminants by deep mixing of pollutant bearing particles.

The micro-, meio- and macro-benthos that reside in surface and deeper sediments significantly impact the major ecological processes. Benthic organisms contribute in the regulation of carbon,

[25] Fine gauge nets that catch small fish

nitrogen, and sulphur cycling, water column processes, pollutant distribution and fate, secondary production, and transport and stability of sediments. Tubes of animals (e.g. Ampeliscid amphipods) and mucous (e.g. motile gastropods) bind particles and stabilize sediments. Thus, destabilizing effects of bioturbation, stabilizing effects of mucous binding, and variable effects of biological sediment redistribution and alteration of bottom roughness influence sediment erosion.

Sediments ranging from gravel to fine mud make the largest habitat in area coverage. Some sediment is uniform in grain size distribution, while others are constituted of mixed particles. On the other hand, sediment also varies in their origin; they may be of biological or geological origins. Sedimentation rate impacts on coastal ecology, circulation and geology (e.g. beach erosion) and elevated nutrients in coastal oceans may lead to algal blooms and associated hypoxia, changes in benthic community makeup, and thus coastal habitat and ecosystem.

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

Invasive or introduced species

Ballast water Cargo ships normally use seawater to provide ballast. At source port it fills in the seawater while discharging the cargo. At the destination port it discharges the ballast water. There are thousands of marine species that may be carried in ships' ballast water. This may include anything that is small enough to pass through a ship's ballast water intake ports and pumps. These organisms include bacteria and other microbes, small invertebrates and the eggs, cysts and larvae of various species. The problem is compounded by the fact that virtually all marine species have life cycles that include a plank tonic stage or stages. It is fortunate that a vast majority of marine species carried in ballast water do not survive the journey, as the ballasting and de-ballasting cycle and the environment inside ballast tanks can be quite hostile to organism's survival. Even for those that do survive a voyage and are discharged, the chance of surviving in the new environmental conditions are generally low, particularly where predation by and/or competition from native species further reduces the chances of survival. However, when all factors are favourable, an introduced species may survive to establish a reproductive population in the host environment, it may even become invasive, out-competing native species and multiplying into pest proportions. As a result, this factor imposes problems on the whole ecosystems and the community composition begins to change. It is estimated that at least 7,000 different species are being carried in ships' ballast tanks around the world.

Pakistan needs to start a program to monitor ballast water for possible invasive species. The Karachi Port Trust (KPT) authority Karachi has started such a program and efforts are planned to meet the international obligations in this regard. Ports in Pakistan should have proper receptacles for collecting ballast water as required under "Guidelines for the control and management of ships' ballast water, to minimize the transfer of harmful aquatic organisms and pathogens". Guidelines were adopted by the International Maritime Agency IMO Assembly in 1997, by resolution A.868 (20) of the GEF/UNDP/IMO Global Ballast Water Management Programme (GloBallast).

It has been reported by the Karachi Port Trust KPT that among flora, the dinoflagellates, diatoms and Algal spores of the blue green algae may be transported through the Ballast water. Among fauna, the planktonic life forms of Crustaceans copepods, barnacles, crabs etc have the tendency to be transferred from one place to another. According to some studies, Ctenophores and Cnidarians are

more opportunistic to transfer from one place to another place through ballast water. KPT reports that it is in contact with the Ministry of Science and Technology through Ministry of Ports and Shipping for participation in a program for Alien Invasive Species.

Box 11: Marine Turtle Conservation[26]

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 lying on the beaches of [27] 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 egg-laying 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 metal tags on both front flippers. Each tag carries "W" as a code for Pakistan with the return addresses 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 genus 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 and aware them about the conservation of this species and the protection of our natural heritage.

Hawks Bay and Sands Pit beaches are among the major 11 turtle nesting beaches of the world and thus conservation activities here are viewed from a global perspective by the International Community. Two globally threatened species of marine turtle species viz: Green turtle *Chelonia mydas* and Olive Ridley Turtle (*Lepidochelys olicvacea*) visit the Sandspit and Hawk's bay area of Karachi. Karachi Port Trust has allocated a piece of land to Sindh Wildlife Department (SWD) at SandsPit area where a hatchlings nursery has been established to protect hatchlings from the predators. The marine turtles are protected under the Sindh Wildlife Protection Ordinance 1972 and the department is actively involved in protection and conservation. Regulations have been enforced by KPT on area users and hut owners to provide conditions to facilitate turtle nesting. The backwaters of KPT were the home ground of the small cetaceans and dugongs. They can be restored through improvement in the backwaters.

[26] Case Study prepared by Dr. Fehmida Firdaus Sindh Wildlife Department Karachi

Box 12: Mangrove Ecosystem

Realizing the importance of mangroves and the need to promote their ecological and economical significance, the Karachi Port Trust KPT has developed partnerships with various organizations. In 1990s KPT worked with IUCN on the reforestation project at Sandspit back waters. In late 1990s, KPT assigned a piece of land to WWF in the middle of mangrove forests at Sandspit to establish a Wetland Center. The centre has since been established and functioning well. The main objective of this center is to create awareness about living coastal resources including mangroves. At least 1000 mangrove saplings are planted each year to make up for losses suffered earlier by the mangrove forests in the area.

In 2001-2002 KPT embarked upon a project "Restoration of mangroves in China Creek". Further, in 2003-2004 KPT developed a working partnership with local CBOs with financial assistance from UNDP-SGP for the mangrove conservation at China Creek. The project had to be aborted after a year but KPT continued its mangrove restoration plan of China Creek through its resources.

In January 2006, the Marine Pollution Control Department of KPT started work on rehabilitation of Mangroves in China Creek. Under this project, an area of about 10 hectares was selected for the direct sowing of *Rhizophora mucronata*. Three thousand saplings were sown by direct sowing methods and 40 % survival has been achieved.

Both eastern and western backwaters of Karachi Harbor have sizable mangrove areas (approximately 1000 hectares) facing tremendous population pressure. Out of the 8 species that were found in the area a few decades back, now there are only few species like *Avicennia marina* and *Rhizophora mucronata*.

The only Protected Area in Pakistan that has some marine areas is the Hingol National Park in the boundaries of which are included coastal waters. IUCN-P is working in collaboration with various governmental and non-governmental organizations to get 10 % of the marine areas declared as protected under the Global 2010 Biodiversity Targets.

Institutional arrangements

There is a need of better coordination between the various agencies dealing with marine fisheries; such as the Ministry of Food, Agriculture and Livestock (MINFAL) which is controlled through the Marine Fisheries Department, the Fisheries Development Commission, the Sindh Wildlife and Fisheries Departments and the Ministry of Environment. The Fishermen Co-operative Society, Karachi, looks after the fishermen's interests.

IUCN Pakistan along with other governmental agencies is making efforts to prepare the Integrated Marine and Coastal Zone Management (ICZM) Plan. Amongst the actions taken to improve the scientific knowledge in Pakistan's marine biodiversity are: 1994 Integrated Coastal Zone Management (ICZM) Workshop jointly organized by UNESCO Intergovernmental Oceanographic Commission and the National Institute of Oceanography, Karachi, workshop on Coastal Zone Management and Environmental Impact Assessment held at the British Council, Karachi 1998. Center of Excellence in Marine Biology initiated a short course on Coastal Zone Management in 2004. A draft document 'Coastal Environmental Management Plan' prepared by Economic and Social Commission for Asia and the Pacific, is also available. The WWF Scientific Committee has also funded some small projects on marine biodiversity. The latest initiative of the Ministry of Food Agriculture and Livestock (MINFAL) in preparing the National Fisheries Policy 2006 through a wide consultative process with the financial assistance of FAO is expected to have a holistic approach in this sector.

The port authorities like Karachi Port Trust (KPT) and Port Qasim Authority (PQA) have some officers who have acquired skills in ICZM at International Universities under UNCTAD training programs.

Chapter 8: Freshwater Biodiversity

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**.

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.

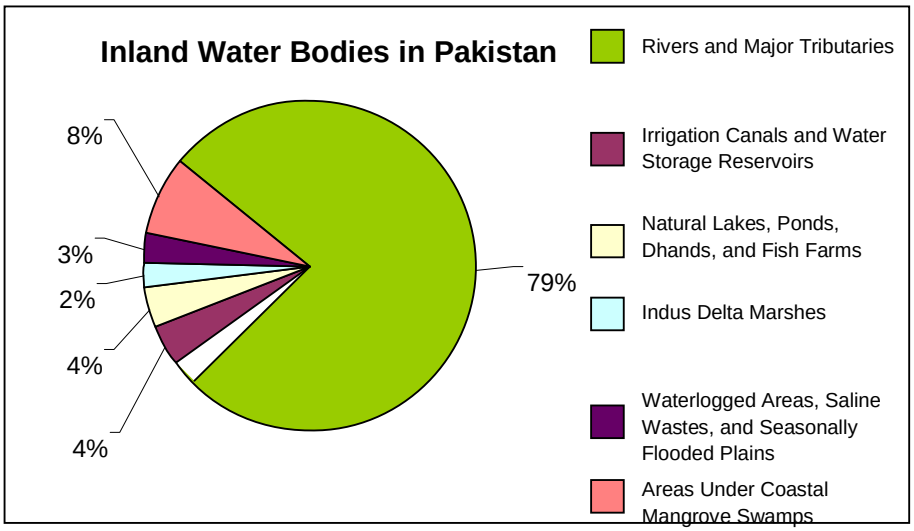

Figure 8.1 Inland Water Bodies in Pakistan

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 Sukkur 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 and several others 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.

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 South 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).

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.

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.

Fish Distribution and Temperature Zones

The temperature-related distribution of fish and other aquatic organisms, distinguishing cold water fish from warm water fish is very clear in Pakistan. 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 species 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 species 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.

Endemic Species

A total of 32 fish species and sub-species are known to be endemic to Pakistan. These are not yet recognised as endangered at the national level. However, at least two of them are 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 *Tenualosa 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. It has been observed in past that blind dolphins had been strangled to death in the fish ladder of Chashma Barrage and other such places. 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.

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. Alien invasive species remain, however the biggest threat to freshwater biodiversity (please see chapter 8 for details).

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 thereby eliminating the chances of survival of non commercial species. Many fish seedling nurseries have also been established in the private sector.

Alien Invasive Species

A major threat to the fresh water ecosystems has emerged lately with the large scale infestation of fresh waters with alien aquatic species that are highly invasive. Due to the extent of the problem and availability of literature freshwater alien invasives have been discussed in more detail, please see chapter 14 of this book.

Freshwater Biodiversity Conservation

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 plan, focuses on aquaculture and does not refer to the conservation of indigenous aquatic Biodiversity.

Strategies and Policies

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 Ministry of Food Agriculture and Livestock after wide consultations prepared the National Fisheries Policy 2006 that encompasses all the physico-social aspects for better management of the fisheries sector. The Pakistan Wetlands project under implementation by the MOE and WWF envisages the promotion of wise use of wetlands.

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.

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.

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 1998 at Chashma Barrage, where it was also reported for the first time that dolphins occur upstream the Chashma Barrage as well.

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.

Chapter 9: Agricultural Biodiversity

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. Hybrid 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.

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**).

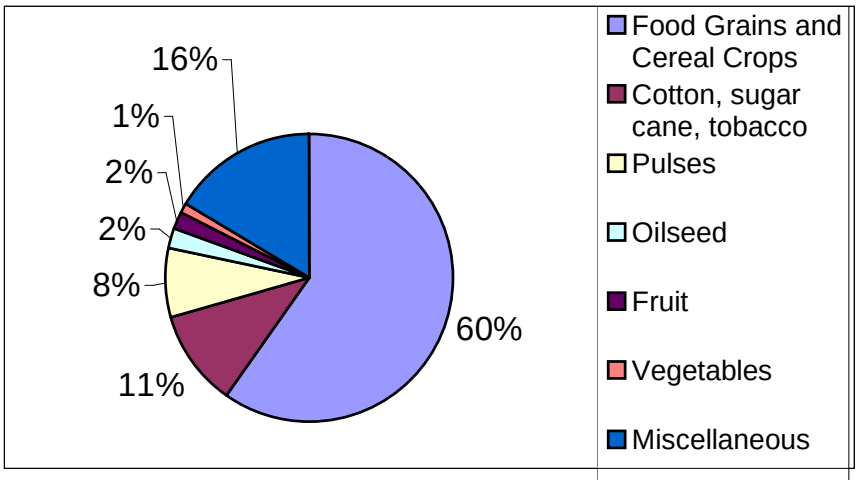

Figure 9.1: Agricultural Profile of Pakistan

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

Crop Genetic Diversity

Pakistan lies in close proximity to the four major centres of Biodiversity.[28] Further, the diversity in agro-climatic regions, crops, agricultural systems and farming cultures make this region rich in agro-

28 Hawkes (1983) has described eight centers of biodiversity of cultivated plants. These centers are in China, Indo-Malaya, Central Asia, the Near East, the Mediterranean, Abyssinia, and South America. These are the centers where maximum plant variability exists or most of the plants have originated in these centers. 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.

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, Bitter gourd
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: Dr. Zahoor Ahmad, Plant Genetics Resource Institute, 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 a-biotic 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**[29]. There are no projects for the *in-situ* conservation and promotion of cultivation of the wild relatives of these crops.

Table 9.2: Wild Relatives of Crop Plants in Pakistan

Common Name	Scientific Name	Distribution in Pakistan
Wild relative of wheat	*Aegilops squarossus*	Mountain areas of Northern Pakistan
	Aegilops triuncialis	Mountain areas of Northern Pakistan
Wild relative of wheat	*Elymus borianum*	Endemic to Swat
	Elymus kuramensis	Endemic to Kurram
	Elymus nodosus	Kurram
	Elymus stewarti	Endemic to Kashmir
	Elymus longe aristatus	High alpine areas of Hindukush Himalayas and Karakorum
	Elymus russelii	Endemic to Karakorum
	Elymus jacquemontii	Endemic to Kashmir
Wild relatives of barley	*Hordeum bogdanii*	Karakorum, Ziarat, and Harboi Range
	Hordeum spontaneum	North Balochistan
	Hordeum murinum	NWFP, Murree Hills
	Oryza coarctata	Indus Delta
	Sorghum nitidum	Hazara and Murree Hill tract
	Sorghum halepense	Common weed throughout the country
Wild relatives of millet	*Pennisetum flaccidum*	High alpine slopes of Karakorum, Himalayas, Hindukush

29 Ahmad, Zahoor, 1998, The Diversity of (Minor) Fruit Crops and Wild Relatives in the Mountain Areas of Pakistan, in T. Partap, and B. S. Thapit (eds.) Managing Agro-biodiversity, ICIMOD, Kathmandu, pp.235-240

Common Name	Scientific Name	Distribution in Pakistan
Wild relative of cotton	*Gossypium stocksii*	South Sindh
Wild relatives of mustard	*Brassica junacea*	Western area of Balochistan
	Brassica deflexa	Western part of North Balochistan
Wild relatives of kenaf	*Hibiscus caesius*	North Punjab, NWFP, Kashmir
	Hibiscus micranthus	Sindh and Balochistan
	Hibiscus lobatus	Salt Range, Kurram Valley, Sindh
Wild relatives of chick pea	*Cicer macranthum*	Hindukush, -Himalayas,-Karakorum
	Cicer microphyllum	Hindukush, -Himalayas,-Karakorum
Wild relatives of bean	*Vigna spp*	
Wild relatives of fruits	*Pyrus pashia*	Temperate Himalayas
	Mallus chitralensis	Chitral
	Prunus prostrata	Temperate Himalayas
Wild almond	*Amygdalus brahuicus*	North Balochistan
Wild cherry	*Cerrasus rechingeri*	North Balochistan
Wild relatives of grapes	*Vitis jacquemontii*	Himalayas
Pomegranate	*Punica granatum*	Foothill Himalayas
Wild relative of olive	*Olea ferruginea*	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**.

Crop Biodiversity

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.

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 in conventional food legumes, chickpea, lentil, and

mung.

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.

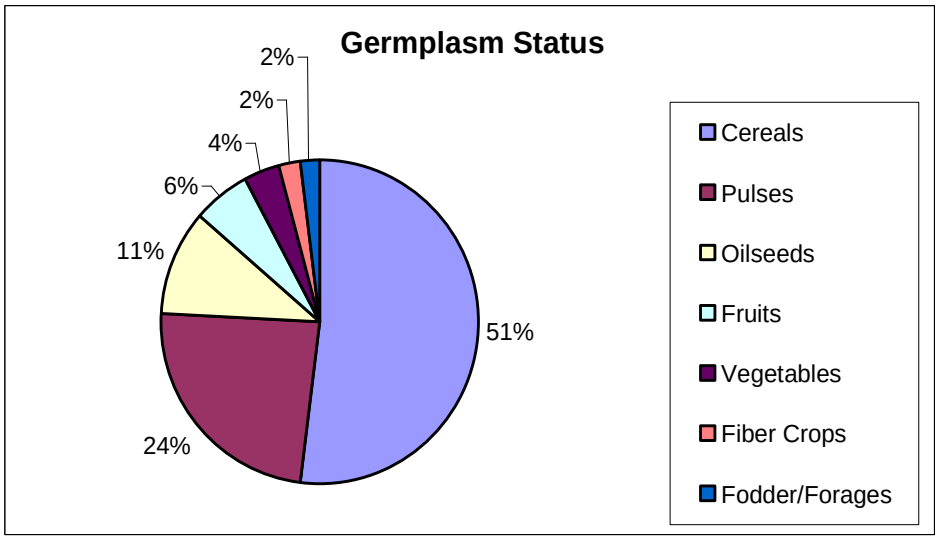

Figure 9.2: Germplasm Composition at the NARC National Gene Bank Pakistan

All the mangoes grown in Pakistan are mono-embryonic. 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.

Changes in Food Habits[30] 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 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.

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.

The Conservation of Crop Biodiversity

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.

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[30] The authors made a literature review 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 book.

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.

Ex-situ Collections

Plant collecting expeditions by the scientists of NARC numbering to 28 were able to collect and conserve 18,000 samples of different crops at the PGRI.

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.

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.

Chapter 10: Livestock Biodiversity

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 goats, one of horse, four of camels and three indigenous breeds of poultry. Wild relatives of cattle are not known (Table 10.1). The urial is believed to be the wild relative of 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 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**.

Important breeds of Cattle [31]

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

[31] W.A. Pirzada, 1998, The Diversity of Mountain Farm Animals Resources and Conservation Concerns in Pakistan, in T. Partab and B. Athapit (eds.) *Managing Agro-biodiversity*, ICIMOD, Nepal, pp.208-296

they have interbred with Kankrej, red Sindhi, 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 strong 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 can 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 found at Malir outside Karachi, Hyderabad and Lasbella 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. 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 660-770 lbs and the female 500-600 lbs. 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. Females weigh 770-900 lbs, have a medium-sized udder and are good milk producers. Kankrej bullocks are prized as fast and powerful draught animals. Adult males weigh 1100-1450 lbs. As both good milk producers and strong workers, Kankrej cattle serve a dual purpose.

Breeds of Goats and Sheep

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**.

Horses

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 are:

- **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.

Camels

Camels are widely used for draught animal and for 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 hardy and docile. Breeds of this category are 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 Thall and Bahawalpur.

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.

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*. 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 forms the basis to judge 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

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.[32] The lack of incentives for farmers to conserve the local breeds is the other factor that threatens the local breeds.

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 T**able 10.2**. The case study given in **Box 13** gives details of the activities undertaken for the conservation of the local breeds.

The Government of Pakistan is also conscious of the need for preserving local poultry breeds. A four-year project (1999-2004) entitled "Selection and Breeding of the Indigenous Poultry Breeds in Punjab" has been executed with a total cost of Rs. 8 million. The project envisaged the procurement of local poultry breeds and rearing them scientifically. Final objective was to redistribute vaccinated poultry. The project also intended to find and encourage the Kashmiri *desi* breed.[33]

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 field[34] 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.

[32] Personal communication with Dr. Hasan Aziz Javed, Director Livestock, Livestock Department, Government of the Punjab, Lahore, 1999 for the preparation of the First National Report.

[34] Personal interview by the authors (Dr. Aslam Malik and Syed Mahmood Nasir) 1999. 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.

Box 13: The Ghulaman Livestock Experiment Station[35]

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 have 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 Thall 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

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

[35] Based on case study conducted for the preparation of the First National Report 1999.

Table 10.2 List of Institutions working for the conservation of the local breeds of cattle

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 Bhuinkey	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
	Shergarh 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 Sindhi 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

Chapter 11: Genetic Biodiversity

Pakistan is a country with diverse geographic and climatic conditions. High mountains, deserts, plateaux, 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 spoilt by the evils of environmental pollution. These regions are likely to have unique indigenous texa including microbes.

Conservation and Institutional Arrangements

In Pakistan, MoE serves as the focal point for Biosafety and the Cartagena Protocol on Bio-safety. It has set up a National Biosafety Committee. The National Institute for Biotechnology and Genetic Engineering (NIBGE)[36] has 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. The Biosafety Guidelines 2005 have been notified by the MoE under the Pakistan Environmental Protection Act 1997. The Guidelines propose a three-tier system to meet this bio-safety requirement, i.e. the implementation of bio-safety practices in genetic engineering and biotechnological work. The institutional bio-safety 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.

The Federal Seed Certification Department under the Ministry of Food, Agriculture and Livestock after wide consultations with all stakeholders has prepared the Farm Breeders rights Act' that includes provisions for the ban on terminator seed. Pakistan has also acceded to the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRA) that provides for procedures for the exchange of genetic material of cereal crops.

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. 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.

Table 11.1: Institutions Involved in Genetic Engineering Research and Biotechnology

Area	Institutions
Tissue Culture	Quaid-i-Azam University Islamabad (QAU), 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), CAMB Punjab University. (Lahore) CRI, Cotton Research Institute (Multan)
Environment	
Pesticides	HEJ (Karachi), PCSIR (Lahore)
Air Pollution	NIBGE (Faisalabad), PCSIR (Lahore)
Toxic Effluents of Industries	Quaid-i-Azam University Islamabad (QAU), PINSTECH (Islamabad),Cell and Molecular Biology Laboratory Department of Zoology Punjab University (Lahore), NIBGE (Faisalabad), PCSIR (Lahore), Centre for Molecular Genetics, Karachi University
Industry	

[36] NIBGE, Voluntary Code of Conduct for the Release of Organisms into the Environment, Faisalabad

Area	Institutions
Fermentation	PCSIR (Lahore), NIBGE (Faisalabad)
Bio fuel	Department of Biological Sciences, QAU (Islamabad), NIBGE (Faisalabad), PCSIR (Lahore)
Health	
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	Quaid-i-Azam University, Islamabad, Dr. A.Q. Khan Research Laboratories (Islamabad)
Animal	
Livestock	NARC (Islamabad)
Vaccines	NIH (Islamabad), HEJ (Karachi), SPVC (Karachi), VRI (Lahore)

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 that have now been applied at the farm level. The NARC has extracted bio-fertilisers from algae like Azolla. The HEJ Institute of Chemistry, Karachi and the PCSIR laboratories, Lahore, have 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.

Threats[37]

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 bio-safety 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.

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. On the other hand these new technologies carry a lot of potential in increasing the food production for the rapidly rising population and also carry the promises of reducing the costs of agricultural inputs.

[37] Nasim, A., 1997, Plant Biotechnology in Pakistan, Country Report presented at Asia-Pacific Workshop on Biosafety Environmental Impact Analysis of Transgenic Plants, held at M.S. Swaminathan Research Foundation.
Nasim, A., 50 Years of Biotechnology in Pakistan, Paper presented at 22nd International Nathiagali Summer College on Physics and Contemporary Needs, Nathiagali

Chapter 12: Access and Benefit Sharing of Biological Resources

Introduction

Since time immemorial, communities have traditionally used plants and animals for their livelihood this included collection, growing, and raising varieties of food crops, livestock, and medicinal plants. The value of these genetic resources and the associated traditional knowledge has attracted a lot of attention in recent years especially after the Rio summit of 1992 in which the Convention of Biological Diversity (CBD) was negotiated and adopted by most of the countries. The CBD came into force in 1993and has three objectives i.e. conservation, sustainable use and equitable sharing of the benefits arising from the utilization of genetic resources and associated traditional knowledge. As a result of the intergovernmental negotiations the national governments became the legal owners of genetic resources and associated traditional knowledge and countries started to develop policies and legal instruments to protect, promote and mange them.

The challenge however, remains how to convert these resources and the associated knowledge into modern economic wealth in an ecologically sustainable and socially equitable manner. In the pre-CBD era access to genetic resources and the associated traditional knowledge was considered freely available to all. The multinational pharmaceutical industry takes the lion's share of the profits. The issue of access and benefit sharing remained under intense negotiation (and still are under the aegis of the CBD Working Groups) the Bonn Guidelines on access and benefit sharing were adopted as voluntary guidelines by the CBD after extensive negotiations.

Article 8 (j) and Article 15 are the two main Articles of the CBD that deal with the issue of traditional knowledge, indigenous communities, and access and benefit sharing respectively. Article 15 provides the framework for national governments to implement ABS mechanisms that regulate and protect knowledge and genetic resources, and facilitates access in a way that ensures fair and equitable benefit sharing out of these resources. Bonn Guidelines **BG** were adopted in the sixth Conference of Parties 2002 at Kula Lumpur, Malaysia. BG address Prior Informed Consent **PIC** of the holders of traditional knowledge for all bio-prospecting activities, that has to be on mutually agreed terms **MAT** and mechanisms for equitable sharing of the benefits.

There are no exact estimates of the market value of the commercial products that are derived from biological resources/ traditional knowledge—one estimate puts the vouched value at 500 to 600 billion US $. The Australian Asia-Pacific Economic Cooperation (APEC) Study Centre has put up its analysis on the potential negative impacts of ABS on the industry due to the reasons discussed above and highlights possible benefits that may accrue to the indigenous communities on business as usual basis. The other divergent view is held by the mega-diverse countries led by India and Brazil that insist on having the international regime on Access to biological Resources and Benefit Sharing (ABS) with compulsory certificate of origin with all patent applications of new products/ inventions that are derived from Traditional Knowledge (TK). Pakistan has the opportunity to devise its national policies on ABS keeping in view the international scenario. The Biodiversity Working Group constituted by the Ministry of Environment is the relevant forum to consider all the policy options

Key concepts and definitions

For a better understanding of the terms used in all documents related to this subject it is proposed that appendix H may be viewed for key concepts and definitions. These definitions are mainly reproduced from the text of the CBD and are agreed by the parties to the CBD after lengthy negotiations. The following Articles deal with the issues related to the third aim (equitable benefit sharing) of the CBD:

Article 8 (j)

States that parties will, subject to national legislation, respect, preserve and maintain knowledge, innovations and practices of indigenous and local communities embodying traditional lifestyles relevant for the conservation and sustainable use of biodiversity promote their wider application

with the approval and involvement of knowledge holders; and encourage the equitable sharing of benefits arising from the utilization of such knowledge.

Article 10 (c)

This Article addresses the customary use of biological resources in accordance with traditional cultural practices, support the local populations to develop and implement remedial actions in degraded areas and encourage cooperation between the government agencies and the private sector for developing methods for sustainable use of biological resources.

Article 17.2

This Article addresses the facilitation of the exchange of information including the indigenous and traditional knowledge

Article 18.4

This Article addresses the promotion of international technical cooperation in the field of conservation and sustainable use including traditional and indigenous technologies.

Article 15

According to this Article each contracting party shall endeavor to create conditions to facilitate access to genetic resources for use by other parties and not to impose restrictions counter to the objectives of the CBD. The access to the genetic resources shall be on mutually agreed terms (MAT) and subject to prior informed consent (PIC) of the contracting parties. The commercial benefits arising from genetic resources shall be shared in a fair and equitable way on mutually agreed terms (MAT).

Article 16.3

Each party shall take legislative and other measures for access to genetic resources and transfer of technology including technology protected by patents and other intellectual property rights on MAT.

Article 19

Promotion and advance priority access on a fair and equitable basis the results and benefits arising from biotechnology based on genetic resources. The Cartagena Protocol on Bio-safety to which Pakistan is a signatory deals in detail the issues related to this Article of the CBD.

Towards a Global Treaty on Access and Benefit Sharing

The negotiations for a legally binding international regime for ABS are hot issues and are under negotiations under the CBD Working Groups on Article 8 j and on Access and Benefit sharing. The other intergovernmental processes where these issues are under intense negotiations are the WIPO committee on Genetic resources, TK, folklore, the TRIPs agreement under the WTO the complimentary ITPGRFA, UPOV, The WSSD under the sustainable development provisions ABS is considered as a tool for poverty alleviation and environmental sustainability through monetary and non-monetary benefits that can be gained in exchange for access to potentially valuable resources.

The global negotiations for drafting a legally binding law on Access and Benefit Sharing continue even a decade after the entry into force of the convention. A critical view on these negotiations gives a clear impression that the developed North with the financial interests of the multinationals favors a status quo. While the developing countries with a degree of variation in their respective national interests and level of awareness do push for having a law in place that safeguards the interests of the nation states as well as the indigenous communities residing therein.

While it is easier to define the indigenous groups, TK is a bit difficult to define and document. Traditional knowledge (TK) generally refers to the traditions and practices of local communities it also encompasses their wisdom, knowledge, and teachings. Traditional knowledge has been orally passed for generations. Some forms of traditional knowledge are expressed through stories, folklore and rituals and folklore and even music and laws. Other forms of traditional knowledge are often expressed through different means. Indigenous and local communities often do not have the tradition of ownership over knowledge that resembles the modern forms under the realm of intellectual

property rights.

At the international level attention has been diverted and has turned to intellectual property laws in order to preserve, protect, and promote traditional knowledge under the aim of equitable benefit sharing. The Convention on Biological Diversity (CBD) recognized the value of traditional knowledge in protecting species and ecosystems. It soon became apparent that implementing these provisions would require that international intellectual property agreements would need to be revised to accommodate them.

The gist of the deliberations on traditional knowledge at the World Intellectual Property Organization (WIPO) and the Convention on Biological Diversity (CBD) is that the development of any policies, laws or regulations on traditional knowledge must involve the full and effective participation of indigenous and local communities. Another point is that the access to traditional knowledge and genetic resources can only be obtained through the prior informed consent (PIC) of indigenous and local communities. And that the indigenous and local communities have the right to determine the parameters of benefit sharing, and use by others; it could proceed on the basis of mutually agreeable terms between the holders of knowledge and resources and those who seek commercial benefits out of traditional knowledge.

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;

This aspect of the CBD has not yet been fully addressed in Pakistan. However, The Biodiversity Action Plan (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. In Pakistan some work has been done in the Ministry of Environment by the establishment of a Biodiversity Working Group 2006. However many countries have clear definitions of indigenous groups and their traditional knowledge, there is a need to consider on nationally agreed definitions in Pakistan

The Sustainable development Policy institute SDPI has implemented a project entitled "Farmer's Rights to Access and Benefit-Sharing from Plant Genetic Resources' This is a South Asia regional initiative carried out through the South Asia Watch on Trade Economics and Environment (SAWTEE) network of which SDPI is a member. This is a six-year program, (comprising of two phases of three years each) funded by the Ford Foundation, NOVIB and Action Aid Asia. Various studies conducted in this program primarily focus on raising the level of debate on issues related to the protection and promotion of farmers' rights in the WTO era at the level of civil society, public sector, and policy makers and conducting research on vital issues. These studies analyze the possible opportunities for, and threats within the multilateral trading system to farmers of the Hindukush-Himalaya (HKH) region. During the first phase, SDPI produced 12 briefing papers, two research reports and an online database of medicinal plants found in Pakistan.

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 SUNGI[38] have been advocating that the revenues earned by the state from forest harvesting in the high hills should be shared with the local population.

[38] 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.

The Draft Biodiversity Act 2006 on Access and Benefit Sharing

Pakistan prepared its National Biodiversity Action Plan (BAP) during 2000. Pakistan also prepared and sent its three National Reports to the CBD Secretariat. Section 4.11 of BAP on ABS briefly touches Article 15 and 19 of the Convention; however the quintessential Article 8 j has not been touched. This could be attributed to lack of capacity, awareness and technical know how on the issue at the time of preparation of Biodiversity Action Plan.

Another important activity that directly relates to ABS is the formation of the Biodiversity Working Group (BWG) in the Ministry of Environment that had been successful in preparing the first draft ABS Law for Pakistan. Composition of the BWG comprising of 34 members shows that efforts have been made to include all relevant stakeholders. The Draft Pakistan Biodiversity Law 2005 was prepared by a sub-committee comprising of experts. However, with the establishment of a full time Directorate of Biodiversity within the Ministry of Environment' its capacities increased tremendously. The draft law was circulated to all stakeholders and many inadequacies were identified. These are summarized in the following lines:

The Bonn Guidelines have been altogether been ignored, ii) While there are adequate provisions on procedures for access to genetic resources there is no provision on the safeguard of traditional Knowledge related with biological conservation (TK), iii) sharing of benefits with the holders of TK, iv) There is no clarity on who the indigenous communities are and how the benefits would be shared, v) There is no reference to the Patent laws of Pakistan, vi) Definitions of the basic terms are altogether missing, vii) There is no provision on who will be responsible for the implementation of what, viii) No penalties for violators of the provisions of the Act are provided.

Box 14: The Cycle of Despair[39]

"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 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.

Amongst the NGOs only SDPI and Inter-cooperation (IC) have the exposure to deal with the complex issues of Bonn Guidelines. In view of above it is evident that Pakistan has a long way to reach the threshold required to deal with the subject in a holistic manner.

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

Box 15: Conserving the Indus River Dolphins through Boat Safaris[40]

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.[41] 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 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.

Another initiative is the three-year project (2003-2006) titled "Documentation of Indigenous Knowledge about Medicinal Plants of Pakistan". This project is financed by Pakistan Science Foundation and executed by Pakistan Museum of Natural History Islamabad. This project is meant to undertake field studies to determine the status, trends and threats related to the knowledge, innovations and practices of medicinal plant use by indigenous and local communities

[40] Case Study by Mehjabeen Habib Fellow LEAD Pakistan

[41] During interviews conducted during 1998 by Syed Mahmood Nasir, for the preparation of Pakistan's First National Report, with the Deputy Director Fisheries, Chashma, it was learnt that this species also occurs upstream of the Chashma Barrage. This also highlighted that organizations like the Directorate of Fisheries, WAPDA should be on the panels that deal with biodiversity as they have rich first hand information.

Keeping in view the comments received, the Ministry of Environment has notified the BWG keeping in view the current trends. However the complicated issue of who would represent the local and indigenous communities to safeguard their interests has yet to be resolved. The issues related to WIPO, WTO and ILO convention 107 that are directly related to Bonn Guidelines are yet to be resolved. The Ministry of Labor and Manpower is the focal point for ILO 107 Convention while the Ministry of commerce deals with WTO and WIPO issues, the Ministry of Food Agriculture and Livestock deals with Farm Breeders' rights, ITPGRFA and UNPOV: issues directly related to the issue of ABS/ Bonn Guidelines. The newly established Pakistan Intellectual property Organization (IPO) has also been contacted by the Ministry of Environment in this regard.

The CBD through its provisions on access and benefit sharing have the potential for poverty alleviation, one project on the Indus Blind dolphins can be considered as a step in this direction (see box 13); however continuous and dedicated efforts are needed to achieve the objectives of the CBD.

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 (PBUH) 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.

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 16: The Peacocks of Kallar Kahar and a Sufi Saint - the Unofficial Conservator of Nature[42]

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 Jillani 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 have been 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 Rupees.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 also roam freely near the shrine of Choa town. Even in Choa Saidan Shah nobody dares to 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.

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.

Box 17: From Pet to Pest a Story of Otters[43]

There are two species of otters in Pakistan. The Common otter *Lutra lutra* and the smooth coated otter *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 Jughur Trout hatchery he saw four stuffed otters on display in 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 frequently enters 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) describes 'clusters of boats which formed the fishing villages on the Indus' while mentioning his Sindh voyages. Here one could see as many as twenty to thirty tamed 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 does not exist.

[42] Case study by Syed Mahmood Nasir

[43] Research conducted Syed Mahmood Nasir, 1999 for the First National Report.

The Haqdari System in the Hill Forests of Murree and Kahuta[44]

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 estimated at 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 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.

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 categories 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

[44] Case study prepared by Shabbir Ahmed, Conservator of Forests, Punjab Forest Department and Syed Mahmood Nasir

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 environment friendly scientific harvesting of trees. This also includes the elimination of outsiders (timber mafia)[45] in the purchase and over-harvesting of their forests.

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 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 c*ollected 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 bye-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.

[45] 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.

Table 12.1: Rates of Grazing Fee in Cholistan (latest rates)

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

Divergent Views on the Use of the Resource

Cholistan had a population of approximately 150,000 nomadic people. They would traditionally graze their livestock in the desert for months and would only return to the irrigated areas in the periods of droughts, and would throng back to the desert after rains. However this traditional lifestyle has almost changed in the past few years. This was possible due to allotment of agricultural lands to the Cholistanis locally called *Rohillas*. Only a few traditional Rohilla grazers remain while the majority now employ paid workers to take the livestock for grazing in the desert area. They live/d in small hamlets and their main profession have traditionally been grazing of livestock. Traditionally each tribe and clan has had control over their respective *tobas* and other watering points. Arranged marriages within and between the clans largely depended 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.

Box 18: The Harvesting of Naturally Growing Khar[46]

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.

There are no rights of grazing in the government records over the area of Cholistan except for the kharoolas. The case of harvesting of Khar (see Box 8) highlights the need to educate the traditional

[46] Case study by Javeed Kausar ex Conservator of Forests, Punjab Forest Department

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.

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.

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.

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 19**.

Box 19: Trophy Hunting in Pakistan-an Important Tool for Conservation [47]

In Pakistan as in almost all other 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.

[47] Case Study by Naeem Ashraf Raja Fellow LEAD Pakistan

Chapter 13: Biodiversity and Climate Change

Introduction

The world's climate patterns have always been highly dynamic. However, recent decades, reveal new patterns, indicating more rapid changes than has been seen for thousands of years. These changes have been linked to equally rapid changes in atmospheric concentration of gases, and the release of "greenhouse gases" by human activities. These gases include oxides of carbon, methane, nitrous oxides and oxides of sulfur. These gases are dealt under the UNFCCC, while other proven gases that deplete the ozone like Chloro-Floro-Carbons (CFCs), bromides and other halogens are covered under the Montreal Protocol for Substances that deplete ozone. While a lot of progress has been made in eliminating the Ozone Depleting Substances (ODS), efforts are under way to limit the use of the gases covered under the UNFCCC.

Impacts on Biodiversity

Climate change is likely to have considerable impacts on most or all ecosystems. The distribution patterns of many species and communities are determined to a large part by climatic parameters, globally there is a consensus that the predicted climate changes will effect the whole distribution and dynamics of biodiversity at many levels. It may be possible for species to migrate in response to changing conditions. Vegetation zones may move towards higher latitudes or higher altitudes following shifts in average temperatures. Rainfall and drought will also be of critical importance. Extreme flooding will have implications for large areas, especially riverine and valley ecosystems. Changes in seasons are already being noticed in many temperate regions. Many birds are being reported earlier and spring flowers are emerging when it was once winter. In agricultural landscapes changes in the length of growing seasons may improve productivity in mid-latitudes and increase the potential for arable crops at high latitudes. Negative impacts may include increased ranges of insect pests and diseases, and failure of crops in some regions from drought or flooding. Rising sea temperatures will further affect the distribution and survival of particular marine resources. Corals have already shown an extremely high sensitivity to minor increases in temperature. In addition to causing a warming effect, increased concentrations of atmospheric carbon dioxide is known to increase the rate of photosynthesis in many plants. In this way the climate changes may increase growth rates in some natural and agricultural communities. International efforts are being focused towards reducing the amounts of gas emissions, however climate change has already begun, and the impacts will increase considerably over coming decades.

Global biodiversity is under particular risk: habitat loss, pollution and over-exploitation, species and natural systems are now faced with the need to adapt to new regimes of temperature, precipitation and other climatic extremes. Nature conservation has difficult challenges to face that are increasing day by day.

Kyoto Protocol

A milestone in the global climate change negotiations is the signing of the Kyoto Protocol adopted in Kyoto, Japan in 1997 and it has been ratified by Pakistan on 11th January, 2005. The protocol sets quantifiable emission reduction targets. Developed countries agreed to reduce their combined green house gases (GHGs) emissions by 5.2% below the 1990 level during the period 2008-2012. It introduces market based flexible mechanisms for the emissions reduction, clean development Mechanism (CDM) for example.

Kyoto Protocol is the comprehensive agreement under UNFCCC which is purely based on market-based mechanisms on Green House Gases trading between developed and developing countries. Clean Development Mechanism (CDM), under the Protocol, is the most promising mechanism that is built on the principle of least cost abatement of carbon. It implies that costs of controlling carbon in developing countries are far less than the costs in developed countries. Under CDM, developed countries can cost-effectively meet their obligations to control carbon by purchasing carbon emissions referred as CERs (Certified Emission Reduction). The unit of a CER is ton of carbon dioxide

equivalent. The underlying rationale is that forest trees act as carbon dumps by trapping carbon dioxide from the air and convert it into wood so free carbon is no more available in the atmosphere; this decreases the overall carbon concentration from the global atmosphere. The trading in CERs in the year 2006 was for 3 billion US $ while the market size is expected to increase to 100 billion US $ by 2012. Most of the trading in CERs done so far is on energy conservation, alternate energy (wind/solar/hydel), solid waste management etc.

There are many alternate options to invest in carbon sequestration activities. For example, some parties in developing countries (both from public or private sector) can get into a pre-project agreement with investors in developed countries (both from public and private sectors). In this case, carbon credits are directly accrued to the investors. Alternatively, if there are no investors available in hand, developing countries can finance in these projects themselves. The World Bank has also started its Prototype Carbon Fund to catalyze CERs trading in developing countries. The carbon credits earned this way are registered and saved with the CDM Executive Board (EB). These credits are marketable commodity and can be sold to any buyer who offers good price. For any CDM project, registration with the Executive Board is a mandatory requirement. Since CDM projects are based on carbon quantification, an independent validation by the Designated Operational Entity DOE is essential. These DOEs are consultancies accredited by the CDM Executive Board.

Scope of Forests and Agriculture in Climate Change Mitigation

Forests and trees have woody biomass which is composed of carbohydrates, synthesized from carbon dioxide and water. Therefore, forests are termed as "sinks" of carbon. Although expansion of carbon sinks has been identified as an important measure in the Convention and Kyoto Protocol, yet CDM projects in Forestry sector could not be developed and implemented in any part of the world mainly due to the reasons that methodologies were not finalized, and lack of capacities to develop CDM projects in forestry. The major problem in CDM forestry projects is that under the CDM there is a major paradigm shift in forestry related definitions that the traditional foresters find difficult to accept. However most of the uncertainties are now clear and it is time that Pakistan includes carbon credits as a source of earning foreign exchange.

Pakistan's Response

The Ministry of Environment, after the ratification of the Kyoto Protocol established a CDM Cell that devotes its entire energies to develop capacities to achieve the goals of the Protocol. The Global Change Impact Studies Center has also been established. Scientific seminars and conferences have also been organized by the University of Arid Agriculture. Some capacity building projects are also in the pipeline. There is a vigorous interest in preparing CDM projects in the forestry sector. It is hoped that by the end of the First Commitment Period of the UNFCCC i.e. 2012 Pakistan will be better prepared to fulfill its global commitments under the Kyoto Protocol. There is little research carried out by the academia on the impacts of climate change specific to Pakistan. Moreover capacities are further needed to be built to understand the science of climate change and estimation of the Green House Gases Emissions etc.

There are certain caveats in dealing with CDM projects in the forestry sector: the main thrust of CDM is carbon sequestration that could possibly pose and environmental hazard with the large scale use of fast growing genetically modified trees. Moreover in the scenario of establishment of a large number of forests as carbon sinks the fate of forest biological diversity remains uncertain. However more scientific studies would definitely help adjust to conserve biodiversity. No wonder forestry projects under the CDM are insignificant so far.

Chapter 14: Other Biodiversity Related International Conventions

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:

Table 14.1: Various Multilateral Environmental Agreements Signed by Pakistan

Sr. No	Particulars of Multilateral Environmental Agreements	Date of Signing	Date of Ratification
1	RAMSAR Convention on Wetlands	1971	January 1976
2	Convention on Migratory Species (CMS)	1971	December 1987
3	Convention on International Trade in Endangered Species (CITES)	1973	April 1976
4	Convention on Biological Diversity (CBD)	June 1992	June 1994
5	United Nations Convention to Combat Desertification (UNCCD)	October 1994	February 1997
6	Basel Convention on the Control of Trans-boundary Movements of Hazardous Waste	May 1992	October 1994
7	Montreal Protocol on Substances that Deplete the Ozone Layer.	January 1989	December 1992
8	Vienna Convention on Substances that Deplete the Ozone Layer		December 1992
9	United Nations Framework Convention on Climate Change (UNFCCC)	June 1992	June 1994
10	Kyoto Protocol to UNFCCC	December 1997	Ratified January 2005
11	Stockholm Convention on Persistent Organic Pollution (POPs)	December 2001	Ratification in process
12	Rotterdam Convention on Prior Informed Consent (PIC) for certain hazardous chemicals and pesticides	1999	August 2005
13	Cartagena Protocol on Bio-safety to the CBD	June 2001	Ratification in process

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

Convention on International Trade in Endangered Species of Wild Fauna & Flora

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. The following are the obligations 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

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.

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

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 20** 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 20: 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.

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 19 Ramsar sites in Pakistan which are listed below:

Table 14.2: Ramsar Sites of Pakistan

	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
9	Astola (Haft Talar) Island	5000
10	Sandy beach and cliffs, Astola (Haft Talar) Island Hub (Hab) Dam	27000
11	Jiwani Coastal Wetland	4600
12	Jubho Lagoon	706
13	Nurri Lagoon	2540
14	Indus Dolphin Reserve	125000
15	Miani Hor.	55000
16	Ormara Turtle Beaches	2400
17	Deh Akro-II Desert Wetland Complex	20500
18	Indus Delta	472800
19	The Runn of Kutch	566375
	Total:	134, 2302 Ha

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.

The seven years Pakistan Wetland Project has been launched by the Government of Pakistan during 2006; it aims to promote the conservation of the country's freshwater and coastal wetlands and their associated biodiversity by means of creation of enabling environment and provision of replicable models of conservation with community participation. The project is under implementation in four demonstration sites namely: Makran Coastal, Central Indus, Salt Range and the North-western Alpine Wetlands.

Chapter 15: Invasive Alien Species (IAS)

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, fish, 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.

Article 8(h) of the Convention on Biological Diversity (CBD), calls upon the parties to "prevent the introduction of, control or eradicate those alien species which threaten ecosystems, habitats or species". There is no legislation that deals specifically with IAS. Pakistan has taken the important step of establishing the IAS Specialist Group-Pakistan (ISSGP) at the national level, with support from IUCN and CABI-Bioscience. This group will work to increase awareness of problems created by IAS, among the public at large, policy makers, and other stakeholders, and identify increasing problems of IAS. Prevention is recommended as the prime method for management of IAS, as control and eradication are technically difficult and expensive

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.

What is an Invasive Alien Species

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.

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*, *E. citriodora, E. territicornis* and *E. microtheca,* have adapted to local conditions. However, only *E. camaldulensis* is widely grown on farmlands for commercial purposes. Eucalyptus 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.

Although it does not occupy a large area, Eucalyptus has established itself in Pakistan and can be seen everywhere from the mountains to the seacoast, 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. However, contrary to the claims of the anti-eucalyptus campaigners, birds roost and nest on this tree, and honey bees flock to collect its nectar.

This species is also found in the linear land strips, village surroundings and grazing lands. Most of the man-made irrigated plantations have sizeable areas under *Eucalyptus camaldulensis*. At least 7.7 million cubic feet 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.[48] It has an excellent coppicing power and ratoon[49] cropping can be practised for pulp and small timber.

Allelopathic[50] Affects

Experiments at Punjab Forestry Research Institute (PFRI) Faisalabad 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.

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 scientific data is required on this issue.

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 gravel 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.

[48] Personal observations by the author/s.
[49] Sprouting of plants from stumps after the tree is cut; this is used as a tool for regeneration of tree crops.
[50] Plants produce certain chemicals that inhibit others from growing near them.

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, 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. glandilosa*), as well as five varieties were introduced in the country in the last century. These were the arid country form; 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.

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, also research on its ecological and social impacts has not been conducted, yet there is a general view that it has helped the rural poor by providing a cheap source of fuel and livelihood for small traders in fuel wood and in charcoal kilns.

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 sixties 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. Birds disperse its fruit (which ripens in June). Additionally, it also sends root suckers, thus forming layers around the mother plant.

Other notable invasive species include:

Parthenium: (*Parthenium hysterophorus*) is a native of North Central America was probably introduced into the plains of Pakistan in late nineties through India where it was reported much earlier. The species has replaced the native vegetation and shows vigorous growth by forming thick continuous mats along the roadsides in many cities of the country where the climatic conditions are favourable. It is also one of the major weeds of the disturbed areas causing allergy.

Ailanthus: A native of China, ailanthus (*Ailanthus altissima*) was introduced in early 1970s. At present, it is growing along the roads and other naturally disturbed habitats of northern Pakistan. Ailanthus has already created a lot of problems in USA and Canada as invasive species because it produces abundant root sprouts that can develop into extensive thickets and displace native vegetation. In Pakistan, its impact as non-native species is yet to be evaluated.

Robinia: A native of North America Robinia (*Robinia pseudoacacia*) introduced in early 1990s in the hilly areas of northern Pakistan mainly along the road-sides and stream bottoms. It is feared by some experts that its rapidly growing stands may displace native vegetation particularly pine forests. Its assessment as an invasive tree is needed to be done at the earliest.

Lantana: One among the world's worst 100 invasive weed, Lantana (*Lantana camara*) has extensively invaded the countryside by forming pure continuous thickets. It not only replaces the native vegetation but also repels the associated fauna by its strong odour. Lantana has entirely changed the vegetation picture of certain areas in Punjab and the Federal Capital.

Fauji Khagga as an Invasive Species[51]

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).

Introduced Cats in Islands of the Arabian Sea[52]

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.

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, whereas gambusia was 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 Tilapa (*Oreochromis aureus*, *O. niloticus*, and *O. mossambicus*) are well established in the saline waters of Okara, Bahalwalnagar, Bahawalpur and Rahim Yar Khan. The Tilapia fish is internationally known as

[51] Prepared by Dr. Nazir Bhatti, Director General, Fisheries, Government of Punjab

52 Adapted from the article in The Dawn by Baghwan Das

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 up to 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.

Impacts of Exotic Fish

Until now, apart from three exotic 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 15.1** gives information on the exotic fish found in Pakistan.

Table 15.1: Exotic Fish in Pakistan[53]

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

[53] Source: Dr. Nazir Bhatti, former Director General, Fisheries, Government of Punjab

Marine Invasive species

A species if it has been introduced by man to a location, area or region where it did not previously occur naturally Ballast water Cargo ships normally use seawater to provide ballast. At source port it fills in the seawater while discharging the cargo. At the destination port it discharges the ballast water. There are thousands of marine species that may be carried in ships' ballast water. This may include anything that is small enough to pass through a ship's ballast water intake ports and pumps. These organisms include bacteria and other microbes, small invertebrates and the eggs, cysts and larvae of various species. The problem is compounded by the fact that virtually all marine species have life cycles that include a planktonic stage or stages. It is fortunate that a vast majority of marine species carried in ballast water do not survive the journey, as the ballasting and de-ballasting cycle and the environment inside ballast tanks can be quite hostile to organism's survival. Even for those that do survive a voyage and are discharged, the chances of surviving in the new environmental conditions are generally low, particularly where predation by and/or competition from native species further reduces the chances of survival. However, when all factors are favourable, an introduced species may survive to establish a reproductive population in the host environment, it may even become invasive, out-competing native species and multiplying into pest proportions. As a result, this factor imposes problems on the whole ecosystems and the community composition begins to change. It is estimated that at least 7,000 different species are being carried in ships' ballast tanks around the world.

Pakistan needs to start a program to monitor ballast water for possible invasive species. The Karachi Port Trust (KPT) authority Karachi has started such a program and efforts are planned to meet the international obligations in this regard. Ports in Pakistan should have proper receptacles for collecting ballast water as required under "Guidelines for the control and management of ships' ballast water, to minimize the transfer of harmful aquatic organisms and pathogens". These Guidelines were adopted by the IMO Assembly in 1997, by resolution A.868 (20) of the GEF/UNDP/IMO 'Global Ballast Water Management Programme (GloBallast)'.

It has been reported by the KPT that among flora, the dinoflagellates, diatoms and algal spores of the blue green algae may be transported through the Ballast water. Among fauna, the planktonic life forms of crustaceans copepods, barnacles crabs etc have the tendency to be transferred from one place to another. According to some studies, ctenophores and cnidarians are more opportunistic to transfer from one place to another place through ballast water. KPT has requested the Ministry of Science and Technology through Ministry of Ports and Shipping to participate in this program

There is virtually no awareness on this important issue among general public and policy makers, therefore awareness on the dangers and adverse impacts of alien species is required to be created.

The Biodiversity Action Plan (BAP) of Pakistan deals with alien species problem very superficially. The action 6.6 of BAP reads as; "Take measures to control invasive alien species of fauna and flora, and to prevent further introduction". To achieve Millennium Development Goals (MDGs), Pakistan has made some headway regarding environmental sustainability and reducing environmental degradation by promoting indigenous species.

Since Pakistan is signatory of CBD and other Multilateral Environmental Agreements, these agreements obliges countries to undertake necessary control measures to prevent the spread of invasive alien species, pests and diseases. Well-established quarantine facilities are required to be developed to cope with the danger of invasive invasion

Freshwater Alien Invasive Species

Pakistan is blessed with about 225 significant man-made and natural wetlands spread over approximately 10% of the country. Pakistan's wetlands occur in a broad variety of ecological zones including arid, semiarid, alpine and coastal areas. The problem of invasive species, though not sufficiently quantified, is increasingly being recognised by scientists for their impact on biodiversity. There is, however, limited awareness of the problem in general and lack of capacity to address the issue in Asia, including Pakistan (Hussain et al, 2000).

Unfortunately, several of the freshwater bodies in Pakistan are badly affected by invasion of some alien invasive species like Water fern *(Silvinia molesta*), water hyacinth *(Eichhornia .crassipes)* and water lettuce *(Pistia stratiotes).* The issue of alien invasive species is relatively new in Pakistan and

any comprehensive cataloguing of alien species or any study on the magnitude or impacts of invasive species has not been done so far. For the very first time in year 2000, CABI SA and IUCN-Pakistan conducted a workshop and compiled a joint report in which several invasive species have been black listed including aquatic plants like *Silvinia molesta, Eichhornia crassipes and Pistia stratiotes*. These invasive species have been accidentally introduced in the wetlands of Pakistan. Among these, water fern *(S. molesta)* is the most aggressive and dreaded aquatic weed, which has established itself in many tropical countries, like Sri Lanka, India, Zambia, Australia and South Pacific islands. *The plant* is native to southeast Brazil (South America) and introduced in Pakistan through an unknown source. Now, it has spread to many wetlands of Sindh and few lakes in Punjab. The exact distribution of *S. molesta* in Pakistan is, however, not known and needs to be explored. It is reported that *Salvinia* is carpeting some lakes of international importance like Kinjhar Lake, Haleji Lake and various irrigation canals and ditches in the Thatta District of Sindh Province.

Similarly *Eichhornia crassipes*, native of Amazon basin, South America was first brought outside its native home as an ornamental plant, but it became an aggressive invader in all tropical and subtropical countries. Exact time of arrival in Pakistan is not known. This species is widely distributed in water bodies of most parts of Pakistan, except in the high altitude and cold regions. It is a highly invasive species due to extremely fast growth rate and gregarious nature. Like in many other tropical countries, it is becoming a troublesome invasive in Pakistan also.

Pistia stratiotes native of South America is widely distributed in Pakistan and found in water reservoirs, ponds and marshes along the edges of large lakes where they are able to thrive amidst the offshore vegetation and debris, in slow moving or stagnant waters and in old wells.

In developing countries like Pakistan, the impacts of alien weeds can be devastating. The major impacts reported by many scientists are:

Socioeconomic damage: Mats of *S. molesta, E .crassipes* and *P. stratiotes* impede access to and use of waterways for commercial and recreational purposes and degrade waterside aesthetics. Mats reduce habitats for game birds, limit access to fishing areas, and probably alter fisheries, all with negative economic consequences. Invasive alien aquatic weeds can clog water intakes and interfere with agricultural irrigation, water supply, and electrical generation. Weed mats provide excellent habitat for mosquitoes (important vectors of human diseases) with serious socio-economic impacts.

The impacts can be devastating because weed mats block the use of waterways for transportation, cutting off access to important services, farmlands, and hunting grounds. The harm from weed mats to fisheries also can be very significant to communities dependent on fish for local consumption (sometimes as the main source of protein) or in areas where fish sale is the main source of cash income (Bennett, 1966; Thomas and Room, 1986). Salvinia is also a weed of paddy rice that reduces production by competing for water, nutrients and space.

Ecological damage: The ability to grow very quickly (Cary and Weerts, 1983; Mitchell and Tur, 1975; Mitchell, 1978/9; Room, 1986) and blanket water bodies makes salvinia an aggressive and competitive weed. Initially, salvinia forms a single layer over water, but with continued growth the mats become multi-layered and can reach up to 1m in thickness (Thomas and Room, 1986). Thick mats support other colonizing plants, and the high biomass and stability of such mats make them difficult to dislodge and destroy (Storrs and Julien, 1996).

Plants and animals dependent on open water to gain sunlight, oxygen, and space for sustenance and growth, or for landing, fishing, nest building, or mating, are displaced by dense weeds infestations. Water under mats of aquatic weeds has a lower oxygen concentration (due to reduced surface area of water available for oxygenation, inhibition of photosynthesis by submerged plants, and consumption of dissolved oxygen by decaying Salvinia), higher carbon dioxide and hydrogen sulphide concentrations, lower pH, and higher temperatures than nearby open water (Mitchell, 1978; Thomas and Room, 1986). Through high growth rates and slow decomposition rates, salvinia reduces the concentration of nutrients that would otherwise be available to primary producers and organisms that depend on them (Sharma and Goel, 1986; Storrs and Julien, 1996). Animal habitat is most noticeably altered by the obliteration of open water. Migratory birds may not recognize or stop at water bodies covered with these weeds, which may alter the route and can cause change in the natural ecosystem.

Biological control of water weeds

Water weeds have become a menace in the provinces of Sindh and Punjab; weeds not only reduce the efficiency of the irrigation system but also badly affect the freshwater ecosystems. This infestation causes depletion of fishes and also destroys the feeding grounds of water birds. Heavy investments are made to remove weeds from the Lal Sohanra National Park Lake each year with little success. The Commonwealth Agriculture Bureau **CABI** has the technology and expertise to control the water weeds through cheap biological control methods. According to CABI biological control through the introduction of natural enemies of *Salvinia molesta*, *Eichhornia crassipes,* water Hyacinth etc. has been tested in other countries by the controlled release of weevils. The weevils have not shown any negative impact on the environment as shown in the tables below:

Table 15.2: Status of Releases of *Cyrtobagous salviniae* Calder and Sands

Country	Initial Release Date	Status
Australia	1980	Control in tropical and subtropical areas; some control in temperate areas
Botswana	Spread from Namibia	Control in 1 to 5 years
Cote D'Ivoire	1998	Established and spreading
Fiji	1991	Successful control
Ghana	1996	Control
India	1983	Control at Bangalore and Kerala
Indonesia	1997	Status is unknown
Kenya	1990	Control except where affected by herbicide
Malaysia	1989	Control where released. Needs redistribution
Namibia	1984	Good control
Papua New Guinea	1982	Good control
Republic of South Africa	1985	Successful control within 2 years
Sri Lanka	1986	Successful control
Zambia	1990	Excellent control
Zimbabwe	1992	Good control within 2 years

Table 15.3: Release of biological control agents on water hyacinth

Countries	*Neochetina bruchi*	*Neochetina eichhorniae*	*Niphograpta albigutallis*	*Eccritotarsus catarinensis*	*Orthogalumna terebrantis*	*Xubida infusellus*
Australia	1990	1975	1977			1981; 1996[f]
Benin	1992	1991	1993	1999[h]		
China	1996	1996		2000[a]		
Congo	1999[h]	1999[h]				
Cuba	1995					
Egypt	2000[b]	2000[b]				
Fiji		1977				
Ghana	1994	1994	1996			
Honduras	1989	1990				
India	1984	1983			1986	
Indonesia	1996	1979				
Kenya	1995	1993				
Malawi	1995	1995	1996	1996		
Malaysia	1992	1983	1996			
Mexico	1995	1972				
Mozambique	1972	1972				
Myanmar		1980				
Nigeria	1995	1993				
Panama	1977		1977			
Philippines	1992	1992				
PNG	1993	1986	1994			1996
Rwanda	2000[d]	2000[d]				

Solomon Islands		1988				
South Africa	1989	1974	1990	1996		
Sri Lanka		1988				
Sudan	1979	1978	1980			
Taiwan	1993	1992				
Tanzania	1995	1995				
Thailand	1991	1979	1995			1999
Uganda	1993	1993				
USA	1974	1972	1977			
Vietnam	1996	1984				
Zambia	1997[c]	1971; 1996	1971; 1997[g]	1997[c]	1971	
Zimbabwe	1996	1971	1994	1999[e]		
Totals	30	32	13	6	2	3

Chapter 16: Arrangements for Cross Boundary Movement of biodiversity and its components

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 bio-safety issues.

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).[54]

On an average, the department handles more than 12,000 cases annually of import and export of animals, birds and animal products. The export value of animals, birds and animal products obtained was a total Rs. 4744 million subsequent to clinical and laboratory examinations carried out by the Animal Quarantine Department.

[54] 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.

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

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APPENDICES

Appendix A: Internationally Threatened Animals in Pakistan[55]

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**
    - Indian Wolf **EN C 2a (i); D**
    - 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 *Antilope 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**
    - Chinkara *Gazella bennetti* **L/cd**
    - Goitred Gazelle *Gazella subguttorosa* **L/nt**

[55] Source:Dr. Aleem Chaudhry, ex chief conservator of forests see details of IUCN categories at iucnredlist.org/info/categories_criteria2001

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 *Pelicabus 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 horsefieldii*

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

ACTINOPTERYGII
SYNBRANCHIFORMES
MASTACEMBELIDAE
Spiny Eel *Macrognathus aral* **DD**

INSECTA

LEPIDOPTERA

SPHINGIDAE

Hyles hippophaes **DD**

Appendix B Internationally Threatened Birds in Pakistan

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

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

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: http://www.iucnredlist.org/info/categories_criteria2001

Appendix C: Biodiversity Related Research Institutions in Pakistan

Agricultural Biodiversity Research Institutes in Pakistan

- Agricultural Research Institute, Sariab, Quetta
- Agricultural Research Institute, Tandojam
- Agricultural Research Institute, Tarnab, Peshawar
- University of Agriculture, Faisalabad
- Agriculture University, Peshawar
- Agriculture University, Tandojam
- Animal Sciences Institute, NARC, -Islamabad
- University for Arid Agriculture , Rawalpindi
- Arid Zone Research Institute, Quetta (with four substations)
- Ayub Agricultural Research Institute, Faisalabad
- Bahauddin Zakria University, Multan
- Cereal Crop Research Institute, Pirsabak, Nowshera
- Cotton Research Institute, Multan
- Cotton Research Institute, Sakrand
- Crop Sciences Institute, NARC, -Islamabad
- Fodder Research Institute, Sargodha
- Pakistan Forest Institute, Peshawar
- Islamia University, Bahawalpur
- Livestock Research Institute, Bahadar Nagar
- Maize, Sorghum and Millet Institute, Sahiwal
- Nuclear Institute of Agriculture and Biology, Faisalabad
- Nuclear Institute for Agricultural, Tandojam
- Pakistan Museum of National History, Islamabad
- Plant Genetic Resources Institute, NARC, Islamabad
- Quaid-i-Azam University, Islamabad
- Rice Research Institute, Dokari
- Rice Research Institute, Kala Shah Kaku
- University of the Peshawar
- 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.
- Quaid-i-Azam University, Islamabad

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
- Quaid-i-Azam University, 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, Madinatal 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
- Quaid-i-Azam University, Islamabad

Ethanobotany, Database, Pharmacopeias

- Baital Hikmah Research Institute, Hamdard University, Karachi
- Department of Plant Sciences, 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 ofnoise levels SO_2 particulate, Ozone, CO and Lead	Regulation on emission and
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 Ethno botanical Leads[56]

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

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

Drug	Medical Use	Plant	Family
Sennoside A,B	Laxative	*Cassia angustifolia*	Caesalpiniaceae
Scopolamine	Motion sickness	*Datura stramonium*	Solanaceae
Stigmasterol	Steroidal precursor	*Physostigma venenosum*	Fabaceae
Strophanthin	Congestive heart failure	*Strophanthus gratus*	Apocynaceae
Teniposide	Bladder neoplasms	*Podophyllum peltatum*	Berberidaceae
THC	Antiemetic	*Cannabis sativa*	Cannabaceae
Theophylline	Diuretic, asthma	*Camellia sinensis*	Theaceae
Toxiferine	Surgery, relaxant	*Strychnos guianensis*	Loganiaceae
Tubocurarine	Muscle relaxant	*Chondrodendron tomentosum*	Menispermaceae
Vinblastine	Hodgkin's disease	*Catharanthus roseus*	Apocynaceae
Vincristine	Paediatric leukaemia	*Catharanthus roseus*	Apocynaceae
Xanthotoxin	Vitiligo	*Ammi majus*	Apiaceae

Appendix F: Breeds of Livestock of Pakistan

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 (*Bos grunniens*)	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

BREED	RANGE
Gojal	Sindh and Balochistan
Hallenjoo	Sindh
Harnai	Balochistan
Hashnagri	NWFP
Hissar dale	-
Jhala wani	Sindh
Kacchi	Sindh
Kaghani	NWFP
Kail	Azad Kashmir
Kajli/Kali	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 the most common Breeds:

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 average 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/Kajli

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 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, Sheikhupura, 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 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 south-western 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 120-day lactation. Hair yield is 600 g per head annually. Chappar goats are raised for meat and hair production.

Jattal (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 and meat.

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