BIODIVERSITY ACTION PLAN

FOR BHUTAN 2002

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Ministry of Agriculture
Royal Government of Bhutan

Acknowledgements

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HER MAJESTY THE QUEEN

TASHICHHODZONG
THIMPHU, BHUTAN

Thursday, 04 April 2002

FOREWORD

Biological resources, especially plants, have always been important for Bhutanese. These resources have been conserved in their ecosystems by local communities who utilised them. The huge genetic resource base our country has, due to its diverse agro-ecological zones spanning from subtropical forest to alpine meadows, is one of our most precious patrimonies. Indeed, it is of global importance now. The global interdependence of genetic resources is apparent from the introduction of exotic varieties into our country and our country's contribution to germplasm and herbarium collections to several institutions abroad.

There is abundant biological diversity both on-farm and in the 'wild'. It is pleasing to note that the strategies for the conservation of biodiversity have given equal importance to both. Farmers in our country have bred impressive varieties of crops, fruits, vegetables to find the characteristics most suitable for local culture and environment. Some of the varieties are best suited to marginal areas where main varieties can scarcely be cultivated. Close to five hundred landraces of rice grown by our farmers is proof of the genetic variations that the farmers have selected and adapted. In addition, significant portion of foods, fodder, and indigenous medicines in our country comes not only from domesticated farmer-bred varieties or species, but from the yearly harvest of plants from the 'wild'. A good deal of self-sufficiency in food and fodder in rural societies are met out of the biodiversity found in nature. The dependence on wild relatives is also true in the case of the most important livestock in our country: *jatsha, jatsham*

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jatsham and other *mithun* cross breeds. Those who breed livestock in our country know that to develop good diary cattle, the genetic materials in the wild must continue to be available.

Generations of local communities have contributed to the knowledge about development of breeds and varieties of food crops, as well about wild plants and animals. The transmission of this accumulated, indigenous knowledge, which exists mostly in vernacular form, is equally important for the conservation of biodiversity and uses of biomaterials. Conservation of biodiversity can be strengthened hand in hand with enhancement of indigenous knowledge about biomaterials we have traditionally used.

With the explosion in biotechnologies, the potential uses of biomaterials are far greater than what were possible in the past. Genetic materials are being incorporated into commercial products, and a considerable and increasing part of the global economy is based on biotechnological products. For our country, too, biotechnology holds bright prospect, and we must move in that direction as quickly as possible. The golden bridge linking development and conservation is biotechnology.

In the context of conservation, this updated biodiversity action plan represents a serious and ambitious effort made by our country. May the merit of this publication benefit both man and animal, who ultimately depend, directly or indirectly, on the diversity of plantlife.

Dorji Wangmo Wangchuck

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Acronyms

ACC: Annual Allowable Cut
ADB: Asian Development Bank
BAP: Biodiversity Action Plan
BFI: Bhutan Forestry Institute
BIBIS: Bhutan Integrated Biodiversity Information System
BMB: Biodiversity Management Board
BTF: Bhutan Trust Fund
BUCAP: Biodiversity Use and Conservation in Asia Programme
BWS: Bomdiling Wildlife Sanctuary
CARD: Centre for Agriculture Research and Development
CBD: Convention on Biological Diversity
CBNRM: Community-Based National Resource Management
CDM: Clean Development Mechanism
CGIAR: Consultative Group on International Agricultural Research
CIAT: The International Centre for Tropical Agriculture
CLSD: Crop and Livestock Services Division (now DALSS)
COP: Conference of Parties
CSO: Central Statistical Office
DALSS: Department of Agriculture and Livestock Support Services
DANIDA: Danish Development Assistance
DFES: Dzongkhang Forestry Extension Services
DFS: Department of Forestry Services
DOT: Department of Tourism
DRDS Department of Research and Development Services
DSC: Druk Seed Corporation
DYT: Dzongkhag Yargye Tshogchung (District Development Committee)
EIA: Environmental Impact Assessment
EU: European Union
FAO: Food and Agricultural Organization
FCB: Food Corporation of Bhutan
FED: Forest Extension Division
FSD: Forestry Services Division (now DFS)
FMU: Forest Management Unit
FYM: Farm Yard Manure
FPUD: Forest Protection and Utilization Division
FRDD: Forest Resource Development Division

FYP: Five Year Plan
GATT: General Agreement on Trade and Tariff
GCR: Government of Costa Rica
GDP: Gross Domestic Product
GEF: Global Environment Facility
GIS: Geographical Information System
GPS: Global Positioning System
GYT: Geog Yargye Tshogchung (Block Development Committee)
HRD: Human Resource Development
HYV: High-Yield Variety
IARC: International Agricultural Research Centre
IBRD: International Bank for Reconstruction and Development, World Bank
ICDP: Integrated Conservation Development Programme
ICIMOD: International Centre for Integrated Mountain Development
ICPGR: International Commission on Plant Genetic Resources
ICS: Information and Communication Services
IEE: Initial Environmental Examination
INBio: National Biodiversity Institute
IPGRI: International Plant Genetic Resources Institute
IRRI: International Rice Research Institute
ITMS: Institute of Traditional Medicine Services
IUCN: International Union for the Conservation of Nature
JDNP: Jigme Dorji National Park
JSWNP: Jigme Singye Wangchuck National Park
LUPP: Land Use Planning Project
MOA: Ministry of Agriculture
MOHA: Ministry of Health and Education
MTA: Material Transfer Agreement
MTI: Ministry of Trade and Industry
NBC: National Biodiversity Centre
NBPGR: National Bureau of Plant Genetic Resources
NCD: Nature Conservation Division
NCS: Nature Conservation Section (now NCD)
NEC: National Environment Commission
NES: National Environment Strategy
NGO: Non-Government Organization
NORAD: Development Fund for Norway
NRTI: Natural Resources Training Institute

NTFP: Non-Timber Forest Product
NWFP: Non-Wood Forest Product
O & M: Operation and Maintenance
PA: Protected Area
PBR: Plant Breeders Right
PGR: Plant Genetic Resources
PGRP: Plant Genetic Resources Programme
PIC: Prior Informed Consent
PLA: Participatory Learning and Action
PPD: Policy and Planning Division
PRA: Participatory Rural Appraisal
PWS: Phibsoo Wildlife Sanctuary
QCRS: Quality Control and Regulatory Services
REID: Research Extension and Irrigation Division (now DRDS)
RGOB: Royal Government of Bhutan
RIM: Royal Institute of Management
RMNP: Royal Manas National Park
RNR: Renewable Natural Resources
RNRRC: Renewable Natural Resources Research Centre
RRA: Rapid Rural Appraisal
RSPN: Royal Society for the Protection of Nature
SDA: Sustainable Development Agreement
SEA: Strategic Environment Assessment
SEARICE: South East Asian Institute for Community Education
SES: Socio-Economic Surveys
SWS: Sakteng Wildlife Sanctuary
TNP: Thrumshingla National Park
TOR: Terms of Reference
TRIPS: Trade Related Intellectual Property Rights
UNDP: United Nations Development Programme
UNFPA: United Nations Population Fund
UNIDO: United Nations Industrial Development Organization
UPOV: Union of the Protection of Varieties
WCMC: World Conservation Monitoring Centre
WTO: World Trade Organization
WWF: World Wildlife Fund

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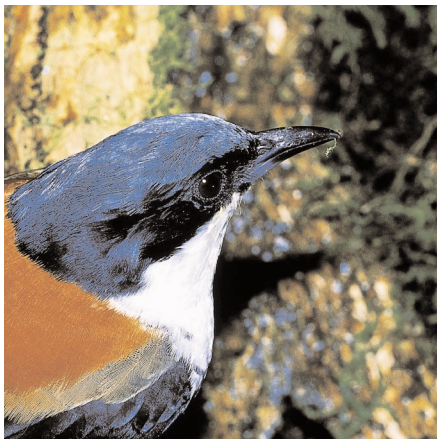


Introduction

Part I

1 Biodiversity and Its Values
2 The Action Plan Process in Bhutan
3 Follow up:The BAP as a Living Document
4 Organization of the BAP
5 Principal Accomplishments since BAP I

Introduction – Part I

1 Biodiversity and Its Values

The Role and Values of Biodiversity

The United Nations Convention on Biological Diversity (CBD) defines Biological Diversity 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 a part; this includes diversity within species, between species and ecosystems." Biodiversity is generallyconsidered in terms of ecosystem, species, and genetic diversity. Biodiversity refers to all living organisms, and thus includes all wild, domestic, terrestrial and aquatic species.

It has become increasingly recognized that biodiversity is absolutely basic to human survival and welfare. The role of biodiversity in human affairs and therefore its values to mankind can be described as ethical, cultural, aesthetic, utilitarian, and ecological. Of course, these roles are not separate from one another. For example, the ethical and aesthetic roles are combined in Bhutan's culture, and the aesthetic interest in biodiversity drives much tourism, which can play a distinctly utilitarian role in many countries.

Ethical, Cultural and Aesthetic Values

The ethical, cultural and aesthetic roles of biological diversity are mentioned first because in Bhutan the Buddhist religion plays such a central role in peoples' lives and culture, and nature – which in this sense is essentially biodiversity – is so central to Buddhism. The basic principles are to give back to nature what has been taken away and to respect all forms of life. Thus, in Bhutan, the ethical and aesthetic roles of biodiversity are integral components of the culture. In other countries, however, they may be more separate, yet the ethical concern for biodiversity can still play a major role.

In many industrialized countries there is a dramatically different culture and one in which religion plays a much less overt role than here. Yet many people maintain a strong ethic about biodiversity. This ethic can be described as a conviction that it is wrong to needlessly take life, or that since humans have the technological capability to exterminate other species, they also have an ethical responsibility to avoid doing so. This ethic can also have important economic or utilization implications. For example, because of the public's strong ethical objection to killing baby seals, the import and sale of seal skins were banned in Europe, which had important economic effects in seal-producing countries such as Canada.

The Utilitarian Values

The utilitarian value of biodiversity is great. Biodiversity provides direct products such as food, medicines and timber along with genetic materials and chemicals for agriculture, medicines and biotechnology. It can also provide the basis for economically significant tourism. In Bhutan 79 percent of the population live in rural areas and depend directly on biological resources. Food, fibre, construction materials, clothing, fuel and medicines are a few of the biodiversity products in direct daily use. Wild species provide a

significant food source for people on all continents. But on a global scale, the genetic diversity represented by wild species is of even greater importance. The need for wild genetic material to improve and diversify domestic crops, livestock, and other agricultural products and processes is well known. This utilitarian value of biodiversity, along with the recognition of its threatened status, was one of the important motivations for the Convention on Biological Diversity.

There are increasing efforts to achieve conservation and sustainable use of biodiversity in agriculture. Beyond assuring supplies for immediate use, the rationale for conservation of agro-biodiversity is to maintain the materials for use by future generations. In the proposal for the Bhutanese Agro-Biodiversity Project (RGOB 1996) it was noted that the conservation and utilization of agro-biodiversity would contribute to three primary areas in Bhutan: sustainable development, food security and financial benefit. While these goals and contributions were described for Bhutan, they are also valid for most other countries throughout the world.

In Bhutan an estimated 300 species of plants and animals are used for medicinal purposes in forming nearly 200 different traditional medicines. The National Institute of Traditional Medicine Services (ITMS) has developed standardized preparations of many of these medicines and is making them available through traditional medicine clinics across the country. Various herbal products are also marketed and some are exported.

But biodiversity resources also are essential and are of great economic importance to industrialized countries and to urban dwellers throughout the world. It is estimated that a key component of over 80 percent of the modern medicinal prescriptions currently filled in the industrialized nations originally derived from wild biodiversity. New uses are continually being found for biodiversity, and some of these are of great economic value. This point is well illustrated by the volcanic Hot Springs in America's Yellowstone National Park. These springs have been found to harbour a variety of curious micro-organisms. These organisms are yielding genetic material with uses that range from developing bacteria which consume toxic wastes, to providing scientific insights into the possibilities of life on Mars. One form already has earned several hundred millions of dollars from using these genetic materials in a process to identify DNA, a basic building block in the genetic make up of humans and other animals.

Bioprospecting – the search for new genes or chemicals of value in pharmaceutical, biotechnology, or agriculture industries – is a rapidly growing endeavour, and one, which, as the Yellowstone example shows, can have immense economic benefits. However, bioprospecting in most developing countries must involve significant international exchange of biodiversity since these countries lack the technological capacity for complete product development. In view of this, bioprospecting falls under many of the provisions of the Convention on Biological Diversity and in particular Articles 15 and 16 on Access to Genetic Resources and Transfer of Technology. If it is very carefully approached and with the protection of the Convention, bioprospecting may offer an opportunity for substantial economic benefits.

Ecological Values

Initially, ecological values may seem academic and detached from day-to-day life.

However, wild species and the ecosystems of which they are components provide a number of ecological services that are of critical importance to human welfare. Forests regulate and ameliorate climates, maintaining conditions necessary for agriculture and other human needs. Forests and other vegetation provide watersheds, assuring sustained flows of clear water. Vegetation prevents erosion, soil slumps and landslides. Plants and various animals, including micro-organisms, create and maintain soil and its structure and fertility. Healthy ecosystems recycle nutrients. Birds, insects and some bats provide pollination for agricultural crops as well as wild plants. Many wild species are predators that help to control pests. Forests and other wild ecosystems play key roles in global cycles such as those of carbon and water. Vegetation absorbs or filters many air pollutants. And of course, ecosystem biodiversity provides the essential habitats for species and genetic diversity.

Forest biodiversity provides two particularly critical ecological services for Bhutan, erosion protection and maintenance of water discharge patterns. Bhutan's steep slopes would be particularly subject to landslides and erosion without the forests, with resultant severe impacts on settlements, agriculture, and hydropower. Forest cover also smoothes out water flow to and in the rivers, reducing peak wet season flows and providing continuing flow during dry seasons. Loss of watershed vegetation creates a "tin roof" effect, with sudden run off in the wet periods and minimal flow in the dry, causing damaging floods, interrupted water supplies, and significantly impacting the operation and economics of hydropower developments. These results of lost ecological services are all-too-evident in neighbouring areas where the forest biodiversity has been lost.

The Global Concept of Conservation and Sustainable Utilization of Biodiversity

The main objectives of the Convention on Biological Diversity are the conservation of biological diversity, the sustainable use of its components, and the sharing of the benefits. Although Conservation is often used in the broader sense of including protection and sustainable use, in this Biodiversity Action Plan (BAP) we have maintained the distinction of the Convention, with the caveat that conservation in the Bhutanese context does not exclude sustainable use.

There is much confusion about the definition of sustainable use. In the Convention on Biological Diversity, sustainable use is defined as the use of components of biological diversity in a way and at a rate that does not lead to the long-term decline of biological diversity, thereby maintaining its potential to meet the needs and aspirations of present and future generations. In practice there are several components of the definition of sustainable use which must be considered together. These include:

Sustainability of the yield of a particular consumed biodiversity product, such as timber, medicinal plants, domestic crops, etc.

Sustainability of the ecosystem on which the consumed biodiversity product depends, as opposed to a plantation or cropped field. That is, it may be possible to sustain timber harvest in some conifer trees but in the process the forest has been transformed from a forest ecosystem with rich biodiversity into the equivalent of a plantation with very limited biodiversity – so there is a basic difference between

sustainability of wood production and sustainability of the natural ecosystem with its full biodiversity and the benefits (including those of ecosystem services) which the natural ecosystems provide for humans.

Long-term sustainability considerations. There are long-term sustainability issues, which often are overlooked. It is often argued, for example, that logging only small percent age of a forest annually has little effect in any one year and therefore is sustainable. But after some years the small percentages can add up to 100 percent, and the original, mature ecosystem, which may have taken centuries to establish, is lost.

Lateral considerations. As far as we know, each species plays some role in the ecosystem, and it has a set of relationships with other species. Some are predators, some are prey providing food for others, and some tree or other plant species provide shelter or food for other plants and animals. Therefore, harvesting any species, plant or animal, from an ecosystem will have some effect on the other species (including threatened ones) that make up the ecosystem. Removing prey species may leave predators without natural food, so they may starve, or shift to domestic livestock. Removing "keystone species", i.e., species which play a key role in maintaining the ecosystem, may cause the collapse of the ecosystem even though only one species was removed.

Sustainability of ecosystem services. Sustainability of an ecosystem includes sustainability of the ecosystem services, which the ecosystem provides for humans (and others). Ecosystem services include maintenance of watersheds, control of erosion, climate amelioration, provision of critical habitats for other life forms and development of soils, so the impact of use on these services is another consideration in determining the sustainability of use of any component of the ecosystem.

Sustainability of non-consumptive uses. Non-consumptive uses (i.e., uses that do not remove individual species, e.g. trees, from the system) are assumed to be sustainable because they are not believed to have an impact. However, this is not necessarily true. Tourism is an example of non-consumptive use of biodiversity, but even though tourism is non-consumptive, unless it is carefully planned and implemented it may have a significant impact on the biodiversity.

2 The Action Plan Process in Bhutan

The Royal Government of Bhutan (RGOB) undertook the development of the Biodiversity Action Plan (BAP I) for Bhutan in 1996. The process followed by RGOB was comprehensive, involving, among other things, workshops and consultations throughout the country. BAP I was completed and submitted to RGOB for approval in June of 1997, and the RGOB immediately initiated a series of actions to implement the Action Plan. The BAP is intended to be a living document, to be revised from time to time as the actions it specifies are completed and conditions change. By 2001 so much progress on implementing the original action plan had been achieved that RGOB decided to undertake the first revision, BAP II. Since this process relied upon the comprehensive foundations laid in the development of BAP I, the preparations for both BAP I and BAP II are described below.

Preparation of BAP I

On 19 November 1996, RGOB initiated a project funded by the United Nations Developement Programme and Global Environment Facility (UNDP/GEF) to enable the RGOB to develop a National Biodiversity Conservation Strategy with prioritized action plans. This was to serve as an overall framework to consolidate, strengthen and improve its activities and programmes to conserve and sustainably utilize the rich natural biodiversity in Bhutan. In addition this project enabled the RGOB to prepare its first National Report on Biodiversity to the CBD Conference of Parties (COP) in 1997, thus fulfilling Bhutan's obligation to the CBD under Article 26.

The Nature Conservation Section of the Forestry services Division within the Ministry of Agriculture was given the responsibility for co-ordinating the development of the National Biodiversity Conservation Strategy and Action Plan (BAP). This was because the Forestry Services Division was then the main governmental agency responsible for the execution of biodiversity conservation programmes as well as overseeing and enforcing measures to conserve and sustainably utilize the biodiversity resources of Bhutan. The Nature Conservation Section is now the Nature Conservation Division (NCD) of the Department of Forestry Services (DFS).

The Core Team

A Core Team was formed comprising of:

- T.N. Acharya, Crop and Livestock Services Division (now the Department of Agriculture and Livestock Support Services);
- Karma Tsering/Cheki Wangmo, Research Extension and Irrigation Division (now the Department of Research and Development Services);
- Tenzing Dhendup, Research Extension and Irrigation Division;
- Durga D Sharma, Forest Services Division (now the Department of Forestry Services); and
- Deki Yonten, Forest Services Division.

Each person played a key role in developing the BAP I. This was a nearly full-time assignment from mid-January to June 1997.

Task Force

Individuals from other Ministries, NGOs and the UNDP were also nominated as members of a Task Force, which served as a Steering Committee and acted as a forum for consultation, discussion, review, analysis, and co-ordination for the development of the Strategy and Action Plan. The Task Force Members were:

- Kunzang Norbhu, Planning Ministry;
- Karma Nyedrup, National Environment Commission;
- Dorji Thinley, National Institute of Traditional Medicine;
- Ugen P Norbhu, World Wildlife Fund;
- Kunzang Yonten, Royal Society for the Protection of Nature;
- Thinley Wangchuk, Ministry of Trade and Industry;
- Sonam Tobgay, Tourism Authority of Bhutan;
- Gyem Tshering, Bhutan Chamber of Commerce and Industries
- Chhador Wangdi, Ministry of Health and Education
- Ugen Norbhu, Ministry of Finance, National Budget and Aid Co-ordination Division

- Tenzin Dorji, United Nations Development Programme
- and more from the Ministry of Agriculture

National Workshop

On January 13, 1997, a one-day national workshop was convened in Thimphu to discuss the approach to be adopted in the preparation of the National Biodiversity Conservation Strategy and Action Plan. An outline of the National Biodiversity Strategy and Action Plan prepared by the consultant Dr. Lee M. Talbot was reviewed and Terms of References (TOR) for the Co-ordinator, Focal Persons and Task Force Members were also discussed.

This workshop was immediately followed up with a meeting of Biodiversity Task Force Members to discuss the TOR for Focal Persons as well as to devise the course of action and future programmes for the core team. The team was given the responsibility of identifying, collecting and reviewing existing reports and plans that should be included in or could contribute to the National Biodiversity Conservation Strategy and Action Plan. One means of collecting the information required for the BAP was familiarisation tours throughout the country for the purpose of meeting relevant persons.

Regional Workshops

In an effort to ensure broad participation of all stakeholders, as well as encourage constructive contributions to the BAP, a series of regional workshops were held throughout the country:
12-14 March 1997: Regional Workshop in Paro
19-21 March 1997: Regional Workshop in Bumthang
24- 26 March 1997: Regional Workshop in Trashigang

The workshops provided a mechanism for consensus building and information gathering. Their purpose was

- To provide a forum for participation for local people who use, affect, study and conserve biodiversity, in order to assure wide participation in the BAP process;
- To assure the differing needs and perceptions of people from different regions is incorporated in the BAP process;
- To seek and to build understanding and support for the BAP through local participation; and
- To compile information from the different regions to assure that the BAP reflects the varied conditions in the differing parts of the country.

Participants

To achieve the objectives the workshop organisers tried to seek the widest participation from groups using and affecting biodiversity. These included representatives of the local people such as Gups, Chimis and Mangi-Aps from each Dzongkhag. Government officials included Divisional Forest Officers, District Agricultural Officers, District Animal Husbandry Officers, Dzongkhag Forest Extension Officers, selected District Education Officers, Research Officers from the RNRRCs, selected Dungtsos, lecturers from institutes such as the Bhutan Forestry Institute, Natural Resource Training Institute, and Sherubtse College. Local users included sawmill owners and paper industry owners.

Task Force Members were invited to join the Core Team at various stages in the tour and to participate in at least one workshop. This provided better insight and understanding of the BAP process for the Task Force Members as well. The workshops were organised and conducted by the BAP Core Team.

Workshop Process

Since the objective was to both gather information as well as seek to build consensus, the workshops were structured so as to encourage maximum participation by local representatives. The workshops were informal with no papers 'read'. Each workshop began with an explanation of biodiversity, sustainable development, the importance of conservation, the Convention on Biological Diversity and the country's obligations to the CBD. Participants were divided into groups dealing with (a) Forestry; (b) Livestock/Pastoral; (c) Arable-Agriculture/Horticulture; (d) Wetlands/Freshwater; (e) Pasture/Grazing; and (f) Wildlife.

The group discussions were held for two days and mainly addressed the following topics,

- The status of biodiversity (varieties known to participants);
- The special significance of biodiversity;
- Existing threats to or from the use of biodiversity;
- Distribution of species;
- Status of wild biodiversity;
- Uses of biodiversity and sustainability of these uses;
- Existing conservation measures currently in use in any region;
- Conservation actions that may be required for the future;
- Conflicting issues; and
- Recommendations to the government.

The local representatives were very keen to share their knowledge with the other participants and also did many presentations. A Task Force meeting was organized to present and discuss the findings of the regional workshops and discuss further actions required.

Based on the findings of the regional workshops, the Forestry Services Division nominated a small working group to discuss the issues raised and come up with solutions or actions for recommendations that came from the workshops. In late May and June 1997, a series of meetings of the Focal Persons and Consultant were held to review progress and compile the draft BAP on the basis of the materials collected, prepared and drafted by the Focal Persons. The draft was assembled from sections drafted by each member of the Core Group. The draft was subsequently reviewed at a meeting of the Task Force and submitted to a final National Workshop.

Final National Workshop

A final National Workshop was held on 17 June 1997 to present and discuss the Draft National Biodiversity Conservation Strategy and Action Plan. The draft was then revised in accordance with the workshop recommendations and submitted to RGOB for approval.

Preparation of BAP II

Bhutan has made significant progress in implementing the original action plan and

improving the conservation and sustainable utilization of biological diversity in the nation. Consequently, in November 2001, the Nature Conservation Division under the Department of Forestry Services of the Ministry of Agriculture took the initiative to update the BAP document with financial support of the UNDP/GEF. The objective was to update the original BAP in the light of these achievements and to present them to the 6th Conference of Parties on the Convention on Biological Diversity in 2002 as the country's second national report on biodiversity.

The updating was to be a part of the ongoing BAP process, so it built upon the extensive work done in the preparation of BAP I, rather than starting anew. Consequently, the process and methodology for updating the BAP was different from the original effort. It primarily involved review and revision of each part of the original BAP to reflect new information and what has been done in the last four years. The action plan proper, in Chapters 3, 4 and 5, was then revised to reflect new priorities for action.

To accomplish this, a process was followed that was similar to the initial phase where a Task Force representing members from different institutions and sectors contributed relevant material.

The Task Force

A Task Force for BAP II was established consisting of a Core Group and Focal Persons representing components of the RGOB, NGOs and the UNDP. The Task Force served as the Steering Committee for the BAP II revisions and acted as a forum for consultation, discussion, review and recommendations for the development of BAP II.

The Core Group: The Core Group comprised of:

- Sonam Choden, Nature Conservation Division;
- Deki Yonten, Nature Conservation Division;
- Karma Tenzin, Department of Forestry Services;
- T.N. Acharya, Department of Agriculture and Livestock Support Services;
- Mahesh Ghimeray, Department of Research and Development Services; and
- Medon Yaganegi, National Biodiversity Centre.

Focal Persons: The Focal Persons were:

- Dr. Sangay Wangchuk, Nature Conservation Division;
- Dr. Ugyen Tshewang, Programme Director, National Biodiversity Centre
- Tenzin Choephyel, Policy and Planning Division
- Dr. Manohar Sharma, Quality Control and Regulatory Services
- Kencho Wangdi and Ed Santos, Renewable Natural Resources Information and Communication Services
- Lam Dorji, Royal Society for Protection of Nature
- Tobgay Sonam, Bhutan Trust Fund for Environmental Conservation
- Chado Tenzin, World Wildlife Fund Bhutan Programme
- Thuji Nadik, Department of Tourism
- Kesang Choden, Department of Aid and Debt Management
- Tshewang Tandin, Department of Education
- Ugyen, Institute of Traditional Medicine Services
- Kumbu Dukpa and Thinley Dorji, National Environmental Commission

- Tenzin Dorji, Seeta Giri and Dr. Durga Devi Sharma, United Nations Development Programme, Thimphu

Initial Workshops and Consultations

Five workshops were held between 16 and 30 November 2001. The participants included the Task Force members plus other individuals relevant to the preparation of the BAP, and the BAP Consultant, Dr. Lee Talbot. The workshops participants agreed on the procedures and methodology, an initial review of BAP I, and identification of the main areas where revision was necessary. During the same period an extensive series of consultations was held between members of the Core Group, the Consultant, and representatives of the RGOB ministries and agencies, NGOs, international organizations, and others in Bhutan who were concerned or involved with biodiversity conservation. These consultations involved Honourable Ministers, other officials of the relevant ministries, departments and agencies, and senior officials of the other institutions and organizations involved, and provided important perspectives and information for the BAP revision.

Preparation of the Revision

During December, January and February the Focal Persons prepared and drafted additions and other revisions to the BAP and forwarded them to the Consultant. From these materials the consultant compiled a first full draft of the BAP II, which was then circulated back to the Focal Persons involved and to the Task Force, which reviewed, commented and improved upon it. Based on this, the consultant prepared the final draft which was again circulated to a wider audience and presented in a final workshop held on 25 March 2002. The draft was then revised as per the workshop recommendations and submitted to the government for approval.

3 Follow up: The BAP as a Living Document

This revision of the BAP illustrates that the BAP is a living document. It is an ongoing process, not a one-time document to be noted and set aside. The BAP provides a framework for action that will enhance Bhutan's ability to ensure the productivity, diversity and integrity of its biodiversity and natural systems, and, as a result, its ability as a nation to develop sustainably. To be successful the BAP must be used and implemented, it must lead to action – and it has. Conditions are changing. Bhutan is developing; its population is rising; knowledge and understanding about biodiversity is increasing; and the nation's ecosystems are in a dynamic state. The successful achievement of some of the goals in the BAP will themselves change conditions – and indeed they have. Consequently, the BAP must be and is a dynamic document, which changes to reflect these changes.

As a result, the BAP is an ongoing process of:

- Defining goals and action to attain them;
- Monitoring the actions to see that they are carried out;
- Assessing the success of the actions, both administrative and in the field;
- Determining what changes are required in the BAP itself;
- Making those changes; and
- Repeating the cycle.

Assessing the progress of implementing the BAP will require establishing goals and standards against which progress can be measured. The first-order goals would be the achievement or progress on the actions and objectives specified in the BAP. The second-order goals would involve, for example, the status and trends of key species, habitats and ecosystems – which themselves indicate the ultimate success of the BAP process – and these in turn would require the development of indicators and indicator criteria. This process will be relatively crude initially, given the present state of scientific knowledge about Bhutan's biodiversity. But with time and the achievement of key goals of the BAP, the process is becoming significantly refined.
Experience with BAPs in other countries has shown that it is important to monitor, evaluate and revise the BAP reasonably shortly after its approval by government. Such initial re-evaluation and revision has proved particularly important in Bhutan's case. This is Bhutan's first effort of this type; as noted above both the original and this revised document were prepared from separate parts of drafts prepared by different people; and the time available was short. Consequently some areas of biodiversity have received more complete attention, and some, such as microflora, are not yet covered. Therefore, it is anticipated that relatively significant revisions will continue to be required.

Thereafter, it is desirable for such action to be taken relatively frequently (this first revision was undertaken about three years after publication of the initial BAP) and timed to precede the Conference of the Parties to the Convention on Biological Diversity, so that the results of the evaluation can serve as the nation's report to that conference, as required by the Convention. If they are properly carried out, the periodic evaluations of the BAP can serve as a report on the state of the nation's biodiversity. Such a report can be of great value both to the government and to the general public, and as such it can help build continued support for biodiversity conservation.

In the future, the BAP document will be updated by the National Biodiversity Centre (NBC) with the approval and recommendation of the Biodiversity Management Board (BMB). The NBC has been established with the mandate to facilitate and coordinate all the biodiversity related activities in the country. It is recommended that the NBC establish a BAP Task Force – basically the one which prepared this BAP II – that will be responsible for meeting every six months to review progress under the BAP and consider and recommend what actions need to be undertaken. Depending on the reviews, the BAP Task Force must determine the time for the next publication, as it can be an expensive activity. However, the recommendation is that during the course of the RGOB's 9th Five Year Plan period at least one revised version should be published.

4 Organization of the BAP

The Biodiversity Conservation Action Plan for Bhutan is organized into an Introduction and Five Chapters. Chapters One and Two represent an inventory of what Bhutan has at present (spring, 2002) in terms of biodiversity and efforts to conserve it. The last three chapters, Chapters 3, 4 and 5, represent the Action Plan proper. On the basis of the information in the first two chapters, Chapters 3 and 4 present the actions that need to be undertaken to conserve and sustainably use the biodiversity. The last chapter presents options for actions that Bhutan can take to realise additional benefits from its biodiversity.

The Introduction – Part I provides a discussion of biodiversity and its values; the process by which the BAP II was developed along with a discussion of the nature and organization of BAP II and the BAP as a "living document", i.e., an ongoing process. The Introduction-Part I also includes a section on Bhutan's achievements in biodiversity conservation in the period since publication of BAP I.

The Introduction – Part II provides an orientation to Bhutan; the nation's unique approach to environment and development; the Buddhist perspective on biodiversity; and the presentation of "wild" versus "domestic" biodiversity in the BAP.

Chapter 1 focuses on the biodiversity itself. It provides an inventory and assessment of what is known about the biodiversity, its status and trends, its special features and significance, the threats to it, and the urgency of conservation and sustainable development.

Chapter 2 focuses on what is being done to conserve or sustainably use the biodiversity. It describes what is being done, evaluates the strengths and weaknesses and identifies what are the areas where more needs to be done to improve the situation.

Chapter 3 is the first part of the Action Plan proper. It specifies the direct actions needed for the conservation and sustainable use of the biodiversity itself, covering ex situ and in situ measures.

Chapter 4 specifies the measures that are essential to support the direct actions described in Chapter 3. These essential supporting actions include measures such as policy and law, institutions, research, capacity building and public awareness.

Chapter 5 presents options for actions (additional to and in more detail than those in the previous two chapters) that Bhutan can take to realise additional substantial but sustainable benefits from its biodiversity resources. The actions covered include such areas as ecotourism, bioprospecting, and carbon storage.

5 Principal Accomplishments since BAP I

Since publication of BAP I in 1998, significant parts of the Action Plan have been accomplished. The principal accomplishments are listed briefly below. They and others are discussed in more detail in BAP II, particularly in Chapter 2, but are also mentioned elsewhere throughout the BAP.

1 Strengthening Government Institutions to Conserve Biodiversity

In BAP I, there was a strong recommendation to establish an integrated National Biodiversity Programme within the Ministry of Agriculture (MOA) as an operational level programme, and mechanism to improve the co-ordination, efficiency and effectiveness of Bhutan's efforts in biodiversity conservation. This recommendation was necessary given that the biodiversity related responsibilities in Bhutan were scattered among different institutions often causing overlaps in activities and difficulties in co-ordination, goal setting, planning and cooperation.

Establishment of the National Biodiversity Centre

In order to improve the nations' efforts towards a mechanism for biodiversity conservation, an integrated national biodiversity programme called the National Biodiversity Centre (NBC) was formally established as a non-departmental agency under the MOA in late 1998. The NBC has a mission to oversee and ensure the implementation of the Biodiversity Action Plan and to promote the effective conservation, sustainable utilization and ensure equitable sharing of benefits arising from the conservation and the sustainable utilization of the nation's rich biological resources.

The NBC is vested with the following institutional mandates:

- Co-ordinate Bhutan's biodiversity related activities and serve as a national focal institute;
- Facilitate national decision-making on biodiversity concerns, cutting across sectors, divisions and institutions;
- Guarantee a national balance between conservation and sustainable utilization of biological resources in general, and between in situ and ex situ conservation in particular;
- Assure a participatory approach to building national consensus on biodiversity around complex issues and resolving conflicting situations;
- Facilitate sub-regional, regional and international cooperation; and
- Assure continuity of biodiversity related activities over time.

These broad-based directives are in agreement with the long-term development goals of the RGOB. This means that the ecological, economical, social, cultural and aesthetic values of biodiversity are recognized in the nation's planning and policies and in the prioritization and the deployment of financial and other resources.

There are currently various projects being implemented under the NBC regarding ex situ and in situ conservation efforts towards wild and domestic biodiversity in the nation (details in Chapter 2, Section 2.4.3).

Establishment of a National Biodiversity Management Board

A National Biodiversity Management Board (BMB) was formalized on 2 August 2000, with 13 members representing a cross-sectoral body comprising of important stakeholders involved with biodiversity management. The board was formed to have the executive authority over the National Biodiversity Centre and to advise on, review or reform any national policies, projects and actions taken regarding the nation's biological resources.

The mandates of the BMB are to:

- Oversee the implementation of the Biodiversity Action Plan;
- Develop a national policy framework that fosters the sustainable use of biological resources and the maintenance of biodiversity;
- Strengthen capacity for sustainable conservation and utilization of biodiversity;
- Create conditions and incentives for effective biodiversity conservation; and
- Catalyze conservation actions through international co-operation and national planning.

Since its establishment, the BMB has met three times. The TOR and the executive charges of the BMB are further elaborated in Chapter 2, section 2.4.4.

Strengthening of the Nature Conservation Division

The Nature Conservation Section has been upgraded to the Nature Conservation Division (NCD) with increased authority and responsibility. Efforts have been made to increase staff and provide for expanded training opportunities to increase capacity. The NCD now has three sections, (1) Management Planning and Integrated Conservation and Development Programme (ICDP) Section, (2) the Inventory and Data Management Section, and (3) Species Conservation, Research and Monitoring Section. Each national park's management is now structured in the same way. In addition to the annual protected area conferences, NCD holds quarterly meetings for Protected Area Managers and NCD staff to keep up to date on activities and developments.

2 Strengthening Direct Conservation Efforts for Wild Biodiversity

2.1 In Situ Conservation Efforts

Establishment of Protected Areas as on-the-ground entities and completion of management plans

Since the first BAP, Bumdeling Wildlife Sanctuary (BWS) and Thrumshingla National Park (TNP) have been established as on-the-ground entities with a park manager, wardens and park staff. There are now five fully functional Protected Areas (PAs) including Jigme Dorji National Park (JDNP), Jigme Singye Wangchuck National Park (JSWNP) and Royal Manas National Park (RMNP). Management plans for RMNP, JDNP, TNP, and BWS have been prepared and approved, and a one-year plan for JSWNP has been prepared. There have been substantial additional actions to strengthen the protected area system, including expanding the boundaries of TNP and BWS, and completion of infrastructure in most of the PAs. A programme of annual national parks conferences has been instituted. The aim of the conferences is to encourage exchange of information between various PAs, to present technical papers, assess the progress in the implementation of management plans and to share and discuss problems experienced by park staff and seek common solutions, while learning from each other's experience.

Biological Corridors – Linking Protected Areas

Declared as a "gift to the earth from the people of Bhutan by Her Majesty the Queen Ashi Dorji Wangmo Wangchuck in November 1999, a total area of 9percent (approximately 3,804 sq. km) was declared as Biological Corridors to link the various PAs. The designated corridors have been granted full recognition by the RGOB.

The objective of designating these areas was to allow the movement of wildlife between otherwise isolated Protected Areas. Biological Corridors are not strictly Protected Areas and need not be included within the Protected Area Network. The areas will have low intensity land uses such as Forest Management Units, community forests, agricultural lands and riparian corridors.

Park Self Assessment conducted in 2001

Using a format based on International Union for the Conservation of Nature (IUCN) procedures, self-assessment of all operational PAs except RMNP was conducted during July and August 2001. The main objectives were to help provide guidance to NCD and

PAs under the 9th Five Year Plan; to help set priorities for donor support; to review the progress and constraints of protected area management, and to help NCD sections plan for necessary assistance to the PAs.

Integrated Conservation and Development Programme

A common feature among all the Protected Areas is the presence of local communities living in villages in and around the Protected Area. As a result of the complex park-people relationships, any Protected Area policy and management decision has an effect on the local communities and their way of life. The Integrated Conservation and Development Programme (ICDP) is a tool to reduce the impacts on biodiversity of the PA resources use by local communities, make resource use more sustainable, reduce resource use in the core areas of the PAs while at the same time serving to improve the living conditions of the local population.

2.2 Ex Situ Conservation Efforts

Royal Botanic Garden, Serbithang

The Royal Botanic Garden, Serbithang (RBGS) was established on 2 June 1999 to commemorate the 25 years of golden reign of His Majesty King Jigme Singye Wangchuck, the Fourth King of Bhutan. The 28 acres of garden space is to be designed to explore and exhibit the therapeutic value of the plants. The focus will be on plants of economic significance such as those useful for food, fibre, cosmetic and industry, including those species that are endangered.

3 Strengthening Direct Conservation Efforts for Domestic Biodiversity

3.1 In Situ Conservation Efforts

Agro-biodiversity Conservation Project

The Agro-biodiversity Conservation Project, implemented by NBC's Agro-Biodiversity Section, aims to (a) conserve and sustainably use plant genetic resources (PGR) for food and agriculture and (b) assist on-farm conservation techniques.

Biodiversity Use and Conservation Asia Programme

The Biodiversity Use and Conservation Asia Programme (BUCAP) is complimentary to the Agro-biodiversity project in terms of PGR on-farm conservation with emphasis on rice and maize crops.

3.2 Ex Situ Conservation Efforts

National Gene Bank

The National Gene Bank is currently being constructed by NBC to act as a future reservoir of PGR in the country. H.E. Lyonpo Kinzang Dorji, Minister of Agriculture, laid the foundation stone on 18 June 2001.

4 Strengthening Efforts in Essential Supporting Measures

4.1 Strengthening Human Resource Development

Capacity Building for Protected Area Management

Capacity building of Bhutanese nationals through in-country and overseas training has

been given high priority by the MOA. The Bhutan Trust Fund (BTF) sponsors many short-term as well as long-term training programmes for NCD and park staff. In addition to this, individual protected areas also have funds allocated from their respective donor projects to train park staff and park partners.

A number of park staff have undergone training outside of the country in various aspects of wildlife management, survey and monitoring techniques, Rapid Rural Appraisal (RRA), Participatory Rural Appraisal (PRA), ICDP, forest fire protection and control, environment and development, bird censusing, biodiversity assessment and monitoring and community forestry. Groups of park staff, extension agents, forestry staff and Dzongkhag staff, park risups and local school teachers were sent outside of the country on study tours of protected areas in Nepal, Philippines and Australia, but mostly in the Southeast Asia region.

Capacity Building for the NBC

Advanced training in taxonomy has been initiated with the University of Missouri, U.S.A., where an NBC staff is undertaking a Masters course.

NBC staff members received a short training course in herbarium techniques in the Philippines.

4.2 Strengthening the Biodiversity Information Base

The National Herbarium

A new National Herbarium complex has recently been constructed at the NBC in Serbithang. The new herbarium will also have a library with a good reference collection of botanical literature from Bhutan and outside.

The Flora of Bhutan

All nine volumes of the Flora of Bhutan, documenting the nation's wild flora, have now been completed and are available for use.

Biodiversity Survey and Monitoring

The NCD has undertaken a major effort to establish comprehensive programmes for biodiversity survey and monitoring in Bhutan's Protected Areas and other areas of conservation concern such as Biological Corridors and Conservation Areas. Biodiversity surveys have now been completed in all but one of the Protected Areas, and the results already have been applied to management and, in some cases, to expanding boundaries.

Bhutan Integrated Biodiversity Information System

The proposed Bhutan Integrated Biodiversity Information System (BIBIS) is based on the recommendation in the original BAP for the development of a scientific knowledge base for biodiversity in the country. BAP I emphasized that the presence of basic knowledge on the country's biodiversity is a prerequisite for the effective conservation and sustainable use of the nation's biodiversity. The BIBIS project will assist in documenting and creating inventories of all the biological resources in Bhutan into one integrated web-based system. This inventory and information link will play a key role as the scientific knowledge base for implementing bioprospecting in Bhutan.

4.3 Ecotourism

National Ecotourism Strategy
The Department of Tourism has developed the Bhutan National Ecotourism Strategy, with wide participation by the tourism industry, including major stakeholders, and industry workshops in April and September 2001. The Strategy addresses the whole of the tourism sector and establishes a set of ecotourism related principles incorporating biodiversity conservation to guide the future development of the tourism sector.

4.4 Bioprospecting

A biodiversity prospecting training workshop and programme entitled "The Fundamentals of Biodiversity Prospecting: Management Approaches for the Kingdom of Bhutan" was held in May 2001. Bhutan also has now drafted a bioprospecting action plan for the nation.

4.5 New Policies and Laws to Strengthen Biodiversity Conservation

A substantial number of policies and laws have been established since BAP I to help implement parts of the action plan. These include:

- Agro-biodiversity Policy and Legal Framework, being undertaken under NBC through the ABC project funded by the Netherlands;
- Cooperatives Act;
- Environment Assessment Act;
- Farm Road Construction Guidelines;
- Forest and Nature Conservation Rules;
- Land Swapping Policy;
- Livestock Act;
- National Ecotourism Policy and Strategy;
- National Environment Protection Act (under preparation);
- National Environmental Education Strategy (under preparation);
- National Environmental Strategy – The Middle Path;
- Pasture Policy (Draft);
- Pesticides Act; and
- Seeds Act.

Introduction

Part II

1 Brief Description of Bhutan
2 Bhutan's Unique Approach to Conservation and Development
3 A Buddhist Perspective on Environment and Conservation
4 "Wild" and "Domestic" Biodiversity and their Integration within the RGOB

Introduction – Part II

1 Brief Description of Bhutan

The Kingdom of Bhutan is situated on the southern slopes of the Eastern Himalayas. It is land locked between China in the north and India to the east, south and west. It covers an area of 40,076 sq. km (LUPP, 1995) and has a population of 698,950 (CSO, 2001). Its physical features are characterized by high, rugged mountains and an intricate network of deep valleys, ravines and depressions earmarking watercourses, drainage basins, waterfalls, human settlements, glacial lakes and moraine. The components of its biotic feature are as diverse as its geo-physical elements, broadened further by the consequent climatic attributes. Through this natural endowment, the Kingdom has acquired special significance at the global level with regard to biological diversity.

Bhutan is one of the least densely populated countries with 79 percent of the people living in rural areas (CSO, 2001). The local topography and areas with agriculture and business prospects determine the human settlement pattern. The population is growing rapidly at an estimated rate of 2.5 percent per annum (National Health Survey Report, 2000). Updated estimates of land cover based on the analysis of 1989 satellite imagery, showed that forest accounted for 72.5 percent (includes 8.1 percent of scrub forest) of land area. Cultivated area accounted for 7.8 percent of the land cover and includes cultivated wetland, dryland and horticulture, Tseri/Fallow rotation, mixed cultivated land and others. Table 1 shows percents of classified land cover and arable land under different production systems.

Table 1. Land Cover Areas and Percentages

Land Cover	Area (sq. km)	%
Forest	25,787	64.4
Scrub Forest	3,258	8.1
Pasture	1,564	3.9
Tseri/Fallow-Rotation	883	28.1
Agriculture*	3,146	7.8
Snow and Glacier	2,989	7.5
Water Spread/ Marshy	339	0.9
Rock Outcrop	2,008	5.0
Other	985	2.5
TOTAL	40,076	100

Agriculture Land Cover	Area (sq. km)	%
Cultivated Wetland	388	12.3
Dryland/Horticulture	977	31.1
Mixed Cultivated Land	840	26.7
Other	58	1.8
TOTAL	3,146	100

* See separate Table for Agriculture Land Cover

Development in Bhutan is guided by principles which emphasize the need to ensure the preservation of natural and cultural heritage. This allows development from subsistence to a modern economy to proceed in a sustainable manner. The Renewable Natural Resources (RNR) sector of the RGOB, represented by the MOA, covers agriculture, livestock and forestry. Although the economy has been diversified, the RNR sector remains the single-most important sector accounting for 35.9 percent of the Gross Domestic Product in 2000 (CSO, 2001) with 79 percent of the population directly depending on agriculture for their livelihood.

2 Bhutan's Unique Approach to Conservation and Development

His Majesty the King Jigme Singye Wangchuck has stated that:

"Throughout the centuries the Bhutanese have treasured their natural environment and have looked upon it as the source of all life. This traditional reverence for nature has delivered us into the twentieth century with our environment still richly intact. We wish to continue living in harmony with nature and to pass on this rich heritage to our future generations (RGOB, 1996)."

The people of Bhutan have managed to achieve this goal primarily due to the enlightened leadership of our Kings, by maintaining the integrity of our culture and by revering and adopting the philosophies of Buddhism, which is the state religion of Bhutan, in our daily lives.

The RGOB, to further strengthen its role towards sustainable development in Bhutan is adopting the middle path approach by applying a policy that supports the integration of conservation and sustainable economic development. To achieve this goal, the RGOB has set up policies and programmes which forego short-term profit at the expense of long-term loss of the biological heritage.

According to Buddhist and pre-Buddhist philosophies, the mountains, rivers, streams, rocks and soils of Bhutan are believed to be the domain of spirits. The Buddhist respect for all living things has led to the development and adoption of ecologically friendly strategies – a solid foundation for a National Biodiversity Conservation Strategy. This, coupled with the Buddhist tenet that the acts of this life will be rewarded or punished in the next, provides a powerful motivational principle for sustaining Bhutan's natural resource base including its outstanding biodiversity.

In accordance with these principles, RGOB has placed primacy on conservation of Bhutan's natural resources, when formulating development and economic policies (Paro Resolution 1990; RGOB 1991; NEC, 1993; FSD, 1995). Cognizant of the environmental disasters in neighbouring countries resulting from development policies that largely ignored the inevitable consequences of environmental backlash in favour of quick economic returns, Bhutan has opted to pursue a cautious and environmentally friendly approach to development. This approach has been embodied within the Forest Policy of Bhutan, 1991. Although the policy recognizes the need for the use of forestry resources, such use will be guided by principles of sustainability. Thus, priority has been placed on conservation, with purely economic benefits relegated to a secondary role.

Conservation is not a new concept to the RGOB and the people of Bhutan. A religious and cultural ethos based on the Buddhist philosophy that values all life forms has fashioned a life-style that is very much conservation oriented (Bunting and Wangchuk, unpublished; RGOB, 1991; FSD, 1995). Bhutan had established an extensive system of Protected Areas, including wildlife sanctuaries and nature reserves by 1978. Since then the RGOB has, among other actions:

- Identified and notified nine Protected Areas representative of Bhutan's diverse ecosystems, comprising over 26 percent of the country's land area;

- Declared an additional 9 percent of the total area as Biological Corridors connecting all Protected Areas;
- Pledged to maintain 60 percent of Bhutan's land under forest cover;
- Included provisions for establishing Protected Areas and conservation regulations in the Forest and Nature Conservation Act, 1995;
- Passed the Forest and Nature Conservation Rules, 2000, for effective implementation of provisions in the Forest and Nature Conservation Act of 1995;
- Established the Nature Conservation Division with a mandate to oversee and manage the Protected Areas System and conserve Bhutan's biological diversity into the future;
- Established the Bhutan Trust Fund for environmental conservation to provide long-term funds for conservation and related activities;
- Established a National Biodiversity Management Board to be the policy and decision making body on biodiversity related activities in the nation;
- Established the National Biodiversity Centre under the MOA to oversee the co-ordination and the implementation of all biodiversity related activities in the country;
- Established a Royal Botanic Garden for ex situ conservation efforts of the flora of Bhutan; and
- Established a National Gene Bank for the ex situ conservation of agro-biodiversity

In spite of the many challenges that Bhutan faces, and the limited economic opportunities, the RGOB has made it a policy to avoid over-exploitation of its forests and minerals. The RGOB has instead chosen to forego immediate economic gains and has placed a higher priority on the conservation of natural resources. The RGOB has continued to take steps to strengthen its legislation and adopt policies that reflect the significance it places on long-term conservation of Bhutan's biodiversity.

3 A Buddhist Perspective on Environment and Conservation

Buddhism, the state religion of Bhutan, teaches respect for all life forms. The Buddha taught his followers to cultivate boundless love towards all beings in the manner a mother would protect her only child at the risk of her own life. Such a philosophy is the basis of the Bhutanese cultural fabric. The four great events in the life of the Buddha took place under the trees – his birth, his enlightenment, his first teaching in the Deer Park of Saranath and his passing away. The Buddha taught love for all beings just as a tree that provides shade even to the axe-man that comes to cut it.

The crux of the Buddha's teaching is "*Tendrel Gi Choe*" or the interdependence among all life forms. In the continuous cycle of birth and death, there is not a single being that has not been, at one point of time or another, our mother. Therefore, the Buddha taught respect for all life forms in the manner that we respect our mother. The physical form, according to Buddhism, consists of four elements – earth, water, fire and air. There are the same

corresponding elements in nature, which are directly linked to the elements of the physical forms. Therefore, if the elements within the life form are to be pure, then there must necessarily be an environment where the same elements can be found in their pure state.

Buddhism is all about the growth of the human mind so that it can achieve the highest level of wisdom. The stories of Buddhist saints and sages are replete with examples of how they moved to nature's wilderness once they had acquired adequate levels of academic proficiency in the Dharma. It is this profundity of nature - its richness, its wilderness, its diversity etc. that helps to stimulate the loftiness of their own thoughts.

In the everyday life of the Bhutanese, certain deities such as '*Lha*' (deities of the heaven above), '*Tsen*' (deities of the mountains), '*Lu*' (beings of the underneath world) and '*Sadag'* (deities of the land) are worshipped and evoked. The practice comes from the society's deep respect for nature and its environment. There is a fervent belief that if we pollute the heaven above, the mountain in-between and the land below, we are bound to suffer the wrath of their respective deities. So concern for environment is found deeply embedded in our beliefs and day-to-day activities.

4 "Wild" and "Domestic" Biodiversity and their Integration within the RGOB

Throughout the BAP the material is presented in terms of Wild Biodiversity and Domestic Biodiversity. This facilitates presentation for several reasons. The Convention on Biological Diversity draws such a distinction, defining domestic or cultivated species as species in which the evolutionary process has been influenced by humans to meet their needs. The RGOB administration, agencies and programmes are specific to wild or domestic biodiversity. Also, in many cases the species are different.

However, there is actually often no clear dividing line between the two. Wild relatives of domestic crop plants may have great significance to domestic agriculture. The use of wild species for purposes such as food, medicine, construction and fuel is an integral part of the life of much of Bhutan's population. Both wild and domestic species are dependent upon the ecosystems and habitats of which they, in turn, are integral parts.

Further, this division does not reflect the integration that the RGOB has sought to accomplish through the creation of the RNR sector and the National Biodiversity Centre.

Chapter 1

The Status of Bhutan's Biological Diversity

1.1 Overview of Biological Diversity in Bhutan
1.2 Terrestrial Ecosystem Diversity
1.3 Aquatic Ecosystem Diversity
1.4 Wild Species Diversity
1.5 Domestic Biodiversity
1.6 Threats to Bhutan's Biodiversity
1.7 The Urgency of Biodiversity Conservation and the Need for Sustainable Development

1.1 Overview of Biological Diversity in Bhutan

The Kingdom of Bhutan has a rich and varied biological diversity (both wild and domestic) that has regional and global importance. Very few countries in the world match Bhutan's biological diversity and fewer still have taken such strong steps to conserve their biodiversity. Bhutan ranks in the top ten percent of countries with the highest species density (species richness per unit area) in the world, and it has the highest fraction of land in Protected Areas and the highest proportion of forest cover of any Asian country. Bhutan is one of a very few biologically diverse countries in the world which have the opportunity to maintain its biodiversity largely intact in the coming decades (REID, 1996).

Bhutan's richness in biological diversity is found at the ecosystem, species and genetic levels. Considering Bhutan's terrestrial ecosystems, forests cover about 72.5 percent. Aquatic ecosystems, although largely scattered, account for a relatively small portion of the total land cover in Bhutan. 26.23 percent of Bhutan is under the Protected Area Management System. In addition, 9 percent has been declared as Biological Corridors connecting all the Protected Areas, and there is a series of Conservation Areas, which are intended to protect important conservation sites outside the formal Protected Area System. As a result, more than 35 percent of the country's area is under some form of conservation management.

Regarding diversity at the species level, inventories undergoing completion have indicated that there are more than 5,500 species of vascular plants, more than 770 species of avifauna and more than 165 species of mammals, with many species being endemic to Bhutan. This rich species diversity indicates an equally rich genetic diversity. The domestic biodiversity in Bhutan includes species that are either native or ones which have been introduced and, which over time, have developed unique genetic, morphological and ecological characteristics. The diverse flora includes many economically important plants such as medicinal herbs, industrial plants, horticultural crops and others yet to be identified.

1.2 Terrestrial Ecosystem Diversity

Bhutan has great diversity of ecosystems partly because of its location at the juncture of the Palearctic realm of the temperate Eurasia and the Indo-Malayan realm of the Indian sub-continent, and partly due to the country's great geological relief and climatic heterogeneity. Valleys in the inner mountains receive less than 800 mm of precipitation, while rainfall in the lowlands is as high as 5,500 mm. The country includes a range of ecosystems from the sub-tropical zone in the south at an elevation of 150 m to mid-elevation temperate zone, and to the northern alpine zone above 7,000 m.

While there are few areas of the country that have not experienced some human activities, most ecosystems remain substantially intact. According to the latest land use survey, conducted by the Land Use Planning Section, MOA, approximately 8 percent of the country is under cultivation, and the total land area under forests is 29,045 sq. km or 72.5 percent of the country. Out of this total, 8.1 percent or 3,258 sq. km have been classified as degraded forest or natural scrub forest. Coniferous forests constitute 26.5 percent, broadleaf forests 34.3 percent, and plantation 0.2 percent. The interaction of topography, climate and human use has resulted in the development of a complex pattern of vegetation and habitat types throughout Bhutan.

1.2.1 Forest Ecosystems – Ecofloristic Zones

The Forests of Bhutan can be divided into three ecofloristic zones based on altitudes. Each zone contains a distinct set of eco-zones as follows:

- Alpine Zone, which includes areas above 4,000 m of altitude and contains no forest cover.
- Temperate Zone, which lies between 2,000 m and 4,000 m of altitude and contains the major temperate conifer and broadleaf forests.
- Sub-tropical Zone, which lies between 150 m to 2,000 m of altitude and contains tropical and sub-tropical vegetation.

1.2.2 Forest Types

a) Fir Forest

This forest type is found in the highest forested ridges, between 2,700 m and 3,800 m. It requires relatively high precipitation (probably 133+ cm), part of which is obtained as condensation. Hemlocks and Birches may also be present. Towards the tree line (at 3,600-3,800 m) Firs becomes stunted and grade into Juniper and Rhododendron scrub. The total area under Fir is about 345,302 ha.

b) Mixed Conifer Forest

This forest type occupies the largest portion of the sub-alpine region of the country between 2,000 m and 2,700 m of altitude. The forests are coniferous and are dominated by Spruce, Hemlock, Larch or mixtures of these species. Hemlock tends to be found on wetter slopes than Spruce and is generally decorated by beard-like lichens and mosses. The total area under mixed conifer is about 486,827 ha.

c) Blue Pine Forest

This forest type is found in the temperate regions between 1,800 m and 3,000 m in Ha, Paro, Thimphu valleys in the West and Bumthang and Gyetsa valleys in central Bhutan. It is sometimes found mixed with Oak and Rhododendron. The total area under Blue Pine forest is about 128,593 ha.

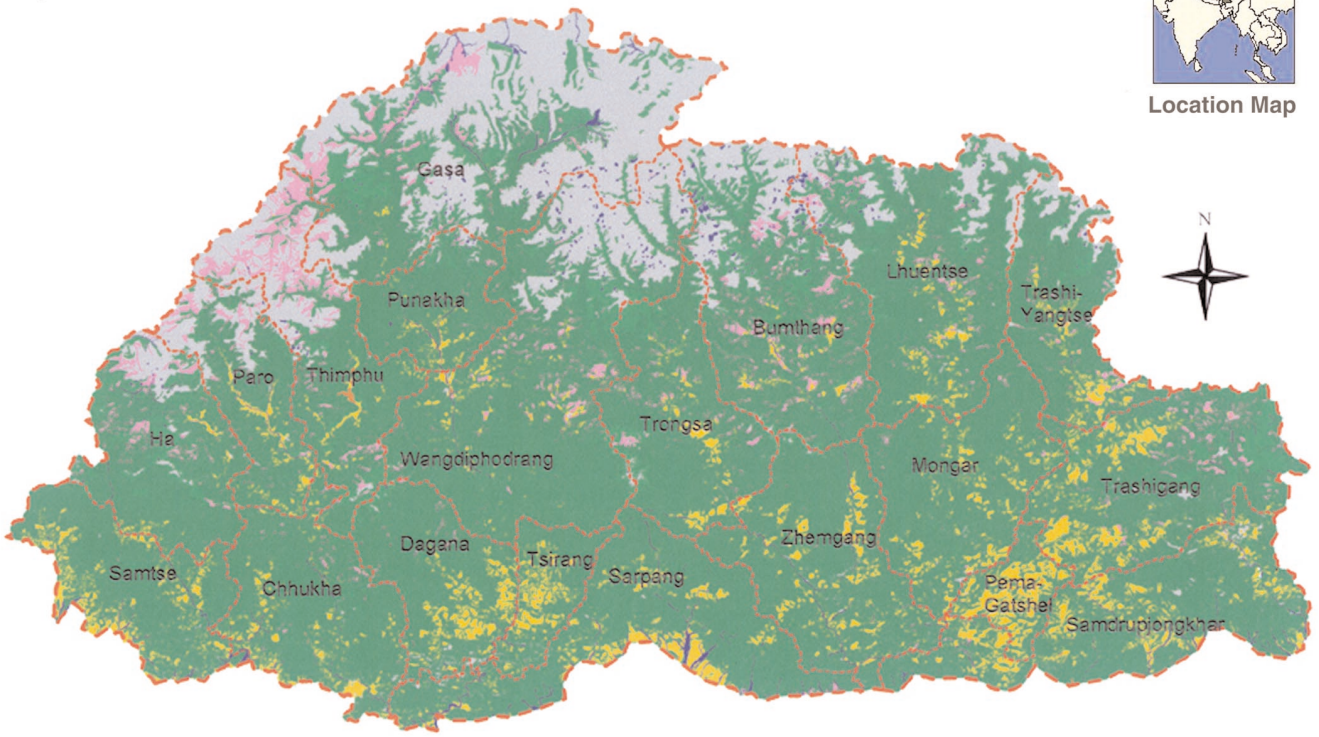
d) Chir Pine Forest

A low altitude (900-1,800 m) xerophytic forest type occurring in deep, dry valleys of Sunkosh, Kuri chhu and Kulong/Dangmechu river systems, is essentially under sub-tropical conditions. A long dry season is characteristic of these areas, the annual precipitation of 1,000-1,300 m falling primarily during the summer monsoon. Chir Pine forests are much influenced by human activities, including tapping for resin, felling for timber, and frequent ground fires that are deliberately set to produce fresh grazing for livestock and to produce new lemon grass growth, which is harvested for essential oil production. The total area under Chir Pine forests is about 100,899 ha.

e) Broadleaf Mixed with Conifer

In some parts of Bhutan, the gradation between Broadleaf and Coniferous forest is gradual and there are extensive areas of a mixture of these two forest types. These mixed forests are generally Oak mixed with Blue Pine or upper hill forest mixed with Spruce or Hemlock. The total area under this forest type is about 135,789 ha.

Map 1. Land Cover



f) Upland Hardwood Forest

This forest type dominates the temperate hillsides between 2000 to 2900m of altitude. The total area under this hardwood forest is about 450,000 ha. There are two maintypes:

i. Evergreen Oak Forest which is more common in the drier areas especially around Trongsa and above Mongar. Maple and Castonopsis dominate at lower altitudes, while Oak predominates higher up. With increasing altitude this type grades towards Blue Pine with xerophytic Oaks.
ii. Cool Broadleaf Forest of wetter hills, which is richer and has many different species.

g) Lowland Hardwood Forest

This forest type occupies the sub-tropical hills between 1,000-2,000 m of altitude. These forests are a rich and diverse mix of both sub-tropical and temperate genera.

h) Tropical Lowland Forest

This forest type occupies the low hills below 700 m. It is broadly classified as semi-ever green but varies from almost totally deciduous on exposed dry slopes to almost totally evergreen in the moist valleys. The forests are multi-storeyed and specie diversity is very rich. The total area under the lowland hardwood forest and the Tropical Lowland forest is about 4,40,000 ha (RGOB, 1995).

1.2.3 Agricultural Ecosystems

The country can be classified into agro-ecological zones based on the agro-climatic condition determined by altitude, rainfall and topography within three broad geographical zones: the Southern Foothills, the Inner Himalayas and the High Himalayas.

Livestock and associated farming systems differ from one agro-ecological zone to the other based on altitude, temperature and rainfall distribution. Their combined effects greatly influence agricultural activities.

a) Temperate Zone

This zone covers cultivated areas in high altitude (2,500-4,000 m) with low rainfall, so dryland farming is common. Nomadic yak herders operate the livestock system. In this zone, livestock forms a predominant feature of the farming system. In particular, a small but distinct population of pastoralists maintain herds of yak and sheep on summer alpine pastures migrating down to about 3,000 m before the snowline during winter. Horses, donkeys/mules and dogs also form part of the livestock living in this eco-system. Wheat, potatoes, buckwheat and mustard are grown in summer; wheat and barley are grown in winter. Crop cultivation and management follow traditional methods.

b) Warm Temperate Zone

This zone falls between 1,800-2,500 metres above sea level. Temperatures are slightly warmer here than the Temperate Zone, although winter frost still occurs. Within this zone are semi-nomadic Siri and Mithun herders, who often have family links with the lower zone. They keep pigs, poultry, dogs, cats, horses and small ruminants. After the harvest, cattle are allowed to graze on the crop stubble. Rice straw is used as winter fodder for the cattle. For a certain period during winter, feeding of crop residues is the only alternative. However, due to severity of the climate at this elevation,most of the farmers migrate to lower altitudes in the south. In the wetland, rice is grown in summer followed by wheat, potatoes

or other vegetables in late winter; rice varieties are mostly traditional red types. The use of improved tools and farm machinery is popular (e.g., power tillers, power threshers, reepers, weeders, etc.).

c) Dry Sub-tropical Zone

In this zone, the temperature is comparatively higher than the other two temperate zones. After harvest, cattle are tethered on the paddy land and maize fields after harvest mostly for manure. Rice is the main summer crop followed by wheat, mustard and vegetables. Improved crop varieties and use of fertilizers and herbicides are gaining popularity, however farmyard manure is still applied. High crop yields are obtained compared to other agricultural ecological zones.

d) Humid and Wet Tropical Zone

This zone fall within 150-1,200 metres above sea level and has excellent areas for crop cultivation. Fodder is scarce here so the cattle are tethered in cropping areas prior to preparation and livestock rearing in these zones is normally stationary. Cattle are kept for milk production and draught power. As these lands are mostly arable, the farmyard or cattle manure is the ingredient of compost fertilizer to be used in the field. Due to scarcity of fodder, maize fodder, grown prior to rice and crop residues, is fed to cattle during winter.

In the humid zone, the main cropping pattern in the wetlands is rice followed by wheat or mustard as in the dry sub-tropical areas. However, due to higher rainfall and humidity there are more insect and disease problems in crops. Citrus (mandarin types, locally called "oranges") are grown as cash crops. In the dryland, maize is the main crop followed by mustard, millet and buckwheat.

In the wet zone rice is the main summer crop. Maize or wheat are grown in winter depending on irrigation. Irrigation sources are mostly monsoon-fed and dry up in winter, therefore lack of water precludes large-scale winter cropping. In the dryland, maize is the main crop. Other crops include cowpea, mustard, niger, millet and sorghum.

Table 2. The Six Major Agro-ecological Zones

Agro-ecological Zone	Altitude (metres above sea level)		Temperature (degree celsius)			Rainfall (millimetres per year)
			Monthly Max	Monthly Mean	Mean Annual	
Alpine	3,600-4,600	High	12.0	-0.9	5.5	<650
Cool Temperate	2,600-3,600	High	22.3	0.1	9.9	650-850
WarmTemperate	1,800-2,600	High	26.3	0.1	12.5	650-850
Dry Sub-tropical	1,200-1,800	Mid	28.7	3.0	17.2	850-1200
Humid Sub-tropical	600-1,200	Mid	33.0	4.6	19.5	1,200-2,500
Wet Sub-tropical	150-600	Low	34.6	11.6	23.6	2,500-5,500

Source: RNR Research Strategy and Plan Document (May 1992).

1.3 Aquatic Ecosystem Diversity

Bhutan has different forms of aquatic habitats scattered throughout the country. A large number of high altitude lakes and the major river systems originate from the high Himalayas – providing a renewable water source. The waters from these rivers and lakes descend from the northern mountainous region to the southern lowlands. The tremendous difference of altitude and the climatic contrast from north to south creates a wide variation of ecological conditions ranging from glacial or freezing lakes and streams to torrential cold waters of mountainous regions to slow flowing to stagnant eutrophic warm waters of lowlands. The fish have also adapted to the diversified ecological conditions by establishing different forms, developing different feeding habits and some developing special organs to attach to rocks or to absorb atmospheric oxygen to respire.

Bhutan's aquatic habitats are found throughout the various ecological zones. They range from glacial origin, perennial torrential rivers to seasonal rivulets or streams, high altitude lakes and springs to lowland lakes, swamps and marshy lands of river flood plains to paddy fields and man-made reservoirs to village ponds. In the near future a greater area of water surface will be added from the implementation of a series of hydropower, irrigation and aquaculture development projects.

a) Rivers

Bhutan has vast inland resources in the form of rivers and lakes. The Manas River system with a total length of 3,200 km is the principal drainage followed by Sunkosh River (1,810 km), Wang Chu (610 km) and Amo Chu (310 km). Besides these, Mangde Chu, Badanadi and Jomori Chu (Dhansiri) are the other rivers which contribute to the overall drainage of the country. Barring Amo Chu, Badanadi and Jomori Chu, the principal tributaries of these river systems are as follows:

Table 3. Major Rivers and their Principal Tributaries

Number	River System	Tributaries	Number	River System	Tributaries
1	Manas River	1. Kholung Chu 2. Tawang Chu 3. Amri Chu 4. Sheri Chu 5. Kuri Chu	4	Mangde Chu	1. Chumey Chu 2. Chamkhar Chu 3. Tang Chu 4. Mangde Chu 5. Chendebji Chu
2	Sunkosh River	1. Pho Chu 2. Mo Chu 3. Dang Chu 4. Daga Chu	5	Amo Chu	–
3	Wang Chu	1. Wang Chu 2. Paro Chu 3. Ha Chu	6	Badanadi	–

b) Lakes

A number of small and medium-sized lakes are scattered throughout the country. All the lakes have not yet been surveyed both for their area, location and the flora and fauna. Studies need to be conducted for flora and fauna of the lakes. It is expected these studies will identify many endemic species of both flora and fauna.

c) Man-Made Reservoirs

There are only a few reservoirs in the country, the prominent one being the diversion dam for the Chukha Hydropower. Not much work has been done either to assess the reservoirs' flora and fauna or to culture fish in the water body. Many more reservoirs are expected to be made in the near future as a number of hydropower and irrigation facilities are either in the process of construction or included in future plans.

Government policy requiring mandatory Environmental Impact Assessments (EIAs) with special consideration for biodiversity and its relationship to the proposed power facilities is needed.

d) Village Ponds

Numerous village ponds are scattered all through the southern region of the country and many more are expected with development plans to enhance aquaculture production.

e) Irrigated Paddy Fields

The staple food of Bhutan being rice there are a lot of paddy fields scattered all over the country. Most of the paddy fields are filled with water for at least a few months during the monsoon. Traditional as well as modern irrigation system presently covers a considerable area of paddy field under irrigation.

f) Marshy Land

In addition to the rivers, lakes and reservoirs, it is estimated that marshy lands, in the form of depressions and water logged areas, constitute a considerable area of the country. Such aquatic habitats are rich in biota and serve as good habitat for resident as well as migratory birds, reptiles, amphibians and fishes.

1.4 Wild Species Diversity

Bhutan is extraordinarily rich in wild species biodiversity, including a large percentage of endemics. Moreover, the ecological and biodiversity integrity of the country is still largely intact. The natural forest covers over 72 percent of the country, agriculture remains largely the traditional, highly integrated farming systems, and the country has a very comprehensive Protected Area system. The system stretches from the sub-tropics in the south, through the temperate areas in the central interior, to the alpine zone in the north. This Protected Area system, including the linking Biological Corridors, serves as a globally unique system for in situ conservation of biodiversity.

It is noteworthy that the wild fauna and flora of Bhutan are very rich but, in general, the fauna remains poorly known. In terms of mammals, for example, the National Conservation Plan for Bhutan (Mackinnon 1991) provides a provisional list of 178 species based on predicted occurrence. This includes 24 internationally threatened species and 64 species that may be nationally endangered; however it needs to be emphasized that this is a provisional list and not a list of known species. A subsequent list of 145 species produced by Yonzon (1992) included 74 species (mostly shrews, bats and rodents) that are suspected but not yet confirmed to occur in Bhutan. Within Bhutan's borders, one can find over 60percent of the endemic species of the eastern Himalayan region.

1.4.1 Mammals

Within the altitudinal range of the Bhutan Himalayas, one can distinguish three different ecological units with their typical mammalian fauna.

- High altitude fauna includes the snow leopard, blue sheep, red panda, marmot, Tibetan wolf, Tibetan antelope, takin and Himalayan musk deer.
- In the temperate zone, the grey langur, macaque, tiger, common leopard, goral and serow are found. The old growth in the temperate broadleaf forests, with a variety of fruit-bearing trees and bamboos provide habitat for the Himalayan black bear, red panda, squirrel, sambar, wild pig and barking deer.
- The sub-tropical lowland fauna in the lush forests of the south includes animals such as the tiger, one-horned rhinoceros, Asiatic water buffalo, pygmy hog, golden langurgaur, clouded leopard, swamp deer, pygmy hog, hispid hare, capped langur and sloth bear. The riverine vegetation serves as habitat for lynx and takin, and the lower riparian acts as dispersal corridors for tigers.

  Several species of mammals are globally or regionally threatened and some are listed in Schedule I of the Forest and Nature Conservation Act, 1995. These include several species that can be considered as 'flagship' species such as the takin, blue sheep, snow leopard tiger and red panda. Other species of conservation importance for reasons of threat and/or their ecological roles as significant predators or prey are the great Indian rhinoceros, Asian elephant, Himalayan black bear, leopard, wild dog, musk deer, sambar, barking deer, goral, serow, marmot and pika.

  Several species of mammals are habitat specialists and thus have restricted range distributions. For instance, blue sheep use alpine meadows for grazing and venture into alpine scree in the ridge tops above the meadows. During winter, blue sheep migrate down into the alpine scrub habitat. Takin follow the blue sheep migratory pattern but remain in one habitat category below, by migrating into alpine scrub in summer and down to the sub-alpine and cool temperate broadleaf forests in the winter. During winter, takin populations can be found around Gasa, Tashithang and Bayla, and in summer around Lingshi, Lunana and Tsharijathang. The distribution of the snow leopard is restricted to the higher elevations, such as alpine scree and meadows. Musk deer, usually found in moist sub-alpine forests, overlap with the red panda, which inhabit old growth mixed conifer and temperate forests with heavy moss cover on trees and bamboo undergrowth.

  Other mammals restricted to higher elevations include the marmot, which is found in localized colonies in the alpine meadows, and pika, which is distributed from the sub alpine forests to alpine meadow. Both these species are likely to form an important base for many carnivores, such as foxes, martens, weasels, snow leopards and predatory birds (NCS, 1996).

1.4.2 Avifauna

Although Bhutan's avifauna is still not well known, around 770 species to date have been recorded (MacKinnon 1991, RGOB, 1996). The avifauna includes both Indomalayan (tropical) and Palearctic (temperate) elements. Approximately 73 percent of the known species are resident. Most of the resident species are altitudinal migrants (Inskipp and Inskipp no date) that move between higher altitude breeding areas and lower altitude

wintering areas. The remainders are summer visitors that breed in Bhutan but winter elsewhere; winter visitors that breed further north; passage migrants or vagrants (Inskipp 1995).

Birds typical of the alpine area include the snow pigeon, yellow billed chough, red billed chough, upland pipit, robin accentor, rufous breasted accentor, grandala, and Tibetan snow finch. Other birds in the alpine scrub include the fire-tailed sunbird, black red start, rose finch, red headed bullfinch, white winged grosbeak and Juniper finch, although most of them are summer visitors. Some of the rarer bird species characteristic to sub-alpine birch rhododendron forests are the golden bush robin, gold crowned black finch and fire-tailed myzomis. Birds in the Temperate Zone include the pheasant, partridge and martin.

Bhutan supports significant populations of at least 119 species of birds whose breeding ranges are restricted to the area encompassing the Himalayas, North-eastern India, Northern Southeast Asia and South-western China (Inskipp et.al, 1993). Several birds that are globally and/or regionally threatened occur throughout the country. Some are listed in Schedule I of the Bhutan Forest and Nature Conservation Act, 1995. At least 12 of Bhutan's bird species are considered to be globally threatened (WCMC/IUCN 1994) and 11 have world-wide breeding ranges of less than 50,000 sq. km (ICBP 1992), putting them at risk from any significant loss. Bhutan's temperate and sub-tropical broad-leaved forests are particularly important for bird conservation, as a high proportion of the area of these forest types remaining on the south subcontinent lies in Bhutan. The low altitude broad-leaved forests in the extreme south of the country support a particularly high diversity of bird species (Inskipp et.al, 1993).

Table 4. Number of Bird Species in Bhutan with Internationally Significant Breeding Populations

Habitat Type	Number of Bird Species
Warm broad-leaved forests	19
Cool broad-leaved forests	35
Mixed coniferous/broadleaved forests	31
Blue pine forests	6
Sub-alpine forests	
a. Fir	45
b. Spruce	10
c. Juniper	10
Alpine scrub	9
Alpine meadows	4
Wetland (river, marsh, pool)	1
Cultivation around villages	1

Source: Department of Forestry Services

1.4.3 Herpetofauna

The herpetofauna of Bhutan is poorly documented but is considered to be rich, particularly in the tropical/sub-tropical areas of the south (MacKinnon 1991). MacKinnon, et al (1994), provides a list of 15 reptiles and three amphibians in Manas National Park, a small part of which extends into the east in the sub-tropical zone. There are many

reptiles including the crocodile, several river turtles, pythons and other snakes, and lizards. Tadpoles were even found in alpine lakes to the south of Tse thso La at 4,300 m (Wikramanayake 1995; NCS, 1996). Threatened species of herpetofauna include the Gharial, the Indian python and the yellow monitor lizard (MacKinnon et al, 1994; WCMC/IUCN 1994).

1.4.4 Invertebrates

1.4.4.1 Butterflies

A start has been made in cataloguing the butterflies in Bhutan. The country is considered to have rich butterfly fauna, including some rare species (MacKinnon 1991). Yonzon (1992) lists 50 species as occurring in Bhutan, based on literature review and field studies, of which 28 are endemic to the Eastern Himalayas and the others are rare or uncommon. At least four species are considered to be internationally threatened (WCMC/IUCN 1994). Butterflies are extremely varied and include some rare swallowtails and other precious species like the *Bhutanitis lidderdali, Troides spp., Atrophaneura spp. alpine Parnassus spp.* and the spectacular *Teinopalpus imperials.*

Butterflies have been used as an indicator species, ncluding as indicators of habitat condition, in rapid biological inventories elsewhere (e.g. Davenport et al 1994; Howard and Viskanic 1994). It would be useful to develop additional data on butterfly distribution, abundance and habitat associations in Bhutan (Salter, 1995).

1.4.4.2 Bees

Bhutan's diverse agro-ecosystems have provided sanctuary for at least four different species of honeybees, namely, *Apis cerena, Apis dorsata, Apis laboriosa and Apis florea.* These wild bees are the most efficient pollinators of agricultural and horticultural crops. Without their pollination services, both yield and quality of the mountain crops may be compromised. These bees are also an important indicator of ecology and can be used as efficient conservation tools to monitor the health of the ecosystem. Besides producing valuable natural wax, these bees produce as much as 50 kg to 80 kg of honey per colony.

In the neighbouring Himalayan countries and elsewhere in the world, honey hunting and exploitation for wax are leading to shrinkage of wild bee populations. In Bhutan, however, harvesting honey from a bee colony (especially of the wild species) is still considered a taboo. Bhutanese believe that bees put in a lot of work to produce a little honey and so it is a sin to rob them of their hard-earned produce. This philosophy, which is still respected in Bhutan, has probably contributed to the existence of a diverse and rich local bee types. Studies have indicated that Bhutan could be the largest home to the Giant Rock bee *Apis laboriosa*, which is endemic to the Himalayas.

Currently, the beekeeping industry in Bhutan is promoted with introduced European *Apis melifera* species. Some International Centre for Integrated Mountain Development ICIMOD) reports have alleged that there is a threat of replacing the local bees by this species and therefore warrants conservation of the local bees. Besides contributing to conservation of local biodiversity, promotion of bee industry using local bees can provide a viable proposition especially in the southern part of the country. Most of the households in the south keep one or two log hives of local bees.

Observations made by experienced beekeepers in Bhutan indicate changes taking place in the population dynamics of these wild bees. Information on their population distribution, trends and characteristics are limited. Their contribution to agricultural productivity through pollination services is also not widely recognised in Bhutan. The *A. laboriosa* bee, which is considered as a rare species, is still less understood, and not many references are available. Attention is required for the conservation and utilization of these important bee species. The use of wild bees as a tool to monitor the health of the forests could become an innovative, pro-active strategy for ecological monitoring of the mountain ecosystem in Bhutan.

Honeybees such as *Apis laboriosa* are key natural resource indicators to good environments. This bee has not been subjected to gathering – thus the nesting habitat is still abundant. Cliff sites close to riparian forest patches and occurrence of these bees at diverse altitudes contribute to the richness of ecological diversity and pollination services. Conservation through protection of bee habitats, monitoring of nesting sites, mapping of bee-rich zones and understanding their behaviour could be beneficial for understanding the wild bee ecology and their role in the biodiversity conservation.

1.4.5 Flora

Bhutan has a very diverse flora with affinities to Southeast Asia (mainly tropical *taxa*), China/Japan (temperate *taxa*), Tibet, the Euro-Siberian region, and the arctic/alpine areas of Europe and Asia, and, to a very limited extent, to the floras of India and Sri Lanka (Grierson and Long 1983).

Of the known 5,446 species of vascular plants, as many as 750 are endemic to the Eastern Himalayas and 50 or more are endemic to Bhutan itself (Grierson and Long 1983; Myers 1988; Sherpa et al, 1991; Yonzon 1992; FAO 1994).

Several plant species are of high conservation value; e.g. the Himalayan yew (*Taxus baccata*), an important alpine fungus (*Cordyceps sinensis*) which commands a high price in the international market. *Podophyllum hexandrum*, *Aconitum spp.*, *Delphinium spp.*, *Herminium spp.*, *Pleurospermum spp*, *Gentiana spp*, *Corydalis spp.*, *Parnassia spp.*, *polygonatum spp.*, for their valuable alkaloids and various medicinal properties; species of *Allium spp.*, *Fritillaria spp.*, *Lilium spp.*, as wild gene pools for future crops research; *Rheum nobile*, *Pterocephalus hookeri.*, *Aster spp.*, *Senecio spp*, *Saussurea spp.*, *Rhododendron spp.*, *Geranium spp.*, *Meconopsis.*, *Epilobium spp.*, *Anemone spp.*, and *Potentilla pedicularis*, as potential horticultural crops of ornamental value; *Circaester agrestis*, *Triosteum himalayanum*, *Helwingia himalaica*, *Diapensia himalaica*, *Corylopsis himalayana* as rare endemic species for Bhutan.

Several plant species listed under Schedule I of Bhutan's Forest and Nature Conservation Act, 1995 are also from the alpine and sub-alpine regions and have very specific microhabitat requirements. For instance, the threatened species *Podophyllum hexandrum* (Himalayan May Apple) grows only among Berberis-Juniperis shrubberies in rocky areas, and frequent fires and systematic removal of shrubs from such areas may cause the local extinction of this species. Another, *Circaeaster agrestis*, is a rare plant that grows only under rock shelters and caverns.

The comprehensive description of the Bhutan flora is now available in the *Flora of Bhutan*, finished early in 2002. It includes three volumes of three parts each. The species included are 8 families of Gymnosperms, 180 families of Dycotyledons, and 66 families of Monocotyledons (Grierson and Long 1983, 1984, 1987). The *Flora of Bhutan* includes 46 species of rhododendrons and numerous species of economic value, including valuable timber trees, medicinal, aromatic, horticultural and ornamental plants and many species that provide essential non-timber products to rural users (Grierson and Long 1983; UNIDO 1994; Dorji 1995). Bhutanese flora is considered to be of great scientific value, both because of its biodiversity and because of its relatively good state of preservation compared to adjacent Himalayan areas (Grierson and Long 1983), although many *taxa* are now considered to be nationally threatened (WCMC 1995).

Table 5. Characteristic Flora and Fauna

Zones	Altitude (m)	Precipitation (cm per year)	Characteristic Flora	Characteristic Fauna
Dry Alpine Scrub	4,000-4,600	?	*Ephedra gerardiana, Meconopsis simplicifolia, Chesneya nubigena, Picrorhiza scrophularifolia, Tanacetum gossypinum, Saussurea gossypiphora, Rheum nobile.*	**Mammals:** Marmot, Snow leopard, Blue sheep, Pika, Red fox, Musk deer. **Birds:** Tibetan snow cock, Snow partridge, Grandala, Lammergeier, Himalayan monal pheasant, Himalayan griffon, Alpine accentor, Oriental skylark, Blood pheasant.
Juniper/ Rhodo-dendron Scrub	3,700-4,200	?	*Juniperus recurva, J. squamata, Rhododendron lepidotum, Morina nepalensis, Thalictrum chelidonii, Pedicularis megalantha*	**Mammals:** Wild dog, Barking deer, Serow, Musk deer, Takin. **Birds:** White-browed rose finch, Snow pigeon, White-browed bush robin, Golden bush robin, Blood pheasant, Fire-tailed sunbird.
Fir Forest	3,100-3,300 (-3,800)	130 or more	*Abies densa, Juniperus pseudosabina, Skimmia laureola, Viburnum nervosum, Rheum acuminatum, Maddenia himalaica.*	**Mammals:** Musk deer, Leopard, Yellow-throated martin. **Birds:** Rufous-vented tit, Grey-crested tit, Orange-flanked bush robin, Long-tailed thrush, White-browed fulvetta, Eurasian tree creeper.
Hemlock Forest	2,800-3,100 (-3,300)	130-200	*Tsuga dumosa, Larix griffithiana, Gaultheria fragrantissima, Panax pseudo-ginseng, Daphne bholua, Arundinaria griffithiana.*	**Mammals:** Sambhar, Serow, Black Bear, Barking deer. **Birds:** Black-throated tit, Black-throated fulvetta, Green-tailed sunbird, Rusty-flanked tree creeper, Lesser cuckoo.
Spruce Forest	(2,500-) 2,700-3,100 (-3,200)	50-100	*Picea brachytyla, Rosa macrophylla, Taxus baccata, Picea spinulosa, Acer cappadocicum, Larix griffithiana, Hydrangea sp.*	**Mammals:** Sambhar, **Birds:** Black-throated tit, Rusty-flanked tree creeper, Black-throated fulvetta.

Blue Pine Forest	2,100-3,00 (-3,100)	70-120	*Pinus wallichiana, Berberis asiatica, Cotoneaster griffithii, Lyonia ovalifolia, Rhododendron arboreum, Arisaema consanguineum.*	**Mammals:** Leopard, Sambhar, and Goral. **Birds:** Green-backed tit, Yellow-billed blue magpie, Grey-backed shrike, Red-billed cough, Common kestrel, Collared blackbird, White-throated laughing thrush.
Evergreen / Oak Forest	1,800-2,000 (-2,600)	200-300	Acer campbelli, Castanopsis hystrix, C. tribuloides, Elatostema hookerianum, Quercus lamellosa, Skimmia arborescens	**Mammals:** Tiger, Leopard, Barking deer, Sambhar, Wild dog. **Birds:** Kaleej's pheasant, Leaf warbler, Grey-winged black bird, Green-backed tit, Chestnut-breasted partridge, wood snipe.
Cool Broadleaf Forest	2,000-2,900	250-500	Acer campbelli, Betula alnoides, Exbuclandia populnea, Lindera pulcherrima, Persea clarkeana, Symplocos dryophila	**Mammals:** Leopard, Black bear, Barking deer, Red panda. **Birds:** White-throated laughing thrush, Rufous-necked hornbill, Chestnut-crowned laughing thrush, Snowy-browed fly catcher, Mountain hawk eagle, Tawny owl, Ward's trogon, Pygmy wren babbler, Great babbler.
Chir Pine Forest	900-1,800 (-2,00)	100-130	Pinus roxburghii, Cycas pectinata, Cymbopogon flexousus, Euphorbia royleana, Woodfordia fructicosa, Grewia sapida, Buddleja bhutanica, Rhododendron arboreum.	**Mammals:** Goral, Yellow-throated martin, Barking deer. **Birds:** Black bulbul, Mountain bulbul, Grey-tree pie, Rufous woodpecker, Red-vented bulbul, Bar-winged flycatcher shrike, Saphire flycatcher, Himalayan bulbul.
Warm Broadleaf Forest	1,000-2,000 (-2,300)	230-400	Altingia excelsa, Bischofia javanica, Castanopsis indica, Engelhardia spicata, Macaranga postulata, Schima wallichii, Alnus nepalensis, Michelia exelsa, Morus sp., Amoora rhotica.	**Mammals:** Red panda, Barking deer, Sambhar, Tiger, Capped langur, Serow, Leopard. **Birds:** Rufous-necked hornbill, Palla's fish eagle, Great hornbill, Wreathed hornbill, Common Iora, white-breasted kingfisher, Oriental turtle dove, Leaf warbler, Hodgson's hawk cuckoo, Chestnut-breasted partridges.
Sub-tropical Forest	200-1,000 (-1,200)	250-500	Acrocarpus fraxinifolius, Ailanthus grandis, Bombax ceiba, Duabanga grandiflora, Shorea robusta, Pterospermum acerifolium, Aquilaria agaloocha, Gmelina arborea, Terminalia sp., Michelia champaca, Acacia catechu, Chukrasia tabularis, Toona ciliata, Lagestroemia sp., Phoebe sp., Artocarpus sp.	**Mammals:** Golden langur, Capped langur, Pygmy hog, Marbled cat, Asiatic golden cat, Fishing cat, Tiger, Elephant, Clouded leopard. **Birds:** Large-billed crow, Blue whistling thrush, Pin-tailed green pigeon, Orange-breasted green pigeon, Spotted dove, Great coucal, Rose-ringed parakeet, Asian emerald cuckoo, Blue-bearded bee eater, Blue-bearded barbet, Large hawk cuckoo, Rufous-necked hornbill, Pallas's fish eagle.

Note: some species are subject to change
Source: NCD, Flora of Bhutan, Vols. I, II and III.

1.5. Domestic Biodiversity

1.5.1 Agriculture

The traditional, self-sustained farming system integrates crop production, livestock production and use of forest products. The wide range of climate and altitude has allowed Bhutanese inhabitants from different ethnic backgrounds to use a variety of crops and vegetables. This diversity in crop species surpasses normal expectations considering Bhutan's small size.

The dramatic elevation gradients account for the diverse flora and fauna, the species richness is further enhanced through Bhutan's relative isolation from other parts of the continent. Through a long process of natural and human selection, a wide array of crops and of varieties within crop species exists, sometimes hidden in remote areas. Many of the native crops, as well as those which have been introduced into Bhutan long ago, possess significant genetic diversity and are ecologically well adapted to the specific requirements of the local environment.

The Himalayan ecosystem that includes Bhutan has diverse biodiversity values of national and global significance. With over 70 percent forest cover, Bhutan is known to harbour approximately 7,000 species of vascular plants. Many of these include fruits, vegetables and cereal crops that are native, invasive, ecological escapes or introduced long ago so that they have developed unique genetic, morphological and ecological characteristics.

The natural forest and the traditional integrated farming systems remain largely intact. Bhutan not only has a wide diversity of plant genetic resources but also has a large number of endemics – both cultivated and wild species. Thus Bhutan, least developed in economic terms, plays an important role in conserving the global biodiversity in general, and the biodiversity of the Eastern Himalayas in particular.

Today there is a global awareness concerning the urgency and importance of conserving biodiversity and the sustainable use of the biological resources in terms of their roles in the survival of the human species. In Bhutan, farming has remained largely at the subsistence level. Apart from the integration of the three sub-sectors in the farming systems, a special characteristic typical of Bhutan is its tremendous diversity in its landscape and ecosystems. The need to maintain a high level of self-reliance and the variation dictated by climate and other environmental factors has broadened the scope for biodiversity in the agricultural systems.

In addition to the major crops listed below, there are also minor crops such as finger millet, foxtail millet and amaranth. In the past and, to some extent, at present these have played an important role in farmers' diet and cropping pattern. For example, foxtail mitllet is harvested in May/June, a lean period for farmers because the harvest from previous crops is over and other crops are still not ready for harvest.

It is often stated that only 30 crop species feed the world. These are crops that provide 95 percent of the dietary energy (calories) or protein. Based on the extent of cultivation and their contribution to the daily diet of the rural population, maize, rice, millet, wheat and buckwheat are the predominant agricultural crops of Bhutan (Table 6). Horticulture crops

are mainly grown with commercial objectives in mind. There is no definitive list of staple or important crop. Nonetheless, the listing in the table does constitute a range of crops, which include different crop groups, species with different breeding systems, and crops of temperate and tropical origin. There are many other species that are important to large numbers of people at sub-national levels as suppliers of other dietary factors (protein, fat, vitamins and minerals, etc.). A crop-wise review on the state of diversity for some major staple food crops is provided.

Table 6. Major Agricultural and Horticultural Crops: Area, Production and Yield

Crop Specie	Area (000 Acres)	Production (MT)	Yield (kg/Acre)
Rice	111.406	107,877	968
Potato	13.914	43,325	3,113
Wheat	23.642	10,747	454
Buckwheat	18.013	6,443	357
Mustard	11.816	3,686	311
Barley	10.887	4,849	455
Maize	137.072 7	5,380	549
Millet	25.498	9,159	359
Vegetable	14.802	22,257	1,503
Legume	4.070	2,098	515
Chilli	1.688	887	525
Ginger	2.817	4,503	1,598
Orange	19.866	77,031	3,877
Apple	4.858	9,266	1,907
Cardamom	17.231	3,980	230
Arecanut	0.277	1,073	3,870

Source: LUPP, 1995.

a) Maize

Maize is the most important field crop in terms of the area under cultivation. No information is available on how and when it was introduced and distributed in the country. The presence of maize had been noted by Bogyle during his visit to Bhutan in 1774 (Markham, 1876). Some hypothesize that maize might have been in this region even prior to the discovery of the New World. The advent of maritime exploration, especially the opening of communication between the Old and New World, and the trade links between Europe and the East Indies are most plausible explanation of the entry of maize into Bhutan.

Today, maize is grown throughout the country up to an altitude of 2,900 m (Rodder & Gurung, 1990), with main growing areas concentrated in Eastern Bhutan at altitudes below 2,500 m. It is grown in areas without irrigation facilities and on unterraced slopes. Local maize includes dent, flint and popcorn types planted almost throughout the year, and cropped twice in some low-lying areas. Generally, maize is intercropped or relay-cropped with beans, soyabean, vigna spp., potato, taro, sweet potato, amaranth, chenopodium and pumpkin.

Farmers' local or native varieties are called landraces. For plant breeders and conservationists, landraces mean farmers' varieties that are recognizable for their distinctive in their morphological make-up. Therefore, the farmers have names for the various landraces, and different landraces are understood to differ in adaptation to microclimate, soil type, time of seeding, date of maturity, height, nutritive value, socio-economic use and other properties. Landraces are genetically diverse, although they may look similar phenotypically, and are genetically dynamic.The inherent variation within landraces of maize is high since it is a cross-pollinated species.

The RNRRCs in Bumthang and Khangma are currently involved in collecting, characterizing and evaluating high-altitude (>1,800 m) local maize cultivars for use in crop improvement programmes. Large-scale exotic introduction has been curtailed to avoid marginalizing the traditional varieties. Nonetheless, a high-yield variety (HYV), Suwan 1, was released as *Yangtsipa* in 1992. By 1993, this variety had spread to over 30 percent of the maize area in Eastern Bhutan. Studies on the adoption rate and success indicated that over 90 percent of the households were either growing *Yangtsipa* as a sole variety or in combination with a local variety (RNRRC-Bajo, 1996). This HYV is said to have a yield advantage of 20 percent over other landraces. Collected local varieties from Eastern Bhutan have been crossed with the released *Yangtsipa* and segregating materials are currently under evaluation by RNRRC Khangme. Selection is for cold tolerance (>1,800 m) and high yield. Two more varieties, Palmirah 8529 (white) and Suwan 8528 (yellow) were released in 2000. This is definitely a concern from the conservation perspective since the situation leads to widespread replacement of diverse local varieties by homogeneous modern varieties.

b) Rice

Rice is the preferred staple food and often consumed three times a day. The landraces in general have medium to high amylose and a low gelatinization temperature (Chettri, 1990). In Bhutan rice is grown from 300 m to about 2,600 m in altitude. Rice is cultivated in terraces and about 90 percent of the rice fields are irrigated following a rice-fallow or rice-another field crop system of farming. It is estimated that landraces cover about 95 percent of the total rice growing area in the country (Roder, 1990). The number of farmers' varieties in the field is tremendous. Traditionally, rice landraces are assorted into two groups: *Bjakaap* (white pericarp) and *Bjamaap* (red pericarp). Within these groupings, local farmers distinguish several varieties with discrete indigenous names that relate to certain unique morphological characteristics or ascribing special socio-cultural attributes. The diversity in rice ecotypes and morphotypes and the genotypic variation within these constitute invaluable genetic resources for the breeding work. The present knowledge across the spectrum of genetic variation in rice in Bhutan is minimal. Bhutan lies within the region considered to be the primary centre of origin and diversity for rice. New variations may be evolving all the time through continued gene flow between crops and their wild relatives. Thus it will be difficult to achieve comprehensive and exhaustive information on rice, but proper inventory and documentation must be maintained to facilitate conservation and use.

To illustrate the extent of diversity in rice, the farmers from five *Geogs* in the eastern part of the country grow in total 16 rice landraces (Chhetri & Schouten, 1995). The concentration of landraces at the country level will, therefore, be very high. These

varieties deserve concerted attention since they confer several benefits that the HYVs cannot provide toward the fulfilment of a farmer's multiple needs.

Since the establishment of the Centre for Agriculture Research and Development (CARD) in 1982, the introduction and evaluation of HYVs has gained momentum in the pursuit for domestic food security. From 5,000 or more introduced lines, seven improved HYVs have been recommended since 1988 for general cultivation in the middle and low-altitude environments. A small-scale shuttle breeding programme has been implemented to develop varieties suited to the high altitude areas (>1,800 m). More than 100 crosses were made between local varieties and HYVs generating 100 bulk populations and over 2,500 pedigree lines. Some of them are undergoing screening for resistance to rice blast and cold tolerance at Gaynekha. Initially CARD relied more on introduction of HYVs for different agro-ecologies and adaptation to local conditions. However, the rice shuttle breeding at the International Rice Research Institute (IRRI) has gained momentum and introductions have reduced greatly. The emphasis now is on utilization of local germplasm in breeding programmes and improving the productivity of local cultivars while retaining their good traits such as red colour and grain quality. From this cross-breeding programme, four improved varieties that contain Bhutanese genes have been released in 2000, and three more are pending release from the blast and cold tolerance programme of Geynekha.

The RNRRC in Bajo, in collaboration with other RNRRCs, has embarked on a nation-wide exploration and collection of traditional rice germplasm. Systematic follow-up leading to utilization is constrained by the lack of storage facilities and associated infrastructure. There is only one reality in the field, and that is to acknowledge that solutions to many problems of rice farming in Bhutan are inherent in traditional landraces.

c) Wheat

Wheat is the third most important cereal crop after rice and maize in terms of production. No records on the introduction of wheat to Bhutan are available. Nakao & Nishiokha (1984) speculated that it might have been introduced from Tibet. Records by early visitors (Markham, 1876; Kuloey, 1865) suggest that wheat cultivation as a second crop after paddy was more important in the last century than it is today (Roder, 1990). There are several factors contributing to the depression in wheat cultivation in Bhutan. Certain social bias has restricted its wide-scale acceptance as a staple food; and often, it does not contribute directly to the alimentary needs. The transition from a subsistence and barter economy to market economy has brought radical changes in the approach to agriculture development. Low grain yield and subsequently low returns to investment, and cheap import from India were considered to be the main reasons for stagnant wheat cultivation (Mann & Hobbs, 1988).

Wheat landraces are the most threatened cereal food species in the country. Many village elders throughout the wheat growing area relate nostalgic accounts of local varieties they grew for various purposes. Most of these landraces, according to them, have disappeared from the field as they are progressively being replaced by exotic wheat varieties (or *Jaga-Kaa* as they call these improved varieties). It is likely that some of them may still survive in the very remote areas, far removed from the present network

of seed distribution. Immediate and effective action must take precedence in all debates on priority issues to save the remaining populations of wheat landraces maintained in the periphery of its gazetted provenance by a few insipid but enterprising farmers.
The common border with India and the prospect of monetary income heralded the demise of wheat landraces in Bhutan. Since wheat is secondary as a staple crop, farmers have been complacent of the entry of Indian improved wheat into the country through the formal system or farmer-driven seed acquisition and exchange system. Under the formal agriculture development programmes, the landraces were further neglected with public resources concentrated into the introduction and identification of improved varieties like Sonalika. As a product of formal breeding work, such cultivars are genetically uniform with narrow genetic base. As a result, problems like the stripe rust epidemic in 1986 and 1987 began to emerge. Sonalika became susceptible and, consequently, two more introduced varieties: Bajo Ka 1 and Bajo Ka 2 were released as rust resistant... but for how long? It has been noted at the First Field Crop Co-ordination Workshop that almost all the area under wheat in the rice-wheat system is under the improved varieties. This roughly accounts for more than 60 percent of the total area under wheat cultivation.

Wheat is grown in almost all the different agro-ecological regions of the country, from 300 m to locations above 3,000 m, as the main crop or secondary crop after maize, rice and potato; and in rotation with buckwheat at higher altitudes. Wheat is also grown as winter fodder at elevation up to 2,500 m, and for haymaking at elevations of 3,500-4,000 m (Roder & Gurung, 1990).

d) Oilcrops

Oilseeds constitute major agricultural crops next to cereals and hold an important place in Bhutan's economy. Mustard and rapeseed (*Brassica juncea and B. campestris*) are the predominant oilseed crops that grow at altitudes from 200 m to 3,000 m. A total of 11,816 acres of land is estimated to be under rapeseed cultivation. Today, the acreage under oilseed crop is gradually diminishing simply because it is not economically viable. This is due to the limited choice of cultivars and the cost of production at home, which is relatively high and, thus, the import of cheaper oil from India depresses domestic production. In the wetlands, there are other competing crops such as wheat and vegetables grown in rotation with rice. In the dry land, mustard is grown only as a secondary crop under marginal/rain-fed conditions. At the national level, the average yield of mustard/rapeseed is only about 311 kg/acre. There is a high diversity of oilcrops in Bhutan, but the local varieties have not been systematically collected and conserved.

So far, four improved varieties of *Brassica spp* have been released from Research Centres, but they are not very popular. In addition to *Brassica species*, there are other oil-bearing crops traditionally grown in Bhutan. Niger seed (*Guizotia abyssinica*) is grown in small areas in Bhutan during summer. Its oil content is 35 percent and is known to produce crop even under poor fertility and compete well with weeds. It is planted late in monsoon in middle hills, and lower hills. Sesame (*Sesamum indica*) is found growing sparsely in the southern part of the country. There are two types of sesame, one with white seed and other with black seed. The oil content in black seed is 60 percent, which is higher than that of white seed. Yields are often low, less than

500 kg/ha. Sunflower (*Helianthus annuus*) is a minor source of vegetable oil and is grown mainly in the Cool Temperate Zone above 2,000 m. Soybean (*Glycine max*) and Groundnut (*Arachis hypogeae*) are two of the leguminous oilseeds cultivated in mainly in eastern Bhutan, which are yet to be exploited for good quality oil mainly due to lack of oil extracting devices. Other exotic high-altitude species in the process of being introduced from India and elsewhere include Ethiopian Mustard (*Brassica carinata*) which is grown for oil in the Ethiopian highland up to 2,500 m elevation. It is generally late in maturity, but early types are also available now. The crop is usually grown from June-September under 13-hour day length.

In addition, there are some perennial oil-bearing trees from which seeds are harvested to extract oil. Locally known as *Yhika* (*Maduca butyretica*) contains 50 percent oil and is found in the Eastern part of the country. It is most commonly used for lamp oil, but the oils and fruits are also used for consumption. *Yhika* lacks improved oil extraction technology and management practices. *Karshing*, also called *Kadam* (*Jatropa curcas*) contains 35 percent oil. It is widespread in the country, and its oil is used for soap making. The plants are used as live fence and for erosion control. *Pangtshi* (*Symplocus paniculata*) contains 20 percent oil and is available in Punakha-Wangdue. Its oil is used for consumption and leaves are used as dye. *Shingshe* (*Neolitsea spp*) contains 28 percent oil and is found in Eastern Bhutan. Its oils are used for consumption and lighting lamps, and oilcakes for manure.

e) Buckwheat

Buckwheat is an important food for the non-rice-growing areas at elevations above 2,500 m (Roder, 1995). Both bitter and sweet buckwheat species are grown. Owing to its short growing period, the crop can be accommodated under various cropping patterns. While it may be the only crop for high altitude farmers, it can be grown as second crop after potato, wheat or barley up to 2,900 m of altitude. Traditionally, buckwheat was the major crop in grassland shifting cultivation systems in regions from 2,500 m to 3,400 m. The duration of fallow period in these systems generallyincreased with altitude such that fallow of 15 years was common above 3,000 m.

So far one local variety of bitter buckwheat and two local varieties of sweet buckwheat have been recorded under cultivation. It may be possible to have great diversity within these landraces. In fact the farmers do discriminate between morphotypes found under different agro-ecosystems. These buckwheat landraces are most prominent in Bumthang and Ha Dzongkhags.

Buckwheat production has not receded under the competition from surrogate crop species and improved varieties within. Research in the introduction and evaluation of improved varieties is at the initial phase. The traditional seed exchange and distribution methods are still intact, thereby preserving the available diversity and contributing to the enrichment of germplasm by assenting to parallel but mutual human involvement and natural evolution.

1.5.1.1 Domesticated Medicinal and Aromatic Plants

More than 300 species of plants are used in Bhutanese Traditional Medicine. These have been collected from the wild resources for many years. This repeated collection from the wild resources led to some reduction in plant population in the wild. Because of this, it has become increasingly difficult to collect medicinal plants from the wild. To address this situation as well as to improve the quality of the traditional drugs and to diversify the income of the rural population the cultivation of medicinal and aromatic plants was initiated in Bhutan.

The Medicinal & Aromatic Plants (MAP) Research Programme at RNRRC Yusipang conduct research on the domestication of high-altitude species where as the research sub-centre at Mongar works on low altitude species and essential oils.

With the cultivation programme that started in 1997, 6 high altitude species have been released to the farmers for cultivation on large scale. In total, more than 20 farmers are cultivating medicinal plants in the three western *Dzongkhags*. Through their cultivation, the Institute of Traditional Medicine Services' (ITMS) annual demand for four species have been met since the year 2000.

As there are many medicinal and aromatic plants species in the country, it is not possible to research them all, therefore future efforts must be focused on a few potential species that have good outside market values, as well as good responses to cultivation practices.

1.5.2 Livestock

The main domestic livestock in different regions of Bhutan are cattle, yaks, poultry, pigs, equines, sheep and dogs. Goats, buffalo and cat are other domestic livestock. Goats and buffalo are found in lower valleys and parts of Southern Bhutan. So far, the following breeds and sub-breeds of domestic livestock have been recorded in Bhutan.

Table 7. Domestic Biodiversity in Bhutan

Specie	Type	Main Breeds	Sub Breeds*
Cattle *(Bos indicus/*	Local	3	9
taurus/ frontalis)	Exotic	2	6
Yak *(Bos grunniens)*		1	9
Pigs *(Sus spp.)*	Local	3	
	Exotic	4	4
Poultry *(Galus domesticus)*	Local	4	
	Exotic	2	
Horses *(Equs spp.)*	Local	4	
	Exotic	1	1
	Donkey	1	5
Sheep *(Ovis aries)*	Local	1	2
	Improved	2	4
Dogs *(Canine spp.)*	Local	7	
Goats *(Capra spp.)*	Local	1	Not known
Buffalo *(Bos spp.)*		Not known	Not known
Cats	Local	Not known	Not known

* Sub-Breeds is used to describe the inbreds between various species and breeds with species.

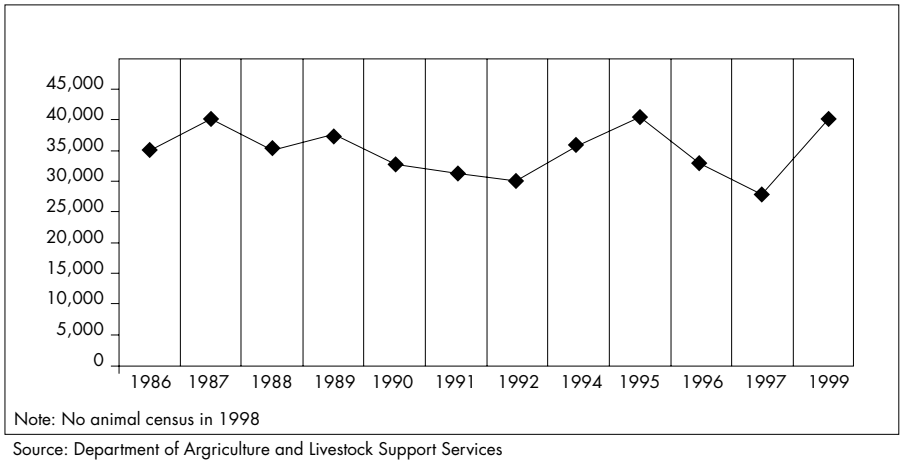
1.5.2.1 Domestic Breeds and Sub-Breeds

a) Yak *(Bos grunniens)*

Yaks are an integral part of the pastoral system and are the most important in terms of domestic biodiversity in Bhutan. They are herded mainly in the northern areas of Thimphu, Trashigang, Ha, Paro, Punakha, Wangdue and Bumthang *Dzongkhags* by pastoral groups. Since the barter system of trade still exists, there is the need to have a large number of yak from an economic point of view. *Brokpa* (yak pastoralists mainly in eastern Bhutan) are entirely dependent upon herds of yaks without having cultivable land holdings. Most of the *Brokpa* do not have permanent habitations but spend their entire year in crude shelters or yak hair tents tending their animals in a migratory pattern that follows fodder availability through the season often covering large distances.

The population of yaks was about 35,000 in 1986. By 1999 this had slightly increased to 40,000. Yaks herds are mostly concentrated in the upper temperate to alpine zones of Tashigang, Gasa, Ha and Paro *Dzongkhags*.

Graph 1. Changes in Yak Population



Note: No animal census in 1998

Source: Department of Argriculture and Livestock Support Services

The yaks of Bhutan are generally smaller than in other regions.

In summer, yaks graze in pastures up to 5,000 m and remain there until late October when they begin their descent to lower altitudes to elevations of 2,500 m. In spring when the weather turns warmer, yaks once again start the cycle of movement to higher elevation grazing lands. Yak herders may have as many as 20 different pastures that are only grazed for a week or a month or more in other situations. In some places, there are also tenant herders who pay 10 to 15 kg of butter per year for each milking animal and keep the rest of the excess butter, cheese, hair and wool.

In some cases yak and *dzom* (the female progeny of *Langu* and yak) herds are kept together for two to three months in the summer but separate at other times. Some households with fewer animals combine their animals with others to form one herd.

The *dzom* herds usually leave for lower elevation winter grazing lands in late September or early October and are kept there till the middle of May. In late May the herds are moved up, usually reaching the highest elevation alpine grazing lands in July where they usually remain until late August. Yaks are crossed with *Golengs* or *Langus* to get different bloodlines. The average annual production of a yak cow is about 25 kg of butter and 30 kg of cheese while that of a *dzom* is 30 kg of butter, and 40 kg of cheese. Butter and cheese are consumed by the herders, exchanged for rice or sold in the market.

The long hair and wool produced by yaks is vital to the herders' existence. The long hair is cut in early summer. The fine inner wool of the yak is obtained at the same time by plucking it out. The inner wool is used for making clothing and the long hair for making ropes, pack strips, bags, blankets and tents. This wool and hair are not sold but spun and woven by herders for their own use. The average hair and wool production from one yak is reported to be 1 to 1.5 kg and about 2 kg respectively. Hides from animals that have been slaughtered or have died from natural causes are used as carpets and are also tanned for making leather straps and ropes. Some yaks are also slaughtered for meat, which is worth Nu. 6,000 to 10,000 per yak depending on their size. Yaks are also exchanged for rice. There is great demand for yak meat and tail throughout the country.

b) Mithun

The Mithun (*Bos frontalis*) is the domestic form of Gaur. It is indigenous to parts of India (Assam and Arunachal Pradesh), Burma and Bangladesh. These animals are big and strong, have a typical dorsal ridge on the crest of the shoulder, a flat forehead and big horns with an enormous base. In order to meet the demand and to create a continual source of genome there are two Mithun breeding farms producing more than 20 pure Mithun bulls per year which are distributed among the farmers for crossbreeding with Siri (*Nublang* in Dzongkha, *Bos indicus*). *Jatshamin*, the F1 generation, obtained from mating Mithun (male) with Siri breed (female) is the most prized animal. The males, *Jatsha*, are huge and powerful and are excellent draught animals compared to the indigenous bulls, but are sterile. The female (*Jatsham*) populations are very good milk producers having relatively higher fat percentage in the milk. They are preferred for easy maintenance in the difficult terrains of Bhutan. They are superior in feeding on steep hills/slopes and for grazing on native grass and tree leaves. The interesting feature is that all the male progenies are sterile.

The following box shows Mithun Breeding practice to produce *Jatshamin*, which is superior productively, compared to either of their parents:

Mithum_X Siri_ 100%

	ß		
F1		Jatshamin 50M X	Siri_ Siri Blood 50S
	ß		
F2		Yankumin 25M X	Siri_ Siri Blood 75S
	ß		
F3		Deobam 12.5M X	Siri_ Siri Blood 87.5S
	ß		
F4		Deotha 6.25M X	Siri_ Siri Blood 93.75S
	ß		
F5		Thabamin 3.125MX	Siri_ Siri Blood 96.75S
	ß		
F6		Thabazing1.5625MX	Mithun_100% Siri Blood 98.4375
	ß		
F7		Jatsham X Jassha	Siri Blood 49.215

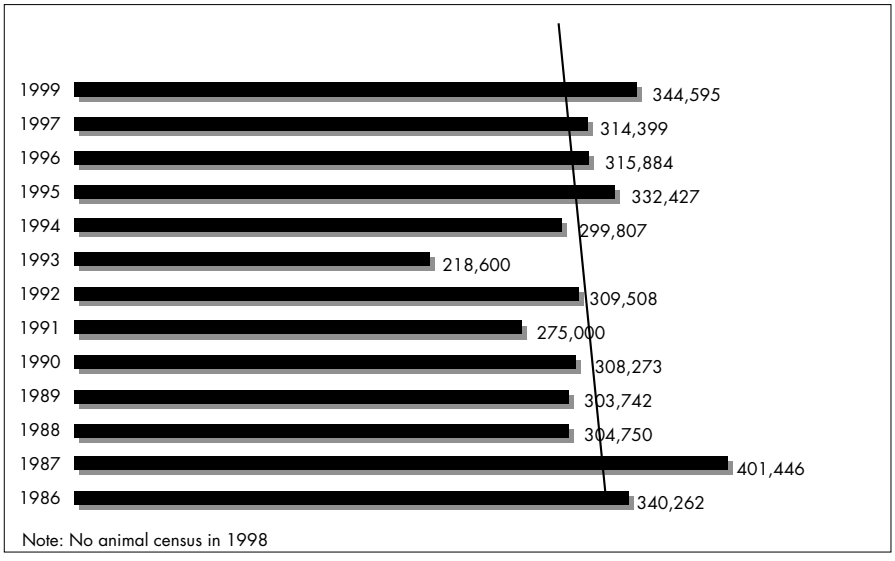
Future research will be focused on producing a stable Mithun breed, whereby mating can be made possible avoiding the disadvantages of the traditional backcrossing system. Preliminary research has shown that there are *jatshas*, which are fertile and are able to produce progenies with all normal characteristics. This research is expected to be quite costly. In the meantime, a technological breakthrough was made in artificial insemination using Mithun semen, and this method is being widely used through out the country now.

c) Siri or Local Cattle

The origin of the *Nublang* is linked withthe legendary lake in Western Bhutan - Nob Tshonapata, located on the western mountain ranges of Haa and above Nakha village of Sombe *Geog*. It is said that the *Tsomen* had given a breeding bull to a kind *Norpen* from Nakha village who had given her a night's shelter in his herd camp and our present *Nublang* is the offspring from the *Tsolang*.

In Bhutan this animal is by far the most trend-setting and important animal. Most farmers keep this breed for milk, draught and for crossbreeding with Mithun. The latter use is one of the foremost purposes in the northern and eastern parts of the country. Although the low milk production, late age of maturity, delayed conception, impaired fertility and long calving interval are some common algeny of our indigenous breeds, they become good asset for some of the productive traits and hetero-genesity, particularly disease resistance, foraging ability, traction capacity and butter fat production. The *Nublang* population is highest in Chukha, Bumthang, Haa and Wangdue. With the continuous use of this breed for crossbreeding, pure stock of *Nublang* is becoming scarce due to inbreeding and degeneration.

Graph 2. Changes in Cattle Population



Source: Department of Argriculture and Livestock Support Services

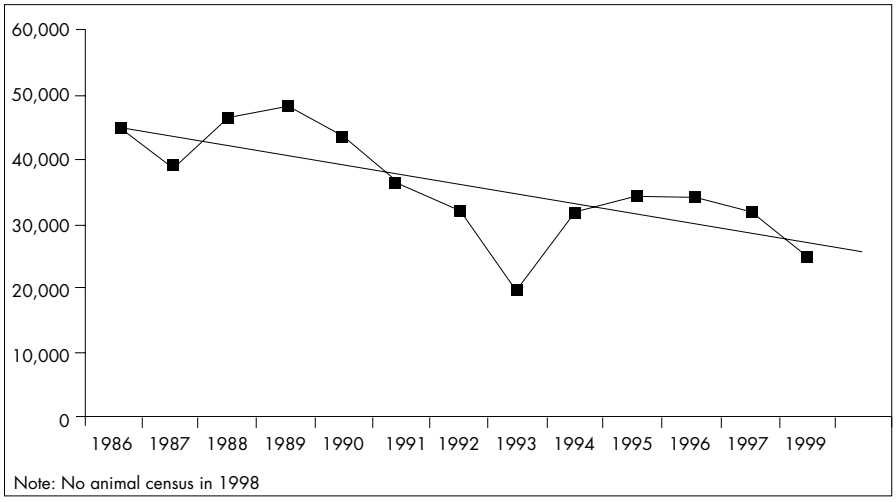
This breed is localized to conditions in the sub-tropical zone although it is prevalent from alpine to lower sub-tropical areas. It migrates to higher areas during summer and low-lying zones (warmer zones) in winter. It is known that these animals like the deciduous vegetation and produce best in warm climates.

d) Sheep

Sheep (*Ovis aries*) rearing tracts of Bhutan are the temperate zones, above 1,800 m, covering Wangdue, Bumthang, Trongsa and Trashigang where concentration is above three sheep per household. But otherwise they are mostly reared along with yaks. The local adult sheep of Bhutan (Tibetan type) has an average 65 cm height at withers, length 70 cm from shoulder point to pin bone, girth 75 - 100 cm and weighs 25 to 50 kg. The average coarse wool yield in two shearing is 0.750 kg to 1.5 kg.

The economic importance of sheep in the sheep rearing areas is only for wool and not for meat. It is, however, very important for the mountain people as the wool is used for making yarn and clothing.

Graph 3. Changes in Sheep Population



Source: Department of Argriculture and Livestock Support Services

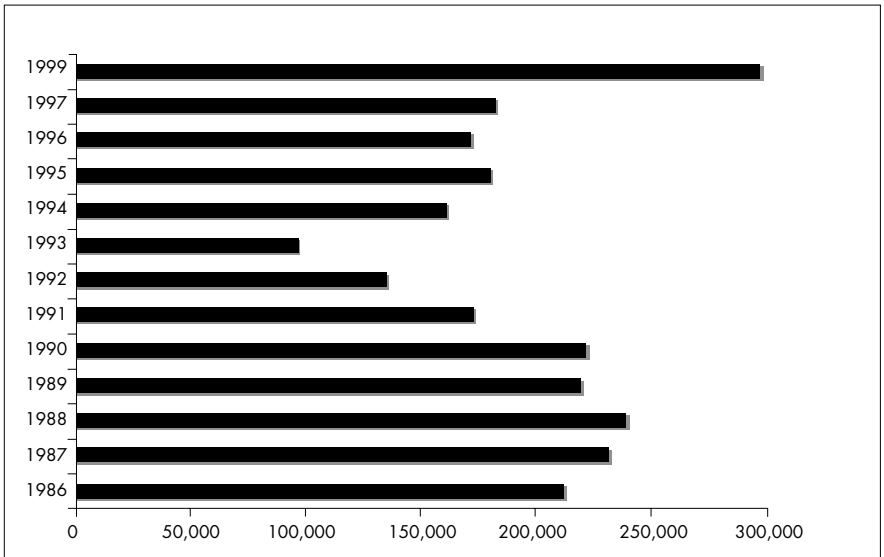
Local sheep, having coarse wool, are the predominant among the farmers. Others types of sheep are the crossbreeds of Merino and Comeback, exotic breeds introduced for production of finer wool. The local sheep are very good for Bhutanese terrain while the crossbreeds give good yields of lamb, wool and have bigger body size. The population of sheep in Bhutan was about 25000 in 1999. There is a decreasing trend in the population.

e) Poultry

Poultry (*Gallus domesticus*) keeping is very common among the permanent rural settlements. It is mostly kept for meeting the household demands of eggs, although it is also used for meat in some pockets of the country. Although many types of poultry birds are found in Bhutan (yet to be surveyed) the common type is the one with single and pea comb. These are of white, buff, red, spangled and striped colored types.

In addition to indigenous breeds (descendant of Red Jungle Fowl), in the past, two exotic breeds of poultry have been used in the country, namely: Rhode Island Red (RIR) and White Leg Horn (WLH). Recently, commercial hybrid chickens have been used for egg production purposes. The indigenous breed is good for scavenging and production, brooding habits, and disease resistance. (The RIR is an exotic dual-purpose breed, while the WLH is very good for egg laying

Graph 4. Changes in Poultry Population



Note: No animal census in 1998

Source: Department of Argriculture and Livestock Support Services

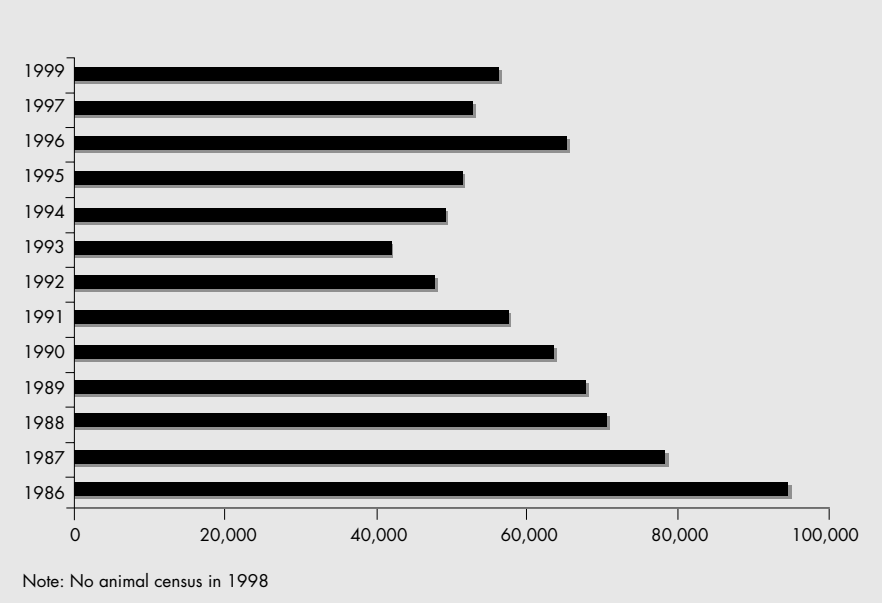
Poultry keeping is predominantly an integrated practice among the crop farmers. In Bhutan the highest relative density per household is in the districts of Chukha, Dagana, Tsirang, Zhemgang, Mongar and Lhuntse. The population of poultry has increased in recent years.

f) Pig

The pig is predominantly present in the central valleys of Phochu-Mochu, Western and Eastern *Dzongkhags*. In addition to local pigs there are also crossbreeds of exotic breeds. The local breed is mostly left free to scavenge. It has tough skin, jaw and a small tapering body with rough bristles.

The crossbreeds are mostly of Duroc breed, Landrace breed, Saddle back breed and Hampshire breed. These are very high yielding animals in terms of piglet production, body size and breeding efficiency.

Graph 5. Changes in Pig Population



Note: No animal census in 1998

Source: Department of Argriculture and Livestock Support Services

g) Horses

Horses play a very important role for transportation in areas where road transport is not available. The Dzongkhags of Gasa, Bumthang, Haa, Trashigang and Zhemgang have the highest density of horses. The local (Tibetan type) horse has been used to crossbreed with the exotic Haflinger breed.

The popular Austrian breed, known for its higher load bearing capacity, was supposed to be very good for higher altitude and difficult terrain. However, it has been rendered unsuitable, and in the quest for suitable horse type for Bhutan, a new breed, Spiti is being tried at the moment.

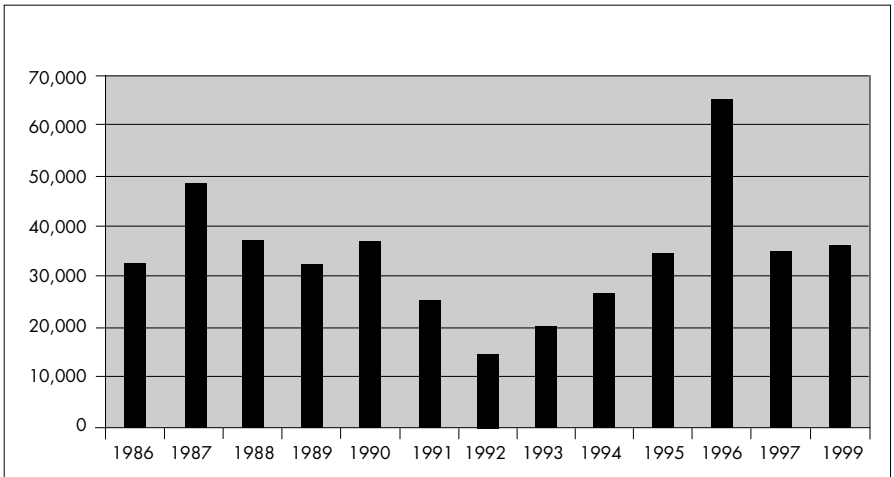
h) Dog

Dogs are the most common forms of domestic biodiversity. For the yak and sheepherders dogs are very important as they provide security and protection against wild animals.

i) Buffalo and Goat

Buffalo are kept by the farmers for milk and draught purpose in the southern tracts of the country. Not much research has been done on this livestock, although it is believed that it is a descendant of the riverine type. Goats are significant for their use as meat. There is a considerable section of the community that depends on goat for emergency cash. Not much information is available on goats. It is, however, believed that the goat type must be Black Bengal and Assam because of the contiguous landmass.

Graph 6. Changes in Goat Population



Note: No animal census in 1998

Source: Department of Argriculture and Livestock Support Services

The following box shows the Genetic Diversity of Livestock.

Genetic Diversity of Livestock

Sub-breeds & inter-breeds of livestock

Yak(F) Langu	Y(F) X BS	Langu X YF	Mithun X Thrabam	Yuta X Donkey	Local pig X Exotic
Zo/Zom	Zo/Zom	Zomo	Jatsham/Jatsha	Yuta X HF Dogs	Gokhi Xsakhi
Toimo/Topla		Golengmo	Yangkum/Yangka	Donkey X HF Dogs	Damkhi Xapsoo
Premo/Prela		Bjomo	Dyobam/Dyob		
Gar		Koi/Kyo	Dyothram/Dyothra or Drangbams		
Chuk		Shingkyo	(Thabamin & Thabazing)		
		Taglangma			
			BS Jatsham/Jatsha		
			Dyobam/Jatsham		
			Dyothram/Jatsham		
			Yangkum/Menchi Nublang X Jersey or BS		

1.6 Threats to Bhutan's Biodiversity

1.6.1 Overview – Threats and Opportunities

In Bhutan, biodiversity is a matter of everyday necessity. All Bhutanese people, especially in the rural areas, depend on the biological resources in one way or another on a daily basis. This interdependency is so strong that a breakdown in one link can create a chain of disorders with disastrous effects on human well being. Despite the RGOB's efforts directed to nature conservation, the on-ground situation is beset with problems. Threats to the ecological integrity of habitats and the species within them stem from several sources.

Some of the main threats are:

- Land Conversion causing habitat destruction and fragmentation, resulting in the loss of biomes, ecosystems and wildlife species which depend on the habitats particularly in the tropical and sub-tropical zones of the south and the temperate zones of the interior;
- Overexploitation causing habitat degradation and direct attrition or loss of plant and animal species;
- Competition/ Replacement by domestic and/or exotic species and varieties; and
- Brown sector activities, such as construction of roads, hydropower facilities, industries, urban infrastructure, mining, etc.

1.6.1.1 Threats at Local Level

- Poaching of endangered species of plants and animals with high commercial values in the international market (e.g.musk deer, tiger and leopard). Easy money and high prices that are offered for these products have triggered people to take up poaching. Poaching, if not controlled, can threaten the viability of the species and can have devastating effect on nature.

- Human/wildlife conflicts refer to damage of agricultural crops by wild animals such as wild boar and deer,and livestock depredation by tigers or leopards. While people are (environmentally) conscious, their main source of livelihood is severely affected by their tolerance to wildlife. This leads to poisoning of wildlife, a change in attitudes and a backlash to conservation efforts.

- Illegal exploitation of timber, non-timber forest products and fishing. Exploitation of these products for commercial purposes may lead to overexploitation.

- Overgrazing by livestock, both in forest and pasture areas, mainly in broadleaf forest, may lead to attrition or loss of species, reduction of productivity and erosion. In forest areas overgrazing leads to the loss of reproduction of plant species and vegetation changes.

- Unsustainable cropping practices and cropland expansion, particularly deforestation and encroachment on steep slopes by tseri cultivation. This causes reduced forest areas and loss of biodiversity, and degradation of ecological services such as soil protection and erosion control.

- Forest fires, which are mostly, if not entirely, caused by humans, and which may cause large scale degradation of forests.

1.6.1.2 Threats at Regional Level

- Economic development projects such as road construction, transmission lines and large-scale infrastructure development, when not carried out in an environmentally friendly way, contribute to destruction and fragmentation of forests, particularly when they cut through Protected Areas. These projects may also cause pollution (e.g. of waters) and threaten biodiversity Problems have increased during recent years due to increasing economic development.

- Increasing population pressure (by 2.5 percent per year) will lead to increasing pressure on scarce land and other biological values, both within and beyond Protected Areas. One underlying problem is that of land ownership and use patterns.

- Transboundary problems, implying that users that undertake illegal exploitation of biological resources can freely move in and out of the country. This threat is most acute along the southern border, and involves mainly poaching of mammals and exploitation of medicinal plants. At the northern border, yak herders crossing the border contribute to over-grazing, and intensive exploitation of medicinal plants.

- Inadequate return of benefits to local people, e.g. benefits from tourism. While local stakeholders are mainly informed about the restrictions to resource use as a result of a protection status, they receive few or no tangible benefits.

- Inadequate environmental awareness. Although the concept of conservation is embedded in Buddhist values, the essence of ecological integrity and the need to set aside areas for conservation purposes is not understood by the general public.

1.6.1.3 Threats at Institutional Level

- Conflicting policies, for instance those promoting conservation and those promoting agricultural or forestry development and exploitation of natural resources for economic objectives. This threat is also related to poor co-ordination between Governmental departments, and inadequate authority of agencies promoting conservation. There is also a problem of overlapping jurisdiction in protected areas, e.g. between conservation and development objectives of *Dzongkhags*.

- Weak law enforcement of existing legislation, partly due to lack of staff and partly due to inadequate or unclear legislation (e.g. how to deal with poachers). This threat is also related to the absence of clear zoning and boundary demarcation of Protected Areas, so that users do not know where the Protected Area is located and what legislation is appropriate.

- Lack of adequate communication between the stakeholders, e.g. inadequate communication and lack of transparency between the various sectors involved in conservation. As a result, an integrated approach to conservation, as required in view of the multiple sectoral interests involved, will be difficult to put in place.

1.6.1.4 Opportunities

In line with Bhutan 2020, it is important to emphasize that biodiversity and natural resources are not a constraint to development, but are an opportunity for sustainable long-term development. The following opportunities were defined and can be classified as ecological, economic, cultural and institutional opportunities.

1.6.1.5 Ecological Opportunities

- The richness in biodiversity and its relatively intact current status represent a major opportunity for successful conservation. Bhutan has more than 72 percent of the country under forest cover, and most of the ecosystems are still relatively intact. Although a small country, the ecological variation is very high, as the country's altitude ranges from 150 meters in the sub-tropics to more 7,000 m in the alpine north. An effective Protected Area system has been established comprising all representative ecosystems in the country. These protected areas house many rare and endangered flora and fauna species. Surveys revealed that Bhutan is home to more than 700 bird species, 5,500 species of vascular plants, 165 mammals, and new species are being discovered on a continuous basis. So while many countries are facing major challenges in trying to restore and reclaim natural areas, Bhutan is in a better position of protecting and conserving its biological values.

- Internationally endangered species are strongly represented by Bhutan's fauna and flora. There are now 24 internationally protected wild animal species found in Bhutan, and 64 species that may be nationally endangered. However, several of these are under current threat. The overview is provisional since not all species are fully known. This situation gives Bhutan the status of a biodiversity hot spot, with associated opportunities for research and donor funding.

1.6.1.6 Economic Opportunities

(It should be noted that these economic opportunities may develop into threats if being exploited and developed in an unsustainable manner)

- Ecotourism and nature based tourism is becoming increasingly popular in the world due to changing perceptions within industrialized countries resulting in a growing demand. Bhutan with its relatively intact natural environment has great potential to benefit from this growing market. The ecotourism incomes may be partly used to support conservation efforts.

- Non-timber forest products, such as mushrooms, caterpillars, medicinal products, bamboos, local handicrafts, etc. constitute a growing market with increasingly good prices as worldwide scarcity increases. There is also a growing demand for ecological nature-based products, with fairly attractive prices mainly in industrialized countries. Bhutan's rich forests may provide a range of these non-timber forest products, with benefits to support conservation efforts through integrated conservation and development programmes.

- The Integrated Conservation and Development Programme (ICDP) in Bhutan seems to show that conservation can be strengthened by promoting development for local communities (through services or concrete economic revenues). ICDP has also

contributed to establishing participatory planning approaches in Bhutan, which can be applied elsewhere.

- Bioprospecting is a growing endeavour that involves the search for new genes or chemicals of value. If carefully undertaken, it may offer an opportunity for substantial economic benefits.

- Carbon trading may generate revenues for forests that remain intact, but these revenues will not be substantial given the small size of the country.

- Hydropower has great potential in Bhutan. It constitutes an opportunity to reduce pressure on forests for firewood, provided that it also serves local communities in (often remote) areas within or nearby Protected Areas.

- Water resources are plentiful in Bhutan, and this represents a resource of growing economic value in Asia as a whole. The continuous availability and quality of water depends upon proper ecosystem management, and may therefore help promote conservation.

1.6.1.7 Cultural Opportunities

- The influence of religion is an opportunity since majority of people are Buddhist, a religion based on the principle of reverence for all life forms and a strong influence on the people towards conservation. Whether still as prominent as in the past, this cultural heritage can be used as basis to maintain or revive environmental awareness.

- Growing environmental awareness is the result of environmental education, greater involvement of stakeholders in conservation issues at all levels, and through participatory planning and ICDP. However, concrete benefits from conservation for people involved, or compensations for restricted use, will be required to strengthen and sustain this environmental awareness, if not a reverse trend may occur.

- Low population pressure can be considered an opportunity, as it is at the basis of overall low pressure on biological values in Bhutan. This is accentuated by dynamics of out-migration from Protected Areas in certain parts of Bhutan, in spite of overall population growth. However, unless efforts to reduce the population growth rate are successful, this opportunity will become a serious threat.

1.6.1.8 Institutional Opportunities

- The existing legislation with respect to conservation provides a supportive basis for effective control and management of Protected Areas.

- Political support and commitment for conservation has always been there. The Royal Government of Bhutan has consistently emphasized the need to conserve the biological values for the benefit of present and future generations. Environmental protection is institutionalized in the planning process of all the agencies involved.

- Strong donor support for conservation is a consequence of Bhutan's relative richness in biological diversity. Bhutan is being looked upon by several countries as

a model for conservation. The international conservation agencies have recognized Bhutan's rich biodiversity as being important for Bhutan as well as for the region and the world at large.

- Research opportunities are still plentiful given the rich biodiversity and the limited amount of research that has so far been conducted. Given the important numbers of recent findings, there are still plenty of opportunities. Research indirectly contributes to economic benefits.

1.6.2 Threats to Domestic Biodiversity – Plants

In Bhutan, specialized forms of crop production have evolved as a result of the country's geography and climate, but the production systems have been sustainable and capable of meeting most of the food needs. Bhutanese agriculture is essentially a family-based farming system, where all household members are involved. At the same time, there are a number of issues facing Bhutanese agriculture in the years ahead. Due to increasing population, particularly non-farming urban population, and the goal of attaining food self-sufficiency, traditional agricultural practices are yielding to new farming systems, crops and varieties, most of which are alien to the country. Hence, there is a concern about the erosion of the native plant genetic diversity. The population and animal pressure and the cropping of the marginal lands could lead to a degradation of rangelands causing the loss of useful plant germplasm. The increasing use of modern HYVs results in the loss of landraces and folk varieties and leads to genetic erosion. The narrowing of the genetic base could pose greater risk of crop failures as witnessed elsewhere in the world.

In Bhutan, the importance of protecting traditional crops, wild relatives and wild collected forms of economic uses is just being realized. Conserving landraces has so far been a de facto investment by the traditional farmers under very diverse environmental conditions. The MOA's role has always been geared towards agriculture development through increased productivity, land use intensification and alleviation of biotic and abiotic stresses. In the process, HYVs of many crop species have been introduced into the country. Many local crop and landraces are being replaced by these HYVs, and in extreme cases, traditional germplasms are so rare that they are in danger of extinction. The general perception is why bother to maintain inferior material when better options are within reach. Traditional crop genetic resources are the products of generations of farmers' experience with informal research and experimentation taking into account the socio-economic, cultural and environmental concerns that influence their vocation. Therefore, they are well suited to the prevailing conditions and serve multiple purposes of fulfilling basic needs. Also, improved varieties coming out of the formal breeding systems originate from such locally developed landraces. Given the immense diversity in geophysical elements and the resulting agro-ecosystems in the country, these landraces hold great potential to contribute profitably to the national system of crop development.

1.6.3 Threats to Domestic Biodiversity – Livestock

The main threats for most of livestock species are deterioration of original breed due to non-systematic breeding and human habitation. Yaks and sheep, which mostly graze in the alpine pastures, are believed by some to compete with the wild animals like blue sheep, but the overgrazing in these areas is probably more due to patterns of domestic livestock grazing than any possible competition with wild species. There is also fragmentation of families and herds, which contribute to degradation of grazing land.

In the case of Mithun and Siri cattle, inbreeding and deterioration of breed is apparent. The two species are the basic genetic material for production of suitable animal for milk and draught. Mithun is not the native animal. Hence there should be a continual source of its supply. On the other hand, Siri is the base genome for all the crossbreeding. Due to economic competition, more and more farmers are going for cross bred or pure bred exotic breeds for higher production and thereby better income.

In the process of crossbreeding there is no selection and recording. As a result some of the quality traits of the local species and breeds are lost.

Livestock still has to depend upon forest grazing. The environmental conservation goal of the RGOB is, however, in contrast to this tradition. The restriction on forest grazing is therefore a threat to the maintenance of domestic animal diversity.

Pigs and poultry are mostly reared in the lower valleys and agricultural belts. Some of the indigenous pig breeds have not yet been identified while some poultry breeds are feared to be extinct already. Farmers who choose pig breeds for their ability to put on weight quickly normally take the exotic pig breeds. There are also no development programmes locally available.

Proximity of the habitat to a border also provides a threat to dilution of breeds because of the infiltration of animals from across the border.

1.7 The Urgency of Biodiversity Conservation and the Need for Sustainable Development

Bhutan is at crossroads, where development has accelerated and we are faced with many difficult issues with relation to development, and associated demographic changes. It is clear that Bhutan's conservation of biological diversity must become an integral component of economic development. Threats to the continued integrity of Bhutan's natural resource base are increasingly being felt from a variety of ëdevelopmental' sources including construction of infrastructure, industrial expansion, increasing urbanization, and the growth of foreign tourism. In addition, Bhutan has to deal with the compromising land-use management practices that are an inevitable result of the steady increase in the country's population. Though Bhutan's population density is low, the constraining fact is that land available for cultivation in the country is very limited. Expansion of the agricultural sector is therefore limited.

Over 79 percent of Bhutan's population practice subsistence farming, relying on an integrated system of crop, livestock and small-scale forest management, with the country currently meeting 65 percent of its food needs (NEC, 1998). The limited amount of arable land, the nature of the terrain which makes intensification difficult, a high population growth rate and the increase in urban non-farm communities are some of the constraints facing the country's efforts at biodiversity conservation.

The biggest challenge for the forestry sector is to keep up with the overall economic growth rate and thus maintain its share of production. This is, however, not the only challenge. Another one is the support to other sectors. The pressure from agriculture and animal husbandry is not going to ease up, even if the value-added share of those two subsectors is going down. One

must bear in mind that even these sectors are still growing. The key linkage that requires forestry's attention is the supply of animal feed. The previous estimate has been that 30 percent of animal feed comes from forests. There are regional studies, which indicate that the portion could be up to two thirds of fodder requirements.

Agricultural biodiversity is the surest insurance against disasters provoked by biotic and environmental anomalies. Therefore, the future of food security lies with the conservation and sustainable utilization of the rich diversity in native or naturalized plant genetic resources. Much of the local germplasm falls within the primary or corresponding elite varieties. The transfer of and the breeding of desirable traits from landraces into such materials should be possible in most cases. To some extent, the presence of local forms in the proximity of cultivars could induce natural introgression, thus broadening the genetic base of a particular crop.

Bhutan ratified the Convention on Biological Diversity (CBD) on 25 August 1995. The Sustainable Development Agreement with Netherlands and other bilateral and international contracts bind the country to take necessary steps in fulfilling its share in the preservation of biodiversity and environment. The greater dependence on few plant species, about 20-30 in the national context, creates the need to conserve the native genetic resources. Agriculture for food production is the basis for sustenance and a primary source of income for the rural communities. Women play a critical role in this profession, and are comparatively more dependent on the plant genetic resources than men. Under any production system, women are intimately associated with the crops they cultivate, and thus are more informed of the crop genetic potential and the compelling environmental determinants. It is more difficult for the rural women to get employment outside the farm life. Their freedom and security are thus closely linked with the genetic value of the crop resources. Food and agriculture programmes will have to be sustainable and productive in order to reinforce women's rights to self-determination and equality in the society. Their indigenous knowledge should be incorporated into modern technologies, and the local crop genepools need to be conserved to the effect of enhancing their livelihood and protecting their socio-economic status.

Chapter 2

Description and Assessment of Biodiversity Conservation Efforts in Bhutan

2.1 Biodiversity Conservation – Overview
2.2 Wild Biodiversity Conservation
2.3 Domestic Biodiversity Conservation
2.4 Institutional Framework
2.5 Policy and Legislation related to Biodiversity
2.6 Economic Valuation of Biodiversity
2.7 Integration of Biodiversity Considerations into other sectors
2.8 Bhutan Integrated Biodiversity Information System
2.9 Education and Public Awareness
2.10 International Cooperation in Biodiversity Conservation

2.1 Biodiversity Conservation Overview

Biodiversity conservation efforts are usually presented in terms of in situ and ex situ conservation. In situ refers to conservation within the natural habitat, whereas ex situ refers to conservation outside of the natural habitat. Therefore in situ refers to conservation of ecosystems, species and genetic materials within the parts of the environment where they are found naturally. Ex situ conservation involves efforts, primarily with species and genetic materials, which have been removed from the habitat where they naturally occurred.

Wild Biodiversity: With wild biodiversity, in situ methods involve the whole range of activities associated with Protected Areas including establishment, the range of management activities, research, education, buffer and enclave zones, and work with local communities. It also involves conservation efforts outside of Protected Areas, including such activities as integration of conservation with sustainable development activities, such as integration of conservation and development programmes and integrating biodiversity conservation into forestry, grazing and agricultural activities, research, various other types of management of human-wildlife interactions, and policy development.

Ex situ conservation of wild biodiversity may involve such activities as zoological gardens, botanical gardens, captive breeding, and various methods and facilities for maintaining seeds, germ plasm and other genetic materials.

Domestic Biodiversity: In situ conservation of domestic plant biodiversity primarily involves conserving the wild crop relatives and wild plants for food production within their natural habitats. This involves efforts both within Protected Areas and outside of them, for example, in forest management and agricultural areas. Conservation efforts include research, survey and inventory, management, education, and policy development.

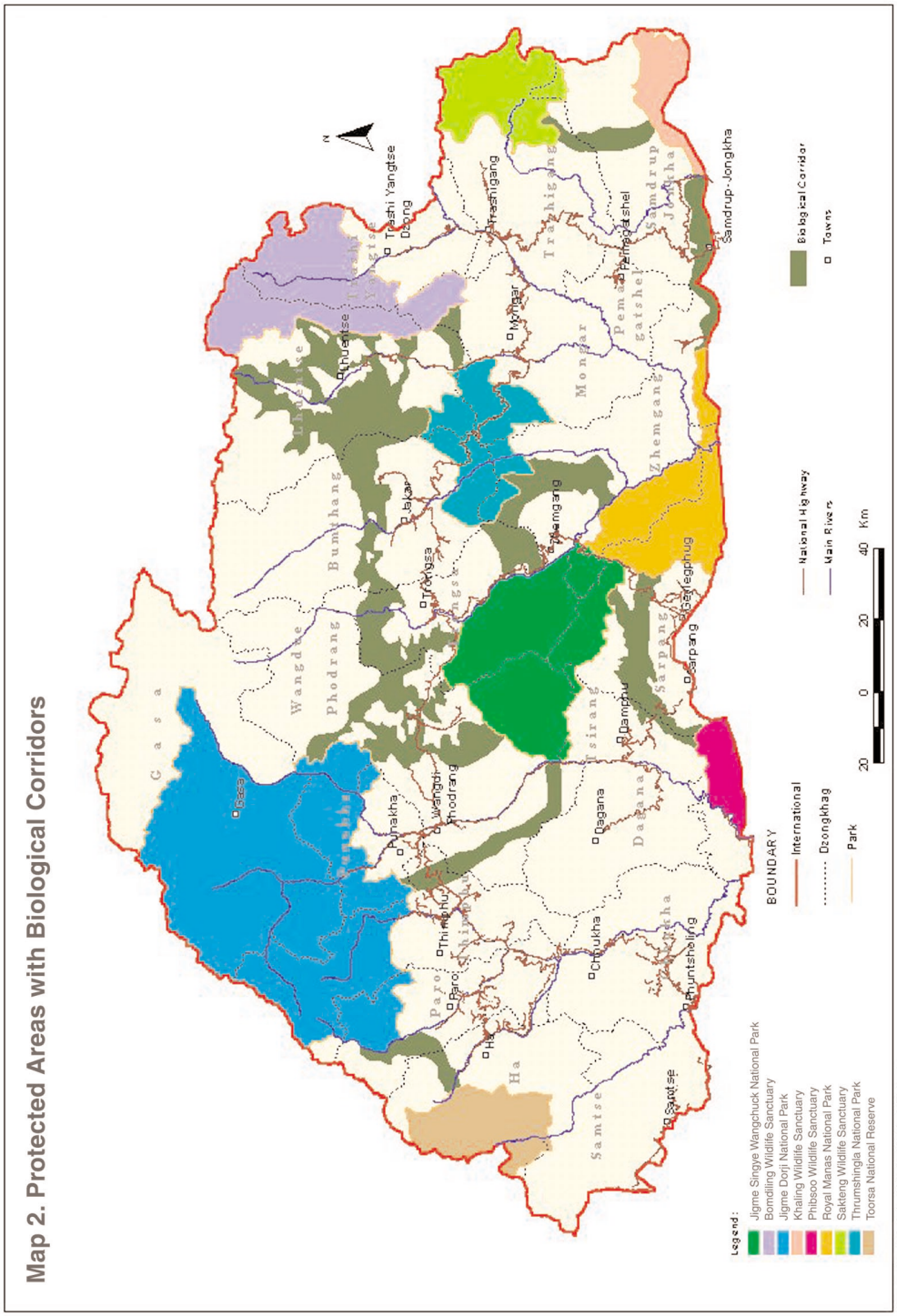
Ex situ efforts include planned and targeted collecting of plant genetic resources, conducting appropriate research, and maintaining them in botanical gardens, gene banks and through the use of new technologies including in-vitro methods.

In situ and ex situ conservation efforts for domestic animal biodiversity generally parallel those for plants, but with the addition of ex situ facilities such as breeding farms.

2.2 Wild Biodiversity Conservation

2.2.1 In Situ Conservation in Protected Areas

The RGOB's policy is to maintain at least 60 percent of the total land area under forest cover with conservation given priority over extraction and utilization of natural resources for economic gains. However, in a country with growing population, pressure on the forests for more agricultural land and settlement is on the increase. Realizing this constraint, the RGOB has adopted the policy of establishing Protected Areas to protect representative samples of the pristine Himalayan ecosystem that are still intact for the conservation of biodiversity and genetic resources. Thus, the previous Protected Area system was revised and a national Protected Area system consisting of four national parks, four wildlife sanctuaries and one strict nature reserve was established in 1993. Currently the Protected Area covers 26.23 percent of the country and the responsibility for their proper


Map 2. Protected Areas with Biological Corridors
Legend:
Jigme Singye Wangchuck National Park
Bomdiling Wildlife Sanctuary
Jigme Dorji National Park
Khaling Wildlife Sanctuary
Phibsoo Wildlife Sanctuary
Royal Manas National Park
Sakteng Wildlife Sanctuary
Thrumshingla National Park
Toorsa National Reserve
BOUNDARY
International
Dzongkhag
Park
National Highway
Main Rivers
Biological Corridor
Towns
20 0 20 40 Km
N
Gasa
Punakha
Wangdi Phodrang
Thimphu
Paro
Haa
Chukha
Dagana
Tsirang
Damphu
Sarpang
Gelephu
Trongsa
Jakar
Lhuentse
Mongar
Trashigang
Trashiyangtse
Samtse
Phuntsholing
Samdrup Jongkha
Prepared at GIS Unit, NCD, DoFS, MoA, Thimphu
December 2001

management lies with the Nature Conservation Division of the Department of Forestry Services.

2.2.1.1 Bhutan's System of National Parks, Reserves and Sanctuaries

The Protected Area system covers a total of 10,878.33 sq. km as follows:

a) Toorsa Strict Nature Reserve (650.74 sq. km)

This reserve protects the westernmost temperate forest of the country from broadleaf forests to alpine parks including the small lakes of Sinchulungpa. The area has no human habitation and is a security area near the Chinese border.

b) Jigme Dorji National Park (4,349 sq. km)

This park represents the largest Protected Area in Bhutan. It is an important natural conservatory of glaciers, alpine meadows and scrublands, sub-alpine and temperate conifer forests, warm and cool temperate broadleaf forests, major rivers and streams, and the flora and fauna that inhabit these ecosystems. The park harbours some 'charismatic' species of wildlife, many of which are endangered or extinct elsewhere in the world. These include the takin, snow leopard, blue sheep, musk deer, Himalayan black bear, marmot, red panda, tiger and several species of pheasants.

JDNP is also famous for its wild flowers. Several species of plants found in the park are valuable cultivars for crops and have other horticultural uses, and a number of others have commercial, medicinal, traditional and religious significance. Over 300 plants are currently used to make indigenous medicine most of which are from the JDNP (BTF, 1995). The area also has high potential for trekking tourism.

c) Royal Manas National Park (1,022.84 sq. km)

This park is the conservation showpiece of Bhutan. Its location is strategic in that, to the north, it is adjacent to Jigme Singye Wangchuck National Park (formerly Black Mountains National Park) and to the south it forms a trans-frontier reserve with India's Manas, which is under UNESCO's World Heritage Programme. Thus, RMNP forms an integral part of a Protected Area complex, which includes a range of habitats, from lowland tropical systems all the way up to permanent ice fields. It is also the only Park in Bhutan where rhinoceros are found. This park contains more significant species than any other in Bhutan, and already 362 species of birds have been confirmed in the park area. Several species of plants found in the park have value as cultivars for crops and other horticultural uses, and a number of others are of commercial, medicinal, traditional, and religious significance. Thus, the park will serve as a genetic depository for these valuable plants (NCS, 1995).

d) Jigme Singye Wangchuck National Park (1,400 sq. km)

This is the former Black Mountains National Park, renamed recently as Jigme Singye Wangchuck National Park (JSWNP) on the recommendation of Her Majesty the Queen Ashi Dorji Wangmo Wangchuck during her visit to the park in early 2002. It covers a wide range of habitat types from permanent ice on the peak of Dorshingla 4,925 m, alpine lakes and pasture, conifer and broadleaf forests. The reserve will constitute the largest and richest temperate forest nature reserve in the entire Himalayas. Surveys have already revealed 449 species of birds in this combined area of JSWNP and RMNP – more than any other reserve in Asia.

The park contains almost no permanent residents. There are a few small farms along the borders of the park along the Mangde Chu River. The only major use currently made of this area is the grazing of yaks in summer on the northern alpine areas of the park.

e) Thrumshingla National Park (768 sq. km)
This is the second major temperate park in Bhutan and contains some spectacular scenic views; beautiful forests from alpine to sub-tropical broadleaf. It also contains some protected examples of chir pine forest. The soil of this area is particularly fragile; rendering it quite unsuitable for logging or other development but it has excellent tourism potential with a good wildlife trail from the Ura valley right down to the Bumthang valley.

f) Bomdiling Wildlife Sanctuary (1,486.75 sq. km)
This sanctuary contains a rich diversity of flora and fauna. The natural ecosystems range from sub-tropical forests in the lower elevations to alpine meadows in the higher elevations. It also contains some of Bhutan's most scenic alpine lakes. Bomdiling valley, located within the sanctuary, is also one of Bhutan's main wintering spots for the rare black-necked crane. In addition to the wide spectrum of ecosystems, the sanctuary houses several cultural and religious sites of international significance, including the Singye Dzong and Khempa Jong, sites held sacred by Buddhists throughout the region (BTF, 1995).

g) Sakteng Wildlife Sanctuary (650 sq. km)
The area is designed to protect the easternmost example of the temperate ecosystems of Bhutan where some endemic species are found such as the eastern blue pine, black-rumped magpie and many other species found only in the east of the country.

h) Khaling-Neoli Wildlife Sanctuary (273 sq. km)
This reserve will consist of the existing reserves of Khaling and Neoli. It is planned to combine the two areas and revise the boundaries retaining the same size. The reserve is important for elephant, gaur, and other tropical wildlife and may be the only locality in Bhutan where pygmy hog and hispid hare occur. Both are known from the Khaling Reserve on the Assam side of the border with which this reserve will form a transfrontier reserve.

i) Phibsoo Wildlife Sanctuary (278 sq. km)
This sanctuary in South-central Bhutan is known for it diverse flora and fauna and important biogeographic position in the country. Tropical fauna such as elephant, gaur, and golden langur are found here. It is the only reserve in Bhutan to have chital deer. In addition, it is the only remaining natural Sal forest in Bhutan (FSD, 1995).

Table 8. Protected Areas

Name of Protected Area	Size (sq. km)	Dzongkhags	Status	Donor
Royal Manas National Park	1,022.84	Zhemgang Sarpang	Operational since 1995 1995-2002	WWF Bhutan Programme
Jigme Singye Wangchuck National Park	1,400	Zhemgang Trongsa Sarpang Wangduephodrang Tsirang	Operational since 1995	Government of the Netherlands 1998-2002
Jigme Dorji National Park	4,349	Gasa Thimphu Paro Punakha	Operational since 1995	UNDP/GEF 1997-2002
Bomdiling Wildlife Sanctuary	1,486.75	Mongar Lhuentse Trashiyangtse	Operational since 1998	DANIDA 1998-2003
Thrumshingla National Park	768	Bumthang Mongar Lhuentse Zhemgang	Operational since 1998	WWF Bhutan Programme 1998-2002
Phibsoo Wildlife Sanctuary	278	Sarpang	2002	Bhutan Trust Fund WWF Bhutan Programme
Sakteng Wildlife Sanctuary	650	Trashigang	2002	None
Khaling/Neoli Wildlife Sanctuary	273	Samdrup Jongkhar	To be operationalized during 9th FYP	None
Toorsa Strict Nature Reserve	650.74	Ha Samtse	To be operationalized during 9th FYP	None

2.2.1.2 Establishment and Development of Protected Areas

The earliest Protected Area in the country was Royal Manas, which was maintained as wildlife reserve for many years prior to being notified as a wildlife sancutary in 1966. It was later upgraded to a national park and extended to link it to the Black Mountains National Park, now Jigme Singye Wangchuck National Park. Consequently other Protected Areas were created, such as the Jigme Dorji Wildlife Sanctuary in 1974. Subsequent reviews of the Protected Area system led to its revision in 1993 to represent all ecosystem types in the country.

At the beginning of the 7th Five Year Plan a policy decision was made to begin operationalising the Protected Areas in Bhutan. In 1993, a preliminary biodiversity assessment of RMNP and JSWNP was conducted by the NCD in collaboration with the WWF Bhutan Programme. The data collected from these assessments were used as baseline information for the preparation of the first management plan for Royal Manas National Park approved in 1995. During this same year, the Government of

Netherlands and the RGOB signed the Biodiversity Conservation Project, which was aimed at strengthening the capacity of NCD, as well as operationalizing Jigme Singye Wangchuck National Park. Major activities in JSWNP consisted of boundary, socio-economic and biodiversity surveys.

Park Managers for RMNP, JDNP and JSWNP were appointed in 1994-1995, and while RMNP began the process of implementing its management plan, JDNP and JSWNP began preliminary surveys to gather information to prepare their management plans.

After the approval of the JDNP management plan in 1997, the RGOB and the UNDP/GEF signed an agreement to implement the Integrated Conservation of Jigme Dorji National Park Project for a period of five years (1997-2002).

In 1998 with the placement of a Park Manager and field staff, a project entitled Conservation Management Planning for Thrumshingla National Park was formulated and it was established as an on-the-ground entity through support from the WWF Bhutan Programme. Also with the Bomdiling Park Manager and support staff in place, the Danida supported Environment Sector Programme Support began providing assistance to this sanctuary (1998-2003). To collect the necessary information needed for drafting the management plans, JSWNP, TNP, BWS carried out socio-economic, biodiversity, bird and mammal surveys from 1998 to 2000. Management plans for Jigme Singye Wangchuck National Park, Thrumshingla National Park and Bomdiling Wildlife Sanctuary were approved recently in 2001.

The Protected Areas are in different planning positions. The RMNP had a 'first generation' management plan based on surveys, with considerable consultant input, and was ambitious, such that it could only be partly implemented. Since then all management plans have been prepared by NCD and park staff, using technical expertise for the survey work and analyses of the information from the field. In BWS and TNP, the management plan preparation was a consultative process involving park staff, *Geog* and *Dzongkhags* and NCD. Also, biodiversity and socio-economic surveys have been more thorough. For JSWNP a one year pilot Managment Plan has been prepared that outlines a programme of surveys and consultations by which a full-fledged management plan will be prepared coinciding with the 9th Five Year Plan.

During the 9th Five Year Plan, it is envisaged that Phibsoo Wildlife Sanctuary will be operationalized while biological and socio-economic inventories will be completed for Sakteng Wildlife Sanctuary and preliminary surveys conducted for Toorsa Strict Nature Reserve and Khaling Wildlife Sanctuary (NCD, 2002).

JDNP is in the last year of its project funded by UNDP/ GEF. Future funding is not definite at the moment. The Biodiversity Conservation Project that funds NCD as well as the activities of JSWNP is also reaching completion in 2002. The project proposal for the second phase has been prepared and submitted to the Sustainable Development Secretariat as well as to the Government of the Netherlands for funding. Bomdiling Wildlife Sanctuary is also reaching its last year of its first phase in 2002. The second phase of the project will be from 2003 to 2005 with continued funding

from Danish Development Assistance (DANIDA). TNP, RMNP and PWS are still being supported by the WWF Bhutan Programme.

2.2.1.3 Expansion of Protected Area Boundaries

Based on field surveys and the recommendations provided by the wildlife and bird specialist, an extension of boundary of BWS was proposed in the area around Singye Dzong and the area surrounding Dongla, Aja and Yarab. Thus the total area of the sanctuary has increased from 1,300 sq. km (MOA, 1998) to 1,487 sq. km. (BWS, 2001)

2.2.1.4 Boundary Demarcation and Zoning of Protected Areas

Boundary surveys of most Protected Areas are underway. In the case of JDNP, prominent landmarks along the Southern boundary have been fully demarcated by the staff. To accommodate both biodiversity conservation and the needs, aspirations and rights of the people living within and around the Protected Areas, the Protected Areas will be zoned into core, buffer and multiple use zones (NCD, 1996). However, zoning has yet to be undertaken. Boundary demarcation and zoning require both time and commitment, not only from park staff but also from other partners/stakeholders like *Dzongkhag*, Territorial Divisions, and local people.

2.2.1.5 Management of Protected Areas

All parks have similar administrative organizations. The Head Office of the park management has three sections, one dealing with ICDP programmes, one dealing with research and monitoring programmes, and one dealing with wildlife management. At field level, parks have warden posts and guard posts to patrol and monitor activities within that particular jurisdiction with support from the park Head Office. In addition to the existing staff, the parks are also supported by *resoops* (village forest guards) who are paid a fixed salary by the Department of Forestry Services. Under circumstances of staff shortage in the parks, the resoops provide a useful source of support. There is also considerable support and collaboration with territorial divisions and staff from Dzongkhag administrations.

a) Human Resources in NCD and Protected Areas

Each of the PAs is now fully operational with a Protected Area Manager and supporting staff. Until this year, the NCD has given higher priority to strengthening and institutional building of the PAs. Currently, there are 196 staff working in NCD and the PAs. This excludes village forest guards and caretakers. Still, an additional 100+ staff are proposed for the already established parks. With additional Protected Areas proposed to become operational within the 9th Five Year Plan, the number of persons involved directly in conservation activities will be even greater.

b) Establishment of Park Infrastructure

Strengthening of park infrastructure has been given the first priority so that park staff can be transferred to their respective warden posts. Park infrastructure includes the construction of new park offices, warden posts, guard posts, check gates, staff residences, visitor centres, water supply, and development and maintenance of trails and bridges inside the PAs. In addition to this, PAs are also being equipped with office furniture, supplies and field equipment. Warden posts are provided with short-range

field equipment and handsets that have greatly facilitated communication from remote warden posts.

Since the newly established PA's are in the process of establishing themselves as on-the-ground entities, the emphasis has been on park infrastructure development, taking over forestry activities from Territorial Divisions, conducting socio-economic surveys, PRAs, building rapport with *Dzongkhag* partners and identifying ICDP opportunities.
With the exception of RMNP and TNP, at the national level the operational Protected Areas have a Project Advisory/Steering Committee that meets on an annual basis to review the yearly progress and discuss the next year's workplan. In preparation for these meetings, PA Managers are required to prepare and present the Financial and Physical progress reports for the first six months/one year and submit the requisitions for the next six months/one year. These committees are chaired by the Minister for Agriculture with representatives from the donor agencies, *Dzongkhags*, National Environment Commission, Ministry of Finance, NCD and other relevant partners.

In addition to this, projects like JDNP also have a Project Advisory Group with the Head of NCD as the chairman. This group, as its name implies, plays a more advisory role to the park management. The Biodiversity Conservation Project and JSWNP are evaluated bi-annually while BWS is reviewed through a joint annual sector review conducted by RGOB and DANIDA. Occasionally technical reviews are also conducted.

Thus project performance reviews for the operational PAs have been based on donor requirements.

c) Lessons Learned
So far the main lessons learned have been at the Protected Areas where donor support has been concentrated and new approaches have been applied.

There have been some positive efforts that have been made towards improving conservation activities in PAs. To begin with, the clear and comprehensive park management plans provide the basis for prioritization and implementation of PA activities. Park staffs are motivated and becoming increasingly well trained. Internal management within parks are improving and while ICDP programmes are providing an opportunity for the parks and local communities to work together, there is increasing collaboration with local stakeholders.

Still there are many weaknesses that have been identified. For example, some external reviews have identified constraints in implementation of projects. These include a) inadequate reporting systems at the park and NCD level, b) need for better coordination of training, c) rapid staff turn-over, d) insufficient planning and managerial capabilities, e) limited numbers and capacity of PA staff, f) limited capacity of NCD to provide institutional support to PAs, g) insufficient staff and human resources for effective park management; and h) financial procedures are not conducive (delay in fund release, complicated procedures). Still other weaknesses identified in the draft vision and strategy for NCD include i) lack of financial sustainability and high dependency on donor funding, j) inadequate reporting

(structure), k) insufficient database, limited research and l) inadequate monitoring.

In general all PA's depend largely on external donors that provide support to individual parks for period coinciding mostly with managment plans (preparation and implementation). As different donors have different priorities there are important differences among the parks in the total amount available as well as the allocation to various activities. The dependence on donors has raised some doubts about future sustainability, even though in most cases funding is in the process of being committed for the coming years at least.

There are quite a few differences in working processes among the parks, each one having developed in isolation to some extent. Nevertheless, good progress has been made particularly in the longer established PA's. Regarding internal management, all parks are satisfied with the internal communication, decision-making processes and leadership. In general, all parks have a good working atmosphere, attaching importance to teamwork, transparency and achieving planned activities.

d) Some Efforts made to Address Constraints

1. Delays in fund release. Most of the Protected Area projects such as JDNP, JSWNP, RMNP have decentralized their funds with an account at the park level. This had resulted in the faster channelling and use of funds.

2. Inadequate reporting systems at the park and NCD level. Park Managers and NCD representatives have started to meet every four months to update each other on the progress in the PAs as well as NCD, and discuss issues relevant to PA management.

3. Need for better coordination of training. During the park conference it was decided that the Management Planning Section would take the responsibility of identifying and coordinating training needs of all PAs and NCD staff.

4. Rapid staff turnover. With capacity building in PAs given high priority, *Park Managers* were nominated for further studies. As a result of this, Park Managers were being changed. Now, since all Park Managers have/are undergoing Masters, this problem is solved.

5. Insufficient backstopping and service delivery by NCD and limited capacity of NCD to provide institutional support to PAs. The main reason for these problems was that the existing three sections in NCD were not yet operational due to staff shortage and priority being given to the PAs. Now, with the three sections in NCD, it is expected that NCD will be in a better position to provide institutional support to PAs. Also with the increase in staff strength and consultation mechanisms being established at NCD level (monthly office meetings, quarterly Park Managers meetings and annual conferences), the opportunities have increased for strengthening the links between NCD and the parks.

6. Insufficient database, limited research and inadequate monitoring. The need was identified to standardize the survey methodology and develop and test a

biodiversity monitoring framework and guidelines. For this purpose, technical assistance was sought to a) develop a Rapid Biodiversity Survey Methodology for all PAs, and b) to develop a monitoring framework for PAs, which will form an essential component of an adaptive management approach (this is explained in more detail in Section 2.2.1.9, Biodiversity Monitoring in Protected Areas).

7. Shortage of staff has been cited as a hindrance to the timely implementation of management plans. Human resources are a concern to all parks, as all have not yet received the full complement of staff according to their establishment. JSWNP feels the shortage most acutely, as it has the smallest staff and the second largest area to manage. The human resource needs of the Department of Forestry Services as well as the *Dzongkhag* Forest Extension Offices have to be met from the Natural Resource Training Institute (NRTI) and the Bhutan Forestry Institute (BFI), from where deputy rangers and forest guards graduate. One measure to tackle this problem has been to increase the intake of forestry students into NRTI and BFI. Still another measure has been to propose hiring of ex-army men to conduct patrolling in highly sensitive poaching areas.

8. Co-ordination with other agencies. Some Protected Areas have established working relationships with a diverse range of partners and stakeholders. Some prominent ones include RNRRCs in Bajo and Yusipang, ITMS, DOT, RSPN, *Dzongkhags*, local communities, local schools and donor agencies.

2.2.1.6 Strengthening NCD and Protected Areas

Organizational strengthening is ongoing at two levels: at the NCD and at the park levels. At the park level organizational strengthening concerns the planning and implementation of project and park management plans, while the NCD level is concerned with providing technical backstopping to the parks as well as support planning and policy development for Protected Area management. This results in mutual strengthening at both levels.

a) Capacity Building

Capacity building of Bhutanese nationals through in-country and overseas training has been given high priority by the RGOB. BTF funds many short-term as well as long-term training programmes for NCD and park staff. In addition to this, individual Protected Areas also have funds allocated from their respective donor projects to train park staff as well as park partners.

A number of park staff have undergone training out of the country in various aspects of wildlife management, survey and monitoring techniques, RRA, PRA, ICDPs, forest fire protection and control, environment and development, bird censusing, biodiversity assessment and monitoring, and community forestry. Groups of park staff, extension agents, forestry staff and *Dzongkhag* staff, park resoops, and local school teachers were sent outside the country on study tours of Protected Areas in Nepal, Philippines and Australia, but mostly in the South-east Asia region. This has increased their awareness on conservation issues and Protected Area management

While most staff have received training in the more general PA management field, field staff now require training on specific aspects such as conducting population, habitat and distribution studies on specific species, risk assessment, and research and monitoring techniques.

b) Park Self Assessment Conducted in 2001

Using a format based on IUCN procedures that was modified to suit the situation in the parks, self-assessment of all operational PAs except Royal Manas National Park was conducted during July and August 2001. The main objectives behind the exercise were a) to serve as input for the development of 'Vision and Strategy Document' for NCD, which will be important in providing guidance to NCD and Protected Areas for implementing its sub-programmes under the 9th Five Year Plan; b) to help set priorities for donor support particularly for the second phase of the Biodiversity Conservation Project which will be more of a programme support to NCD and the Protected Areas; c) to review the progress and constraints of Protected Area management, and lastly, d) to help the sections under NCD to plan for necessary assistance to the Protected Areas.

2.2.1.7 Coordination/Collaboration and Information Exchange

a) Forestry Technical Advisory Committee Meetings

Since it was realized that relationships that facilitate co-ordination and collaboration are still poorly developed in the Department of Forestry Services, a series of technical advisory meetings for all Divisional Forest Officers, Park Managers and senior officers has been initiated from February 2000. To date three technical advisory committee workshops have been organized. In these workshops a wide range of issues pertaining to forestry and conservation were discussed.

b) A Conference for Protected Areas

The first Conference for Protected Areas was held in early March 2001. The aim of the conference was to encourage exchange of information between various Protected Areas, to present technical papers, assess the progress in the implementation of management plans, to share and discuss problems experienced by park staff and to seek common solutions, while learning from each other's experience.

This was funded by the Bhutan Trust Fund for Environmental Conservation and focused on updating all Park Managers on experiences in parks, on the preparation of the 9th Five Year Plan and on discussing and finalizing the roles and responsibilities of the three sections of the NCD. It has been resolved that such a conference will be held annually.

c) Quarterly Meetings for Park Managers and NCD

Quarterly meetings between NCD and Park Managers were initiated last year to keep abreast of the park activities and problems in the field.

d) Warden and Staff Meetings

Wardens are required to submit monthly reports on their activities. Quarterly wardens' meetings are held in PAs at different warden posts on a rotational basis. This was started by JDNP in 1997/1998, and followed by JSWNP in March 2000.

These warden meetings are chaired by the Park Manager. Since mid 2000, Thrumshingla National Park has also commenced with quarterly meetings involving all wardens.

2.2.1.8 Biodiversity Research and Surveys in Protected Areas

Recognizing the need to make Research and Monitoring an integral element of PA management, most PAs have recently established a Research and Monitoring Unit with clear cut responsibilities/TOR for the independent warden/Deputy warden. Under the overall supervision of the Park Manager, this warden will plan and prioritise research and monitoring programmes for the PA, maintain the GIS database and propose management interventions to the park management, compile and maintain field data and prepare reports to be submitted to NCD on a regular basis. As and when needed, these wardens will seek technical assistance from the Species Conservation, Research and Monitoring Section in NCD or work with other research partners.

Current data collection efforts are ongoing in JDNP on takin, leopard, tiger, crop depredation, and medicinal plant and mushroom surveys. On a small scale, BWS has carried out a survey on cordyceps and on the effects of pasture burning. In JSWNP data collection on grazing impacts and human-wildlife interactions as well as on golden langurs and tigers is ongoing. Data is also being collected on potential economic opportunities, potential ecotourism areas, background studies on fishing practises in Berti village (Zhemgang *Dzongkhag*), and a crop damage study, also in Zhemgang *Dzongkhag*. There has been limited data collection at the NCD on tiger distribution, population, livestock depredation and human-wildlife interaction.

Biodiversity surveys have been conducted in all operational Protected Areas with the exception of RMNP where the present situation does not permit much survey work. Surveys in TNP, JSWNP and BWS were preliminary biodiversity surveys, with survey results being used to prepare the respective management plans.

Jigme Singye Wangchuck National Park. Biodiversity surveys in JSWNP began as early as 1993, when a preliminary assessment of Royal Manas National Park and the proposed Jigme Singye Wangchuck National Park was conducted (NCD, 1993). Subsequent surveys were also conducted. While complete biodiversity surveys have not been conducted for the entire park, it is estimated that over 5,000 species of vascular plants are to be found in JSWNP. Over 40 (19 confirmed and 21 expected) species of mammals inhabitat the park. A bird survey specifically for JSWNP has not been carried out to date but literature reviews relating to bird surveys in and around the JSWNP has revealed about 391 species of birds, of which 82 are found in the buffer zone (BMNP, 2001).

Thrumshingla National Park. In the case of TNP, wildlife surveys resulted in a provisional list of 68 mammals in the park with the exception of the Chiropterans. It needs to be confirmed whether or not the park contains the variable squirrel *Callosciurus finlaysonii*. A further enquiry concerning the nomenclature by the surveyor is underway to recognize if a deer species found here can be proposed as the '*Bhutan Show*'. Until now, 622 species of plants belonging to 140 families are known in the park, which also include 152 species with medicinal values. A recent vegetation study

in Thrumshingla suggested that there are 21 species that are endemic to Bhutan, *Lobelia nubigena* is the only endemic species found in one locality of the park when entire Bhutan is considered. In addition, three species in the park bear new records for Bhutan, and one globally threatened species (TNP, 2001).

Bomdiling Wildlife Sanctuary. Biodiversity surveys started in Bomdiling in 1998 and continued through 1999 and 2000. Within the sanctuary and its buffer zone among other species four globally endangered mammals and other globally vulnerable mammals were found. The surveys also served to identify some of the most specie-rich habitats in the sanctuary, such as the areas around Yara, Ngalimang, Singye Dzong and Chudu. Based on tiger evidence during the wildlife survey, it was suggested to extend the Sanctuary boundary to preserve a sufficiently large tiger habitat (BWS, 2001). Bird surveys in BWS were carried out in May-June and September 2000, during which 293 species of birds were recorded in the sanctuary and its buffer zone. Five bird species are on the IUCN international Red List of globally threatened birds, four are globally near-threatened bird species and six are restricted range species. During the wildlife surveys, 32 species of butterflies were collected, of which 10 were common, 13 uncommon and 7 rare (BWS, 2001).

Jigme Dorji National Park. In the JDNP, an annual takin count (in summer) has been ongoing in the Tsharijathang valley since June 1998. Behavioural and habitat information is also being collected by the park (W&C, 2000), and research on takin ecology is almost completed. Snow leopard survey training was conducted in Laya from 8-20 April 2000. At the same time, information on blue sheep were also collected. In a joint collaboration with the ITMS, NCD, and RNRRC Yusipang, the park conducted a survey to study the status and habitat of medicinal plants in the Lingshi and Soe areas in July and August 1999.

While the presence of red panda has been confirmed in JDNP, field staff have also reported seeing tiger evidence in Barshong (elevation 4,000+ m) where the snow leopard is found. While this has to be verified further, it may indicate that there is an overlap of snow leopard and tiger habitat in Jigme Dorji National Park.

Biological Corridors. The first phase of the surveys for the Biological Corridors was completed in May 2001. This was carried out by the NCD in collaboration with the Field Museum, Chicago, with support from WWF Bhutan Programme. The survey revealed many threatened species of vascular plants and birds as well as obscure and nocturnal mammal sightings. The boreal owl was sighted for the first time in the country at a place called Pimi in Eastern Bhutan (see divider Chapter 2).

Recognizing that different PAs were using a variety of different methods to conduct biodiversity surveys, it was determined that one consistent method should be developed for all PAs. A consultant was hired to assist NCD in developing a Rapid Biodiversity Survey methodology, which was discussed at a national workshop (15-16 January, 2002). This methodology has been adopted by park staff and NCD as the methodology that would be used to provide information for 'Background Biodiversity Monitoring', to be repeated every five years. For this purpose, random sample plots have been identified based on Global Positioning System (GPS) readings in each

Protected Area. While it will not be feasible to cover all sample plots, the aim is to cover at least 30 percent of the selected sample plots. This methodology, which has been accepted in principle, has yet to be adopted by all Protected Areas. In the meantime, it is proposed that this methodology be tested in the JSWNP and modified to suit the situation in the Protected Areas.
It has also been recognized that among other vertebrate taxa, the reptiles, amphibians and fishes are poorly documented. Due to the extremely varied habitat types, detailed surveys may well reveal new endemic species. Of the invertebrate groups, the butterfly fauna is extremely rich, but needs to be inventoried in detail. The NCD is expected to begin inventories of other vertebrate taxa during the next five year plan.

2.2.1.9 Biodiversity Monitoring in Protected Areas

Although the importance of monitoring was appreciated, it was not assigned high priority until recently because most of the Protected Areas are still in their infancy. Monitoring was only touched upon during the Protected Area Survey and Monitoring Training workshops, where an overview of monitoring techniques was provided. Even so, these were based on monitoring at species and habitat level.

Recognizing the need to build up an efficient and effective monitoring and data management system, the NCD is taking steps to make the monitoring section within NCD and the Research and Monitoring Wardens in the Protected Areas more operational. The importance of a monitoring system has been recognized as all the Protected Areas are relatively new and experimental in nature, more so with the newly initiated ICDP. Also, with Protected Areas such as JDNP, BWS, JSWNP and TNP already implementing a number of activities in line with the management plans and project documents, the need for performance monitoring of these projects is important so that PAs can adopt an adaptive approach whereby plans and activities are gradually improved and focused using monitoring results,

Through the Biodiversity Conservation Project, technical assistance has been sought to prepare a monitoring framework/scheme to make clear how surveys and monitoring can be part of an adaptive planning approach. The following framework proposes how different survey and monitoring methods are related within an NCD and Protected Area Management Cycle.

A two-day workshop was conducted from 15-16 January 2002. The main objective of the workshop was to present and discuss the monitoring framework with Park Managers and their wardens. Prior to and during the workshop, the park wardens prepared case studies. This helped field staff to familiarize themselves with various aspects of the framework. By the end of the two-day workshop, the participants had adopted three types of biodiversity monitoring, which were to be tested by NCD. These were:

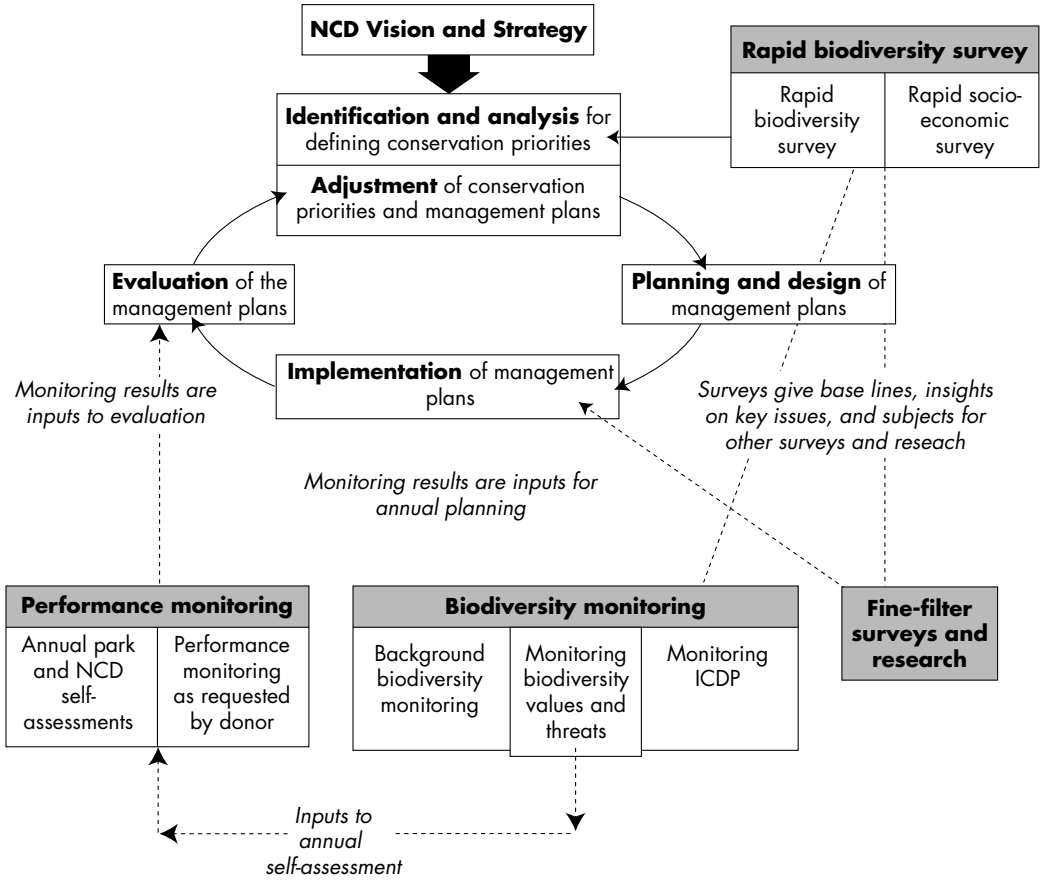
1. *Background biodiversity monitoring*. The objective is to detect changes and long-term trends with respect to biodiversity (in and possibly outside Protected Areas), and adjust plans and policies to avoid irreversible biodiversity changes.

2. *Monitoring of biodiversity values and potential threats.* The objective is to detect changes with respect to critical biodiversity values and potential threats (in and possibly outside Protected Areas), and adjust plans and policies to avoid irreversible biodiversity changes.

3. *Monitoring of ICDP.* The objective is to assess changes with respect to development – conservation attitudes and behaviour and to draw conclusions on the success and sustainability of undertaken ICDP programmes, and based on that to adjust ICDP plans to better reach conservation goals.

A framework for biodiversity monitoring by NCD

The following scheme shows how biodiversity surveys, biodiversity monitoring, evaluation and research activities are integrated in the NCD management system at the park level (Kessler, 2002).



2.2.1.10 Biological Corridors Linking Protected Areas

Declared as a "gift to the earth from the people of Bhutan" by Her Majesty the Queen Ashi Dorji Wangmo Wangchuck in November 1999, a total area of 9 percent (approximately 3804 sq. km) was declared as Biological Corridors linking all the Protected Areas with support from WWF Bhutan Programme. These designated corridors, which were identified using the results from the feasibility studies conducted on tiger and wildlife movement, have been granted full recognition by the RGOB.

The objective of designating these areas was to allow the movement of wildlife between otherwise isolated Protected Areas. Since their designation, the NCD has fielded survey teams to assess the specified areas. A survey in collaboration with the Field Museum of Natural History in Chicago and WWF Bhutan Programme was conducted in March 2001. Current survey work involves ground truthing using GIS technology, inventory of fauna and flora with information on their occurrence and habitat status, and identification of existing and potential threats to wildlife population. These surveys are expected to result in a master plan that will provide further guidance in the preparation of specific management plans for each Biological Corridor.

The Biological Corridors are not strictly Protected Areas and need not be included within the Protected Area Network. However, these areas are to have low intensity land uses such as Forest Management Units, community forests, agricultural lands and riparian corridors.

2.2.1.11 Conservation Areas

Conservation Areas are multiple use areas with special values that do not need to be under the management of NCD, but each requires some special regulations to ensure the protection of local species of conservation importance. Conservation Areas are currently constrained by lack of strong and specific regulations and activities. Of the six Conservation Areas in Bhutan, Phobjikha, as the black-necked crane habitat in addition to being in the buffer zone of Jigme Singye Wangchuck National Park, is the only area that has been exposed to conservation initiatives. In this RSPN, the only national environmental NGO, has been involved in the development and implementation of ICDP that it envisages will make conservation in the area the basis for economic well being of the residents. However, all Conservation Areas, including Phobjikha, require further concrete status that promotes their significance. The future of Conservation Areas needs to be guaranteed so as to make present efforts worthwhile. Respective *Dzongkhags*, NCD and RSPN need to collaborate and strengthen the status of Conservation Areas. Table 9 shows the Conservation Areas in Bhutan.

Table 9. Conservation Areas in Bhutan

Name	*Dzongkhag*	Special values
Docchula	Thimphu	Endemic rhododendrons, birds, red panda
Pele la	Wangdue	Scenery, langurs, red panda, birds
Yutong la	Trongsa	Scenery, pine forests, birds
Durtsachu	Bumthang	Hot springs, geology, scenery.
Phobjikha	Wangdue	Black necked crane habitat
Doga	Paro	Goral habitat

2.2.1.12 Integrated Conservation and Development Programmes in Protected Areas

One common feature among all the Protected Areas is the presence of local communities living in villages in and around the Protected Area. Table 10 shows the names of the *Geogs* in the PAs and the approximate population for these areas. These communities are more or less dependent on agriculture or livestock rearing, and as such are either directly or indirectly dependent on the resources within the PA. As a result of the complex park-people relationship, any Protected Area policy and management decision has an effect on the local communities and their way of life.

Table 10. *Geogs* in the Protected Areas

Name of Protected Area	*Geogs* in the Protected Areas	Approximate Population of the *Geogs*
Jigme Dorji National Park	Khatey, Khamey, Laya, Lunana, Naro, Lingshi, Soe, Lango, Tsento, Twang, Kabji, Goenshari, Chhubu	6,500
Jigme Singye Wangchuck National Park	Athang, Phobji, Patale, Doban, Surey, Trong, Korphu, Langthel, Tangsibji.	5,000-6,000
Thrumshingla National Park	Ura, Tang, Chumey, Kheng, Shinkhar, Saleng, Tsamang, Menji Kurtoe	10,000-11,000
Bomdiling Wildlife Sanctuary	Bomdiling, Khoma, Shermung, Yangtse, Jankhar, Tongjang, Menji, Kurtoe	+ 3,000
Royal Manas National Park	Phangkhar,Tong,Ngangla, Norbugang	5,000

The objective of the National Parks enclaves and buffer zones is 'to encourage sustainable development of local communities in order to alleviate pressure on the park's natural system, and as well as ensure the survival of local communities way of life'. The Integrated Conservation and Development Programme is a tool to reduce the impacts on biodiversity of the PA resources use by local communities, make resource use more sustainable, reduce resource use in the core areas of the PAs while at the same time serving to improve the living conditions of the local population.

Objectives

ICDP serves different objectives within each PA. These include:

- To conserve the ecological integrity of the sanctuary through reduction of the pressures on the natural resources;
- To improve the living conditions of the local people living in or near the sanctuary, and to provide alternative livelihood for people from the park area;
- To increase the awareness of local communities about conservation issues and improve natural resource management by local communities; and
- To integrate biodiversity conservation as one of the strategic considerations in planning of developmental services.

Approach

Different Protected Areas have adopted all or some of the objectives above for their ICDP programmes. JSWNP management plan spells out the policy to be followed while planning and implementing ICDP programmes. These include incorporation of *Geog* plans within the *Dzongkhag* planning cycle, promotion of close cooperation with *Dzongkhag* staff, discussion and finalization of ICDP plans in the *Dzongkhag Yargye Tsogchung* (DYT), vesting the responsibility for implementing the plans with the *Dzongkhags*, and capacity building of *Dzongkhag* staff for implementation of ICDP through internal workshops and training.

Generally speaking, all ICDP programmes were initiated only after conducting Socio-Economic Surveys (SES) and extension activities like a Participatory Rural Appraisal (PRA) in the villages inside the PA boundaries. These were carried out in order to gain an understanding of the local farming systems, the uses of natural resources in the PA, the problems encountered by the local communities and possible solutions. Procedures have now been institutionalized within the parks to promote participatory planning. There are ICDP warden posts for which staff members have been trained on the job and outside the country in participatory techniques to enable them to work with local communities in the park and to develop ICDP plans involving the *Dzongkhags*, parks and the community.

ICDP and Community-Based Natural Resource Management Activities

In JDNP, the ICDP team comprises of an ICDP warden, deputy warden and support staff. Community-Based Natural Resource Management (CBNRM) plans were developed through Participatory Learning and Action (PLA) methods. The JDNP/ICDP team spent a number of months developing its methodology, training park and *Dzongkhag* staff, and developing rapport with the *Dasho Dzongdags and Dzongkhag* RNR Sector heads. Pilot plans have been prepared for Laya, Soe Yaksa, Soe Yutoe, Lingshi and Lunana, with each plan focusing on a different management issues: grazing (Laya), Ecotourism (Soe), Lunana and medicinal plants (Lingshi). For Laya, PLA exercises were undertaken in five villages in July and August 1999. Since the different *Dzongkhags* are now aware of the planning process, this is expected to be much shorter and more streamlined in the future. Implementation of the CBNRM plans for Laya and Soe Yaksa are ongoing at the present moment. Planning for other areas like Khatey, Naro, Chubu, Shari *Geogs* in the park are planned for the next field season.

In JSWNP ICDP has been carried out for about two years. The first stage 'identification' is fully incorporated in the park staff activities within the park boundary. In JSWNP, the aim is to involve all staff in participatory park planning, instead of restricting these activities to the ICDP warden alone. SES and PRAs have been completed in all the villages in three of the five districts. In Trong *Geog* the first activities under the ICDP were tried out on a pilot basis (livestock intensification, cane and bamboo management, corral trap trials). In total these are six villages in Trong *Geog* (Zhemgang), four in Korphu *Geog*, 5 in Langthel *Geog*, five in Tangsibji *Geog* (Trongsa) and three in Athang *Geog* (Wangduephodrang). The villages under Tsirang and Sarpang districts (four in total) are not yet covered.

ICDP training was conducted for park staff and partners in January 2001. It is anticipated that by the end of June 2002, all stages of the ICDP planning process will be carried out in the five *Geogs* and an ICDP plan for 2002-2003 will be written for the other four *Geogs*.

In BWS, shortly after the socio-economic surveys and PRA's in the villages were completed in 1998, activities were initiated to create goodwill and to improve relationships between the sanctuary management and the local communities. Potential areas where future ICDP programmes are identified include intensification of the use of natural resources, finding alternatives for products presently collected from the core zone, collaborating with local and national institutions to improve natural resources management, supporting local conservation initiatives, and supporting economic activities that improve sustainability and reduce the pressure on the natural resources of the sanctuary.

Current and planned ICDP activities are outlined/presented in the BWS management plan. Villagers benefiting in BWS include Bomdiling, Tarphel, Chorten Kora, Dungzam, Pantyeng, Womengang, Tshaling, Singphel, Longkhar, Ngalimang, Tshingmar, Khoma, Yangste, and Shermung *Geogs*. CBNRM will be initiated from 2002-2003.

In TNP, importance is being placed on the preparation of annual ICDP plans by the park management and respective *Dzongkhag*, implementation by the *Geog Yargye Tshogchung (GYT)* and monitoring of the development plans by the *Dzongkhag* to ensure that development-related benefits are equitable under the purview of the *Dzongkhag* Administration. Based on this framework ICDP activities under seven programmes include agriculture, livestock intensification, supply of forest products and energy, service centres, economic incentives, awareness and monitoring. There is no ICDP ongoing in TNP. These are scheduled to begin during the 9th Five Year Plan. Villages where ICDP have been prioritized include Kheng Shingkhar, Ura, Saleng, Tsamang, Chumey, Sengor, Tang, Metsho, and Jarey.

Monitoring of the ICDP and its impacts will form a crucial part of the ICDP. The objective is to assess changes with respect to development – conservation attitudes and behaviour, and to draw conclusions on the effectiveness of undertaken ICDP to protect biodiversity. It is expected that this will be conducted in collaboration with the *Dzongkhag* and other partners. Based on lessons learned from the field, ICDP will be modified/adapted to meet conservation objectives without hampering the development objectives or the needs of local communities. The yearly Parks Conference is expected to provide a suitable forum for all PAs to share their ICDP experiences and learn from successful initiatives.

In the near future, a common ICDP framework will be formulated for all Protected Areas in Bhutan. With this common framework, new ICDP activities will be defined. The proposed ICDP activities will then be funded through an ICDP basket funding judged by a technical committee. This is anticipated during the second phase of the Biodiversity Conservation Project. The planning process of ICDP in Bhutan will be harmonised in order to have a common message to the different *Dzonkhags, Geogs* and communities.

2.2.1.13 Integrated Conservation and Development Programme in Conservation Areas

Phobjikha Integrated Conservation Development Programme is a pilot ICDP in a Conservation Area. Phobjikha is not just the home for diverse plants and animals that include globally threatened species but also the livelihood base for about 5,000 people living in about 500 households. The local people are subsistence farmers that have aspirations for economic development. This poses a tremendous challenge to biodiversity conservation and wise use of natural resources. Issues in the valley are related to current and potential threats to the alpine, temperate and wetland ecosystems of the valley. A number of threats to biodiversity conservation have been identified. Some of the current threats include the desire of the local people for materialistic development that could lead to encroachments and conversion of wetland to agricultural land; lack of knowledge and awareness on environmental conservation; increasing use of fuel wood that degrades the adjacent forests and watersheds, which serve as habitat for many animal and bird species; wildlife crop predation and damage which is viewed by the locals as undermining their subsistence livelihood; unplanned extraction of forest products that causes flash floods and soil erosion; growing tourism that provides negligible benefit to the local community and diversifying economic ventures of the community that have the potential for unsustainable use of biological resources. These factors pose a tremendous threat to the ecosystems and related species in the valley that include the rare and endangered black-necked cranes and their wetland habitat. This will not only impoverish the local people in the long run but also greatly undermine the potential contribution of Phobjikha to global environmental conservation.

It is seen from this that ultimately, the goal of conserving and protecting the fragile wetland and its associated endangered species can be attained only if people see economic benefits emanating from conservation activities. Therefore, efforts must be made to establish a clear link between conservation programme and the material well being of the people. Developed around the black-necked cranes as an indicator species, the Phobjikha ICDP aims to establish this link. The RSPN embarked on an Integrated Conservation and Development Programme in Phobjikha valley at the beginning of 1999. With various programme components, this project aims to integrate economic development and conservation efforts to develop Phobjikha into a model for bio-diversity conservation area that serves the basis for the prosperity of its residents.

The project is also expected to deliver global environmental benefits, and enhance Bhutan's status as a 'global hotspot' for Biodiversity conservation, through habitat conservation of the black-necked cranes, sustainable use of biological resources and use of renewable energy, which mitigates climatic change.

2.2.2 In Situ Conservation and Sustainable Use Outside of Protected Areas

2.2.2.1 Species Conservation

a) Tiger Conservation Programme

The Department of Forestry Services is currently implementing the Tiger Conservation Programme through its network of territorial units located in tiger habitats. At the

central level, the NCD is the nodal agency for providing technical backstopping and co-ordination of field activities. WWF Bhutan Programme provides the financial support for this national programme.

The goals and objectives of the Tiger Conservation Programme are:

- To carry out status surveys of tigers using appropriate scientific methodology to generate reliable data for programme planning and formulation;
- To strengthen and expand the anti-poaching programme to mitigate the killing of tigers and their prey species;
- To promote extension and public education to enlist public support and appreciation for tiger conservation; and
- To enhance professional capacity of project implementation staff through training and workshops to enable effective implementation of the Tiger Conservation Programme.

Since its inception in 1995, one of the main activities of the Tiger Conservation Programme has been to conduct tiger surveys in every *Dzongkhag*, especially in tiger reported areas. Until 1998, five nation-wide surveys were conducted to estimate the tiger population in the country. The assessment results indicated that there is an estimated 115 to 150 tigers inhabiting areas that are connected to each other.

Another major component of the programme is the promotion of education and awareness among the public. Annual activities such as Tiger Quiz Competition, printing of posters, production of audiocassettes, delivering tiger talks, and art and essay competitions have been organized. Such activities are aimed at creating awareness as well as generating support for conservation.

Human Resources Development component is considered another major activity of the programme. To date 37 officials from territorial divisions and national parks have undergone regional training on tiger surveying methodologies and identification and interpretation of tiger signs at Nepal and India. In-country training through refresher courses have been conducted for all relevant territorial and park staff.

With regard to international co-operation, Bhutan is actively co-operating with all the other 13 tiger range countries to ensure the survival of tigers and their habitat. This has also been possible due to the linking of the tiger programme and the anti-poaching programme. Also, our representatives have attended meetings of the Global Tiger Forum, International Tiger Field Assessment Workshops, and the Year of the Tiger Conference.

Since 1998, there have been adequately trained staff at the level of Territorial Divisions and Protected Areas, tiger survey and monitoring has been decentralized to the respective Territorial Divisions and Protected Areas, with some support from The Tiger Conservation Project in terms of funds, equipment or technical support.

In addition to conducting surveys to assess the status of tigers, the condition of their habitat and the availability of prey species, research will be given more priority in the future so that management decisions can be taken accordingly. This

will begin on a pilot basis and will be scaled up depending on the availability of resources such as field staff, technical knowledge and funds. Parks such as the Thrumshingla National Park have indicated and proposed for the establishment of an endowment fund to compensate for livestock depredation caused by tigers.

Tigers have been reported from the five established Protected Areas: Jigme Dorji National Park, Jigme Singye Wangchuck National Park, Thrumshingla National Park Royal Manas National Park, and Bomdiling Wildlife Sanctuary. Moreover, breeding tigers have been found in areas between these Protected Areas. Therefore in order to ensure the future of the continuous distribution of the tigers as well as other wildlife, the Tiger Conservation Strategy adopted by the RGOB in 1998 called for the protection using Biological Corridors to link the Protected Areas.

b) Anti-Poaching

Poaching of musk deer, bear and tiger and hunting and trapping of deer, pheasants and other wildlife are believed to occur in the BWS sanctuary (NCD, 2001b), and TNP (NCD, 2001). In JDNP poaching of medicinal plants is also quite high. Medicinal plants such as *Fritillaria cirrhosa (Tsega), Cordyceps sinensis (Yartsa Guenboop) and Saussuria spp. (Ganglameth)*, are the most commonly sought after species. In all Protected Areas, regular patrols are being undertaken, especially in areas identified as particularly vulnerable and during the poaching and plant collection seasons. Park staff members are assisted by *resoops*.

Copies of reports from individual Protected Areas are submitted to the NCD where they are compiled by the Anti-poaching Unit, created to provide support to the PAs as and when needed. In addition to this, the Anti-poaching Unit conducts awareness campaigns in areas prone to poaching.

Another means to combat the poaching problem has been the establishment of park range offices and guard posts in selected areas, identification of new patrolling routes, awareness raising during PRAs and village meetings.

The shortage of staff is felt more acutely during the poaching season when small groups of anti-poaching teams have to cover wide areas and walk long distances even during the night. The lack of proper arms and ammunition also pose a risk to staff safety. Another difficulty is that the staff posted in the Protected Areas are mostly young and inexperienced in handling such cases

The problem of poaching is complicated by the fact that the majority of poachers are from across the international borders of India and China, and as such there are no policies in place in dealing with such situations. Here, regular patrolling and enforcement of the Forestry Rules and Regulations seem to be only appropriate means to reducing the problem at the current moment.

WWF Bhutan Programme has provided and continues to support NCD in purchasing field equipment, conducting awareness campaigns and conducting training. A private consultant was hired to prepare a National Anti-poaching Strategy Document,

which has to be reviewed and discussed further. The document identified poaching trends and root causes of the problem. Existing forest policies and legislation pertaining to the protection of wild flora and fauna, and weaknesses in the translation of these policy directives for implementation were also reviewed.

In order to assess the current situation in the country and to monitor trends in illegal activities throughout the country, the Anti-poaching Unit is in the process of collecting information from all the Territorial Divisions and Protected Areas. A detailed report will be compiled by NCD and submitted to the headquarters for necessary action. This is part of NCD's monitoring programme, and will become an annual procedure to gauge the status (extent/nature/frequency) of such activities.

c) Biodiversity Assessment

A limited amount of studies have been conducted on the black-necked crane by the RSPN. In addition, studies have been conducted on the distribution of the snow leopard, blue sheep, golden langur and takin to name a few. Not many plant species have been studied in detail.

d) Aquatic Biodiversity

For the present, the only conservation effort outside of Protected Areas (where no fishing is allowed) is the strict vigilance over the issuance of fishing licenses and monitoring that the regulations are strictly followed.

No comprehensive list of fish found in Bhutanese waters is available. Dubey, as part of an FAO fisheries project in 1976 (1978, cited by Tamang 1993), collected 42 species, primarily from western and central Bhutan, and an additional two species were collected in connection with surveys for the Wangdi Hydroelectric Project in western Bhutan in 1992. Tamang (1993) developed a more extensive list of 197 species based on species occurring elsewhere in the Himalayas and their foothills (Meghalaya, Auranachal Pradesh, Nepal, Sikkim), but the occurrence of all of the same species in Bhutan is highly speculative. MacKinnon et al (1994) provides a list of species for Royal Manas National Park.

It is noteworthy that in Bhutan fish species richness probably varies considerably with altitude, with by far the greatest number of species occurring at low altitudes and very few that are expected to occur above 2,000 m. This is in agreement with the general observation that in the Himalayas fish populations are confined primarily to the major rivers and their immediate tributaries, and are absent from many small streams due to extensive waterfalls and other barriers. Nevertheless, many of the fish species expected to occur in Bhutan are adapted to turbulent and swift-flowing stream habitats (Tamang 1993). In addition, a number of species are widely distributed across a range of elevations and/or are seasonal migrants.

Virtually nothing is known regarding the conservation status of Bhutan's fish populations, although given that fishing pressure is very light, and that water pollution or other forms of habitat degradation are not major problems in Bhutan, fish populations would be expected to be in good condition. Three of the (unconfirmed) species have ranges that are confined to the Eastern Himalayas, and Bhutan may provide regionally important habitat and harbour regionally important populations of

these species, especially as habitat degradation is becoming a serious problem in virtually all of the Eastern Himalayas outside of Bhutan.

So far no detailed information on the adverse effects of a cross dam and the effectiveness of providing a fish ladder is available, No such study has yet been undertaken because there is only one dam in the country.
The introduction of exotic fish species for enhanced production to obtain higher economic benefits may have adverse effects. For instance, the introduction of the Brown Trout (*Salmo trutta fario*) in the cold water regions in the western parts of the country has had negative effects on the indigenous fish, the Asla (*Schizothorax spp.*). It is believed that this exotic fish has become a voracious competitor to the indigenous fish and, above all, it is believed that, being carnivorous in its feeding habits, it forages on the young ones of the indigenous fish. The group of fish brought into the country for the purpose of culturing in the village ponds for their high food value is currently restricted to ponds only; and they have not been released into the natural waters. These are the Common Carp *(Cyprinus carpio),* three Chinese Carps: *Ctenopharyngodon idella, Hypophthalmitchthys molitrix, and Aristichthys nobilis;* the three Indian Major Carps: *Catla catla, Labeo rohita* and *Chirrinus mirgala*. The Goldfish *(Carassius carassius)* in some of the water bodies of the country, due to their ability to breed and thrive in worst conditions, have made closed waters saturated and have started showing signs of stunting.

2.2.2.2 Social Forestry

In 1979, recognizing the importance of community involvement in the protection and management of forest resources, His Majesty the King commanded that a scheme on social forestry, which would involve the local people in the planting of trees in their own private or villages, be prepared. Thus, the Social Forestry Scheme was initiated by distributing free seedlings to households, schools, monasteries and other institutions. Under the decentralization programme, the Social Forestry Scheme was designated as a district-level programme and staff were transferred to the *Dzongkhag* administration. A *Dzongkhag* Forestry Extension Officer is responsible for management of private forestry, community forestry, school social forestry, protection of forest from fire; protection from encroachment into *sokshing* (leaf litter), *tsamdo* (pastureland) and allocation of dry firewood.

To promote tree planting, DFS declared Coronation Day, 2 June, as Social Forestry Day. A scheme for annual tree planting on this day by school students and staff, now Social Forestry Day, was formalised between DFS and the Department of Education in 1985.

The Social Forestry and Extension Section was established in 1989 to cater to coordination of all social forestry related programmes. This followed a series of extension schemes in various parts of the country, first in Chukha and later in Thimphu, Punakha and Wangduephodrang *Dzongkhag*. Under the Decentralization initiative of the RGOB, Social Forestry was designated as a district level programme in 1993. At the Directorate level, the Forestry Extension Section (Social Forestry Section), which will become a full-fledged Division in the future, is mandated to coordinate nationwide decentralized programmes.

The Forest and Nature Conservation Act of 1995 provides a strong legal basis for all social forestry related activities to take place on a large scale. This is further reinforced with the promulgation of the Forest and Nature Conservation Rules of Bhutan, 2000, which in Chapter IV specifies social forestry rules.

Nursery Management

Prior to decentralization, tree seedlings were produced in Forest Range nurseries of the Forest Service Divisions (FSD). With the decentralization of forestry activities, nurseries were and are being established in the *Dzongkhags* by the *Dzongkhag* Forestry Extension Sectors (DFES) to supply seeds for community and private forestry. In some *Dzongkhags* the establishment of nurseries has been assigned to private entrepreneurs; the DFES properly assesses the requirement of seedlings to be produced by private sector nurseries.

The foundation of all social forestry and re-forestation activities depend on the availability of appropriate seedlings for a particular site. A plethora of seedling types are produced for both temperate and sub-tropical plantations. As an incentive, polythene bags for growing seedlings and seeds are distributed free of cost by the DFS. The seedlings are sold and purchased at rates approved by the DFS at Nu. 4/- in the north and Nu. 3.50/- in the south, including border areas.

Community and Private Forestry

Sustainable management of forestry resources at various levels, especially at village level, through the involvement of individuals in tree planting and other forestry related activities on their private land; and groups of traditional users implementing activities specified in a community management plan, enable local forest management on government reserved land. The ultimate objective of this programme is decentralization of forestry related activities to rural communities for effective management and protection.

Table 11. Approved Community Forests

Dzongkhag	*Geog*	Location	Year	Area (ha) Approved	Plan Status	
Lhuentse	Menbee	Tshopecthang	1997	3.33	June 1998	Plantation
Monggar	Drametse	Dozam	1997	300.00		Plantation
	Monggar	Yakpugang		260.00	May 2001	Natural Forest
Punakha	Guma	Gumakha	1991	0.88	June 1999	Plantation
	Limbu	Umtekha	1998	6.00	Oct 1999	Plantation
	Tala	Nobgang	1992	1.30	Nov 1999	Plantation
	Kabji	Issukha	1995	0.40	Nov 1999	Plantation
Trashigang	Yangneer	Tholong-pangthang	1998	10.00	June 1999	Plantation
Zhemgang		Rebati		1.21	June 1999	Plantation
		Yumdang		1.21	June 1999	Plantation
Trashi Yangtse	Teotsho	Tshurgang pek Shang	1998	5.26	Dec 1998	Plantation
	Khamdang shangphola		1997	2.50	Oct 1999	Plantation
Wangdue-Phodrang	Dangchu	Nobding	1994	8.00	June 1999	Plantation
	-	Motalungchu	1998	8.00	Oct 1999	Plantation
Thimphu	Taba	Achey	1991	1.36	May 1999	Plantation
Pemagatshel		Gazor	2001	20.9	Sept. 2001	Plantation
Total Area under Community Forest				**630.35**		

Source: Forestry Extension Division, DFS.

2.2.2.3 Forest Management and Planning

Forest management planning has undergone profound changes in recent years, mainly as a result of the New Forest Policy and Act. In keeping with the policies, forest management aims to ensure:

- Environment safety of the units;
- Critical watersheds and riparian zone protection and rehabilitation;
- Biodiversity conservation and protection of special habitats within the units;
- Social goals and traditional use rights;
- Sustainable utilization through accurate calculations of Annual Allowable Cut (AAC);
- Successful regeneration of harvested areas through appropriate silvicultural systems; and
- Research to provide specific management information and improve the silvicultural systems.

The over-riding principal of the forest policy is conservation of flora and fauna and only thereafter utilization of the forest resources.

2.2.2.4 Afforestation Activities

The DFS, to facilitate in the implementation of afforestation programmes, classifies plantations into two main types (FED, 2001):

- Normal plantation: Plantation of suitable species in barren, degraded wastelands near settlements.
- Rehabilitation plantation: Plantation in critically degraded areas such as those affected by erosion, fires, landslides and mine spoils.

Afforestation plantation dates back to as early as 1940, with the country's national policies oriented towards conservation and protection of the fragile ecosystem. The present goal of the afforestation programme is to restore forest on denuded and degraded forestland, to expand forest cover and to enhance sustainability (FED, 2001). Plantations during the 1960's were mostly confined to the foothills, and it was during this period the programmes reached *Dzongkhag* level. A total of 17,803 ha of both conifer and broadleaf plantations had been established at the end of 1998. The decentralization of afforestation activities effectively took place from July 2000, with implementation currently being carried out by *Dzongkhag* authority. The desirable attributes of species used in plantation include indigenous, fast growing and possessing extensive root systems.

The long-term objectives of afforestation programmes (FED, 2001) include:

- To protect, rehabilitate, and manage degraded watershed within government as well as in private lands;
- To make full use of the productive capacity of degraded lands by planting economically valuable species, which will increase the availability of forest resources for industries and the local people with the potential to generate employment and revenue;
- To combat soil erosion;
- To protect farms and provide basic needs of farmers through social and community forestry programmes;
- To contribute to conservation of biodiversity by supplying need from planted forest rather than from the pristine forest;
- To contribute to the reduction in the detrimental effects of green house gases by greening the country; and
- To maintain a minimum of 60 percent of the country under forest cover at all times.

2.2.3 Ex Situ Conservation Efforts

Current ex situ conservation efforts for wild biodiversity include the National Herbarium and the establishment, in 1999, of the Royal Botanic Garden at Serbithang. These are further discussed in Section 2.4.3.

2.2.4 Status of Knowledge about Biodiversity

2.2.4.1 Existing Information about Ecosystems and Species

Although there are land cover maps, there is no countrywide inventory of ecosystems as such. However, it is possible to provide an idea of their range using survey information from eastern Bhutan (ranging from approximately 200 to 3,800 m elevation) and from the Jigme Dorji National Park in the northwest (ranging from approximately 1,400 to over 5,500 m elevation).

All of the potential avenues for both expanding economic benefits from biodiversity and better ensuring its conservation are currently constrained by the shortage of basic scientific knowledge about the identity, status, and distribution of species and genetic resources; the status and distribution of habitats; the ecological requirements of various species; and the ecological functioning of ecosystems. Basic ecological and

systematic information on Bhutan's biodiversity is limited. Surveys of birds and plants are the most complete, with a fairly extensive plant inventory conducted in the 1970s and the nine-volume *Flora of Bhutan* just published. Recent survey work has been undertaken by the NCD in conjunction with the development of management plans for the RMNP, JDNP, JSWNP, PWS and BWS, but these have involved relatively limited collecting and inventory. There are no baseline data, which would permit determinations of status and trends in plants and animals, and there are very few (or virtually no) data from Bhutan on the ecology or ecological requirements even of key species. Bhutan has few trained taxonomists or ecologists working for the government.

In Bhutan, the number of described plants and vertebrates amounts to about three percent of the total number of species estimated to exist (Reid, 1996). Bhutan is thus among the most poorly known countries in the world from the standpoint of its biodiversity. There is a need to identify the populations or rare plants and their microhabitat in order to protect and monitor them. These micro-habitats include glacial moraines, marsh meadows, stream courses, moist rocks and seeps, caves and caverns etc. (NCS, 1996).

The *Flora of Bhutan* has only covered the flowering plants. Much work needs to be done in order to have a complete inventory of the floristic diversity of the country. Gap analysis and identification under collected groups and their inventory will be the next step towards building up the information of lower plants including ferns, mosses, and lichens etc. As such, fern inventory has been identified as one of the major activities for the 9th Five Year Plan. The fieldwork will be undertaken with the national parks.

2.2.4.2 Traditional Knowledge of Biodiversity and Its Use

The National Institute of Traditional Medicine Services (ITMS) is undertaking the only systematic investigation into traditional knowledge about biodiversity for traditional medicine involving the uses of medicinal plants. Because the majority of the Bhutanese live in such close relationship with biodiversity, there is undoubtedly a substantial reservoir of traditional knowledge. Some of this information surfaced at the BAP workshops, where government representatives were impressed by the local knowledge of biodiversity. This is another area where systematic research should be undertaken as soon as possible to ensure that information is not lost. This information will be of great importance to conservation and especially to the development of regimes of sustainable use for the country's biodiversity.

2.2.4.3 Databases

Efforts have been made to establish databases with biological and socio-economic information in and around Protected Areas. However, it is becoming apparent that these databases cannot be established and maintained until there is a trained database manager along with computers that are solely dedicated to these databases and their management. Thus a GIS unit under NCD has been fully established with adequate computer facilities and staff to cater to the needs of the different Protected Areas.

Data Collection and Analysis
All round improvements are necessary to enhance the technical standards through more reliable data collection and analysis methods. The Forest Resources Development Division (FRDD) now has a well-established system for forestry inventory, data processing, photo interpretation and GIS.

In order to improve the implementation of management plans, initiatives undertaken include introduction of operational planning, providing all the necessary guidelines, introducing monitoring and evaluation of the units and setting up central and divisional level management committees for monitoring the function of the units. To date guidelines have been prepared for forestry inventory, socio-economic survey, forest classification, mapping, identification of FMUs, forest management plans, institutional set up, operational inventory, road construction, monitoring, regeneration survey, social forestry, affforestation and logging.

Training has been conducted in operational plan writing, reconnaissance writing, road construction, cable craning, environmental monitoring, silviculture and marking.

2.2.4.4 Monitoring in Forestry Management Units
Patrol monitoring of the different habitats of certain species and site conditions is conducted routinely by respective divisions and parks and is discussed in Section 2.2.1. Territorial forestry divisions annually monitor logging operations at the FMUs. However, timely implementation of this has not been successful mainly due to limited manpower and time constraints. The FRDD needs to ensure that proper monitoring of operations in FMUs is conducted and that the prescriptions outlined in the management plan are followed.

2.2.4.5 Qualified Staff and Capacity Building
There is a lack of professional and semi-professional manpower in the functional as well as in the operational level, which is compounded by the poor infrastructure development. This is a major drawback in the preparation and implementation of scientific management plans, wildlife policy, and rules and regulations for the different categories of Protected Area management. There is a strong need for the recruitment and training of professional and semi-professional manpower for the conservation of biodiversity.

2.3 Domestic Biodiversity Conservation

2.3.1 Agriculture
Bhutan's agricultural system is in an initial phase of modernization. Bhutanese farmers primarily cultivate traditional crop varieties and also depend upon forest resources for their livelihood. The major crops traditionally cultivated in the country are maize, rice, wheat, barley, buckwheat, potato, apple, cardamom, oranges and a wide range of minor crops including amaranths, sorghum, millet, vegetables, pulses and oilseeds. Few modern varieties of the major crops are being cultivated. However, the area planted with modern varieties is increasing.

2.3.2 In Situ Conservation and Sustainable Use

Protected Areas have always acted as a source of germplasm for agricultural and livestock development. For instance, *'Jatsham'* one of the most important livestock for the farmer is a cross between the Gaur and the local cow. Similarly yaks have also been domesticated from the wild. This is also true for many varieties of agricultural crops, which have been developed from the varieties in the wild. In situ conservation of wild relatives of domesticated species, however, is not yet integrated into the natural Protected Area system.

In situ conservation is the continuing maintenance of a plant population within the ecological community of which it forms a part as well as in the environment to which it has adapted. It is applied to wild progenitors of crop plants, forest trees and wild fauna. But it includes conservation of existing landraces of crops as well as the artificial regeneration of folk varieties or obsolete cultivars, whenever planting is carried out without conscious selection in the same area where a particular farming community developed seed. However, no initiative in resources and time has been set aside to encourage this at the national level.

Subsistence farming, based on traditional culture practised by local farmers, has preserved diversity in field and vegetable crops. Indigenous agro-forestry is an integrated approach to land use that is characterised by the deliberate maintenance of trees and other woody perennials in fields and pastures used for construction purposes, simple tools, firewood, medicine, livestock feed and human food. Home gardens or kitchen gardens hold indigenous germplasm in the form of folk varieties or obsolete cultivars, land races and rare species that thrive side by side and are preserved. These living genebanks provide a considerable species diversity and, to an extent, genetic diversity as well.

Local farmers still maintain landraces and continue to grow them, even when they experiment with and adopt some modern HYVs. The reasons for this practice are as diverse as the crops themselves. On several accounts, these reasons are based on storage properties, nutritional and processing quality, cooking ease, secondary produces and historical and cultural reasons such as dietary diversity, the use of folk varieties in traditional foods or religious ceremonies and filling of unique market niches. There are agronomic reasons too, such as better adaptation to traditional intercropping systems, early or late maturity, or greater resistance to local biotic and abiotic stresses. Yield stability in areas with unpredictable seasons is also a consideration for farmers retaining landraces in addition to planting improved varieties.

The factors that promote in situ conservation in the Bhutanese farming communities are the fragmentation of land holdings, marginal agricultural conditions associated with heavily leached, steeping mountain slopes and heterogeneous soils, economic isolation, cultural values and preference for diversity.

The horticulture research station under the RNRRC-West has a good collection of fruits and nuts. The collection serves many roles for the researchers, students, trainees, extension per sonnel and farmers in the country. Pragmatically, the collection is self-supporting financially by combining conservation activities with revenue from fruit production for the export and domestic processing markets.

Hybridisation of traditional Bhutanese cultivars with improved varieties or lines was started in the mid 1980s as a longer-term strategy for the improvement of indigenous rice. The Bhutanese rice varieties are low yielding as a response to added inputs due to lodging and disease manifestation. However, they are valued for yield stability and grain quality. The principal objective of the cross breeding programme is to assimilate desirable genes for high yield, adaptability, grain quality and disease resistance from various sources. Among diseases, breeding for blast resistance in the cold high-altitude environments is a priority. The assistance of IRRI in the generation of crossbred materials and technical backstopping has been indispensable.

To date, over 130 crosses have been made involving traditional varieties of Bhutanese and improved breeding lines and/or varieties from elsewhere. More than 40 popularly grown varieties from the high and mid-altitude rice growing zones were used as local parents. Some of the local parents frequently used in crossing are *Kaap, Maap, Zakha, Kochum, Dumbja, Zuchem, Bjanaab and Attey*. The hybridisation programme has generated over 5000 breeding lines and bulks for testing in different parts of the kingdom. Several breeding lines have shown excellent performance in terms of suitability to local conditions, higher productivity, quality and pest resistance. Four lines with superior yield and desired grain characteristics such as the red pericarp have been identified and formally released as new varieties for mid-altitude rice valleys.

The high-altitude rice breeding programme based at Geynekha, Thimphu has been gaining success in isolating blast-resistant, cold-tolerant and high yielding lines for the warm temperate environment. The importance of blast resistance in high-altitude rice varieties has been underscored by the blast outbreak in 1995. The disease devastated about 712 ha of rice area leading to an estimated loss of 1,099 tons of paddy or an equivalent Nu 11 million. Not a single traditional rice variety possessed appreciable blast resistance. Breeding for blast resistance is, hence, accorded high priority. So far three very promising lines, which are an improved version of the local disease-prone varieties, are awaiting official release.

2.3.3 Ex Situ Conservation Efforts – Domestic Biodiversity

Ex situ conservation implies conservation of germplasm outside the natural habitat of the plant concerned. In crops, this is samples of seeds stored at subzero temperatures in airtight containers, tissue cultures in glass vials, or complete plants in field genebanks where seeds are recalcitrant or cannot be dried and frozen for storing in a genebank. For the farmers, it means saving up their own seeds for the next season. At the present, almost all external funding is expended on ecosystem conservation without any consideration for sustaining and enhancing ex situ conservation. This, despite the latter having laid the groundwork for expertise applied with some modification to in situ work and to a system that will sustain the food security of the world. Therefore, in situ methods must not detract from the overwhelming need for more effective ex-situ conservation programmes for crop species.

Bhutan believes that preserving and strengthening the natural resource base is central to a sustainable development process. However, in the absence of the national capability to assume conservation and utilization activities on a large scale, the ex situ needs have not been put into proper perspective. So far, limited formal germplasm collection has been

undertaken in Bhutan. An IPGRI mission to Bhutan in 1981 collected 483 samples of food plants, legumes and vegetables. The mission noted a serious threat to indigenous wheat and rice varieties. In 1983, a joint RGOB-IRRI mission collected 184 traditional rice varieties from high- and medium-altitude rice growing areas, but most remote areas were not visited (Pradhan, 1996). Between 1996 and 1999 the RNRRC Bajo, with support from IRRI, collected more than 300 rice varieties. These are maintained as a breeders' working collection at Bajo, pending completion of the genebank at Serbithang.

Extensive collection of ornamental plants from Bhutan has been recorded. Grierson and Long (1983) listed 163 horticultural species introduced to other countries from Bhutan. Among others, the list included 52 rhododendron, 34 primula and 8 meconopsis species (Pradhan, 1996).

The country is now building a genebank at Serbithang. No time should be wasted in collecting germplasm of major food crops before farming communities succumb to the pressure of population growth, migration to urban areas and a shift toward consumerism. The IPGRI in 1989 proposed the establishment of plant genetic resources units as an integral part of the agriculture research system (Engels, et al., 1990). The NBC was established with the support from The Netherlands under the Sustainable Development Agreement (SDA) framework. The NBC programme includes the establishment of a national genebank in Serbithang for crop species and the improvement of the national capacity to integrate the conservation of PGR with agricultural development. The on-farm management component will build on the current experiences with traditional farming systems, the indigenous germplasm exchange networks and traditional markets (REID-MOA, 1997).

2.3.4 Utilization

In Bhutan, agricultural development projects and programmes include a component of preserving the crop diversity of agro-ecosystems anchored in the traditional farmers' rationale to utilise local resources together with their intimate knowledge of the environment. Over 90 percent of the area under rice, which is by far the most important food crop, is still being cultivated to local varieties (Chettri, 1997). The people are still dependent on a variety of domesticated and wild resources for staple food, fibre, cash crops, natural dye, medicinal plants and others of ethno-botanical importance. Thus, in some cases there is no clear difference in diversity between the cultivated and the natural ecosystem. A study carried out in a district revealed that farmers collect as many as 164 different plants from the forest for their livelihood (Wagner, 1994). A similar study in a block revealed that farmers collect as many as 22 different types of mushrooms,16 medicinal plants, 11 cash generating non-timber forest products, 14 for home utility, 6 wild fruits, 15 food plants and 8 beverages from the forest (Namgyel, 1996).

To meet the steadily increasing demand for food and other agricultural products, Bhutan continues to introduce exotic crop varieties. The emerging Private Sector Seed Corporation and the strengthening of RNR research are expected to accelerate this process. Local varieties are still maintained by farmers for their culinary appeal, higher market prices and secondary uses, while HYVs are adopted for their yield potential and resistance to biotic and abiotic stresses. This seems to suggest that on-farm conservation of landraces can be a viable proposition even if modern techniques are applied to boost yield in traditional farming practices.

2.3.5. Livestock Biodiversity Conservation Efforts

Bhutan's policy of self-reliance aims at achieving self-sufficiency in livestock and livestock products. This sub-sector, which is traditionally centred on small, subsistence and the migratory pattern of livestock farming, is of immense importance to the country's rural economy. Over 90 percent of the households own cattle. Livestock rearing forms an integral part of the Bhutanese farming system in integration with crop production (provides draught power, farm yard manure), forest (means of collecting, concentrating and breaking down large amounts of plant materials) and producing milk, butter, cheese, meat, eggs and pack animals in the higher altitude areas. The average farm holding of an individual farmer is 0.8 ha to earn his subsistence living. Depending upon the geographic location, livestock represent a major or minor proportion of farmers' income. The livestock production system therefore, is seldom regarded as a distinct enterprise.

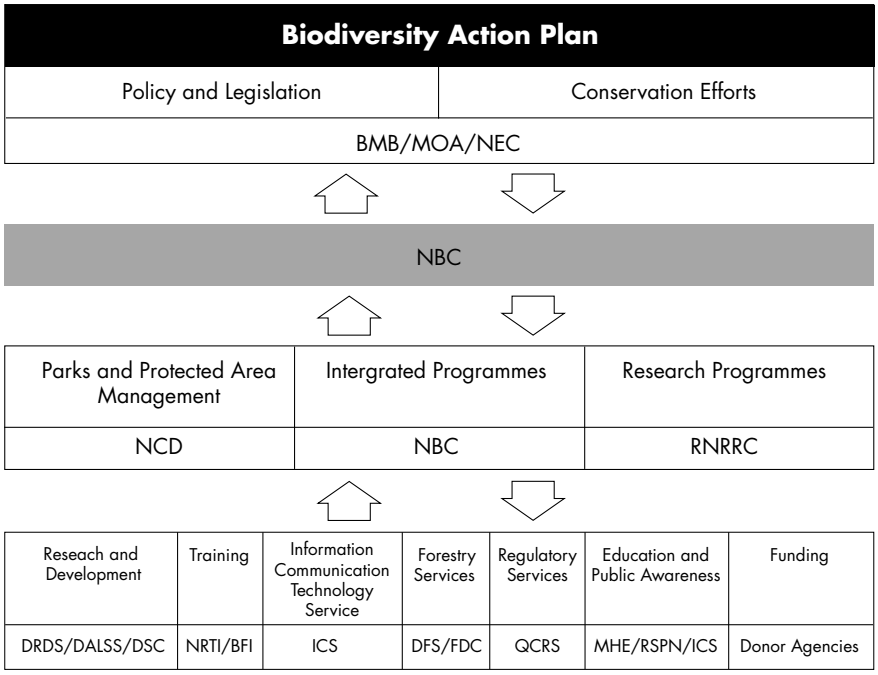
Livestock, particularly the grazers, have traditionally been a very important part of the agricultural production system and the economy of Bhutan. The traditional form of agriculture that has been practiced enables livestock to be managed in harmony with the environment. The livestock numbers are, however, in excess compared to the country's feed resources (about 10-12 percent of the total land area is under permanent or seasonal grazing. In general there is a shortage of fodder by about 26 percent). The increase in livestock numbers has led to concerns about overgrazing of grasslands and forests.
order to combat the problem of environmental degradation, a number of strategies were introduced by the RGOB. Initially steps were taken to increase animal nutrition sources by the development of pastures. Intense efforts were made to encourage farmers to sow productive species of grasses and legumes, as it was believed that through the establishment of these, communal grazing land could be reduced. In addition to these strategies, the government embarked on a genetic upgrading exercise, as it is believed that the remaining factor limiting animal productivity in Bhutan was the genetics of its livestock.

Within the framework of the national development strategy, which is guided by the principle objectives of Self-reliance, Sustainability, Environmental Preservation, Efficiency and Decentralization of Government, Privatization, Institutional Strengthening, Manpower Development and Regionally Balanced Development, the specific RNR sector policy objectives are:

- The sustainable development of arable agriculture, animal husbandry and forestry for the enhancement of self sufficiency in food, fodder, fuel wood, construction timber and other products;
- Improvement of income and living and nutritional standards of the rural population; and
- Environmental conservation, emphasizing an integrated crop/livestock/forestry system development.

2.4 Institutional Framework

2.4.1 Overview of the Central Government Institutions and Functions Related to Biodiversity



2.4.1.1 Strategic Level

Policy, legislation and policy directives within the RGOB primarily are the responsibility of National Environment Commission (NEC), the Biodiversity Management Board (BMB), and the Policy and Planning Division (PPD) of the Ministry of Agriculture (MOA).

The NEC is the national focal point for environment policies and the RGOB's instrument for undertaking the responsibilities outlined in the Convention on Biological Diversity (CBD), which in turn constitutes the framework for international effort in biological diversity

The MOA, better known as the RNR sector, encompasses agriculture, animal husbandry and forestry. It is charged with long-term planning and development of policies and proposals for legislation within the MOA's areas of responsibility. An expanded description of the MOA and RNR sector given in Section 2.4.5.

The BMB is charged with advising, reviewing or reforming national policies, projects and actions taken regarding the nation's biological resources. It also oversees implementation of the BAP, has executive authority over the National Biodiversity Centre, and helps develop the national policy framework to foster the conservation and sustainable use of biological resources and maintenance of Bhutan's biodiversity. An expanded description of the BMB is given under 2.4.4.

2.4.1.2 Coordination Level

The National Biodiversity Centre (NBC) is charged with coordinating the RGOB's actions to conserve biodiversity. It is an autonomous, non-departmental agency, intended to fulfill the RGOB's commitment to the conservation and sustainable utilization of Bhutan's diverse biological resources for ecological integrity and socio-economic well-being of the country in particular, and the world in general. An expanded description of the NBC is given under 2.4.3.

2.4.1.3 Programme and Activity Levels

The principal responsibility for implementing direct conservation of wild biodiversity lies with the NCD under the Department of Forestry Services. NCD is responsible for management of the Protected Areas, which constitute 26.23 percent of Bhutan's area, and also for key aspects of conservation of wild biodiversity outside of PAs. The institutions of the RNR sector have responsibilities for implementing conservation of both domestic and wild biodiversity outside of PAs. Under the BMB, the NBC has responsibility for integrated programmes related to biodiversity conservation, such as Agro-Biodiversity, BUCAP, *Flora of Bhutan*, herbariums, information and databases, and bioprospecting.

These institutions, central to biodiversity conservation in Bhutan, are described in more detail below.

In addition to the RNR Sector, the Ministry of Health and Education (MHE) plays a particularly important role in biodiversity conservation. The MHE has a major role in educating the citizens about the importance of biodiversity conservation. Under the MHE, the Institute of Traditional Medicine Services (ITMS) undertakes research and maintains collections of Bhutanese medicinal plant diversity. The Institute's role will become increasingly important in connection with bioprospecting.

2.4.2 The Nature Conservation Division of the Department of Forestry Services

2.4.2.1 Mandate of NCD

The mandate for NCD is to manage the wild biodiversity and the Protected Areas of Bhutan. More specifically, as formulated in the BAP for Bhutan, the mandate is to:

- Manage the wild biodiversity of Bhutan;
- Develop and implement management plans for Protected Areas;
- Formulate nature conservation policy;
- Identify potential additional Protected Areas; and
- Prioritise inputs from conservation related agencies.

2.4.2.2 Vision and Strategy for the NCD and Protected Areas

In 1995 a strategy for NCD titled "Setting Conservation priorities into the year 2001, a Strategy for the Nature Conservation Section, Bhutan" was prepared. This strategy highlighted four priority programmes, namely i) strengthening NCD, ii) developing conservation policy and rules for Protected Area management and other natural forest area management, iii) implementing the management and operational plans identified for the 7th and 8th Five Year Plans, and iv) developing environmental education and public awareness programmes. While the programmes stated above may not be fully

in place, the strategy has provided a useful direction and guide for NCD. Over the past years, NCD has made tremendous progress and has improved capacity and human resources to embark on more ambitious plans.

Following the diversity experiences and results achieved by NCD, mainly through management of Protected Areas, it was deemed necessary to consolidate the successes and elaborate a new vision and strategy for NCD. This present vision and strategy will serve as a guide for NCD to meet the challenges that lie ahead. This vision and the associated strategy have a time horizon of 15-20 years.

There are seven strategic operational principles that are part of NCD's strategy. These principles have general applicability for each programme, project or activity undertaken by NCD and its partners to realise the vision. The operational principles can be considered as crosscutting the strategic components that will help shape NCD's strategy. The operational principles reflect the integrated nature of biological conservation in Bhutan. These include participation and multidisciplinarity, adaptive management, integrating conservation and development, recognising conflicting interests, magnification/scaling up, non-negotiable principles, and sustainability

In total, four strategically chosen components will help shape NCD's strategy to realise the vision and reach the set objectives. These components are:

- Management of Protected Areas, Buffer Zones and Biological Corridors;
- Integrated Conservation Development programmes;
- Environmental Education; and
- Research, Survey and Monitoring.

These strategic components are linked to the analysis of the current situation by addressing threats and realizing opportunities. NCD will focus its efforts to reach the set targets for each component, in collaboration with partners. NCD aims to simultaneously put into operation these four strategic components, as only their synergy will create expected conservation impact.

2.4.2.3 Organizational Structure of NCD

The NCD consists of its headquarters and the parks. Both have their own organizational structures. The NCD is administratively set up with three sections with six units. The roles and responsibilities of the different sections and units can be described as follows.

Section 1. The Management Planning and ICDP Section

Unit 1: Protected Area Management Unit (PAMU)

- Prepare management and operational plans for the Protected Areas in consultation with the park management and other units;
- Provide technical assistance and back stopping to the independent national park and Protected Areas during management plan implementation;
- Evaluate and monitor implementation of management plans and incorporate lessons learned into preparation of next five year management plan;
- Provide technical and managerial back-stopping to the park management;
- Prepare and implement the HRD plan of the Protected Areas system; and
- Manage the taxidermy unit.

Unit 2: Integrated Conservation and Development Unit (ICDU)

- Assist in the development of ICDP and facilitate the implementation in the Protected Areas;
- Prepare management plans for the Protected Areas in co-ordination with the PAMU and advise on the preparation of annual ICDP work plans for the Protected Areas;
- Monitor and evaluate the progress of ICDP implementation and provide feedback for future planning needs;
- Develop and facilitate the implementation of environmental awareness programmes in the Protected Areas; and
- Identify ecotourism potential in the Protected Areas and formulate plans for its development.

Section 2. Inventory and Data Management Section

Unit 3: Biodiversity Inventory Unit (BIU)

- Conduct biological field surveys as required by the workplan and in consultation with the parks;
- Conduct socio-economics field surveys in consultation with the ICDU, PAMU and parks;
- Conduct boundary surveys and demarcation in consultation with the parks and local communities;
- Initiate and establish Herbaria in the relevant park areas of all existing flora in the country; and
- Initiate a database of plants corresponding to it's ethno-botanical, phenological and other characteristics.

Unit 4: Data and Mapping Unit (DMU)

- Management of biological and socio-economic data gathered by the BIU and parks, including data entry, updating, data extraction and basic analysis as required by other units;
- All GIS related work such as interpreting, digitising, mapping and analysis for conservation management;
- Monitor park conditions using GIS/remote sensing data, and provide feedback to the various units of NCD;
- Analyse data and prepare maps at the request of other units; and
- Identify information needs such as satellite images, digital data, equipment needs (software and hardware) problems and constraints in the units.

Section 3: Species conservation, Research and Monitoring Section

Unit 5: Species Conservation Unit (SCU)

- Plan species conservation activities both inside and outside Protected Areas and integrate them into park management plans;
- Plan and coordinate tiger and other species conservation programmes;
- Conduct specie-specific surveys, as and when required on vertebrates and invertebrates.

Unit 6: Monitoring and Research Unit (MRU)

- Conduct and coordinate all monitoring and evaluation activities related to species and habitat/ecosystem conservation, ecology and other natural resources;

- Investigate, collect and submit scientific reports for priority areas identified by the parks and the NCD based on the studies conducted (both long term and short term) with management prescriptions and recommendations;
- Formulate a long-term strategy for biodiversity conservation monitoring, evaluation, and research in consultation with other DFS Divisions, WWF Bhutan Programme, NEC, RSPN and BTF;
- Consult with the Management Planning and Integrated Conservation Development Section (MPICDS) to design and implement long-term scientific studies to assess impacts of ICDP on biodiversity conservation; and
- Set permanent plots and transects for long-term monitoring of biodiversity (conservation evaluation).

2.4.3 The National Biodiversity Centre

2.4.3.1 Background

The RGOB has always ensured that the development processes of the country are consistent with maintaining its environmental and cultural integrity. Our commitment to protecting the many rare, endangered and endemic species in Bhutan and upholding the national and global responsibility was demonstrated when the 73rd Session of the National Assembly rectified the CBD in 1995. Following this commitment, the Biodiversity Conservation Strategy and Action Plan was formulated in 1998 to provide the framework of action to enhance and to ensure the productivity, diversity and integrity our biodiversity and natural systems. In addition, the Bhutan Trust Fund for environmental conservation was created to support environmental activities in the nation.

The diverse conservation initiatives in the country suffered from lack of co-ordinated planning and management compounded by the lack of resources and isolation from related activities. The RGOB recognized this need for organizing and coordinating the national biodiversity activities under a single administrative and management structure to establish the foundation for local, regional and global efforts in biodiversity conservation and sustainable uses of its components. Such a mechanism would promote international cooperation on access to plant genetic resources and the fair and equitable sharing of the benefits arising from their uses.

The National Biodiversity Centre (NBC) was formally established as the non-departmental agency under the Ministry of agriculture to oversee and ensure the implementation of Biodiversity Action Plan. The institutional arrangement was decreed on the 14 October 1997 by Ministerial Order No. MOA/115/2108. However, it was only from July 1998 that the NBC was able to convene an organized modus operandi for the implementation of its roles and responsibilities. Since then, it has established itself as an important component of the RNR sector's research and development system. With its recognized vision and mission to integrate the efforts of the RNR sub-sectors in conservation activities, it provides a collective instrument for advancing sustainable development through biodiversity conservation. Its mandate is clear, the scope of involvement is realistic with concrete objectives, and the capacity and capability in terms of resources have improved several fold. Currently it is implementing three donor-assisted projects and one supported by BTF to intensify efforts

in the areas indicated under the Biodiversity Action Plan (BAP). There are more potential ventures expected to be implemented during the 9th Five Year Plan.

2.4.3.2 Vision

The NBC's mission is:

The effective conservation, sustainable utilization and equitable sharing of benefits arising from the conservation and the sustainable utilization of the nations rich biological resources.

2.4.3.3 Mandates

In summary, the National Biodiversity Centre is vested with the following institutional mandates:

- Co-ordinate Bhutan's biodiversity related activities and serve as a national focal institute;
- Facilitate national decision-making on biodiversity concerns, cutting across sectors, divisions and institutions;
- Guarantee a national balance between conservation and sustainable utilization of biological resources in general, and between in situ and ex situ conservation in particular;
- Assure a participatory approach to building national consensus on biodiversity around complex issues and resolving conflicting situations;
- Facilitate sub-regional, regional and international cooperation; and
- Assure continuity of biodiversity related activities over time.

2.4.3.4 Objectives

Long-term

1. To identify and meet national needs through rational, sustainable, effective, and equitable approaches to the conservation and use of biological resources in natural and agricultural ecosystems for the benefit of the present and future Bhutanese people and sustain environmental well-being of the country.

2. To ensure adequate national capacity to participate in global efforts to conserve and use biodiversity resources for food, agriculture, industry and environment and to share in the benefits arising from their use.

Intermediate

1. To give high priority to establishing the essential elements of an integrated national programme with a recognized national status for the Biodiversity Conservation; and thereby improve institutional and sectoral linkages and strengthen integration of institutional and community efforts.

2. To develop appropriate policy and institutional framework including mechanisms for coordinated planning and action; and a programme strategy; benefiting from help to do so.

3. To develop national capacity in the technical, managerial and policy areas of biodiversity.

2.4.3.5 Strategies

The appropriate strategies that have been outlined to meet the objectives of the NBC are:

- Institutionalize and establish interdisciplinary programmes;
- Link conservation with utilization by identifying and overcoming constraints;
- Promote institutional collaboration and operational linkages with appropriate institutes that share NBC's goals, at the farming community, district, regional and national levels for integrating complementary activities during planning and implementation to achieve maximum effect;
- Co-ordinate biodiversity activities within the country and link national work to regional and international activities;
- Enhance capacity at all levels through education and training within and outside the country to promote institutional development, programme human resources, strengthen co-operation, and devise financial mechanisms;
- Integration of conservation, research and development with the meaningful utilization of genetic resources;
- Enhance the capacity of farmers and their communities through on-farm management of agro-biodiversity based on equal participation and ownership of responsibilities;
- Establish gene banks, botanical gardens, herbarium and zoological parks for ex situ collections to facilitate the conservation and sustainable utilization of the biological resources;
- Survey, inventory, characterization and documentation of biodiversity resources; and
- Prioritize programmes.

Long-term Strategies for Sustainability

- Develop bioprospecting for the sustainable utilization of the rich natural resources;
- Form a functional Board of Trustees;
- Collect user fees and have memberships for the botanic garden, genebank, national herbarium and zoological garden; and
- Link with other global programmes in biodiversity and BTF for environment conservation in Bhutan.

2.4.3.6 Policies

Bhutanese people have a culture and lifestyle that are closely related to the surroundings in which they live. They have often developed sustainable methods of managing the resources they use. The national policy objectives in biodiversity are:

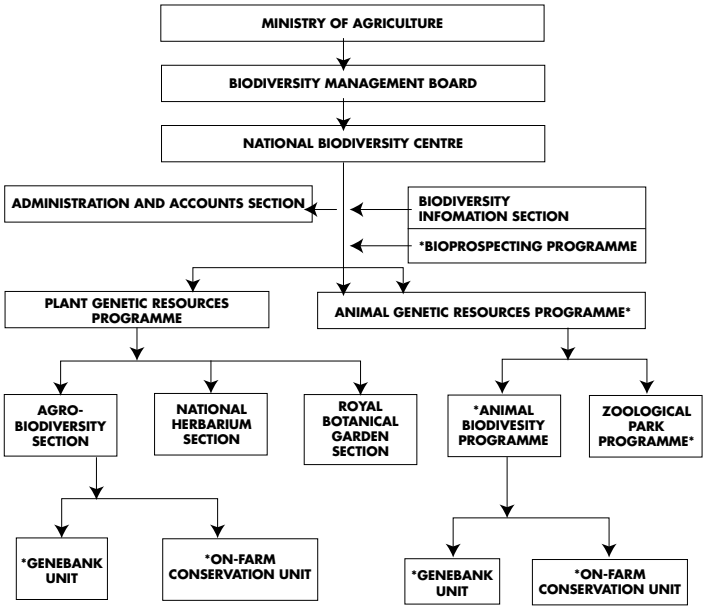
- Biodiversity issues will be integrated into the economic development plans and programmes;
- Special attention will be given to support parks and Protected Areas and effective buffer zones management; and
- Information on biological diversity will be developed for conservation and sustainable utilization of biodiversity resources.

Bhutan's policies on biodiversity parallel those of the Convention on Biological Diversity, particularly those, which specify that:

- Conservation of biological diversity is a priority national objective;

- Any use of biodiversity components must be sustainable; and
- There should be fair and equitable sharing of the benefits arising from biological resources.

2.4.3.7 Organization



*Note: *Indicates yet to be operational*

2.4.3.8 Projects

Since its inception in late 1998, NBC has been managing the following notable projects under the different sections to intensify its efforts towards the conservation and the sustainable utilization of the biological resources.

The Agro-biodiversity Conservation Project, implemented by NBC's Agro-Biodiversity Section and funded by the Government of Netherlands, aims to (a) conserve and sustainably use plant genetic resources (PGR) for food and agriculture and (b) assist on-farm conservation techniques. To support such initiatives, the National Gene Bank is currently being constructed to act as future reservoir of plant genetic resources in the country. H.E. Lyonpo Kinzang Dorji, Minister of Agriculture, laid the foundation stone on 18 June 2001.

Corollary to this, **a pilot agro-biodiversity inventory and survey** in Drametse, eastern Bhutan has already been completed. Samples were collected and are being characterized. Other crop seeds, especially threatened varieties as identified by local farmers, are also being collected from the representative areas and kept temporarily in RNRRC Bajo's cold storage. In the future, the project hopes to collect and make inventories of all kinds of Bhutan's PGR of agricultural importance and usage, including ethno-botanical resources. A draft PGR policy has been formulated and circulated.

The Biodiversity Use and Conservation Asia Programme (BUCAP) is complimentary to the Agro-biodiversity Project in terms of PGR on-farm conservation with emphases on rice and maize crops. It is implemented in collaboration with South East Asian Research Institute for Community Education (SEARICE) and funded by the Development Fund for Norway (NORAD), this project focuses on "Participatory Plant Breeding and Participatory Varietal Selection" techniques through "Farmers Field School" approaches.

Under this project, in-country training through the "farmers field school" approaches is being conducted. The inception phase of the project is underway in collaboration with RNRRCs: Wangdue (RNRRC Bajo); Drametse, Khaling, and Kanglung (RNRRC Khangma); and Katsharabchu (RNRRC Yusipang).

The National Gene Bank is being constructed as an integral part of an Agro-biodiversity complex at the National Biodiversity Centre and is financially supported through the Government of the Netherlands as part of the Sustainable Development Agreement between the two countries. The National Gene Bank, which is to be completed by the end of 2002, will assist in the ex situ conservation efforts of the crop genetic resources in the nation. Seeds and other planting materials will be stored under controlled conditions of temperature and humidity and will represent Bhutan's base as well as active working collections.

The Royal Botanic Garden, Serbithang (RBGS) is implemented by the Royal Botanic Garden Section and funded by the Bhutan Trust Fund (BTF). The RBGS was established on 2 June 1999 to commemorate the 25 years of Golden Reign of His Majesty King Jigme Singye Wangchuck, the Fourth King of Bhutan. The 28 acres of garden space is to be designed to explore and exhibit the therapeutic value of the plants. The focus will be on plants of economic significance such as those useful for food, fibre, cosmetic and industry, including those species that are endangered. Plans of the RBGS include a rock garden, sub-tropical house, floricultural activities, an orchidarium, an information centre and various facilities for recreation such as a children's park, restaurant and a souvenir shop. In the long term, the garden will also focus on the ecology and the evolutionary biology of plants. With maturation and experience the garden will reflect the traditional Bhutanese architecture and the traditional Bhutanese values and culture. A nature trek from Serbithang to Dagala is being developed as part of the RBGS activities. In order to establish the above objectives a garden master plan was developed, with technical support from the International Association of Botanic Gardens in Japan, that includes the landscaping, the architectural design, irrigation systems and management plans.

The National Herbarium houses 120,000 plant specimens, some dating back to 1914, which were originally placed at a temporary storage facility that was converted in the late 1980s into a herbarium in Taba. This herbarium was maintained by the then Forest Research Division (now the RNRRC Yusipang) The herbarium at Taba has always been a matter of concern due to its old age, poor condition and inadequate space and infrastructure for collected specimens.

The need for a new herbarium building was expressed when work on the *Flora of Bhutan* was being conducted in 1998. With the financial assistance of DANIDA, a new herbarium building complex has been constructed at the National Biodiversity Centre in Serbithang. The new herbarium has adequate working space and the capacity to house more than 20,000 specimens. The old mounted specimens will be transferred from Taba to the new site within a few months. In addition, people have now undergone specialized training in herbarium management and plant taxonomy in order to effectively manage and maintain the National Herbarium of Bhutan.

The new herbarium will also have a library with a good reference collection of botanical literature from Bhutan and outside. It is hoped that the National Herbarium will serve its purpose for research and for education for those interested in the flora of Bhutan.

Implemented by the Herbarium Section and funded by the DANIDA, this project aims to conserve and sustainably use the nation's rich wild botanical resources. In the future, the herbarium will also house samples of domesticated crop specimens, ornamental flowers, medicinal plants and other plants of economic significance.

The *Flora of Bhutan,* a nine-volume publication documenting the nation's wild flora, has now been completed and is available for use. The nine volumes are comprised of three parts with three volumes each. The work was completed with the financial assistance from DANIDA and technical assistance from the Royal Botanical Gardens, Edinburgh (for the Family Orchidaceae from the Royal Botanical Gardens Kew). The completion of the *Flora for Bhutan* took more than ten years, with the first part being published in 1983 and the third part published and released in January 2002.

In summary, the contents of the *Flora of Bhutan* (on higher plants only) cover a total of 8 Gymnosperm Families (Volume I), a total of 180 dicot Families (Volumes I and II) and a total of 66 monocot Families (Volume III). Parts two and three are devoted to the Family Gramineae and the Family Orchidaceae respectively.

The Community-based Zoological Garden complements the conservation activities in PAs in the wild and further enhances the efforts towards the protection, production and the genetic conservation of wild faunal diversity. A feasibility study for a community based zoological garden has been approved by the BMB and is almost ready for implementation. The community-based zoological garden plans to exhibit and rehabilitate some of the rare and endangered herbivore species of Bhutan. The community will be involved in managing the zoological garden and increasing public awareness and education of the species presented.

The Bhutan Integrated Biodiversity Information Systems (BIBIS) Project is based on the recommendation in BAP I for the development of a scientific knowledge base for bio diversity in the country, and has the financial support of the WWF Bhutan Programme. The NBC along with various partners involved in biodiversity conservation and sustainable use have developed a five-year project proposal to integrate the nations biodiversity related information into one web-based system called BIBIS. The project proposal was submitted to the government in January 2002 for the purpose of

securing funds. By the end of the 9th Five Year Plan, it is expected the BIBIS will be a well-known and highly accessible source of biodiversity information for use to biodiversity stakeholders in Bhutan and beyond. It should become a reference point for dissemination of biodiversity information for use by policy makers and planners for the conservation, management and the sustainable utilization of the biological resources in the nation. The establishment of BIBIS would further contribute to activities such as bio diversity gap analysis, ecotourism, education and bioprospecting that have the potential of generating additional revenue for the country. Depending on the success of the BIBIS project in addressing all biodiversity areas, it could continue be developed in the 10th Five Year Plan to complete any remaining areas of biodiversity information to be included in the system. Thereafter, BIBIS would continue to act as centre of biodiversity information, initiating new related activities and providing of expertise, guidance and support for biodiversity information management.

The Bioprospecting Programme aims for meaningful utilisation of Bhutan's conservation efforts. It is envisaged that a pilot bioprospecting project will be initiated during the 9th Five Year Plan, after July 2002. The implementation of the pilot project will include collaboration efforts with international research institutes, pharmaceutical companies, and other concerned agencies. Bioprospecting, basically the search for useful new genes for pharmaceutical products and agrochemicals from the biological resources, has the potential to reap benefits through commercialisation. With the assistance of the World Foundation of Environment and Development, Bhutan drafted a bioprospecting action plan for the nation in May 2001. The project proposal for the development of the policy and legal instruments critical for the implementation of the pilot project and bioprospecting activities in the nation has been prepared and is awaiting funding.

The Animal Biodiversity Conservation Programme is to be implemented in the 9th Five Year Plan in recognition of the importance of animal genetic resources to sustaining and developing food and agriculture production that is within the framework of the Biodiversity Action Plan for Bhutan. A task force of professionals is currently developing the project proposal. The funding needs to be secured for the project. In addition, a wildlife conservation programme will be implemented by the establishment of a zoological park during the 9th Five Year Plan. The centre has secured funds from UNDP to carry out the feasibility studies along with the involvement of the local community, and to recruit external assistance for landscape architecture and a zoo planning. The zoo will aim to primarily represent a collection of herbivores that are endangered and unique to Bhutan.

With these major developments, NBC, as an integrated programme, will coordinate mechanisms within the country to ensure the most effective prioritisation in the deployment of resources for biological diversity. However, international collaboration is necessary in a world where countries are interdependent. It is an international goal to establish practical, rational, and economical means to conserve biodiversity, enhance its use, encourage access, and share benefits. Within Bhutan, NBC is continually conducting meeting and workshops to increase public awareness and interest in conservation and sustainable use of biological resources.

2.4.4 The National Biodiversity Management Board of Bhutan

The National Biodiversity Management Board (BMB), with 13 members, was formalized on the 2 August 2000, with the Honourable Minister of Agriculture as the Chairperson and the Honourable Secretary of Agriculture as the Vice Chairperson. The Rules of Procedure for the BMB were issued on the 9 March 2001 in order to provide guidance on the procedural and the functional aspects of the BMB.

Management Board Members

The Board consists of members that cuts across various Ministries and organizations that have relevance to the biodiversity conservation and utilization.

Chairperson: Honourable Minister, MOA, Thimphu
Vice-Chairman: Honourable Secretary, MOA, Thimphu

Members:

1. Director, Department of Research and Development Services, Ministry of Agriculture
2. Director, Department of Forestry Services, Ministry of Agriculture
3. Director, Department of Argriculture and Livestock Support Services, Ministry of Agriculture
4. Deputy Secretary, Policy and Planning Division, Ministry of Agriculture
5. Deputy Secretary, Administration and Finance Division, Ministry of Agriculture
6. Director, Natural Resources Training Institute, Lobesa
7. Director, National Institute of Traditional Medicine Services, Ministry of Health and Education
8. Joint Director, Nature Conservation Division, Department of Forestry Services
9. Head, Policy and Planning Division, National Environment Commission
10. WTO Officer, Ministry of Trade and Industry
11. Programme Director, National Biodiversity Centre, Serbithang

2.4.4.1 Functions and Powers

All powers of the management of the National Biodiversity Centre are vested with the Biodiversity Management Board.

Mandates

- Oversee the implementation of the Biodiversity Action Plan;
- Develop a national policy framework that fosters the sustainable use of biological resources and the maintenance of biodiversity;
- Strengthen capacity for sustainable conservation and utilization of biodiversity;
- Create conditions and incentives for effective biodiversity conservation; and
- Catalyze conservation actions through international co-operation and national planning.

Terms of Reference of the Biodiversity Management Board

- Supervise and issue directives for smooth management of National Biodiversity Centre;
- Authorize technical operations in conservation and sustainable utilization of biological resources;

- Provide policy and legal guidance along the process of implementing the Biodiversity Action Plan;
- Approve project proposals, secure funds to support projects and authorize fund disbursements;
- Approve annual work plans, annual budget proposals and Five-year Plan proposals;
- Negotiate and formalize collaborations at the international and regional levels in biodiversity thematic areas;
- Facilitate institutional capacity development through the provision of adequate and appropriate human resources along with the prospects for career and skill advancement;
- Monitor and evaluate the performance and achievements of National Biodiversity Centre;
- Review progress and administer contextual action;
- Provide a forum for continuing dialogue and debate among interested parties on the options for action to save, study and use biodiversity sustainably and equitably;
- Provide advice on priorities for research, funding and action;
- Review and reform existing policies that oversee biodiversity considerations and adopt new public policies that support conservation;
- Incorporate biodiversity conservation into the management of biological resources for socio-economic development;
- Integrate the conservation of species, population and genes into the management of the Protected Areas system;
- Integrate biodiversity concerns into education and training curricula;
- Formalize collaboration with local communities, NGOs and private sector institutions in conservation and sustainable use of biological resources; and
- Develop the Terms of Reference for subsequent elaboration of the Biodiversity Action Plan.

2.4.5 The Renewable Natural Resources Sector

2.4.5.1 Ministry of Agriculture

The Ministry of Agriculture (MOA) is comprised of the three Renewable Natural Resources (RNR) sectors: agriculture, animal husbandry and forestry. During the restructuring exercise carried out by the RGOB in 2000, the three technical divisions: the Research Extension and Irrigation Division (REID), the Forestry Services Division (FSD) and the Crop and Livestock Services Division (CLSD) were upgraded to the current Department of Research and Development Services (DRDS), Department of Forestry Services (DFS) and the Department of Agriculture and Livestock Support Services (DALSS) respectively. Further, three new offices: Quality Control and Regulatory Services (QCRS), RNR Information and Communication Services (RNR-ICS), and National Biodiversity Centre (NBC), were established and given non-departmental status directly responsible to the secretariat. An Internal Audit Unit was also established directly under the secretariat. The Administration and Finance Division and the Policy and Planning Divisions continued to provide support functions to the MOA. In addition, the Natural Resources Training Institute (NRTI), the Druk Seed Corporation (DSC), the Forestry Development Corporation (FDC) and the Food Corporation of Bhutan (FCB) are all closely involved with the MOA.

2.4.5.2 Department of Research and Development Services

The Department of Research and Development Services (DRDS) coordinates and implements renewable natural resources research and development programmes throughout the country. These programmes aim at improving the overall productivity and sustainability of agriculture, horticultural, forestry and livestock enterprises. The three functional divisions within DRDS are the Research Division, Extension Division and Engineering Division. Its research operations are implemented through four integrated research centres known, as Renewable Natural Resources Research Centres (RNRRCs) located at Yusipang (Thimphu), Bajo (Wangduephodrang), Jakar (Bumthang) and Khangma (Trashigang). Each of the centres has a national mandate for coordination of research in one of the four major fields of research: forestry at Yusipang, field crops at Bajo, livestock at Bumthang and horticulture at Khangma. Each of these centres has a multi-disciplinary team of scientists. The extension and irrigation services are carried out through the Dzongkhag administration concerned and are supported by several donor-assisted projects. There are thirty-five RNR centres, one hundred and fifty-nine Agricultural Extension Centres and one hundred sixty-two Livestock Extension Centres including 20 veterinary hospitals.

2.4.5.3 Department of Forestry Services

The Department of Forestry Services (DFS) is entrusted with the responsibility of the management of the forest resources and biodiversity. DFS fulfills its mandate through four functional divisions such as Forest Protection and Utilization Division, Forest Resource Development Division, Nature Conservation Division and Forest Extension Division. There are eleven territorial divisions and five operational national parks/ sanctuary offices that implement field activities. Bhutan Forestry Institute trains forest guards who act as trained personnel for field programmes. The primary focus of the DFS is to ensure that at least 60 percent of the country's area is maintained under forest cover at all times, and to conserve the rich biological diversity through the establishment of an effective network of Protected Areas.

2.4.5.4 Department of Agriculture and Livestock Support Services

The Department of Agriculture and Livestock Support Services (DALSS) consists of the Crop Production Division, Livestock Production Division and Livestock Health Division. It is responsible for the organization, production, procurement, supply and distribution of inputs ranging from agricultural seeds to livestock breeding animals. It is also responsible for veterinary laboratory services and runs a network of regional veterinary laboratories and district veterinary hospitals backed up by the Royal Veterinary Epidemiology Centre at Serbithang. The DALSS also monitors the end-use of the inputs and services that it is providing. The department has two Mithun breeding farms, one Jersey Breeding Farm, one brown Swiss cattle breeding farm, one sheep breeding farm, one horse breeding programme, two pig breeding centres, two poultry breeding centres and a semen processing centre. It runs the National Nublang Breeding Farm, which, through its Open Nucleus Breeding Schemes, breeds and maintains the indigenous breed of Siri cattle. It also looks after the Agriculture Machinery Centres and works closely with the Druk Seed Corporation.

2.4.5.5 Quality Control and Regulatory Services

The Quality Control and Regulatory Services (QCRS) was institutionalized as a perpetual, public-sector instrument to promote the quality of goods and services related to the Ministry of Agriculture and its clients and to coordinate and liaise with other agencies related to regulations and quality of the products that are locally produced or imported. With its crosscutting mandates, encompassing the three sub-sectors of the RNR, this organization has been conferred with a non-departmental status. It was officially inaugurated on 5 August 2000 and is headed by the Executive Director. It is governed by the Management Board with the Minister of Agriculture as Chair and Secretary as Vice Chair and senior officials from both within and outside MOA as members. It has two divisions, which are the Quality Control and Quarantine Division, and Analytical & Certification Division. In addition, it also has nationwide coverage with offices in all the *Dzongkhags*, regions, major entry points and Thimphu town, which are managed by the Regulatory Inspectors. This network also controls entry and exit of protected biodiversity.

2.4.5.6 RNR Information and Communication Services

RNR Information and Communication Services (RNR-ICS) is the communication arm of the Ministry of Agriculture. It was established in 1992 as the Information and Publication Unit (IPU) under the DRDS. It was renamed as the Farmers' Extension Communication Support Unit in 1993. With the restructuring of the MOA in 2000, it was changed to Information and Communication Services and given a non-departmental status, directly responsible to the secretariat. It consists of four functional sections, which are: Publication Section, Audio/Video Section, Information Technology Section and One Stop Information Shop Section. Its mandate is to design, develop, and produce information and communication materials in support of the RNR programmes, serve as the portal of RNR information and activities and promote RNR programmes and activities.

2.4.5.7 Natural Resources Training Institute

The Natural Resources Training Institute (NRTI) offers integrated training to the technical support staff and extension agents of the RNR sector. It is mandated to conduct diploma courses for extension agents and conduct in-service courses for extension agents.

2.4.5.8 Bhutan Forestry Institute

The Bhutan Forestry Institute (BFI) trains forest guards that act as a source of trained personnel for field programmes.

2.4.5.9 Druk Seed Corporation

The Druk Seed Corporation (DSC) is mandated to produce and supply seeds and seedlings; procure and distribute fertilizers; and produce and export high value vegetable seeds

2.4.5.10 Forest Development Corporation

The Forest Development Corporation (FDC) is responsible for the sustainable harvesting of timber and timber products, marketing and forestation.

2.5 Policy and Legislation related to Biodiversity

2.5.1 Overview

The national policy and strategy resolved in the proceeding "Towards Sustainable Development in Unique Environment (Planning Ministry, 1992) stressed the following needs:

- Sustainable use of natural resources, including biodiversity;
- Strengthening existing institutions, including environmental impact assessment;
- Promotion of conservation ethics and environmentally sound farming systems;
- Community participation in the management and protection of natural resources;
- Revision of the forestry policy and legislation; and
- Human resource development.

The overall policy objectives of the RGOB for biodiversity are that

I. Biodiversity issues will be integrated into the economic development plans and programmes;
II. Special attention will be given to support parks and Protected Areas and effective buffer zones management; and
III. Information on biological diversity will be developed for conservation and sustainable utilisation of biodiversity resources.

Bhutan's policies on biodiversity parallel those of the Convention on Biological Diversity, particularly those, which specify that:

- Conservation of biological diversity is a priority national objective;
- Any use of biodiversity components must be sustainable; and
- There should be fair and equitable sharing of the benefits arising out of biological resources.

2.5.2 National and Sectoral Policy and Legislation Affecting Biodiversity

2.5.2.1 General

There are master plans and strategies, along with numerous by-laws and acts, for the development of important sectors. All of these have the potential to impact biodiversity negatively or to assist in its conservation, depending on how much attention is given to the issues of biodiversity conservation. Examples include the following:

- Afforestation Strategy
- Agro-biodiversity Policy and Legal Framework, being undertaken under NBC through the ABC project funded by the Netherlands
- Arable Agricultural Development Policy and Strategy
- Bhutan Forest Master Plan
- Bhutan Land Act
- Bhutan Power Master Plan
- Cooperatives Act
- Environmental Assessment Act
- Farm Road Construction Guidelines
- Forest and Nature Conservation Act of Bhutan
- Forest and Nature Conservation Rules of Bhutan

- Forestry Subsector Development Policy and Strategy
- *Geog* Planning Policy and Process
- Horticulture Master Plan
- Land Swapping Policy
- Land Use Master Plan
- Live Watershed Management and Social Conservation Act
- Livestock Development Policy and Strategy
- Mining Act
- National Ecotourism Policy and Strategy
- National Environment Protection Act (under preparation)
- National Environmental Education Strategy (under preparation)
- National Environmental Strategy – The Middle Path
- National Irrigation Policy
- National Pasture Policy
- Pasture Policy (Draft)
- Pesticides Act
- Plant Quarantine Act
- Seeds Act

For details on some of these policies see the following sections.

2.5.2.2 Forest Policy

Most direct biodiversity legislation falls under the Forest Legislation. At present, the majority of Bhutan's environmental legislation concerns the conservation of forests and the protection of wildlife and wildlife habitat. Over the last few decades the RGOB has come to recognize that if its forest estate was not to go through a process of deterioration similar to some of its neighbours, a systematic forest management programme would have to be put in place. This would have to be based on a balancing of conservation and economic development goals through long-term, sustainable, multi-purpose forest management.

The 1974 Forest Policy envisages that 60 percent of the land area should be under forest cover and recognized the need for forest demarcation and inventory, and preparation of management plans. The 1979 Policy Statement was more conservative in its approach to utilising forest resources and restricted logging by commercial operators. The preparation of the Forest Policy Statement of 1991, Decentralization and Privatization Policy, Wood Pricing and Marketing Policy, Social Forestry Rules (1990) and Forest and Nature Conservation Act, 1995 and Forest and Nature Conservation Rules, 2000 are evidence of the RGOB's determination to develop a firm policy and strategy for the future.

Within the policy guidelines of 1991, there is a set of General Principles for Biodiversity Conservation in Forest Management in Bhutan, as follows:

- National forest policy and planning should recognize biodiversity conservation as a major development goal;
- A national system of Protected Areas should be established that is representative of all ecological zones and types, and protect areas of high biodiversity and endemism and rare or endangered species and associations;

- Protected Areas should be linked by corridors of natural forest and surrounded by buffer zones;
- The greatest proportion of the country's natural forest areas should be dedicated to multi-use, multi-purpose management where biodiversity conservation is one of the major management objectives;
- Riparian areas should be reserved, accorded special management status and incorporated into a network of continuously-connected biodiversity reserves within the working forest providing both horizontal and vertical ecological linkages through the landscape;
- Silvicultural systems should conserve biodiversity composition, structure and function, and, thus, be based as closely as possible on natural ecosystem disturbance patterns;
- In order to retain the full range of natural forest age classes, portions of the working forest should be managed under very long felling cycles, while others should be reserved in perpetuity and incorporated into the ecological network
- The distribution of logged and unlogged areas should be managed to maintain ecological corridors and prevent ecological fragmentation;
- Within felling coupes, "keystone" biodiversity assets with important ecological functions, such as wildlife food and habitat trees, snags and coarse woody debris, should be retained in both harvesting and stand tending operations; and
- Biodiversity status of forest management areas should be assessed at regular intervals (5-10 years) through comprehensive surveys and between these major censuses there should be annual monitoring of easily identifiable indicator species.

The RGOB has recently approved the Forest and Nature Conservation Rules of Bhutan, 2000, to facilitate the implementation of the provisions under the Forest and Nature Conservation Act, 1995.

2.5.2.3 Decentralization Policy

The policy on decentralization is a recent development within the policy framework of the RGOB, where all possible programmes that have a direct impact on the local people or their participation are to be decentralized. This policy came into effect at the beginning of the 7th Five Year Plan period. The decentralization and zoning policy implementation of the past provided sufficient experience for the selection of appropriate forestry programmes and other activities to be decentralized.

2.5.2.4 Tourism Policy in Protected Areas

The RGOB recognizes the negative impacts that unregulated or excessive tourism can have on a nation's culture and biodiversity. Experience in neighbouring countries has emphasized this key point. Consequently, the RGOB has limited the total number of tourists by imposing a relatively high blanket fee for all tourists other than Indians.

With respect to tourism policy directed toward biodiversity in the Protected Areas, especially in JDNP which has a number of tourists trekking through the park, the tourism policy is as follows:

- Tourism and visitation will be allowed within the park, but will be secondary in priority to nature conservation and the needs to protect the ecosystem and the need

to prevent adverse effects on the social, cultural and traditional integrity of the local communities;
- Tourism practices will be based on the principle of sustainability, they must be environmentally and ecologically friendly, and socially and culturally acceptable;
- Tourism and tourists will be confined to designated visitor zones; and
- Tour operators will be held accountable for violation of park rules by visitors and guides, and will be fined and/or their licenses revoked under the regulations of the Department of Tourism. A park-entry fee will be charged from foreign visitors, which will be used for local development and park management (NCS, 1996).

2.5.2.5 Education Policy in Protected Areas

The parks will be used as a tool towards educating the public and school children. Park management will, through awareness programmes, encourage park use by Bhutanese nationals to promote broader support and appreciation for the Protected Area system, the need for conservation of biological diversity, and Bhutan's conservation policy and philosophy; and to instill an appreciation for Bhutan's natural beauty. (NCS, 1996).

2.5.3 Access to PGR, Benefit Sharing and Realization of Farmers' Rights

In 1969, the Forestry Act was drawn up. In 1995, it was revised and became the Forest and Nature Conservation Act. The new Act provided a regulatory mechanism for conserving and managing the forests. The National Plant Quarantine Act, 1993, provides legal measures to control the movement of diseases, insects and other pests of economic importance. However, a policy and legal system for regulating conservation and use of (bio-logical) resources under agricultural systems is yet to be developed. The issuance of government circulars at occasions has so far established guidelines for regulating PGR processes. The validity of such a document is limited and often over-ruled by subsequent releases. A formalized instrument through national ruling will best serve the interests of the country to secure just treatment beyond its boundary.

Access to and transfer of some economically important plant species are subject to restriction, but essentially without the legal framework to support its contextual application. Sometimes, access to and the ultimate use of PGR are conditioned to facilitate the sharing of benefit, but loopholes in the current system give rise to misuse and loss of mutual trust. A national framework/legal policy on PGR is being developed with the help of a consultant. It includes germplasm exchange and access, MTAs, collection protocols, etc.

The WTO has established a framework for national policy and legislation pertaining to the trade in PGR and exercise of ownership rights while respecting the rights of others. As a part of the global trading community, Bhutan must consider all aspects of PGR such that imposing nonnegotiable demands on its own resources does not restrict access to others' resources. Within this framework, there is ample opportunity to exercise its sovereignty, implement the rights of its indigenous people, and create an amenable environment for outside interests to establish themselves within the country.

The actual work specifically targeting PGR conservation and use is minimal. What has been achieved so far in this direction are spin-offs of other objectives. This is because first, the research programme and consequently the scientific and technical capability are weak.

Secondly, the development priority in real economy leaves little room for agro-biodiversity education, which in turn thwarts efforts to promulgate awareness among the planners, policy makers, general public and even within the scientific community itself.

At the government level, the concern for PGR is emerging. The number of nationals being trained in conservation and natural resources management courses is on the rise, with a few already being absorbed into conservation programmes. In the context of present socio-economic and demographic trends, the need for education and awareness on conservation and utilization of PGR must be addressed urgently.

2.5.4 Environmental Impact Assessment

In 1993 NEC published the first Environmental Impact Assessment (EIA) guidelines for Bhutan. Since then, NEC in collaboration with line ministries and other interested organizations has worked steadily to improve and institutionalize the EIA process. In September 1996, NEC with assistance from the Asian Development Bank undertook a major revision of the EIA process, which culminated in the release of two draft documents in May 1997.

The first, "Institutionalizing and Strengthening of the Environmental Assessment Process in Bhutan" contains sections, which include the following:

1. A revised EIA process for Bhutan, including a proposed legal basis for EIA implementation, an institutional structure for EIA implementation, and an analysis of the training and institutional strengthening requirements to implement RGOB environment policies effectively;
2. A proposed mechanism for environmental permitting, monitoring and enforcement; and
3. Environmental quality objectives and guidelines, which are intended to provide guidance both for evaluating new projects and the performance of existing operations.

A companion document, "Environmental Assessment Sectoral Guidelines" has been released. It describes potential environmental problems commonly associated with activities in the following sectors:

- Hydropower;
- Power transmission lines;
- Forestry;
- Highways and roads;
- Mining and mineral processing; and
- New and existing industries.

Two additional documents have been produced:

- Strategic Environment Assessment Manual; and
- Ambient/Discharge Standards Process Manual

A section on Strategic Environmental Assessments (SEA) was also included in the second document. It emphasizes the importance of incorporating environmental assessments at an early stage of planning and policy development, rather than at the project level when mitigation options are frequently limited.

There has been a series of recent developments, which includes:

Environmental Assessment Act, 2000

The National Environment Commission Secretariat (NECS) formulated an Environment Assessment Act, 2000, through a series of consultation with all affected stakeholders in the country. It was enacted in July 2000 with the primary objective of setting up procedures for the assessment of potential effects of strategic plans, policies, programmes and projects on the environment. This Act specifies the RGOB's policies on measures to avoid or mitigate potential adverse effects on the environment due to developmental activities.

Environmental Assessment Act Regulation

The National Environment Commission (NEC) issued the Regulation for the Environmental Clearance of Projects in April 2002, defining responsibilities and procedures for the implementation of the EA Act, 2000 concerning the issuance and enforcement of environmental clearance for individual projects. This regulation was adopted by the NEC to ensure the objectives of the EA Act, 2000 are implemented through a uniform process for all projects while issuing their environmental clearances.

Strategic Environmental Assessment Act Regulation

As mandated by the EA Act, 2000, the NEC adopted the Regulation on Strategic Environmental Assessment (SEA) that came into effect in April 2002. The purpose of this regulation is to ensure that environmental concerns are fully taken into account by all governmental agencies while formulating, renewing, modifying or implementing any policy, plan or programme, including national Five-Year Developmental Plans. This regulation also ensures that the cumulative and large-scale environmental effects are taken into consideration and to promote the design of environmentally sustainable proposals that encourage the use of renewable resources and clean technological practices.

Sectoral Environmental Assessment Act Guidelines

The National Environment Commission Secretariat (NECS) is in the process of updating the existing Environmental Assessment Sectoral guidelines. These sectoral guidelines are considered living documents and are intended to assist the staff at NECS, affected ministries and agencies and the project proponents, to incorporate environmental protection parameters into the project cycle, particularly at the early planning stage.

In addition to these Environmental Sectoral guidelines, the NECS has developed the Environmental Assessment Process Manual to assist the applicant in applying for environmental clearance.

Environmental Codes of Practice (ECOP)

To promote sound environmental management for the development activities in the urban areas and also to specify key environmental terms, NECS develops ECOPs, one or more of which may be attached to the environmental clearance issued for a relevant project or activity under the Environmental Assessment Act, 2000.

The following ECOPs for urban areas, which have been circulated to all relevant agencies and printed, may be be relevant to biodiversity issues:

- ECOP for Solid Waste Management in Urban Areas
- ECOP for Sewage and Sanitation Management for Urban Areas
- ECOP for Urban Roads and Traffic Management for Urban Areas

In addition, the ECOP for Hazardous Waste Management for Urban Areas is in process.

2.5.5 Strategy and Planning Relating to Wild Biodiversity – Processes and Results

The RGOB's general strategy for wild biodiversity conservation is as follows:

Give priority to the following areas within the Convention on Biological Diversity:

(1) Conservation and sustainable use of biodiversity through:
- Identifying important components of biodiversity;
- Monitoring activities that pose threats to biodiversity; and
- Where possible establishing Protected Areas.

(2) Identification and monitoring of biodiversity through:
- Identifying and monitoring components of biological diversity important for conservation and sustainable use;
- Identifying and monitoring processes and activities having or likely to have significant adverse impacts on the conservation and sustainable use of biodiversity; and
- Maintaining and organizing data derived from identification and monitoring activities.

(3) Support in situ conservation through:
- Developing guidelines for the selection, establishment and management of Protected Areas or areas where special measures need to be undertaken to conserve biological diversity; and
- Rehabilitating and restoring degraded ecosystems and promoting the recovery of threatened species, inter alia, through implementation of plans or other management strategies.

(4) Support research and training through:
- Establishing scientific and technical education and training for the identification, conservation and sustainable use of biological diversity and its components; and
- Promoting and encouraging research that contributes to the conservation and sustainable use of biological diversity.

(5) Provision of financial resources to enable Bhutan to meet the agreed full incremental costs through implementing measures, which fulfil the obligation of this convention.

(6) Provision of support to control access to genetic resources through human resource development in the field of environmental legislation. (MOA, 1996)

2.5.6 Strategy and Planning Relating to Domestic Biodiversity – Processes and Results

Specific objectives for the RNR sector are national food security, conservation of natural resources, enhancement of rural income and employment generation. The role of the RGOB in the RNR sector should be one of facilitator, extending the range of available

opportunities through constructive regulatory measures, appropriate fiscal policies, provisions of infrastructure, cost-effective research, technical support and advisory services. Governmental interventions in the RNR sector have been brought within a stronger 'Programme Framework' approach. Activities in the sector are grouped under six principal programmes:

- Management and planning services;
- Farm system development;
- Crop and livestock production services;
- Forest management services;
- Export horticulture development; and
- Human resources development.

Activities of RNRRCs with strong relevance to PGR conservation and use:

1. **Agriculture**
   - Germplasm collection of cereals – rice, maize, wheat, barley, buckwheat, millets
   - Germplasm collection of grain legumes – mungbean, soybean, pigeonpea
   - Germplasm collection of oilcrops – mustard, groundnut, niger, sesame
   - Characterisation and evaluation of collected germplasm
   - Rejuvenation and seed maintenance of accessions
   - Cross-breeding of local varieties with HYVs
   - Selection and variety development
   - Introduction and evaluation of exotic germplasm of different crop species and varieties
   - Baseline studies and inventories on agro-biodiversity

2. **Horticulture**
   - Germplasm collection of native vegetable species and their varieties
   - Characterisation and evaluation of collected germplasm
   - Production assessment of elite germplasm
   - Introduction and assessment of exotic vegetable species
   - Germplasm collection of native fruits (as seeds and seedlings)
   - Use of collected materials in grafting and propagating
   - Maintenance of a living collection
   - Introduction, evaluation and adaptation of exotic fruit species
   - Collection and other studies on medicinal and aromatic plants

3. **Forestry**
   - Baseline surveys on species distribution, availability and uses
   - Collection and propagation of native species
   - Comparative studies of exotic and native species
   - Seed collections of native species
   - Introduction and evaluation of multi-purpose species
   - Inventories and databases – flora and fauna

4. **Livestock**
   - Collection and evaluation of native feed and fodder species

- Field genebanks/live herbaria of pasture/fodder species
- Introduction and assessment of exotic species
- On-farm testing of various species
- Comparative performance research
- Assessment of genetic variation of selected species

2.6 Economic Valuation of Biodiversity

There has been little attempt to develop an economic valuation of biodiversity in Bhutan. There are some economic data on timber, especially on export and some gross figures on tourism, with estimates of the number of tourists coming for biodiversity reasons. However, economic valuation of biodiversity in particular, and resource or environmental economics in general remains an area where work is badly needed. This is considered a particularly important need in view of the direct reliance of most of the population on biodiversity and its critical importance to the nation as a whole.

Greening National Accounts

The need to start work on greening accounts is clearly explained by the RGOB in following words:

"The greening of our system of national accounts would certainly result in higher GDP estimates than those arrived at through conventional routes. However, this would not be its main value. More importantly, it would help to provide us with quantitative indicators of the importance of the environment to our economy and of the sustainability of our development path. In this sense, the greening of our system of national accounts would contribute to the quantification of Gross National Happiness (GNH)." (Bhutan 2020: A Vision for Peace, Prosperity and Happiness, p 88).

As a result, the Central Statistical Organization (CSO) approached WWF Bhutan Programme for support to start the process. WWF Bhutan Programme has given a grant to CSO to commence the process of greening the national accounts. CSO is collecting necessary information from concerned organizations. The main advantage of green accounting is that the detailed information used to produce the accounts highlights policy choices, which further both environment protection and economic growth, creating 'win-win' results.

2.7 Integration of Biodiversity Considerations into Other Sectors

Biodiversity is impacted by virtually all sectors of the RGOB, but there has been relatively little integration of biodiversity conservation into sectors other than those of the MOA. The new Strategic Environment Assessment (SEA) process is intended to assure that all government plans, policies and programmes shall incorporate environment considerations, including biodiversity.

As an example of the need for integration, the primary RGOB responsibility for forest industry development is assigned to the MTI. The MOA/DFS mandate in forest industries is limited to assuring the sustainable production of raw materials on which rational industrial development can be planned. The department, therefore, implements those aspects of forestry development related to harvesting and supply of timber and other forest products on a sustainable basis.

Some of the issues are:

- Development of favourable circumstances, and business and institutional environment for the wood industry, including ensuring availability of raw materials on a sustainable basis; and
- Development of appropriate home and cottage industries to add value to basic forest products in order to support local community-based economies and improve rural livelihoods.

a) Land Use Planning

In the past, opportunities to improve land use allocations and resource use intensity for maximum sustained yield were largely ignored. This has not been too serious a problem in the past due to the low population and largely subsistence economy.
However, the marked changes now occurring in demography and economy make land use planning an essential requisite for sound and sustained development. To guide the RNR Sectoral development, land use planning has been considered essential for some time now, as a means by which an effective synthesis of available land resources and optimum land utilization can be achieved. Land use planning is taken here at different scales and degree of detail as required, present land utilization in terms of different economic functions, and evaluation of land productivity and capability and land classification at different scales and for different purposes including soil and water conservation. The Land Use Planning Programme (LUPP) of the MOA is responsible for co-ordinating land use and planning activities within the MOA.

The primary objective of the LUPP is to promote appropriate land use through adequate land evaluation for multiple use of forest resources. LUPP also assists in developing a system of related activities of forestry use, nature conservation, management of critical watersheds, as well as in developing guidelines for area management to achieve specific land use objectives.

b) Hydropower

Hydropower electricity generation in Bhutan is increasingly becoming synonymous to economic development because of its immediate impact on the country's balance of payment and down stream development activities. It is the largest contributor to the country's exchequer. However, these figures can change drastically if the catchments of the hydroelectric dams are not protected. Implementation of proper watershed management plans including biological diversity conservation programmes can contribute to the sus tainability of this very important source of income for the country.

Maintenance of forest covered catchment areas is required to keep them in such shape that the hydroelectric production is not harmed by siltation resulting from erosion upstream. In economic terms, an even more important requirement is the maintenance of the regulatory capacity of the watersheds in such a way that the run-off characteristics of the rivers originating in these areas are not harmed by becoming more flood prone and less capable of reserving water for the dry season.

c) Traditional Medicine and the Institute of Traditional Medicine Services (ITMS)

Throughout Bhutan, traditional medicine is still practiced, using more than 300 species

of medicinal plants. The ITMS is an organized institute staffed with traditional and western-trained doctors. It regularly collects plants to produce medicine as per formulae cited in ancient medical scriptures. The ITMS combines traditional medicine with acupuncture to treat all types of diseases.
Medicinal plants are vulnerable to overexploitation. For example, it is known that in the past at least two plants, ruta (Saussurea lappa) and manu (Innula helenium), were cultivated and marketed in the Bumthang valley. Today many people do not remember what these plants look like. A remnant of manu, however, has been found and is being cultivated by at least one family (FAO.1996). Recognising this, the ITMS has a programme for research on, and propagation of medicinal plants.

Upon request by ITMS to collect medicinal plants, the DFS issues permits on a case by case basis. The location for collection and quantity to be collected are to be specified in the permits. But often the collection of the permitted quantity is not possible if required species is not available in adequate volumes. ITMS shows samples of the medicinal plants to local labourers, who are then requested to collect and bring in the required quantity of each specie. The collectors are paid on a daily basis, or sometimes contracted under lump-sum agreements. It is impossible, however for the scant core of technicians to reach every collection area for screening. Lacking technical directives and proper guidelines, some species have decreased by almost 50 percent over the past 20-25 years in localities where they once grew abundantly.

Generally, alpine plants flower in August, which coincides with the ITMS team's collection schedule for herbal plants. At this time, even the fruits from the earlier flowering plants are not yet ripe or mature enough for their seeds to be shed. For many herbs, the whole plants are collected, including both flowers and fruit. This method of collection reduces the chances for regeneration and hence threatens the very existence of some species. If such methods continue, some species may become extinct (FAO.1996).

d) National Ecotourism Strategy

The Department of Tourism has drafted the Bhutan National Ecotourism Strategy with financial assistance from WWF Bhutan Programme. The process of developing the Strategy has involved wide participation by the tourism industry, including two major stakeholder and industry workshops in April and September 2001.

The term "ecotourism" is now widely used in both conservation and tourism circles, although definitions vary widely. Taking a broad definition, all of Bhutan's tourism can be said to be ecotourism. Therefore, rather than plan for ecotourism in a separate way, the Strategy addresses the whole of the tourism sector and seeks to incorporate the principles of ecotourism where appropriate. Furthermore, the Strategy uses the language of ecotourism as means to explain, in a positive way, Bhutan's unique approach to tourism.

The Strategy generally reaffirms Bhutan's overall tourism policies. RGOB will continue to actively intervene in quality, pricing and payments. A new slogan, "high value, low impact", has been adopted to more clearly explain Bhutan's determinedly cautious "product-led" and "values-led" approach to tourism development. Ecotourism, defined the Bhutanese way, will be an ideal towards which the whole tourism industry will

strive. In keeping with this approach, a set of ecotourism related principles is established to guide the future development of the tourism sector.

e) Agro-Tourism
As Bhutan's agricultural system is still largely intact in its traditional form and mainly rurally based, there is a potential for enhancing tourism with a purpose in the countryside of Bhutan. Tourists could be educated and presented with the traditional agricultural techniques and practices, organic farming and farm products and the diversity of crops sustaining the rural-based communities.

2.8 Bhutan Integrated Biodiversity Information System

Many of the Bhutan's biological resources are insufficiently and/or poorly documented relative to what should be known about them for optimal conservation, access and use. Documentation of wild relatives of crops and on-farm genetic resources located in situ is particularly poor. Derived information on where materials have been distributed, pertinent ethno-botanical information, farmer and indigenous knowledge have not been maintained on material conserved in the herbarium and the seed stores. This situation is exacerbated due to the fact that at the national and institutional level, data management and documentation activities are given an inappropriately low priority in the allocation of funding. There is no standard procedure and systematic data-recording format corroborated by the agencies and institutes concerned with biodiversity issues. In the proper format, data can be used not only to assist conservation efforts, but also to "add value" to plant genetic resources for food and agriculture.

With the financial support of the WWF Bhutan Programme, the NBC along with various partners involved in biodiversity conservation and sustainable use have developed a five year project proposal to integrate the nations biodiversity related information, including PGRFA information, into one web-based system called the Bhutan Integrated Biodiversity Information System (BIBIS). The project proposal has been submitted to the government in January 2002 for the purpose of securing funds. By the end of the 9th Five Year Plan, BIBIS should be a well-known and highly accessible source of biodiversity information for use to biodiversity stakeholders in Bhutan and beyond. It should become a reference point for the dissemination of biodiversity information for use by policy makers and planners for the conservation, management and the sustainable utilization of the biological resources in the nation.

Concept of the BIBIS:
Currently there is no easy way for users to know what biodiversity information exists or how to get to it. When one considers the nation-wide variety of locations where biodiversity information is being collected and stored, the need for RGOB to establish a BIBIS is compelling.

The idea of BIBIS is simple: a focal point where the many parties that generate, manage, or use data on biological resources can collaborate and make decisions leading to broader access to that information. BIBIS will direct users to sources for the data they seek, while working with funding agencies to encourage development of tools and strategies to make data more accessible. BIBIS will not duplicate existing databases or information, but will provide

directory services for the large array of available information. It will also identify gaps where new databases are needed, and help development and transfer applications of new technologies. Further, BIBIS could co-ordinate access to data outside the usual realm of the biological sciences.

BIBIS's mission will be to provide leadership and a neutral venue to facilitate collaborative discussions about the availability of biodiversity data and information. It will also be a clearing house to provide knowledge of, enable access to, and facilitate the use and exchange of biodiversity data and information. The objectives BIBIS will be to promote and encourage the use of well documented biodiversity data and information; address the full scope of biodiversity from molecular data through ecosystems; connect those seeking information and data on biodiversity to those having data custody; and facilitate structured identification of and access to data pertinent to user needs. This will be accomplished through an interactive computer system that uses metadata (data about the data) information on geographic location, species, ecosystem, or other keywords to sort, aggregate, and/or integrate data sets, identify gaps in existing data and knowledge and provide a forum for collaborative approaches to biodiversity information issues.

BIBIS must be responsive to user needs, providing both data and information services tailored for different audiences. BIBIS must also be responsive to the needs of providers, and must offer incentives and encouragement for them to offer their data on the BIBIS system. It will facilitate development of metadata standards (minimum criteria for data documentation and format) and the establishment and provision of data collection and reporting protocol. Guidance on appropriate uses of data or information will also be provided. BIBIS will facilitate the improvement of data-set quality with a feedback system that allows comments on data quality and utility. Data custody will reside largely with primary data collectors and producers, and users will be referred to original data sources. Therefore, data holdings by BIBIS will be reduced. BIBIS will use appropriate information integration and analysis technologies and promote the adoption and use of appropriate information standards.

BIBIS will have a distributed structure that will function based on a consensus-building and partnership approach. BIBIS will serve as a convenor, facilitator and host. BIBIS experts will move discussions along and involve key constituencies. An Advisory or Governing Board from the broad community of contributors and users will provide general direction. BIBIS must establish partnerships with the other organizations, whose activities include data and information collection and assessment of biodiversity issues.

BIBIS' location will be within the NBC The aim is to provide strong computational and information management services support; a creative and active programme in biological sciences, especially involving the use of computers in biodiversity information management; broad-based expertise or strong links to systematic ecological research, and collections, information management, understanding of modern and historical Bhutanese collections, reasonable access to national and international transportation; and comfortable, modern facilities for conferences and BIBIS staff.

2.9 Education and Public Awareness

During the 6th Five Year Plan the RGOB accorded further recognition to the role of communities in forestry development. In order to support and facilitate the participatory forestry development, the government drew up and adopted a set of social forestry rules. These cover model concepts in participatory development and utilization, including private forestry, community forestry and lease forests.

Initial efforts led to the establishment of 2 June as a 'Social Forestry Day' held annually involving the planting of trees around households and public institutions such as community schools. However, the greatest success has been planting at schools. Initially social forestry schemes sought to encourage community participation as a primary means for afforestation of degraded lands in the vicinity of rural villages. The community forestry programmes aim to motivate and educate user groups to build confidence for improved management of forest resources.

Some of the activities of this programme are identification of user groups; motivation and education including organization of field training on tree planting for communities; organization of public meetings regarding participatory forestry and study of problems of communities; and participation in discussions about policy guidelines and rules related to social forestry. A more holistic participatory programme involving farmers, researchers, and extension personnel combining conservation/protection (in situ and ex situ) aspects with development/management aspects (introductions, selection, improvement, breeding, multiplication, cultivation, etc.) will be the key programmes in the implementation of the Biodiversity Action Plan.

Funded by WWF Bhutan Programme, NEC is coordinating in drafting a National Environmental Education Strategy for the country. NEC has formed a core group comprising of key stakeholders to lead in drafting the strategy. The main objective is to streamline environmental activities of different stakeholders to mitigate duplication of efforts, and more importantly to have positive impact on the environment conservation.

a) The Royal Society for the Protection of Nature

The Royal Society for the Protection of Nature (RSPN), an NGO, has been the most active organisation with regard to improving public awareness and education. In the last nine years, the RSPN has established a network of school nature clubs, and several research projects including some on fuelwood consumption, water quality, ecotourism as well as workshops on environmental issues for village headmen and representatives of the National Assembly. It also addresses a wide variety of conservation issues, using a variety of educational methods such as public meetings, magazines, debates, seminars and workshops.

RSPN, since its establishment in 1987, has Environment Education and Awareness as a major component of the organization's programme activities. With the assistance of WWF Bhutan Programme, RSPN has implemented conservation education and awareness activities throughout the country. These activities were mainly implemented as co-curricular activities in schools. With 78 established to date, nature clubs serve as the target group as well as the medium for dissemination of conservation to others.

These nature clubs are coordinated by mostly by teachers who have attended work shops or training programmes conducted by RSPN. The members of the nature clubs, who act at their own local levels, have conducted awareness campaigns, exhibitions, shows and planted trees.

RSPN and NCD have also initiated collaborative efforts in the implementation environmental education in the national parks. Environmental education programmes were conducted collaboratively in RMNP, JSWNP and TNP.

b) The Bhutan Forestry Institute and the Natural Resources Training Institute

The curriculum of the BFI under DFS has been revised to include wildlife management, Protected Area management and biodiversity conservation. Every year, BFI trains forest guards who are recruited by the various Divisions/Sections of the DFS.

The NRTI provides three-year training in the fields of animal science, agriculture and forestry. Refresher courses for in-service RNR staff are also conducted on a yearly basis.

c) World Wildlife Fund Bhutan Programme

The communications unit in the WWF Bhutan Programme office was set up in 1994 with a communications officer to help prepare a variety of publications and materials to support WWF Bhutan Programme activities, to correspond with the WWF network and to maintain contacts with local media.

Communications activities of the Bhutan programme office have succeeded in promoting its work through strategic alliances with local media. The Bhutan programme has produced videos and audiocassettes, organized quiz contests, supported discussion forums and developed a website. WWF Bhutan Programme has worked to enhance understanding and awareness of the environmental issues and WWF activities in the kingdom through programmes such as the BBS produced *GOWA* discussion forums, joint environmental campaigns with the City Corporation of Thimphu and painting and poetry competitions organized for local schools. Regular press releases are sent to BBS and Kuensel (the national newspaper) to inform them of WWF Bhutan Programme workshops and other activities.

WWF Bhutan Programme is working to build partnerships with other organizations such as the RSPN and Information and Communications Services of the MOA to efficiently and effectively reach a wider audience. The WWF Bhutan supports nature clubs in schools with the annual budget through RSPN.

2.10 International Cooperation in Biodiversity Conservation

2.10.1 International Agreements and Programmes

The RGOB recognizes the importance of co-operating with nations at the international level to bring about biodiversity conservation and sustainable use. In keeping with this policy, Bhutan signed the Convention on Biological Diversity at the United Nations Conference on Environment and Development, "Earth Summit".

In signing the convention on Biological diversity in Rio de Janeiro in 1992 and the ratification of this convention by the national assembly at the 73rd assembly. Bhutan has accepted its global commitment to preserve the country's wealth of biodiversity. Bhutan also recognizes the importance of the part of the Convention that assigns sovereign countries rights to genetic resources. Bhutan has also signed the Framework Convention on Climate Change at the Earth Summit, and the National Assembly ratified the convention in 1995.

Bhutan is also part of the cooperation agreement under the Sustainable Development Agreement (SDA) with Benin, Costa Rica and the Netherlands, based on the principles of equality, reciprocity and participation. One of the priority areas of cooperation identified between the countries is the conservation and sustainable use of biodiversity.

2.10.2 Multilateral and Bilateral Cooperation on Biodiversity

Biodiversity is an important area for developing co-operation between Bhutan and both multilateral and bilateral donors. A few of the projects focused on or relating closely to biodiversity are:

- Biodiversity Strategy and Action Plan, BAP I and II (UNDP/GEF);
- Conservation and Community Strengthening through Small Grants Programme, UNDP/GEF;
- A series of environmentally related projects of the UNDP;
- Sustainable Development Co-operation between the Netherlands and Bhutan, where biodiversity has been considered one of the priority areas for co-operation;
- Assistance to NEC (DANIDA);
- Assistance to NITM (EU);
- Assistance to NEC with the EIA process (ADB);
- Integrated Forest Management Projects with Austria, Germany, FAO, the World Bank, Switzerland-Helvetas and others;
- Biodiversity conservation in Jigme Singye Wangchuck National Park with the Netherlands-SNV;
- Forest Resources Management and Institutional Development Project (UNDP)
- Assistance in the Integrated Horticulture Master Plan (UNDP)
- Assistance in the Integrated Horticulture Development Programme (UNDP)
- Punakha -Wangdi Valley Development Project (UNDP)
- Integrated Warm Water Fisheries Project (UNDP)
- Technical Assistance Programme to the First Eastern Zone Agricultural Project (UNDP)
- Assistance to Essential Oil Development Project (UNDP)
- Tourism development (Austria)
- Assistance to the LUPP (DANIDA)
- Assistance to the ITMS (European Community)
- Development of a National Re-afforestation Strategy (FAO & Japanese Government)
- Food processing (natural resources use) (Switzerland-Helvetas)
- Manufacture of energy-efficient wood stoves (Switzerland -Helvetas)
- Assistance to NRTI (Switzerland -Helvetas)
- Assistance to the Irrigation Section of MOA (Netherlands- SNV and Save the Children-USA)
- Agro-biodiversity Conservation Project (Netherlands)
- Assistance to the National Herbarium and the *Flora of Bhutan* (DANIDA)

- Assistance to the Agro-biodiversity Project and the genebank (CGN/ IPGRI)
- Assistance to on-farm conservation of rice and maize (SEARICE/ NORAD)
- Assistance to an integrated biodiversity information system (WWF, Bhutan Programme)

The Bhutan Trust Fund for Environmental Conservation

Bhutan Trust Fund was established in 1991 as the world's first environmental trust fund, and legally incorporated in Bhutan under the Royal Charter in 1996. It is an independent grant-making organization created to sustain financing for Bhutan's conservation programmes. Donors to the trust fund endowment include the Global Environment Facility, WWF and the governments of Bhutan, Denmark, Finland, Netherlands, Norway and Switzerland. Today, the trust fund is governed by a high-level board composed of Bhutanese representatives from the government's agriculture, environment, education and finance sectors, the private sector and civil society.

Using annual income from an endowment of about $ 30 million invested in domestic and international capital markets, the trust fund awards grants annually to eligible institutions and individuals through a set of strategic five-year funding objectives focusing on supporting in situ and ex situ conservation and sustainable ultilisation initiatives, strengthening integrated conservation and development planning, and promoting conservation education and public awareness. By charter, BTF is mandated to support the following broad themes:

- Train professionals in ecology, natural resources management, forestry and environment;
- Assess biological resources and develop ecological information base;
- Develop management plans for Protected Areas and implement them;
- Support public awareness and environmental education in the schools;
- Provide institutional support to related sectors/agencies; and
- integrate conservation and development projects.

Below is a list of major grants financed by BTF since its inception:

1. Development of Jigme Dorji National Park
2. Development of Royal Manas National Park
3. Electric Cookers as an alternative to firewood (Royal Bhutan Police)
4. Endowment Fund, Royal Society for Protection of Nature
5. Environmental Education at lower primary level, Department of Education
6. Environmental Monitoring of Forest Management Units, DFS
7. Environmental research and building capacity for natural resource management at Sherubtse College
8. Human resources development at the National Environment Commission
9. Human resources development for biodiversity conservation (RGOB)
10. Incremental staffing and recurrent costs of conservation (RGOB)
11. Institutional Support to Nature Conservation Division, DFS
12. Integrated Conservation and Development Project in JDNP
13. Researching and mitigating the effects of cattle migration (MOA)
14. Strengthening forest fire management, DFS
15. Strengthening forest fire management, DFS
16. Support for Phibsoo Wildlife Sanctuary

17.Support to Bomdiling Wildlife Sanctuary
18.Support to Royal Botanic Garden, Serbithang

International Co-operation in the Conservation of Genetic Diversity

International co-operation in the conservation of genetic diversity at the policy level is structured through the FAO International Commission on Plant Genetic Resources (ICPGR) and the FAO International Undertaking. So far, Bhutan has chosen not to participate in the FAO-Commission, but to participate in its regional and global forums and activities.

On the operational level the International Plant Genetic Resources Institute (IPGRI), part of the Consultative Group on International Agricultural Research (CGIAR), co-ordinates a network of Plant Genetic Resources Programmes with the International Agricultural Research Centres (IARCs).

The Convention on Biological Diversity supersedes the FAO Undertaking and as such is binding. In the Convention, national sovereignty over biodiversity is explicitly recognized. During the UNCED in Rio de Janeiro, Bhutan signed the Convention on Biological Diversity. The 73rd session of the National Assembly ratified the Convention and by that the commitment of the Royal Government of Bhutan to conserve its biodiversity was further strengthened.

An Agro-Biodiversity Project is being implemented within the framework of the Sustainable Development Agreement between Bhutan and The Netherlands. A centre in the Netherlands and SEARICE (NGO) from the Philippines assist the agro-biodiversity project by providing technical assistance and relevant training in the field. Consequently the principles of sustainable development: reciprocity, equality and participation are built into the project. Relevant agreements reached between Bhutan and the Netherlands in the context of SDA is also taken into account. Given the objective and scope, this project should be integrated as one of the themes upon which the biodiversity strategy and action plan will expand.

At the regional level, the South Asia regional office of IPGRI has supported national capacity development through numerous short-term training on PGR research and development. However, the benefit from this training was not realized without the institutional and policy support for a national PGR programme. The officials from MOA continue to participate in the regional workshops, seminars and meetings conducted by the South Asia Regional Network for PGR management.

The MOA has a good relationship with the NBPGR in New Delhi, which has provided technical assistance in germplasm collecting and seed storage management. In addition to the PGR newsletters, which are regularly distributed to individual agriculture researchers and research stations, certain publications and periodicals are also provided free of cost. The Government of India supported a survey of forest resources in Bhutan from 1974-1980. It is still the most comprehensive forest inventory covering 29,176 sq. km or 72 percent of the total land area, excluding the permafrost in the north. Some 78 tree species were inventoried and the data mapped at 1:50,000 scale (Pradhan, 1996).

2.10.3 Biodiversity Cooperation with International NGOs

WWF Bhutan Programme is the principal international NGO that has assisted Bhutan with biodiversity for many years. It has provided important support for biodiversity conservation since 1977, including training programmes and other efforts to expand staff capabilities, surveys and inventories of biodiversity, assistance to national park development, and institutional support to the NCD and RSPN. For the future, WWF Bhutan Programme has adopted a programme approach and shall focus on the following programmes:

- Support on-going improvement in policy development and implementation to conserve forest and freshwater ecosystems;
- Promote alternative, environmentally sustainable rural livelihoods to reduce pressure on natural resources;
- Promote environmental education and awareness;
- Conserve species of special concern including plants and birds.

Currently the major activities of WWF Bhutan Programme include Thrumshingla National Park, Royal Manas National Park, Biological Corridors, Bhutan Integrated Biodiversity Information System, Tiger Conservation Programme, anti-poaching, taxidermy, survey and GIS, medicinal and aromatic plants, environmental education, PICO hydel, electric cookers at the Institute of Language and Cultural Studies and Royal Bhutan Police messes, ecotourism, and institutional support to NCD and RSPN. Most of these activities will be continued for the next five years.

Other international NGOs have had a much more limited involvement with biodiversity in Bhutan.The World Resources Institute (WRI) of Washington D.C. has provided personnel to assist with development of Bhutan's National Environmental Strategy with a study of biodiversity policy options (Reid, 1996). The Snow Leopard Trust has assisted WWF Bhutan Programme with training in field survey techniques. The World Foundation for Environment and Development (WFED) of Washington D.C. is assisting the NBC to develop a Bioprospecting Action Plan for Bhutan and facilitating a programme of workshops and training in aspects of bioprospecting management.

Chapter 3

Direct Conservation Actions

3.1 Wild Biodiversity

3.2 Domestic Biodiversity

3.1 Wild Biodiversity

3.1.1 In Situ Conservation Efforts

3.1.1.1 Protected Area System

In general, the park policy places the highest emphasis on protecting the ecological integrity of its ecosystems and ensuring that locals legally settled within the park boundary prior to its establishment are entitled to remain within the park. It also encourages the practice of traditional culture and customs as well as sustainable use of natural resources.

a) Long-term Objectives

- To protect a large, contiguous natural area containing the range of ecosystems in each Protected Area in a way that will allow natural processes of succession and evolution to continue with only minimal human influence. Minimal management interventions will target the protection of valuable biodiversity and important river catchments, but only if and when necessary;
- To maintain the current diversity of habitats in the Protected Areas so that the full range of biodiversity can be maintained. In the event of local extinctions reintroductions may be undertaken but no exotic species will be introduced;
- To provide specific protection to endemic and endangered species contained in the Protected Areas;
- To provide suitable, tested management to increase the viability of specific endemic and endangered species provided such management is confined to areas not exceeding 5 percent of the park area; and
- To encourage the undertaking of biological research that will improve management, and develop a better understanding of the evolution and ecological features of the ecosystem, provided these activities do not damage the environment or threaten endangered species.

b) Intermediate Objectives

- To develop guidelines for the selection, establishment and management of Protected Areas or areas where special measures need to be taken to conserve biological diversity; and
- To formulate and implement management plans for the Protected Areas in order of priority;
- To review what is known about the nationís ecosystems and species to determine whether there are additional areas that should be protected, and to initiate action to establish these additional areas.

c) Actions

- Prepare guidelines for the preparation of management plans for Protected Areas to ensure that the plan incorporates management necessary to meet the objectives of the Protected Area system;
- Continue and accelerate the phased approach to preparing and implementing management plans. Management planning for Protected Areas must reflect the reality of the conditions within each area (including conflicting traditional uses and existing populations) and the relationship to the surrounding (buffer) areas, land use, tenure and settlement patterns. Efforts are to be integrated as much as possible to resolve conflicting issues;

- Complete the review of the current Protected Areas to assess the full range of biodiversity, bio-physical and socio-economic situations. Each Protected Area should be examined in terms of land use, vegetative cover, pressure from the resource use, land tenure and so on. Appropriate boundary revisions may be required. Baseline maps are to be prepared for each Protected Area to illustrate physiography, habitat types, land systems and other special features;
- Utilize baseline information for zoning of the Protected Area into core zones, multiple-use zones, visitor zones, seasonal grazing, enclave and buffer zones;
- Review and evaluate progress under the management plan every year, as per the mandates outlined in the plan. National authority, local governments as well as representatives from the local communities should also be involved in the process;
- Implement, for established and fully functioning PAs, management plans or prepare second management plans and proceed with zoning different areas (core, multiple use, and buffer zones), ICDP programmes, monitoring, environmental education, data collection, field surveys and staff training;
- Formulate and implement an ecotourism strategy for all PAs by the end of the 9th Five Year Plan;
- Operationalize Phibsoo Wildlife Sanctuary;
- Complete the biological and socio-economic inventory for the Sakteng Wildlife Sanctuary; and
- Conduct preliminary surveys for the Khaling/Neoli Wildlife Sanctuary and the Toorsa Strict Nature Reserve.

3.1.1.2 Buffer Zones and Enclave Zones

Most of the current Protected Areas include scattered human settlements within their boundaries. The importance of sustaining economic activities for these populations runs the risk of conflicts with the environmental and conservation objectives of the Protected Areas and with the perpetuation of ecosystems that harbour biodiversity and genetic resources.

a) Long-term Objectives

- To encourage sustainable development of local communities in order to alleviate pressure on the Protected Areas as well as to ensure the survival of the local community's way of life;
- To provide, where possible, alternate income-generating methods to reduce dependency on the natural resources in the Protected Area;
- To maintain existing forest cover and restore degraded forests through reforestation, agro-forestry, social forestry, and alternative energy projects;
- To ensure that all major development activities proposed in the areas are sympathetic to the needs of the local people, and are planned and executed in ways that do not adversely affect the ecosystems of the park;
- To strengthen the capacities of local government and community-based institutions which manage and regulate the use of natural resources; and
- To promote the participation and involvement of local communities in conservation and development programmes (NCS, 1995).

b) Actions

- Give priority attention to the 'enclaveí and 'buffer' zones surrounding designated Protected Areas, including the needs of existing populations within and near the areas;
- Developing strategies to minimize the impact on such populations without adding to utilization pressures on the buffer zones;
- Promote participation and involvement of local communities in conservation and development and facilitate new and existing initiatives for the Integrated Conservation and Development Programme within and around core zones; and
- Work closely with other governmental organizations, national development agencies and extension services to facilitate and co-ordinate the process, and develop and implement practical workable programmes.

3.1.1.3 Promoting In Situ Conservation of Wild Crop Relatives and Wild Plants for Food Production

Natural ecosystems hold important plant genetic resources for arable agriculture systems, including endemic and threatened wild crop relatives and wild plants for food production. Many are not managed sustainably. This genetic diversity, because of interactions that generate new biodiversity, is potentially an economically important component of natural ecosystems and cannot be maintained ex situ. Unique and particularly diverse populations of these genetic resources must be protected in situ when they are under threat. Most of the country's national parks and other Protected Areas, however, were established with little specific concern for the conservation of wild crop relatives and wild plants for food production. Management plans for protected and other areas are not usually broad enough to conserve genetic diversity for these species to complement other conservation approaches. Moreover, they cannot provide comprehensive geographical and biological coverage of the diversity of many species. It is, thus, necessary to complement the conservation in Protected Areas with measures aimed at conserving genetic diversity that lies outside such areas. In situ conservation implies comprehensive planning in which protection, production and genetic conservation aspects are considered and made complementary.

a) Long-term Objective

- To promote conservation of genetic resources of wild crop relatives and wild plants for food production in Protected Areas and on other lands not explicitly listed as Protected Areas.

b) Intermediate Objectives

- To initiate planning and management practices which take into account wild crop relatives and wild plants for food production. To identify which wild crop relatives and wild plants need to be protected in situ for food production. To gain knowledge of the uses of wild plants as sources of income and food;
- To create a better understanding of the contributions of plant genetic resources in arable agriculture systems to local economies, food security, and environmental health. To improve management and planning and promote complementarity between conservation and sustainable use in parks and Protected Areas by, interalia, broadening the participation of local communities in these processes; and

- To establish better communication and co-ordination between various institutes and organizations working on in situ conservation and land use management, nationally, regionally and locally. To conserve genetic diversity for these species to complement other conservation approaches.

c) Actions

Policy Strategy

The RGOB, subject to national legislation and with the co-operation of the relevant public sector institutes, non-governmental organizations, farmers and traditional communities living near Protected Areas, should:

- Include as appropriate, among the purposes and priorities of national parks and Protected Areas, the conservation of plant genetic resources in arable agriculture systems, including appropriate forage species, wild relatives of crop plants and species gathered wild for food;
- Consider integrating conservation and management of plant genetic resources in arable agriculture systems in national land use plans;
- Support the establishment of national and local objectives for Protected Area management through broad-based participation, involving in particular, and where they are present, groups most dependent on wild plants for food production;
- Support the creation of advisory panels at the appropriate levels, that where appropriate, involve farmers, indigenous communities, plant genetic resources scientists, local government officials, and community leaders, to guide management of Protected Areas, according to national rules and regulations;
- Recognize the rights of indigenous communities to PGRFA in Protected Areas;
- Recognize that women are a valuable source of information on the feasibility of in situ conservation and management practices;
- Support indigenous and local communities' efforts to manage wild crop relatives and wild plants for food production in Protected Areas, or where existing rights are recognized;
- Review existing environmental impact statement requirement to incorporate an assessment of the likely effect of the proposed activity on local biodiversity in arable agriculture systems, particularly on wild crop relatives; and
- Integrate genetic conservation objectives in the sustainable management of wild crop relatives and wild plants for food production in Protected Areas and other managed resource areas.

The RGOB with the co-operation of the relevant national institutes, non-governmental organizations and the farming, indigenous and local communities living in non-Protected Areas, should seek, where possible and appropriate, to:

- Establish conservation of wild crop-relatives and wild plants for food production as an integral component of land-use planning;
- Encourage local communities to conserve and manage wild crop relatives and wild plants for food production, and provide for their participation in decisions relating to such local conservation and management; and
- Promote Protected Area policies that sustain rather than restrict those human activities which maintain and enhance genetic diversity within and among plant species. Participatory approaches to protected and related area management should also be encouraged to reconcile the sometimes conflicting goals of conser vation and local livelihood security.

Capacity Development

The RGOB should, whenever possible and as appropriate:

- Develop a prioritised plan, particularly for those ecosystems in which high levels of diversity related to plant genetic resources in arable agriculture systems are found, and conduct national reviews to identify those management practices needed to protect the desired level of genetic diversity for wild crop-relatives and wild plants for food production;
- Assist local communities in their efforts to identify, catalogue and manage wild crop relatives and wild foods; and
- Monitor the holdings, the distribution and diversity of wild crop relatives and wild plants for food production, integrate and link data and information from in situ conservation programmes with that of ex situ programmes and encourage private and non-governmental organizations to do likewise.

Co-ordination and Administration

- Link Protected Area planning and management with institutions responsible for the conservation and sustainable use of wild relatives of crop plants and wild plants for food production, such as centres for crop genetic resources, national crop genetic resource co-ordinators and botanical gardens.
- Designate an appropriate national focal point to catalyze co-ordination of in situ protection programmes and liaise with other countries in the region;
- Establish mechanisms for periodically reviewing and modifying conservation plans.

3.1.1.4 Conservation Outside Protected Areas

Given the commitment of the RGOB to maintain 60 percent forest cover, conservation outside the Protected Areas is of immense importance to Bhutan. Considering that we have all Protected Areas under forest cover, 34 percent of the country's forests that lie outside the Protected Areas still need to be maintained. This makes conservation outside the Protected Areas more significant. With the limited capacity and resources of the government, NGOs have a greater role in conservation outside the Protected Areas. There is the need to direct and coordinate the efforts of agencies in the relevant areas of conservation.

3.1.1.5 Conservation Areas

Phobjikha Conservation Area is has outstanding conservation significance and experience there has relevance to the other Conservation Areas in the country. This is due to the fact that it represents unique high altitude marshland ecosystem that serves to sustain the growing economic needs of its human inhabitants as well as habitat for the rare and endangered black-necked cranes. Research indicates that people are beginning to look at conservation there as an obstacle to economic development, which in the long term will be detrimental to ecosystem integrity. RSPN has developed community based conservation and development programmes to address the issue. However, it is equally concerned about the status of the area. RSPN's experience in the valley shows that the status of conservation areas needs to be strengthened as they lack a formalized protection.

a) Long-term Objective

- To protect the conservation values of conservation areas.

b) Immediate Objective

- To guarantee the future of the Conservation Areas, Which, among other things, would justify and facilitate the efforts of donors, NGOs and relevant agencies in projects and programmes to manage and protect the areas.

c) Actions

- Define and demarcate the official boundaries of the Conservation Areas;
- Develop and enforce set of rules and regulations that are specific to that Conservation Area; and
- Develop implementation arrangements for the conservation programmes, including ICDP and law enforcement.

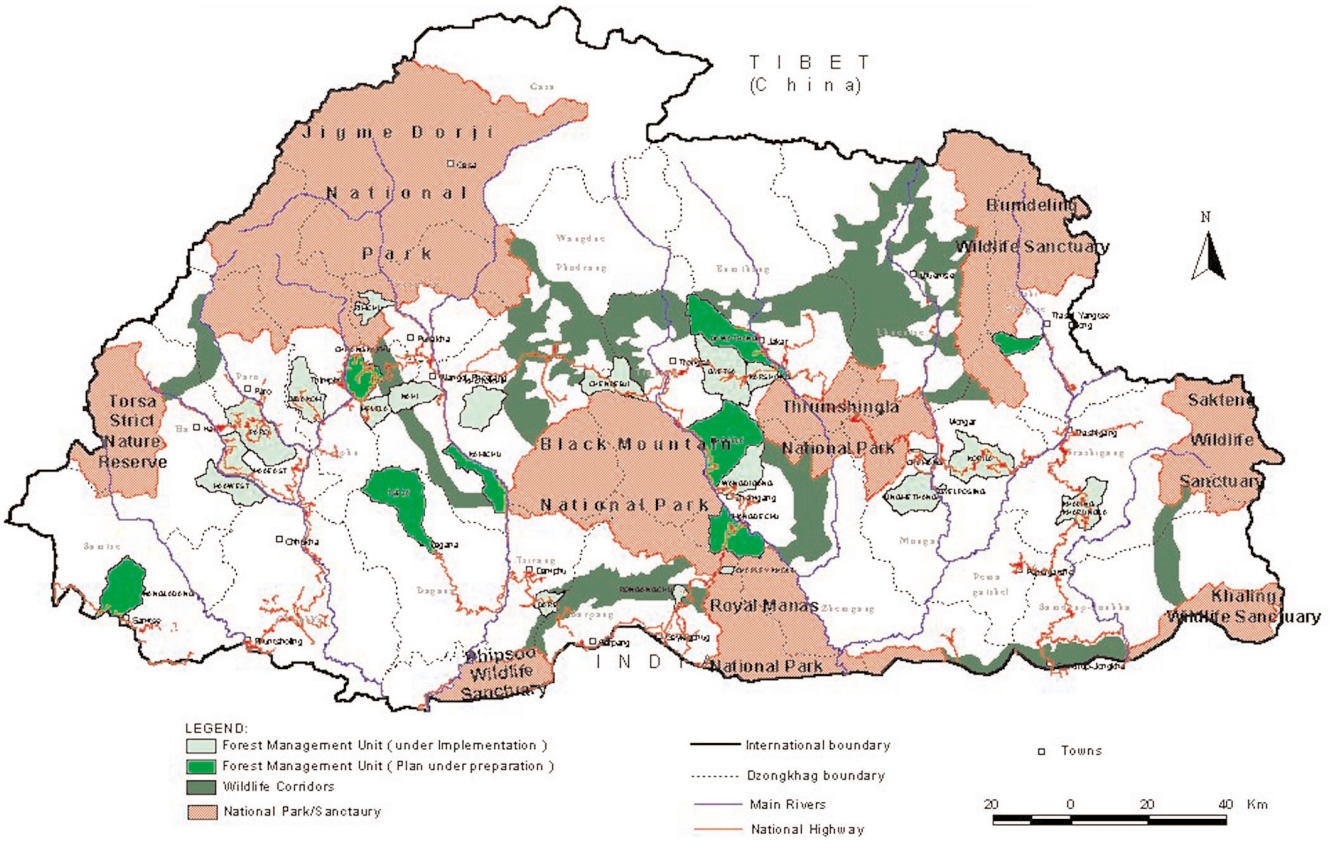
3.1.1.6 Conservation in Forest Management Units

Forest management outside Protected Areas is through the establishment of Forestry Management Units (FMUs), working schemes and cushion areas located in strategic parts of the country to cater to rural as well as urban demand for timber and other forest resources in the country.

Existing and potential FMUs in Bhutan not only have an important biodiversity conservation function, but should also provide buffers around, and genetic corridors between, the system of national Protected Areas. Thus, FMU planning will have to look both internally and to the regional scale in its working circle designations and management prescriptions. In particular, Protected Area designations within FMUs will have to pay attention at the landscape level, and to the vertical and horizontal linkages between biological protection areas, watershed protection areas, and stream protection corridors. Isolated protection of single FMUs will not fulfil these functions and this concept should be abandoned in favour of integrated biodiversity conservation at the landscape levels. Cushion areas are constituted for harvesting mature and over-mature trees, from small pockets of forest areas that are scattered throughout the country (FRDD, 2001).

The total forested area in the country is about 2,90,450,000 ha, out of which about 46,140,000 ha can be operated (FRDD, 2001). At present about 152,455 ha of forest area are being managed which relates to about 4 percent of the total land area (FRDD, 2001). And this process is intended to continue so that all direct forest management will be within the FMU system. There are about 14 FMUs distributed throughout the country. The present potential gross growing stock is about 184 million cubic metre and the potential Annual Allowable Cut (AAC) is estimated at 1.1 million cubic metres (FRDD, 2001). As of now about 4,790,960 ha of forest area have been demarcated. While the objectives are environmentally sound, care must be taken to assure that during planning and implementation these objectives are adhered to.

Map 3. Forest Management Units with Working Schemes



Source: FRDD, DFS

a) Long-term Objective

- To protect forests, soil, water and wildlife and to assure successful conservation of the forest ecosystems, their genetic resources and biodiversity in Bhutan.

b) Immediate objective

- To balance commodity production with the maintenance of biological diversity and forest landscape stability.

c) Actions

- Assure that FMUs are planned for integrated biodiversity conservation rather than as single isolated working circle blocks. Protection Areas within an FMU must be established to meet very specific functions, such as: critical habitat for particular wildlife species; protecting "keystone" biodiversity values (i.e. species, groups of species, habitats or abiotic factors that play a pivotal role in ecosystem processes and upon which biodiversity depends); buffer zones around nationally established Protected Areas; areas which are particularly representative of the range of local ecosystems; and corridors to ensure ecological links;
- Assure that only degraded forest areas and not productive mature forests are converted to plantations;
- Assure that enough mature and old growth forest is maintained permanently to provide the necessary range of habitats and ecological stages. Without such planning, even cutting relatively small patches each year can eventually totally remove mature forest from a large area;
- Establish sound management plans and implement them so that forests are managed on a sustainable basis. Forest use has to be based on scientific management plans, taking into account such factors as long-term growth and yield relationships, responses to silvicultural treatment and reforestation strategies;
- Implement and monitor approved management plans and evaluate the performance, particularly with respect to anticipated impacts of harvesting and other uses;
- Update plans on a periodic basis based on feedback from actual operational implementation; and
- Determine the long-term sustainable capacity of the appropriate FMUs and the future use of forest resources, given the growing and conflicting demands and the risks of environmental damage.

3.1.2 Ex situ Conservation Efforts

3.1.2.1 Expansion of Royal Botanical Garden and Arboretum and Establishment of Branch Botanical Gardens

"Botanical gardens are institutions holding documented collections of living plants for the purpose of scientific research, conservation, display and education" (Jackson 1999). Botanical gardens, therefore, play an important and a complementary role to herbariums in building the scientific knowledge base of the floristic diversity in the country.

The first botanical garden in Bhutan was established in Serbithang in May 1999 as an ex situ conservation effort to represent the floristic diversity of Bhutan and to function as

a recreational as well as an educational centre. As Bhutan has diverse ecological zones and microclimates, the experiences have indicated that the garden at Serbithang cannot represent the nations floristic diversity due to high costs associated with the creation and maintenance of an artificial environments. Therefore, the establishment of the branch botanical gardens in different ecological zones needs to be established as a means of ex situ conservation for financial sustainability and true representation of the floral diversity of Bhutan.

a) Objective

- To strengthen the ex situ conservation efforts towards representing the different ecological zones and their representative floristic diversity.

b) Actions

- Expand and improve on the existing physical facilities at Serbithang;
- Establish branch botanical gardens representing alpine and sub-tropical plant diversity;
- Select suitable sites and develop the associated infrastructures and facilities;
- Develop and implement collection and management protocols for all botanical gardens according to international scientific and horticultural standards;
- Establish the information system on the plant collections using international IMS standards;
- Establish linkages with regional and international botanic gardens, universities etc, to develop further ex situ conservation techniques and practices;
- Develop educational displays of rare, endangered and economically significant plant species, to highlight the need for their conservation; and
- Develop the technical capacities for the development and the management of representative botanical gardens.

3.2. Domestic Biodiversity

3.2.1 In situ Conservation Efforts

3.2.1.1 Policy on Introducing Exotic High-Yielding Varieties versus Indigenous Species

In workshops and other forums, there has been much discussion of the appropriate national policy on importing and using exotic high-yielding varieties versus maintaining the indigenous species and races. Farmers want to get the highest yield possible from their lands, and much agricultural effort has been directed to encouraging farmers to adopt high-yielding exotics. On the other hand, as is discussed in more detail below, most high-yielding exotics represent monocultures with a relatively narrow genetic base. Consequently, they are particularly vulnerable to diseases, parasites and changes in climate and other environmental conditions to which the indigenous species are genetically well adapted. It is essential, therefore to maintain the indigenous genetic diversity to provide the broader genetic base to assure sustainability in crop or livestock yield. With the enactment of National Seeds Act and Seed Policy, some policy guidelines now exist with regard to introduction and use of exotic germplasm versus the native. HYVs, especially if they contain native genetic materials (e.g. crossbred rice

varieties), are an improvement over the local varieties that are low in productivity and disease-prone. In fact, there is genetic base broadening rather than narrowing. Due to diversity in environments and ecologies in Bhutan, "diversity has to replace diversity". So exotics are a lesser threat than in flat, uniform environments.

A further issue concerns the overall balance of costs and benefits for the country. For example, some exotic varieties of livestock do provide higher yields to the farmers, but because they are less well adapted to the local conditions, diseases, etc., the costs for veterinary health services (borne by the government, not the farmer) have increased greatly. When exotics are considered for import there should be an overall assessment of the costs and benefits, including the environmental ones, not simply an assessment of anticipated increased immediate yield of farm products.

Introduced exotic tree species represent another issue. While some, such as eucalyptus and some imported pines produce fast growth, their effect on the environment is usually far from benign. In much of the world it has been found that relative to natural forest, a eucalyptus or imported pine plantation often accelerates rather than retards erosion. It is far less usable as wildlife habitat for most indigenous species; and it maintains a grossly impoverished biodiversity relative to the native forests it replaced. Therefore, as a general rule, plantations of exotics should not replace intact native forest systems. However, where the native forests have been lost or very greatly degraded, the exotics can provide the useful benefits of relatively quick revegetation (at least of the exotics) and wood productivity.

Therefore, a rational policy would be to allow exotic high-yielding species on the basis of decisions made after an assessment of the overall costs and benefits to the country. But at the same time, there should be assurance and, as necessary, suitable programmes to ensure that the indigenous species and varieties will not be lost.

3.2.1.2 Surveying and Inventorying Crop Genetic Resources

Rational conservation ideally begins with the surveying and inventorying of existing resources. In order to elaborate policies and strategies for the conservation and utilization of crop genetic resources, the national agricultural centres need to know what resources exist in the country. By ratifying the Convention on Biological Diversity, Bhutan has acknowledged certain needs and responsibilities concerning this subject.

a) Long-term Objectives

- To identify, locate, inventory and, as feasible, assess any threats to those species, ecotypes, cultivars and populations of plants relevant to food and agriculture, especially those that are of anticipated use; and
- To facilitate the development of complementary conservation strategies (e.g., weighing the need and importance of collecting for ex situ conservation and/or continued conservation in situ and national policies related to the conservation and sustainable use of plant genetic resources in arable agriculture systems.

b) Intermediate Objective

- To develop useful methodologies for surveying and inventorying plant genetic resources in arable agriculture systems.

c) Actions

- Survey and inventory plant genetic resources in arable agriculture systems as a step in the process of conservation and reducing the rate of loss of biodiversity. Without the capacity to conserve and/or use, however, such work may have marginal utility. Thus, surveying and inventorying should ideally be linked to specific objectives and a plan, such as one for in situ conservation, or collecting, ex situ conservation, and use. Local and indigenous knowledge should be recognized as important components of surveying and inventorying activities and should be properly considered in all such efforts;
- Provide financial and technical support, from the RGOB or other sources, to survey and inventory plant genetic resources in arable agriculture systems, and assist in providing appropriate access to existing and planned GIS facilities and data. Training and capacity building should be undertaken in areas such as taxonomy, population biology, ethnobotany, and eco-regional and agro-ecological surveying;
- Give adequate support to developing better methodologies for the surveying and assessment of intra and inter-specific diversity in agro-ecological systems. Existing information sources should be used in research to determine to what extent wild relatives of domesticated species are already in the national parks and Protected Areas; and
- Establish the NBC as a strong co-ordinating body , with policy support and high level institutional mandate. The NBC should develop strong linkages with central programmes, training institutes, regional and Dzongkhag level research and extension networks and with the users of plant genetic resources in arable agriculture systems (breeders and farmers) in order to inform, direct and prioritize the conservation process. The national programmes and projects are to collaborate in surveying and inventorying activities in order to build in-country capacity development.

3.2.1.3 Supporting On-Farm Management and Improvement of Plant Genetic Resources in Arable Agriculture Systems

Bhutanese farmers choose to grow new cultivars for many reasons including market conditions, family food security and environmental sustainability. Unfortunately, these choices often result in significant on-farm genetic erosion. Still, in some parts of the country, the overwhelming majority of farmers, as a matter of choice or necessity, engage in de-facto conservation and development of plant genetic resources in arable agriculture systems as they select and save seed for the next planting season. These farmers typically practice low-input farming. Such farmers often lack access to new and diverse genetic materials which could be integrated into existing crops to improve production. Historically, farmers' access to a broad range of germplasm has contributed to yield increases and greater crop adaptability through farmer selection. It has also led in many cases to the rise of local seed system and local system of crop development.

Without appropriate and creative approaches, prospects of markedly increasing the productivity of low-potential and low-input farms through genetic improvements alone also would appear limited. Yet, increased productivity is important for food security and to reduce pressure on fragile environments. Neither the private sector nor public agricultural research institutions presently have the capacity to serve this large,

economically disadvantaged population completely. The RGOB must also seek broad-based participation to realise farmers' rights through national legislation, as appropriate.

Initiatives focusing on participatory, on-farm management and improvement of plant genetic resources in arable agriculture systems offer the potential to reach a large number of farmers and promote further agricultural development. It would, of necessity, depend on farmers themselves and their decisions to build upon and make use of their on-going efforts to improve their crops through mass selection and other breeding efforts. Efforts to provide farmers greater access to appropriate genetic resources and training could assist farmers in improving various characteristics of their planting materials (such as disease or pest resistance), and in increasing food production. The DRDS of MOA, especially the Research and the Extension Divisions should engage in projects researching and promoting on-farm management and improvement of plant genetic resources in arable agriculture systems. The capacity development of such projects may need to be expanded to reach the maximum number of farmers across the country. In this way, the full potential of on-farm improvement may be realised. The present on-farm conservation programme is being implemented in collaboration with RNRRCs and Dzonghags through the Biodiversity Use and Conservation in Asia Programme (BUCAP) projects.

a) Long-term Objectives

- To better understand and improve the effectiveness of existing on-farm conservation, management, improvement, and use of plant genetic resources in arable agriculture systems;
- To achieve a better balance between ex situ and in situ conservation;
- To realize Farmers' Rights at the international, regional, and national levels;
- To promote the equitable sharing of benefits from plant genetic resources in arable agriculture systems as called for in the Convention on Biological Diversity; and
- To foster the future emergence of public or private seed enterprises and co-operative concerns as an outgrowth of successful on-farm selection and breeding. To encourage traditional seed exchange and supply systems.

b) Intermediate Objectives

- To gain greater knowledge about the dynamics, methodologies, effects, and potential of on-farm conservation and plant improvement;
- To establish or strengthen programmes and networks for on-farm management of farmer's varieties, wild relatives of food crops, harvested food plants and rangeland genetic resources;
- To extend the role of national, regional and international genebanks to include support for and provision of materials to on-farm improvement programmes; and
- To build on-farm and garden programmes based on local systems of knowledge, institutions, and management, ensuring local participation in planning, management and evaluation.

c) Actions

Policy Strategy

On-farm activities are a means to improve existing practices in selected communities. They are complementary to and not a substitute for more formal varietal development and seed supply systems. Institutional flexibility will be

needed in working with farming communities. No single plan or recipe is possible or advisable. Working examples must be identified for conservation and sustainable use of plant genetic resources in arable agriculture systems that support and maintain the social, economic and cultural values of local and indigenous communities and improve the quality of life.

The RGOB should consider how production, economic incentive, and other policies, as well as agricultural extension and research services might facilitate and encourage on-farm management and improvement of plant genetic resources in arable agriculture systems. Where appropriate, the RNRRCs should consider strengthening local level capacity development to participate in all stages of breeding, including on-farm selection and adaptation. The research system and others should incorporate gender and socio-cultural factors into the design and implementation of agricultural research on crop genetic resource activities.

Capacity Development

Adequate support should be given to farming community-based institutions and farmers' associations and groups engaged in providing practical assistance to on-farm conservation and improvement work. Considering the needs of and numbers of the farmers served, national agricultural institutes should consider identifying appropriate landraces/farmers' varieties for multiplication and/or developing new breeding populations incorporating specific characteristics into locally adapte materials for on-farm improvement activities. Step-by-step incorporation and improvement should be encouraged rather than the hasty replacement of on-farm diversity. As a general practice, quantities of seed and planting materials distributed should encourage research and experimentation by farmers, and not be so large as to displace normal seed supply sources or on-farm seed management.

Interdisciplinary training programmes should be developed for researchers, extension workers, contact farmers and others in facilitating and catalysing on-farm activities, including selection and breeding techniques appropriate to supplement and improve those already used by farmers. The focus of training programmes should be to help farmers better incorporate new knowledge and technologies and indeed become better technicians, and researchers become better enablers and supporters of farmers. Training should be aimed at four different groups: scientists, technical support staff, extension agents (including NGOs), and farmers. Support for advanced degree work should include relevant work in the biological and social sciences. Training of extension agents should aim to increase their skills in crop identification, selection and breeding and seed maintenance in order to provide the important bridge between national agricultural research staff and farmers.

Training of (and by) farmers should emphasize enhancing the identification of plant traits, selection/breeding, utilization and maintenance of local crops. It is important to develop farmers' skills in selection of plants in the vegetative state and not only after harvest. Training programmes should be designed in close collaboration with the RNRRCs and farmers and their organizations and be based on particular needs as they see them. Programmes should consider the different uses of biological resources by women and men, including women's concern for the multiple uses and processing requirements of crops.

Research and Technology

Four basic types of rigorous, multi-disciplinary scientific research are needed:

1. Ethnobotanical and socio-economic research to understand and analyse farmers' knowledge, selection/breeding, utilization, and management of plant genetic resources in arable agriculture systems, consistent with the approval of the farmers involved and with applicable requirements for protection of their knowledge and technologies;
2. Population and conservation biology research to understand the structure and dynamics of genetic diversity in local landraces/farmers' varieties (including population differentiation, gene flow, degree of inbreeding, and selective pressures);
3. Crop improvement research, including research in mass selection and simple breeding as a means of increasing crop yields and reliability without significant losses of local biodiversity; and
4. Research and extension studies for little known crops will be promoted, including seed production, marketing and distribution.

Scientific research should, when possible, be coupled with on-farm activities in order that the context and purpose of the work are fully appreciated. Research should assist in the monitoring, evaluation, and improvement of on-farm efforts. Research should be undertaken in a participatory and collaborative manner to foster interaction and co-operation between rural people and the staff of the DRDS. Other institutions must be involved appropriately whenever necessary. Methods should be developed and assistance provided for recording and linking in situ farm and garden management and conservation of plant genetic resources in arable agriculture systems with a national genebank and the RNRRCs.

Co-ordination and Administration

National co-ordination efforts in this area should allow for and encourage local, community-level initiatives in proposing programmes. Small, grass-roots projects should receive priority in funding and support services. Priority should be placed on farmers within a technical project area promoting the maintenance of pre-existing diversity and collaboration between communities and research institutions. Subject to satisfactory progress, programmes should be sufficiently long (10 years or more) to achieve results. Efforts should be co-ordinated closely with RNRRCs, the decentralized extension network and the farming communities.

3.2.1.4 Assisting Farmers in Disaster Situations to Restore Agricultural Systems

Natural and man-made disasters pose enormous threats to agricultural development and pose huge challenges to the resilience of agricultural systems. Often, adapted crop varieties are lost and cannot be recuperated locally. Food aid, combined with the importation of often poorly adapted seed varieties, can lower yields and keep them low for years. While addressing the immediate crisis, such practices can exacerbate hunger conditions, undermine food security and increase costs of assistance well into the future. Indigenous landraces/farmers' varieties lost during calamities can frequently be found in ex situ collections outside the affected country. Properly multiplied, such stocks can be returned to reconstitute locally adapted planting material, an essential component of

sustainable agricultural systems. Partnerships are important in such efforts and can include government and non-governmental organizations.

a) Long-term Objective

- To support farmers' and rural peoples' livelihoods and sustainable agriculture options through the rehabilitation of agricultural systems based on locally adapted plant genetic resources, including the restoration of pre-existing germplasm in cases of disaster- induced loss of plant genetic resources in arable agriculture systems.

b) Intermediate Objectives

- To establish capacity development programmes to deliver seed of adapted local varieties as needed to help re-establish indigenous agricultural systems in areas affected by natural disasters, war and civil strife; and

- To establish institutional responsibilities and mechanisms for the identification, acquisition, multiplication, and re-introduction of appropriate genetic materials.

Policy Strategy

The RGOB with the co-operation of relevant rural-based committees, farming communities and UN bodies and regional, inter-governmental and non-governmental organizations should establish necessary policies at all levels, which will allow unhindered implementation of seed security activities in response to calamities.

To minimize genetic loss, Bhutan should ensure duplication of plant genetic resources in arable agriculture systems outside of the country, such as in genebanks of neighbouring countries, and/or regional or international genebanks and crop genebank networks. Where such ex situ collections do not exist outside the country, support should be given to undertake emergency collections of local varieties as soon as possible within the country, so that they may be multiplied for immediate use and also may be conserved in national and international ex situ collections for future use.

Capacity Development

The RGOB, through the MOA should establish agreements with appropriate agencies, especially national and international agricultural research institutions, for rapid acquisition and multiplication, restoration and provision of materials. Such institutes should endeavour to ensure that their capacity is sufficient for the task. Co-operation with non-governmental and private organizations can be an important component of efforts to distribute suitably adapted germplasm into regions that are recovering from disasters. Adequate information systems must be established to identify and track appropriate germplasm for reintroduction.

The RGOB should consider making available adequate funds to set in motion the multiplication of seed and to initiate other related activities in response to emergencies, after approaching existing national and international emergency funds to determine if they could effectively plan ahead to cover action related to the restoration of plant genetic resources in arable agriculture systems after disaster situations. It should also strengthen farmers' abilities to cope with disasters by supporting the re-emergence of local seed supply networks.

Research and Technology

Previous experience should be reviewed and options developed to enhance preparedness for the rescue of ex situ collections and emergency seed collecting in the context of calamities, including war, civil strife, industrial accidents, and natural disasters. These efforts could benefit from close collaboration with other countries, non-governmental and private organizations, the national, regional and international agricultural research centres (IRRI, for example) regional plant genetic resource networks (such as the South Asia PGR Coordinators Network) as well as relevant inter-governmental agencies such as the Food and Agriculture Organization/ International Commission on Genetic Resources for Food and Agriculture/International Undertaking on Plant Genetic Resources for Food and Agriculture, World Food Programme, UNDP/GEF, etc.

Co-ordination and Administration

This programme should be co-ordinated administratively by MOA in close collaboration with the national and the international agricultural research centres, regional plant genetic resources networks, donor countries and NGOs. Public awareness efforts are needed to sensitize the donor community and NGOs to the importance of adapted plant genetic resources in arable agriculture systems in relief and rehabilitation efforts and to inform them of this programme. Such efforts should also increase awareness of the need for safety duplication of materials in other countries.

3.2.2 Ex situ Conservation Efforts

3.2.2.1 Supporting Planned and Targeted Collecting of Plant Genetic Resources in the Arable Agriculture System

Potential for loss and the opportunities for use are the prime motivating forces behind most collecting. The materials that are currently being conserved do not represent the total variation in plants. In Bhutan, even the major crops have not generally been well collected. Collecting of certain regional, minor, and subsistence crops is much less attended to. Past collecting missions conducted by IPGRI and IRRI with inadequate methodologies may not have successfully sampled diversity. Conditions in genebanks where these Bhutanese materials are stored may also have led to the loss of collected materials, leading to a need for re-collection. In some cases, collecting is needed to rescue materials under imminent threat in situ. In others, clear utilitarian needs for disease or pest resistance or other adaptive characteristics make further collection warranted.

a) Long-term Objective

- To collect those species, ecotypes, landraces/farmers' varieties, or other cultivars, and associated information that are under threat or are have anticipated use.

b) Intermediate Objective

- To fill gaps in the genetic diversity of existing collections of some crop species with well targeted and prioritized collecting.

c) Actions

Policy Strategy

Policy strategy should be aimed at the development of collecting practices with regard to the objectives and obligations set forth in the Convention on Biological Diversity, for example the right of the traditional farmers and farming communities to Prior Informed Consent (PIC) before providing access to genetic resources and the obligations of collecting missions, subject to the RGOB approval. Knowledge of indigenous communities regarding the conservation and sustainable use of biological diversity should be respected. The collecting conditions and the actual field activities must be consistent and implemented on mutually agreed terms.

Capacity Development

Material so collected should be deposited in facilities which have the capacity to manage them within the country, and possibly elsewhere. Collected materials will be preserved in the Bhutan National Genebank (BNGB), which is under construction at Serbithang. Before collecting is initiated, full consideration should be given to the ability to conserve the material collected effectively and sustainably. Training should be undertaken in scientific collecting methods for plant genetic resources in the arable agriculture system.

Co-ordination and Administration

Co-ordination, as appropriate, should take place within the country. Regional and international level co-ordination, as appropriate, is needed to provide linkages with ex situ collections and gap filling and regeneration efforts. Such co-ordination might concern the identification of specific needs of Bhutan that could be met by plant genetic resources in the arable agriculture system in another. Strong linkages need to be established with regional and crop networks and with the users of plant genetic resources in the arable agriculture system (breeders and farmers) in order to inform, direct and prioritize the entire conservation process, including surveying, inventorying and collecting.

Mechanisms need to be developed at all levels for emergency collection of plant genetic resources in the arable agriculture system. These mechanisms should make full use of and therefore should be closely linked with information and an early warning system at all levels. As part of the national plant genetic resources programme, the RGOB may designate a focal point for administering requests for collecting.

3.2.2.2 Expanding Ex Situ Conservation Activities

The diversity of many species of plants cannot be conserved conveniently or effectively as seed. Some species are vegetatively propagated and others have "recalcitrant" seed. A number of major staple food crops, tropical fruits, and export crops, fall into these categories. Due to technical difficulties, the conservation of genetic resources of such plants is often not given appropriate attention.

Many plants of local importance in the arable agriculture system have been virtually neglected by the government institutes for agriculture research and development. Collections are ad hoc and no co-ordinated efforts have been made to ensure that adequate germplasm samples are maintained for conservation and further development.

Botanical gardens, field genebanks, and the use of new technologies, including in-vitro methods, could be developed more fully to complement and expand conservation of plant genetic resources in the arable agriculture system. A proposal for both central and regional field genebanks is under development between the NBC and the RNRRCs.

a) Long-term Objective

- To conserve plant genetic resources in the arable agriculture system so that they will be available for use.

b) Intermediate Objectives

- To develop management strategies for ex situ conservation of vegetatively propagated and recalcitrant seeded plants, as well as for species neglected in current conservation activities;
- To promote the development and transfer of appropriate technologies for the conservation of such plants; and
- To encourage and strengthen the involvement of botanical gardens in the conservation of plant genetic resources in the arable agriculture system, particularly for those species for which they already have a comparative advantage.

c) Actions

Policy Strategy

The RGOB, IARCs, NGOs (such as the National Women's Association of Bhutan, RSPN, etc.), and funding agencies should provide adequate, appropriate and balanced support for the conservation of vegetatively propagated and recalcitrant seeded plants.

Capacity Development

Botanical gardens and field genebanks should be created and strengthened, particularly in relation to their capacity to conserve species neglected by more agriculturally related facilities. In this regard, capacity building is especially needed in Bhutan. As appropriate, genebank facilities of botanical gardens might be strengthened. Simple, low-cost botanical gardens, arboreta and field genebanks associated with colleges, schools and other institutions should, as appropriate, be established, strengthened and encouraged to promote education and public awareness.

Support should be given to training in in-vitro techniques and to other new and appropriate technologies. In accordance with national and local needs and priorities, support should be given to establishing the capacity to use such technologies.

Research and Technology

Protocols should be developed for in-vitro conservation and other conservation technologies for important vegetatively propagated and non-orthodox seed plants. An assessment should be made of the conservation needs of other species in the arable agriculture system that are not adequately conserved, including a survey of activities as a prerequisite for further planning and co-ordination of collecting and conservation.

Administration and Co-ordination

National Crop and in-country regional networks (between RNRRCs) as well as relevant outside organizations, with the support of IARCs and RNRRCs, should regularly assess the state of conservation of vegetatively propagated and non-orthodox seeded plants, and make recommendations and take action as appropriate. Links with international botanical garden organizations (such as the International Association of Botanical Gardens and Botanical Gardens Conservation International) and those responsible for and engaged in conservation of food and agriculture species (inter alia, FAO, IPGRI and other international agriculture research centres) should be initiated and strengthened. Similar links should be made between institutions, including the private sector (such as the nursery trade), at the national level. Practical co-operation should be encouraged as a matter of priority.

3.2.3 Breed Conservation

Overview

Until about two years ago there was no method for monitoring the various species, breeds and crossbreeds. The recently launched (and ongoing) "breed survey" is aimed at identifying the different species, breeds, breeding systems and sub-breeds with productivity levels. It is done through a structured questionnaire to record breed levels, production and management practices. Attempts are underway to include these elements in the RNR census conducted every five years. The breed survey which was started in 1997 has not been completed for want of adequate resources. Presently data for only *Dzongkhags* are available.

The survey is structured in such a way it captures breeds and crossbreeds and also the level of crossbreeding based on which a proper strategy can be developed. In future works on sample recording of performance traits on a regular basis within sample villages through out the country, should be taken up on priority basis. This is crucial to provide information on the relative performance of the different crosses so that a sustainable breeding and conservation strategy can be developed.

The existing breeding schemes have essentially been crossing systems with no selection system built in. Coupled with the lack of adequate recording, it is not possible to evaluate objectively either the real or the potential contribution which the breeds used can actually make. This holds true to the horse, pig and sheep industries and in basic terms, also to poultry.

Certainly, the tradition of crossing is well established within the Bhutanese cattle industry with the basic cross of Mithun with Siri (*Nublang*) being the major contributor both to draught (*Jatsha*) and butter/cheese (*Jatsham*). Most villagers claim that *Jatsham* is still preferred to the Jersey cross in many places due to greater butter output (as compared to milk).

The environmental impacts are now recognized by the RGOB and the Ministry's responsibilities reflect this. According to observations, different cattle crosses exhibit quite different characteristics in terms of grazing ability, with the traditional crosses able to gain forage from the hill and woodland while the Jersey and Brown Swiss crosses cannot.

While there are concerns about damage from forest grazing, for some time to come livestock will still depend upon forest grazing. The impact of pigs on the environment is unlikely to become a serious problem as long as they are retained in small numbers usually with a household feeding domestic scrap and rice waste. The effect of Yak has to be considered as they cover large areas of land during the whole yearly cycle of movement but the major concerns are during the summer when overgrazing may be a problem.

The genetic impacts of potential schemes are difficult to estimate since there is no reliable statistical base for present performance levels and few good records on which to base any predictions.

The conservation of native breed of livestock (cattle and yaks in particular) is of paramount importance in livestock development programmes where extensive either systematic or haphazard cross breeding programmes are done. The risk of over-dilution of the native/indigenous blood in the long run is foreseeable under such circumstances, which should be avoided by any means.

In view of the above facts, the RGOB in the previous Five Year Plans identified pocket areas where good quality indigenous breeds could be found. But due to the operational problems, this strategy proved quite difficult to implement. Therefore, the Government has now recently established a "*Nublang* farm" in the eastern region of the country. This is a farm where only the indigenous breed is reared and bred. Studies will be done on this breed and the males will be in some cases used for upgrading the indigenous/native population. The priority will be on breed research itself as the country lacks true scientific data on these native breeds.

The "indigenous yaks" will also be conserved. The conservation of other domestic species will also be done at the same time, particularly the pigs and sheep but as yet the strategy has not been worked out as these species are not of priority as of today.

The new Livestock Breeding Policy document adequately foresees these concerns and addresses them in a scientific approach. The document will act as a guiding tool for breed conservation aspects. Breeding programmes will be streamlined with the formation of National Livestock Breeding Programme, a central body to oversee all affairs related to livestock breeding and provide technical backstopping.

a) Siri cattle conservation plan

Considering the importance of *Nublang* for the farmers and the general lack of information regarding the genetic make-up of the indigenous breed of this nature, (information available is either scant or unreliable) a farm has been established. This farm will be the nucleus of the activities related to *Nublang* breeding particularly for:

- Investigation of detailed genesis of this breed;
- Producing, raising and supply of *Nublang* bulls to farmers at cost effective price; and,
- Monitoring the performance of the bulls in the field as well as in the crossbreeding programme.

Two of the long-term objectives of this programme are:
- To study the genesis of Siri breed and make available facts for scientific adoption of conservation of the germplasm and to forgo degeneration through appropriate means; and
- To adopt a scientifically sound crossbreeding programme by producing Siri bulls for distribution in the field and for semen production and preservation.

Strategy for Siri preservation

- The centre has already stocked adequate number of animals. The stock will ultimately be raised to 150 females and 6 males along with additional followers;
- All scientific measures to keep the performance efficiency to its optimum will be adopted;
- Systematic exchange and addition of both males and females shall be carried out periodically in order to prevent inbreeding in herds. At the same time Nublang semen will be preserved to create a genebank;
- Proper health coverage will be done and at the same time, disease/parasite patterns on *Nublang* will be investigated and studied in collaboration with the Regional Veterinary Laboratory in Khaling;
- Initially *Nublang* will be reared under the pastoral/ranch type of management. This will slowly be transformed into an intensive management system. This is to transform the habitat & husbandry into the productive system;
- Computerised data collection and processing will be initiated and to the extent possible external expertise will be invited for *Nublang* preservation logistics and techniques; and
- Ex situ (semen) conservation will be strengthened.

b) Sheep conservation

RGOB already has a breeding farm in Bumthang where exotic breeds are maintained for ram production. This ensures the continued source of exotic genotypes, but ultimately dilutes the local genotypes.

In order to do away with over dilution of local genotypes, a nucleus flock of local (black) sheep will be established. And subsequently selective breeding with the local (superior) rams will be initiated at the farmer level.

The following will be the core activities of the programme:
- Breeding programmes to find a breed suitable for the village condition;
- Production performance (wool, lambing, survivability etc.) of the improved sheep;
- Look into methods of culling which could overcome the religious sentiments; and
- Introduction of simple and efficient wool processing techniques.

c) Yak development strategies in hand

Yak development strategies include:
- Efforts being made to introduce rangeland management practices for providing adequate fodder;
- Creation of marketing outlets for the yak herders; and
- Introduction of better animal health programme.

The Government still supports the yak herders by supplying yak bulls procured from Ha to other regions as they are regarded to be of superior stock. In order to avoid problems of inbreeding in yak population, exchange of yak bulls are being encouraged from one region to another region for breeding purposes. Artificial insemination in yaks includes:

- Introduction of AI in certain areas on trial basis; and
- AI using frozen semen of yak imported from China is being carried out on a trial basis with the main objective to improve the Bhutanese yak by introducing new blood lines and to eliminate the adverse effects caused by inbreeding.

Further trials using frozen semen from Jersey and Tarentaise are still on. However, under the existing circumstances (there is no motorable road to reach the yak herds and on the other hand yaks move to summer grazing land at an altitude of 5,000 m during the breeding season), the implementation of the AI programme on a large scale is very difficult.

In the long term, maintenance of genotype diversity in yaks and selective breeding schemes among the yak herders should be established. This should be linked with proper monitoring and the use and exchange of bulls.
It is also necessary to select bulls for semen production and exchange of this material in proper frequency. A nucleus farm, basically for bull maintenance (for semen production) and to act as a focal point for studying production and socio-economic aspects, may be the best option for long-term yak development and maintenance.

In the meanwhile genetic distancing work among yak herds in Bhutan has been done.

d) Pigs and Poultry

The population of local pigs/poultry is sharply falling. Although some steps are underway to collect local pigs and further breed them, expanding this effort should be seriously considered. A programme to produce our own grandparents from the blend of local poultry and exotic should be urgently initiated. This will ensure that the local poultry are maintained in good numbers for selective blending.

e) Mithun

Mithun is another very important cattle species for the production of crossbreeds in the country. The RGOB has two farms to produce Mithun but the numbers are not adequate. A technological breakthrough has been made in artificial insemination in Mithun. Mithun semen has now been widely used in Bhutan as a means to crossbreeding.

f) Horse

Attempts are underway to identify suitable horse types for the country. A trial consignment of Spiti horse breeds of India has been brought and presently works are underway to establish a nucleus farm to produce the stallions.

g) Buffalo and Goat

In view of the large shortfall in milk and meat supply, the local buffaloes and goats should also be maintained and preserved.

h) Other Services

Health Services: Animal health services are at two levels:

i) Field services

- Disease investigation and diagnosis;
- Animal health extension;
- Co-ordination of field and laboratory services; and
- Mobile clinics and support for field staff.

This is done through the RNR centres (including 20 veterinary hospitals) that provide services in the form of treatment of animals, deworming, vaccination and local extension programmes at the Dzongkhag level.

ii) Laboratory services

The laboratory services are provided by the Regional Laboratories (there are 4 Regional Veterinary Laboratories located at Gedu, Gelephu, Bumthang and Khaling) with further support from the Satellite Laboratories (Phuentsholing, Deothang and Mongar) and the Royal Veterinary Epidemiology Centre (RVEC), which is the National Referral Laboratory in the country. The RVEC, apart from being a national referral laboratory also acts as the co-ordinating body for all the animal health programmes. In view of making laboratory services accessible to all levels of farmers and in different remote areas, mobile laboratory facilities have been introduced. Apart from conducting epidemiological studies, this approach will take the diagnostic services nearer to the farmers. More efforts will be made towards delivery of health services to small holders in view of the fact that small holders are more livestock dependent.

Feed and fodder development support: Traditionally, forest browsing and feeding stubble/straw and kitchen waste has been the practice in livestock rearing. Improved pasture was introduced about two decades back. Thus native pastures, forests, improved pasture; fodder trees; crop residues and farm wastes are the main sources of nutrition to the livestock in Bhutan.

The proposed National Feed and Fodder Programme will streamline the fodder aspects in the country.

Chapter 4

Action Plan: Essential Supporting Measures

4.1 Wild Biodiversity

4.2 Domestic Biodiversity

4.1 Wild Biodiversity

4.1.1 Implement the Vision and Strategy for the NCD and Protected Areas

The new vision and strategy for NCD (discussed in Section 2.4.2) is to serve as a guide for NCD to meet the challenges that lie ahead. This vision and the associated strategy have a time horizon of 15-20 years.

The four strategically chosen components are linked to the analysis of the current situation by addressing threats and realizing opportunities. These components are:
- Management of Protected Areas, Buffer Zones and Biological Corridors;
- Integrated Conservation Development Programmes
- Environmental Education; and
- Research, Survey and Monitoring.

NCD, in collaboration with partners, will focus its efforts on these components to reach the set targets for each. These four strategic components must be simultaneously put into operation, as only their synergy will create the expected conservation impact.

a) Long-term Objective
- To implement the targets and objectives of the NCD Vision and Strategy.

b) Actions
- Improve all aspects of management of Protected Areas, Buffer Zones and Biological Corridors;
- Develop and implement a common strategy for ICDPs;
- Develop further Environmental Education; and
- Develop standardized biodiversity survey methodologies for all PAs; maintain an information database on species found in Protected Areas, update GIS database and develop working maps for all Protected Areas, conduct studies on priority species and initiate surveys on herpeto-fauna and other lesser known species.

4.1.2 Scientific Research to Improve the Status of Knowledge

4.1.2.1 Building the Scientific Knowledge Base

While substantial progress has been made on initiating research, surveys and monitoring, most potential avenues for both expanding economic benefits from biodiversity and better ensuring its conservation are still constrained by the shortage of basic scientific knowledge about the identity, status, distribution of species and genetic resources in the country. Important information has been obtained since BAP I, but lack of scientific knowledge remains an important limiting factor in Bhutan's conservation efforts.

The status and distribution of habitats, the ecological requirements of various species, and the ecological functioning of ecosystems are largely unknown. Further development of nature tourism is constrained by the lack of field guides and individuals with knowledge of the unique biodiversity within the nation. In spite of significant recent

advances, the management of Protected Areas is constrained by incomplete surveys of species and poor knowledge of species requirements. Marketing of herbal medicines is constrained by incomplete information on the status of wild populations of medicinal plants and information on how to cultivate threatened species. Bioprospecting is constrained by incomplete knowledge of what species are present, inability to assure potential "clients" of the validity of the taxonomic identification of a sample, inability to assure re-collection of a sample, and lack of knowledge of the potential ecological role of particular species. Particularly for a country where the potential to enhance benefits from biodiversity is so great, there is a pressing need for an ambitious programme to build knowledge about its biodiversity.

There are a number of possible models for how Bhutan might further develop its own research programme. Costa Rica provides one such model since it has pioneered successful approaches for building its own biodiversity scientific capacity through the strategic use of foreign expertise. The basic elements of Costa Rica's approach are in the following box:

Ecological Research. The country has more than a dozen ecological research stations run by the Organization of Tropical Studies – a group of U.S. and Costa Rican Universities with an office and staff in Costa Rica. Classes are conducted at these field stations for scientists and policymakers, and scientists conduct research at the field sites. Considerable financial resources have been invested in the development of scientific infrastructure in the country and a number of Costa Rican scientists have received training through this programme.

Biodiversity Inventory. Through the National Biodiversity Institute (INBio), an inventory of the country's biodiversity is now underway. Most of the biological collecting is done by a group of "parataxonomists" – local residents, typically with only a basic education, who have been trained by professional taxonomists to undertake field collecting and basic taxonomic identification. The parataxonomists bring their collections from their field sites to INBio once each month. There, curators identify those species that they know, and set aside others that cannot be identified for study by visiting experts. Samples of all species collected are held at INBio and duplicates are sent to international collections with extensive holdings for the group of species involved. For plants, for example, duplicates are sent to Missouri Botanical Gardens, New York Botanical Gardens, and Kew Gardens.

Taxonomic research. By virtue of the unique collection that Costa Rica is developing, international taxonomists with expertise in specific groups found in Costa Rica are interested in visiting the country and studying the collection. INBio invites these scientists to the country to help their own experts identify and describe new species, and in turn, the experts use the collections for their research. The result is that the visiting experts are assisting Costa Rica build its knowledge of its own biodiversity. Where historically taxonomists collected samples for research at their home institution, INBio turns the tables, bringing taxonomists to the country to study samples where they are also able to help train local experts.

a) Long-term Objectives

- To create an extensive national biodiversity research programme; and
- To build a national scientific capacity for biodiversity research.

b) Actions

- **Invite ecological scientists to the country to undertake specified research in collaboration with local experts**

  Ecological research undertaken within the country is a low-risk and high-yield activity.The RGOB can issue research permits that clearly specify that material cannot be collected and removed from the country. (For any ecological research, "type" specimens of the organisms being studied would have to be collected and examined by taxonomists. The research permit should allow such basic identification, but could also specify that the samples be returned to the country or, more likely, could require that a material transfer agreement be attached to the samples collected which precluded any future commercial use.) Researchers could be required to form teams with Bhutanese experts to ensure that local knowledge and capacity is strengthened through their research and to ensure that any published papers stemming from the research are made available in Bhutan.

  Research like this provides a "free" service in increasing the scientific understanding of the species and ecology in the country. In addition, it begins to provide the core knowledge that can be used eventually to build an ecotourism industry or begin other economic uses of biodiversity.

- **Establish a Natural History Museum**

  The first Natural History Museum for Bhutan would be established during the 9th FiveYear Plan. A Memorandum of Understanding to this effect has already been signed between the Ministry of Agriculture and the Field Museum, Chicago, in January 2002. The Museum will be established through financial support from WWF and technical support from the Field Museum. Besides showcasing country's rich collections on birds, mammals and invertebrates, the Museum would serve as a research centre for students and professionals.

- **Invest in the building up of the National Herbarium**

  A new National Herbarium building complex has already been constructed at the National Biodiversity Centre, Serbithang that will house more than 20,000 plant specimens. In addition to wild flora, it will house samples of domesticated crop specimens, ornamental plants, medicinal plants and other plants of economic significance. The Herbarium is expected to serve for both research and education purposes for all those interested in the flora of Bhutan.

- **Explore the establishment of additional biological collections**

  In addition to the Herbarium, a seed genebank, one of the essential biological collections for any country, is currently being established in the country

- **Encourage several Bhutanese biologists to obtain specialized training in plant and invertebrate taxonomy**

  Bhutan, like any small country, will need to rely extensively on international taxonomists as it builds its knowledge of its biodiversity. However, the value of the

international expertise can be magnified if the country also has its own researchers with advanced training in this field. Additional Bhutanese technical expertise in this field will also contribute to the country's ability to set policies regarding the scientific exchange of information and samples.

- **Encourage international taxonomists to visit Bhutan and help with inventory and collections**
  The biodiversity of Bhutan is of sufficient interest that it is likely that some international taxonomists would be interested in visiting the country to work with the existing collections and undertake field collections even if they are not allowed to remove samples from the country. This could be an intermediate step to Bhutan's entry into the international taxonomic scientific network. As with ecological researchers, these taxonomists could be required to obtain a research permit that explicitly prevents the transport of samples out of the country.

- **Allow exchange of biodiversity samples for non-commercial research purposes only**
  After the successful initiation of the above steps, it should be possible for Bhutan to begin exchange of scientific samples for research purposes. Two legal instruments now minimise the risk associated with such exchanges. For a country like Bhutan with tremendous potential for gain from the wise management and use of its biodiversity, the "cost" to the country of not knowing more about its resources greatly exceeds any cost that might be associated with the illegal use of samples from the country. Moreover, since much of Bhutan's biodiversity can still be found in the surrounding countries, the risk is limited – unscrupulous collectors could be obtaining samples from outside Bhutan.

  All biological material collected after the Biodiversity Convention comes into force and obtained from another country falls under the Convention's terms for ensuring prior informed consent for access to biodiversity and equitable sharing of any benefits derived from that diversity. As long as Bhutan's access legislation requires that collectors provide all information about their intended use of the material collected, then any other use (e.g., for commercial purposes) not agreed to by Bhutan when issuing the permit would be in violation of the Convention. The country could use the dispute resolution procedures provided by the Convention.

  Second, Bhutan can make use of "Material Transfer Agreements" (MTAs) associated with each sample that is sent out of the country for research purposes or for incorporation in collections in other countries. A MTA is a short contract between the "supplier", and "recipient" of biological samples. The agreement in this situation would state that the samples are being provided for basic research purposes only. It would state that if during the course of basic research a commercially valuable property or innovation is discovered, then the researcher would have to enter into a negotiation with the supplier (Bhutan) to determine an equitable sharing of benefits with the country, ownership of patent, etc. The agreement would place stipulations on transfer of material to a third party (typically, it would simply state that the material is subject to an MTA and the terms of the agreement are binding on the third party). In practice, the likelihood of

material being exchanged for taxonomic research ever being used for research of potential commercial value is extremely slim. Even so, the combination of an MTA and the protection provided by the Biodiversity Convention provides strong protection to Bhutan in the event that it is. A model MTA for use in transfer of material for taxonomic research can be found in Putterman (1996).

- **Prepared to allow bioprospecting as soon as the country has built the knowledge base and enforcement capacity**
  When Bhutan initiates and builds its biodiversity knowledge base and scientific capacity it could be in the position to allow commercial bioprospecting in a relatively short time. With adequate capacity to monitor and enforce regulations, and enhance information about its biodiversity, Bhutan would be capable of expanding the potential economic benefits of its biodiversity while facing little risk associated with the transfer of biodiversity. As many other countries in the region are losing their biodiversity, Bhutan should recognize that the value of biodiversity it contains will only increase with time. In taking a cautious approach Bhutan should initially develop the basic policies, infrastructure, human and scientific resources and biological knowledge before embarking on commercial bioprospecting ventures.

4.1.2.2 Research in Protected Areas

One of the main constraints to park management is the lack of knowledge and information on the biodiversity in the Protected Area to make any informed decision. With priority being given to park establishment and infrastructure construction, their staffing needs and the planning and implementation of ICDP, scientific research has not received much attention. As a result the degree to which science is being assimilated in management practices and the pace of progress toward truly scientifically based management has been slow.

a) Long-term Objectives

The Targets for Research as identified in the NCD Vision and Strategy document are as follows:

- To improve data and information bases on biological values, at species, habitat and ecosystem level;
- To improve insight on critical habitats for endangered species and biological hot spots, for setting conservation priorities and zoning regulations; and
- To improve insight in impacts of conservation efforts and ICDP on biological values;

Subjects for future data collection and research that have been identified in the Protected Areas are shown in Table 12.

Table 12. Subjects for Future Data Collection and Research in Protected Areas

Location	Data Collection	Research
Jigme Doji National Park	• Snow leopard survey • Crop damage by wildlife • Study on NTFPs such as mushrooms • Tiger studies • Study on fish population in JDNP • Identification of potential Red Panda Habitat in Gasa • Mapping of areas with Cordyceps	• Determine the seasonal habitat use, movement and demography of blue sheep and takin • Ecological interactions between blue sheep and yak • Impact of yak grazing on alpine meadows
Jigme Singye Wangchuck National Park	• Biodiversity and fauna survey • Pilot ecotourism studies	• Grazing impacts and human-wildlife interaction • Species research on tigers, golden langurs
Thrumshingla National Park	• Establishment of baseline information and mapping of all *tseri* in the park • NTFP survey such as Matshutake mushroom harvests, resin tapping, daphne products. • Baseline information on wetland sites and the flora and fauna in these sites • Data collection on herders and their cattle	• Studies on crop damage by wild animals especially wild pigs • Studies on tiger. • Cattle grazing and cattle migration and birds
Bomdiling Wildlife Sanctuary	• Land use changes based on interpretation of recent and old aerial photographs • Fuelwood survey • Wildlife-human conflict resolution, e.g. for livestock depredation and wild boar crop damage. • Survey on bamboo use and the management of bamboo areas related to community-based natural resource management activities	• Threats to the black-necked cranes and its habitat in BWS • Effect of shifting millet seedling cultivation on biodiversity • Effect of pasture burning on species composition and biodiversity • Effect of forest grazing on regeneration, species composition and biodiversity

Future research topics will be selected based on national and park priority, significance of the research to policy and management decisions, availability of funds and staffing, and collaborative partners. The NCD will provide advice and necessary support to the Protected Areas in conducting research on topics already prioritized by the parks and sanctuaries. Certain requirements would need to be fulfilled so that research can be

conducted unhampered. These include planning and prioritization of research, preparation of research proposals by the interested Protected Area, guaranteed funding and staff, data storage facilities, technical expertise and finally commitment by the Protected Area Manager to incorporate and utilize research results to make management decisions, and to update management plans.

b) Actions

- Develop collaborative approaches to research, surveying and monitoring (joint actions, participatory approaches, action-research, linkages with research centres);
- Co-ordinate research, survey and monitoring activities, establishment of a data bank and information centre and library accessible to outsiders for complete information on biological values and conservation management approaches in Bhutan;
- Prioritize species and habitat in terms of biological and protection significance for effective management, based on complete surveys in the parks;
- Revise and specify protected status of species for Bhutan based on research data;
- Study wild pig conservation and management on a pilot basis for a period of three years; and
- Address other issues of priority: human-wildlife conflicts arising from crop damage and livestock depredation, and research on tiger distribution and habitat.

4.1.2.3 Research on Wild Floristic Diversity

The *Flora of Bhutan* was completed with the publication of the ninth book of the series in January 2002. The completion of the *Flora of Bhutan*, however, does not mark the end of the inventory on Bhutan's floral diversity. It provides the baseline information that serves as a basis for identifying and prioritizing future plan of actions. To complement the already existing information, further research needs to be done on the ecology and phytogeography of the already documented species. Further, the *Flora of Bhutan* does not cover the lower groups of plants such as the Pteridophytes, bryophytes and the lichens, which also need to be researched and documented.

a) Objectives

- To have a complete inventory of the floristic diversity of Bhutan (including ethnobotanical information);
- To co-ordinate and establish linkages with relevant national organizations for plant collection expeditions;
- To identify and complete the information for the plant groups not included in *Flora of Bhutan*; and
- To strengthen the National Herbarium as a reliable reference collection for researchers, conservationist, ecologists, botanist and naturalists.

b) Actions

- Identify and recruit specialized technical assistance for taxonomic assessment of diversity at species level;
- Initiate surveys and collections of Pteridophytes, bryophytes and the lichen flora of Bhutan starting with the survey and collection of ferns and their allies;
- Initiate carpological and wood collections of economically important plant species; and

- Identify critical plant groups and habitats that may require special conservation efforts.

4.1.2.4 Research on Forest Biodiversity

The existing research capacity is very small while the research needs are overwhelming. It will be many years before Bhutan will have a modest level of forest researchers ready to significantly tackle its growing problems. Sometimes, where local research capacity exists, the skill is not utilized. Bhutan cannot afford to waste professional skills. Therefore, there is an urgent need to draw strategies to efficiently and effectively address ever expanding research issues to conserve the forest cover while at the same time contributing to the economic development of the country. (Namgyel, 1997).

a) Long-term Objectives

- To contribute to agricultural and horticultural intensification and diversification, so that household food security, income and employment potential of small farm agriculture is enhanced through sound conservation and development of economically and ecologically sustainable farming practices;
- To contribute to enhanced productive and regenerative capacity of the forest and water resources and, most importantly, of biodiversity; and
- To contribute to the increase in contribution of livestock to the household economy and nutrition of rural and urban populations, and farm productivity with less grazing pressure on forest through improvement of livestock breed, feed and fodder availability and maintenance of good livestock health (Dorji, 1997).

Under three components of the project mandate of the Forestry III Project, a list of forest research, both in forest management and social forestry, were identified as follows:

1 Forest Management/Silviculture

(a) Appropriate silvicultural systems for broadleaf, conifer, tropical and sub-tropical forests;
(b) Stand composition and structure of the major forest types;
(c) Growth and yield studies for the logged over broad-leaved, conifer and plantation forests;
(d) Enrichment planting of inadequately stocked forests with indigenous species;
(e) Habitat management in Protected Areas in the Forest Management Units; and
(f) Watershed management studies in the major forest types.

2 Social Forestry/Agro-forestry

(a) Coppicing and pollarding trails on species commonly used for fodder, fuelwood and mushroom culture;
(b) Appropriate technologies for timber harvesting and wood utilization at the village level;
(c) Socio-economic studies in the community forests;
(d) Perceptions and attitudes of user groups towards forest conservation and sustainable utilization;

(e) Productivity and acceptability of priority agro-forestry species;
(f) Hedgerow planting on non terraced agro-forestry farms using, *Leucaena leucocephala*, *Sesbania reban* and *Daphne*;
(g) Documentation of indigenous agro-forestry systems and technologies; and
(h) Socio-economic assessment of agro-forestry practises in the pilot sites.

3 Reforestation/Afforestation

(a) Comparison of reforestation methods: i) natural regeneration, ii) direct seeding, iii) artificial planting;
(b) Sites-species compatibility using endemic and exotic species;
(c) Biology, ecology and control of serious pests and diseases in reforestation;
(d) Weeding, cleaning and liberation cutting to improve tree growth and increase survival in various reforestation sites;
(e) Establishment of seed orchards for priority reforestation species; and
(f) Pruning and thinning techniques for plantations. (Dorji, 1997)

Due to the regeneration problems in the Silver Fir, operations are recommended to be concentrated in the blue pine and other low-altitude mixed coniferous forest. Broadleaf and fir forests need more adaptive research before harvesting operations are carried out. Some of the above research are already being implemented and are ongoing.

4.1.2.5 Research on Sustainable Use

Use of biodiversity resources make a major contribution to the daily way of life of Bhutan's rural population. This involves plants and animals used for medicine, food, construction, fuel and other uses. There is substantial local or traditional knowledge about the resource species and their use, but there is virtually no scientific information about it. Anecdotal information indicates that the present use, in many cases, is not sustainable, particularly in view of the increasing population and its growing needs. Consequently, substantially more information is needed to provide guidance to assure that local people continue to receive the benefits of use, and that the use is sustainable.

a) Long-term Objective

- To assure that the rural people continue to receive the benefit of biodiversity resources through sustainable use.

b) Short-term Objective

- To conduct surveys and research to obtain information on which to base effective sustained management of biodiversity resources outside Protected Areas.

c) Actions

- Identify the key species and species which are or appear to be in danger of overuse and depletion;
- Collect traditional and local knowledge about species and their uses;
- Conduct scientific research to provide the basis for sustainable management of these resources; and
- Develop management programmes such as public education, etc., to apply the knowledge gained and to achieve sustainable use for the benefit of the people.

4.1.2.6 Biodiversity Surveys and Monitoring

With the new monitoring framework developed by the NCD, all Protected Areas are now in a position to begin planning monitoring activities within their PAs. However, keeping in mind the current priorities of the PAs, their staffing situation, and the very recent adoption of the framework by park staff, it is expected that at least one pilot monitoring plan will be made for monitoring biodiversity values and threats and one pilot plan for an approved ICDP. For this purpose, guidelines will be prepared and provided, in addition to support from the Species Conservation, Research and Monitoring Section of NCD. It is also proposed to involve NCD's partners, sectoral agencies, *Geog* and *Dzonkhag* staff where possible, particularly for monitoring of ICDP.

a) Long-term Objectives

- To use background monitoring for detecting changes and long-term trends in biodiversity and factors affecting it both inside and, if possible, outside of Protected Areas, and use the resultant information to feed back into adaptive management of the biodiversity.
- To use biodiversity values and threats monitoring to detect changes in critical biodiversity values and potential threats, both inside and if possible, outside of PAs, and feed back into adaptive management; and
- To use ICDP monitoring to detect and assess changes in attitudes toward conservation and development, assess success and sustainability of ICDPs, and feed back into adaptive management.

b) Actions

- Implement background biodiversity monitoring;
- Implement monitoring of biodiversity values and potential threats;
- Initiate monitoring of ICDPs, starting with a pilot ICDP;
- Revive and renew the previous 'Protected Areas Survey and Monitoring Techniques' training for park staff from 2002. This will incorporate training for field staff on the new rapid biodiversity survey methodology as well as the new monitoring framework;
- Standardize monitoring techniques for all Protected Areas, these techniques should then be taught to forestry trainees at NRTI and BFI;
- Facilitate detailed surveys of key wildlife species both in and outside Protected Areas. Studies should include current status of populations, distribution, habitat requirements and population trends. Once basic ecological information has been obtained, programmes can be implemented to safeguard and monitor them;
- Identify problems, and if adequate trend data are available, undertake small-scale interventions and manipulative strategies. These may include small-scale restoration projects in degraded and disturbed habitats (*tseri*, landslips, areas impacted by fire etc.);
- Establish monitoring plots in degraded areas and undertake restoration efforts as well as initiate structured monitoring programmes in areas of special concern;
- Use satellite imagery and remote-sensing data, aided by GIS to monitor habitat changes and impacts in Protected Areas. Continue monitoring to identify and follow trends and changes in biological conditions and to check whether the applied forms of management are having the desired effects. If and when they are not, make changes in the management practices; and

- Monitor and regularly report on the overall operations and activities in the park as well as human activity in sensitive areas.

4.1.2.7 Aquatic Resources Survey

a) Long-term Objective
- To formulate suitable national and local fishery management plans laws, regulations and adequate conservation measures.

b) Short-term Objective
- To develop national capabilities in planning and initiating a fishery resources survey covering all climatic zones and river systems of Bhutan.

c) Actions
- Provide training to Bhutanese specialists;
- Initiate and conduct a national fisheries resources survey;
- Establish a national reference collection of aquatic species occurring in Bhutanese waters. However, once completed, it is expected that the survey will produce an inventory of water bodies and living aquatic resources, together with a description of their status;
- Formulate, on the basis of the survey results, fishery and aquatic resources conservation measures, including fishery management plans, necessary laws and regulations; and
- Ensure that rivers are not damaged by pollution and accumulation of hazardous wastes.

4.1.2.8 Databases

Databases are needed to store and to make accessible information on biodiversity and related fields. The need for such databases exists both at national park and broader levels. However, the development, maintenance and management of databases is not possible until qualified database managers are recruited and computers dedicated to housing databases are purchased. Prior to establishment of such databases, work is needed to establish standardized procedures, structures, etc., to assure that the resulting databases will be of maximum use.

a) Actions
- Recruit qualified database managers or provide training to existing staff on data management;
- Dedicate or purchase new computers for databases; and
- Establish standardized procedures, structures, etc., to assure that the resulting databases will be of maximum use.

4.1.3 Improve the Economic Valuation of Biodiversity Resources

a) Long-term Objective
- To assure that Bhutan's biodiversity resources are properly valued, within the context of modern resource or environmental-economics, so that biodiversity resources are accurately valued in national income accounting and in policy considerations and decisions regarding land and other resource uses.

This objective was stressed in the co-operative agreement of Bhutan, the Netherlands, Benin and Costa Rica.

b) Actions

- Initiate a project to develop methodologies for economic valuation of biodiversity resources;
- Apply and test the methodologies initially on a limited basis, and if satisfactory, then apply it on a broader scale; and
- Develop local capacity in economic resource valuation as a part of the project.

4.1.4 Incorporate Biodiversity in Related Strategy and Planning

4.1.4.1 Land Use Planning

a) Actions

- Place greater emphasis on conservation of biodiversity in all aspects of land management;
- Strengthen the policy of retaining 60 percent of the national territory under forest cover;
- Reduce the impacts of potentially destructive practices such as unsustainable logging, grazing, mining, plantation or orchard agriculture, and the construction of roads and hydropower projects. In order to do this, land-use planning exercises should take place at the water catchment level since each catchment has its own needs for water, farmland, fuel, grazing land, industries and its own requirements for hydrological protection; and
- Back up completed, comprehensive land-use plans with enforceable sanctions and adequate legal authority. To this effect the Forest and Nature Conservation Act of 1995, Forest and Nature Conservation Rules of 2000 and the Environment Assessment Act of 2000 provide legal backing to address any aspect of environmental degradation and biodiversity loss in the country.

4.1.4.2. Forest Management

a) Long-term Objectives:

- To conserve and manage forests on a sustainable basis;
- To harvest forest resources within the prescription of scientific management and to generate foreign exchange through export of forest products,
- To ensure ecological stability by maintaining at least 60 percent of the total land area under forest at all times; and
- Rehabilitating and restoring degraded ecosystems and promoting the recovery of threatened species, inter alia, through the implementation of plans or other management strategies.

b) Immediate Objective

- To formulate and implement Scientific Management Plans for all areas.

c) Actions

- Maintain Protected Areas in each ecozone in order to conserve the unique bio-diversity and ecosystems of the kingdom in their natural state. The uses of these

areas will include research, recreation, and appropriate local uses. The principles of selection and development of these areas will include considerations of value for alternative uses and population pressure in the area;
- Develop strict implementation processes for the Territorial Divisions to ensure meeting conservation objectives;
- Manage forest areas in a way that soil losses and erosion are avoided and land capability is maintained. Forest management systems will be developed and practiced, which will improve water quality and maintain proper water balances, allowing optimum stream flow during the monsoon as well as in the dry season, maintain good water quality and mitigate floods;
- Define special management to protect critical watersheds from irreversible changes in their flora, fauna, and ecology. Management rules will focus on avoiding harmful effects to the people and systems downstream; and
- Apply the principles regarding the maintenance of biodiversity to production forestry. This includes avoiding any drastic alteration in the composition of tree species in extensive areas. Special care should be applied in the introduction of exotic species.

4.1.4.3 Harvesting of Forest Resources

a) Long-term objective

- To ensure sustainable use of the forest resource through identifying important components of biodiversity and monitoring activities that pose threats to biodiversity.

b) Actions

- Put suitable forest areas, excluding Protected Areas, under sustainable management as production forests. Sustainability in production forests means that the annual harvest and other loss of timber does not exceed the average annual long term growth for the total area under each forest management plan, and that soil fertility does not decrease;
- Harvest all forest products in such a way that unnecessary losses are avoided and the productivity of the forest is maintained;
- Harvest forest resources through construction of roads and logging in a way that minimizes land and forest degradation;
- Implement management plans efficiently by developing economically and eco logically sound silviculture and harvesting systems; and
- Price wood for full appreciation of the forest resource. The royalties and prices should reflect the true value of the wood.

Because of labour shortages within the country, the FDC has mechanized almost all its activities, and sawmills are already engaging labourers with minimal skills. In the near future, the FDC will be awarding logging and road construction activities to only those contractors who have undergone training and will also be processing certificates, especially for chain saw operators and cable crane crews. With this, the FDC will be in a position to take care of the negative environmental impacts caused by logging.

4.1.4.4 Community Forestry

a) Long-term Objectives

- Protection: To Maintain or improve the biodiversity and ecological functions of forest land;

- Production: To Maintain or improve the sustainable supply of forest products and services in order to enhance the self-sufficiency and improve the economy and living standard of local people; and
- Social Equity: Maintain or improve communal institutions that can sustainably manage forestlands and ensure equitable decision-making, implementation, and distribution of forest benefits by and for its members.

b) Actions

- Transfer the primary responsibility for management (protection, development, and utilization) of forests adjacent to communities to local management groups;
- Strengthen the institutional and technical capacity of forest management groups to sustainably manage and equitably share the benefits from the forests handed over to them; and
- Assist forest management groups in the development of appropriate forest-based home and cottage industries and provide marketing assistance. (SFES, 1996)

4.1.4.5 Industrial Utilisation of Forest Products

a) Long-term Objective

- To have ecologically sound and economically viable forest-based industries that do not deplete Bhutan's forest cover, ecological balance and biodiversity heritage.

b) Actions

- Create a favourable environment for development of forest industries for domestic and export markets consistent with maintenance of the nation's conservation objectives. This support will include institutional development, analysis and exploitation of market opportunities, socio-economic planning, physical infrastructure, and contributions to training, research and development, and financing;
- Encourage an environmentally sustainable and economically viable forest-based industry, based on an analysis of present and future raw material availability, and the demand and supply of wood based energy;
- Undertake proper forest inventories, and Environmental Impact Assessments so that new forest-based industries can be established based on guarantees of the sustained availability of raw materials; and
- Encourage appropriate home and cottage industries and further processing of primary products that will add value to the basic forest products, support the economy of the local communities and improve the standard of living of people particularly in rural areas.

4.1.4.6 Ecotourism

a) Long-term Objective

- To assure that development of ecotourism is based on the principles of sustainability, ecological soundness, and cultural acceptability.

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b) Actions

- Monitor the impact of trekking (and other) visitors to the Protected Area;
- Work closely with the Department of Tourism to determine interim appropriate numbers and monitor the number of visitors accordingly;

- Plan effective management of trekking groups;
- Conduct workshops for tour operators and guides to make them aware of park regulations, negative impacts associated with tourism, and enlist their cooperation to alleviate and minimize the impacts;
- Assess the impact of tourism on the different habitats and wildlife, as well as on local communities; and
- Develop strategies that ensure the local communities become involved in and benefit from tourism (see also Chapter 5).

4.1.5 Strengthen Integration of Biodiversity Considerations in Other Sectors and at Local Levels

Natural biodiversity cannot be conserved and maintained only at one level. National parks and Protected Areas will ultimately become mere isolated relics if they are left as islands in a sea of manmade ecosystems. To truly conserve a country's natural heritage, biodiversity conservation must function at a variety of scales and it must be integrated within the programmes of all sectors.

The primary role for biodiversity conservation at the regional level will be Dzongkhag Integrated Resource Management and Land Use Plans that integrate goals and objectives between sectors. Such plans will usually be developed through multi-party planning processes involving government, private industry and the public, resulting in land use zoning between sectors with the assignment of either management responsibility (government) or tenure (private).

Common land use designations, in addition to parks and Protected Areas, which may be created both nationally and locally, include critical (degraded) areas requiring priority attention, agriculture, forestry and native grazing, urban and industrial areas, watershed protection areas, and special conservation management areas that include Protected Areas, Buffer Zones and regional Biodiversity Corridors.
The regional landscape that emerges from such planning will be a combination of four broad land use types: core Protected Areas; "light touch management" Buffer Zones; Biological Corridors linking Protected Areas both horizontally and vertically; and land devoted to intensive human use.

Integrated resources and land use planning holds the promise of rationalizing land allocation by linking it to real land capability, of slowing the processes of land and forest degradation, and of conserving Bhutan's biodiversity.

a) Actions

- Continue to seek the active co-operation and involvement of the *Dzongkhags* in preparing and implementing Integrated Resource Management and Land Use Plans; and
- Accelerate development and implementation of the Programme on Integrated Resource Management and Land Use Plans, and assure that biodiversity conservation concerns are central to the process.

4.1.6 Strengthen the Institutional Framework Relating to Biodiversity

4.1.6.1 Strengthen Institutional Development and Co-ordination Mechanism at the National Level

As biodiversity is cross sectorial and managed by different institutions and organizations, coordination mechanisms need to be developed to establish an integrated national system for biological conservation and sustainable use in Bhutan. The, NBC, thus needs to develop and propose systems that not only address institutional aspects but also take into consideration the integration of conservation activities with development aspects that would be both economically and environmentally sustainable

a) Objectives

- To fulfil the mandate and responsibilities of the NBC to co-ordinate and facilitate various sectoral based biodiversity programmes;
- To establish an integrated national system for biological conservation and sustainable use in Bhutan; and
- To ensure the effective implementation of the BAP.

b) Actions

- Identify suitable technical assistance for establishing institutional development and linkage mechanism for national biodiversity programmes;
- Facilitate consultative forums such as national workshops to harmonize the roles and responsibilities of the different sectors involved with biodiversity conservation and management; and
- Strengthen the role of the Biodiversity Management Board as a nation-wide decision-making body on biodiversity issues.

4.1.6.2 Improve the Staff Capacity

The central importance of training in achieving sustainable improvements in biological resources conservation and use is widely accepted. At a time when financial support to many programmes is threatened, funding for training has become particularly tenuous. The dearth of well-trained personnel is evident at virtually all levels and in all scientific and technical specialities in Bhutan. Moreover, training and education programmes, which combine technical training with exposure to other needed disciplines, including management, policy and legal fields, associated with biodiversity, appear not to exist very often.

Considering the importance of the biodiversity to Bhutan, the fact that more than a quarter of the nation is in Protected Areas, and the needs for effective conservation and sustainable use of biodiversity outside of these areas, the total size of the staff which is needed is vastly larger than what is presently available.

This also impedes progress in the establishment of adequate Protected Areas and implementation of scientific management of those Protected Areas that have already been formally designated.

a) Long-term Objective

- To obtain adequate trained staff to effectively develop and manage Bhutan's programmes for conservation and sustainable use.

b) Immediate Objective

- To ensure that sufficient numbers of appropriately trained personnel at all levels are available to support the biodiversity activities as well as reduce dependence on long-term expatriate technical assistance personnel.

c) Actions

- Evaluate internally the existing and required biodiversity related manpower within each division keeping in mind the mandates and responsibilities of each section;
- Place new staff according to the existing manpower constraints in each division as well as the programmes and activities outlined in the 9th Five Year Plan;
- Recruit appropriately trained manpower and ensure the proper placement of al trainees upon completion of training to maximize the utilization of skills and knowledge acquired;
- Identify training needs and appropriate candidates for implementation of various programmes and activities;
- Identify the priority needs and seek additional funding for the acquisition, training and recurrent costs of that staff;
- Recognize the key role of human resources development, place emphasis on formal, vocational, and on-the-job training as well as management of human resources;
- Develop a realistic long-term vision of the staff, which will really be required to effectively develop and manage Bhutan's programmes for conservation and sustainable use of its biodiversity resources; and
- Phase the intake of new recruits, making sure that Protected Area manpower requirements are completed, at the latest, by the fifth year of implementation of the management plan. This will enable substantial progress as well as allow the target outputs to be met.

4.1.7 Assure that Biodiversity Conservation Brings Benefits to Local People

4.1.7.1 Multiple Use of Forest Resources

a) Long-term Objective

- Monitor and control multiple uses of the forests including production of fodder, firewood and non-wood forest products as well as, livestock grazing. This is in order to maximize their contribution to local economies, to meet the basic needs of the people in a sustainable way and at the same time to minimize the harmful effects due to indiscriminate use.

b) Immediate objective

- To promote social and community forestry through extension programmes

c) Actions

- Develop proper agro-forestry and agro-silvo-pastoral techniques in order to increase output and decrease the harmful effects of present farming practices, and in particular, to promote alternatives to shifting cultivation;
- Encourage the use of traditional knowledge in the use of herbal plants and other non-wood forest products and strengthen this by proper research, development and an integrated approach;
- Improve access to forest products for all Bhutanese people by creating distribution, marketing and proper monitoring systems;
- Encourage the users of forests to participate in the development and management of their local forests;
- Review the existing forestry rules and develop favourable conditions for forestry on private registered land; and
- Encourage the forest extension service and improve local forest management. It is important to make certain that the villagers know the rules and regulations as well as options available to them.

4.1.7.2 Human-Wildlife Conflicts

Livestock depredation and crop damage by wildlife are two areas of concern that are now emerging as the main issues/problems encountered by the local communities throughout Bhutan.

Crop damage by wild animals ranked as one of the biggest problems faced by most rural communities, and this mostly concerns species that are not on the protected species list, such as wild boar, barking deer, monkeys (especially macaques), porcupine, sambar, bear and rats. While there are a number of reports indicating the level of crop damage to be invariably high, the severity still needs to be ascertained through proper scientific research. Measures taken by farmers to protect their crops against damage by wildlife have been insufficient in addressing the problem. In view of the social and economic losses faced by farmers due to crop damage by wild pigs, a Task Force has been created at the MOA that will provide guidance on the development of a wild pig programme that is proposed to be initiated on a pilot basis. The proposal has been submitted to the BTF for funding.

Another problem that seems to be on the rise is livestock depredation by wild animals such as tiger, leopard, wild dog, bear and snow leopard. All except the wild dog are protected species in Bhutan. No national policy on compensation exists, but in specific cases compensation is awarded to farmers, which is minimal. In some cases there have been reports of retaliatory killing of predators by livestock owners. This poses a big threat to species like the tigers that may be breeding in marginal habitats, and are forced to depend on livestock where natural prey is limited or it is difficult to hunt. Such conditions have been attributed to the killing of livestock in Bumthang in 1997 (McDougal and Tshering, 1998).

NCD with financial support of WWF Bhutan Programme has started a scheme to reward a small amount of money for reporting kills made by tiger and other predators. Reports received from Territorial Divisions and parks are being compiled at NCD. Other socio-economic information from the Protected Area surveys are also being reviewed.

Once reports from all *Dzongkhags* are received, a report will be prepared and presented to the DFS.

a) Long-term Objective

- To reduce and, where possible, eliminate crop damage and livestock depredation by wild animals to benefit the local people and assure the long-term conservation of biodiversity.

b) Intermediate Objective

- To obtain accurate information on the nature and extent of losses and develop measures to deal with the problems.

c) Actions

- Develop the MOA Task Force further to provide information and guidance on the wild pig problem and to propose a pilot control project;
- Implement a project on wild pig management and conservation, at selected pilot sites, so that lessons learned can be used to develop a national programme to deal with pest species: and
- Continue to collect data on livestock depredation from all *Dzongkhags,* and develop a report with specific recommendations to cope with such problems in the future.

4.1.8 Strengthen Biodiversity in Education and Awareness

4.1.8.1 Biodiversity Conservation in Formal and Non-formal Education

Formal Education – Grade I to X:

Special environmental education programmes are now in place in both the formal and non-formal curricula. In the formal curricula, environmental issues are addressed from grade I to X. Effort is being made to incorporate environmental education in many of the taught subjects like Social Studies, General Science, Biology, Geography and Economics. In addition to classroom teaching, outdoor activities like nature clubs and environmental tours are also being encouraged. There is a lot of scope for expanding and improving the programmes.

Non-formal Education

In the non-formal curricula, environmental education forms one of the main contents. Since Non-formal Education (NFE) programmes deal mainly with adults in the rural areas, advocacy and promotion of environmental education could be channelled effectively. The Education Department is in the process of developing post-literacy materials in all aspects of life skills. This would provide ample opportunity to disseminate information on biodiversity.

Institutions and Colleges

In the educational institutions such as the National Institute of Education at Paro, National Institute of Education in Samtse, Sherubtse College in Kanglung, Royal Technical Institute and Royal Bhutan Polytechnic in Rinchending, environmental education is incorporated as an optional or co-curricula subject. In recent developments, steps are being taken to offer a degree in environmental education in

Sherubtse College and further strengthen environmental education courses in other educational institutions.

Natural History Museum
The establishment of the country's first Natural History Museum will serve as an important educational centre for educating the general public as well as for tourists on the country's rich biodiversity, especially the wild faunal diversity in addition to its research functions.

a) Actions
- Review periodically the effectiveness of the existing environmental education programmes from the perspective of biodiversity conservation both in formal and non-formal education;
- Work closely with the Education Department and concerned educational Institutions on developing teaching/learning material at all levels particularly on biodiversity conservation;
- Train teacher educators and school teachers, both in the country and abroad, on biodiversity;
- Organize study tours to educational centres (in-country: forest research, national parks, nature study centres) for teachers/educators and students;
- Work with NGOs especially the RSPN and WWF Bhutan Programme to find and develop new teaching materials for all levels; and
- Establish Natural History Museum during the 9th Five Year Plan.

4.1.8.2 Promoting Public Awareness of the Value of Biodiversity Conservation and Use

Public awareness is the key to mobilizing popular opinion and to generating and sustaining appropriate action within the country and internationally. This is true both for the general public and for the people who live in and near Protected Areas and other areas critical to biodiversity conservation. The capacity to communicate the impact of biodiversity activities to key target audiences is critical to the success of any biodiversity programme. A targeted public awareness programme can promote the development of institutional linkages and collaborative mechanisms such as networks. Within the country, public awareness can facilitate efforts to involve communities and local and non-governmental organizations, thus ensuring a broader base for conservation.

a) Actions
- Strive to integrate fully public awareness in all national, regional and local levels through support mechanisms for co-ordinated public awareness activities at all levels;
- Recognize in national policies and planning the role that public awareness can play in establishing a firm basis for sustainable biodiversity conservation and use. Public awareness should be considered in the development of all national biodiversity conservation activities. National strategies should identify objectives and strategies for public awareness, defining target audiences, partners and tools for public outreach.
- Recognize and encourage the work of RSPN and other NGOs in raising public

awareness. Adequate consideration should be given to production of public awareness materials in appropriate languages to facilitate broad use within Bhutan and other countries;

- Develop an appropriate focal point for public awareness of biodiversity conservation. Biodiversity workers, however, should develop the capacity to articulate the importance of the conservation goals and activities in the broader context of sustainable agriculture and development. They should be able to communicate this to all stakeholders using tools provided by public awareness specialists. RGOB could consider enlisting the help of well-known and influential people to increase access to the media and attract added attention; and
- Draw on public awareness tools and technologies generated at the regional and international level. These tools – and the messages they convey – may have to be adapted to reflect national priorities and circumstances. However, it is likely that many of the regional and global messages will prove useful in supporting national public awareness strategies and activities. This will substantially reduce local costs. Awareness of the value of biodiversity, and of the role of scientists, farmers and communities in maintaining and improving them, should be promoted in schools at all levels, as well as in specialized agricultural research institutions and training centres such as RNRRCs, NRTI, BFI, etc.

4.1.9 Encourage and Augment International Co-operation in Biodiversity

4.1.9.1 Technical and Policy Exchange with Costa Rica

There are striking parallels between the biodiversity situations in Costa Rica and Bhutan. The two countries are almost identical in size, and while Costa Rica, with its largely tropical ecosystems, may have nearly twice the biological diversity of Bhutan, they are both extraordinarily species-rich for their regions. Both countries have great hydropower potential. Both have designated more than 20 percent of their area for biodiversity protection, and both have leaders who see that the most promising long-term approach to development is through the maintenance of their forests and biodiversity, not their conversion.

Costa Rica has far more technical and management capacity related to biodiversity, because of its longer history of research in this field. Consequently, Bhutanese officials and private sector representatives could benefit immensely from a study trip to Costa Rica to observe their Protected Area system, the Organization for Tropical Studies, the National Biodiversity Institute (INBio), their approach to bioprospecting, and their tourism industry. The organization, objectives and procedures of INBio, in particular, would be of significant assistance to Bhutan in the development of its own biological research capabilities. The same is true of bioprospecting, both to learn of Costa Rica's experiences and to explore further collaboration. Many of Costa Rica's current activities could not be transferred directly due to the unique conditions and circumstances in Bhutan. Nevertheless, Costa Rica would provide an opportunity for Bhutanese experts and policymakers to see one potential vision of how they might develop their biodiversity.

The exchange could involve individuals from the DFS, NCD, NBC, NEC, DOT and possibly the Power Sector. The NEC has a list of contacts who are working on projects

in Costa Rica (REID, 1995). Such a visit would require additional funding, but it might be carried out within the existing co-operative programme between the Netherlands, Costa Rica and Bhutan.

a) Action
Plan and obtain the necessary funding to carry out the exchange.

4.1.9.2 Debt for Nature Swaps

Debt for Nature Swaps are an innovative mechanism for financing biodiversity conservation. In these arrangements a donor will either pay off or cancel Bhutan's debt in order to preserve biodiversity and the natural environment. The Gedu Wood Manufacturing Company provides an example of such an arrangement in Bhutan. Although a feasibility study conducted in the 1980s deemed that company to be both economically viable and environmentally sound, the factory proved to be unsustainable. As a result, the RGOB refused to allow it to expand its logging operations and closed the company in December 1995. The Royal Government of Netherlands in a Debt for Nature Swap provided Bhutan with assistance so that the kingdom could pay off a loan to the Kuwait Fund for Economic Development in order to close down the logging operations.

a) Action
- Explore actively other possibilities for Debt for Nature Swaps with Bhutan's present and potential donors.

4.1.9.3 Pursue Active Follow-up of BAP II with the Donor Community

Bhutan already has a number of donors who contribute actively to the country's environmental programmes and projects. Biodiversity is a high priority for many donors. This BAP II provides a co-ordinated, integrated framework, which identifies a number of priority areas for action, some of which are not funded within the present RGOB plans. When it is approved, the BAP II can be used as a basis for additional discussions with donors interested in biodiversity.

a) Action
- Pursue support for the priority unfunded actions in the BAP II with existing donors, and investigate the possibilities of additional donors who would be interested in biodiversity.

4.1.10 Strengthen and Support Family Planning and other Population Planning Activities

In 2001 the population estimated by the RGOB was 698,950 although the UN places the total figure higher with 1.67 million estimated five years earlier by the UN (UNFPA, 1996). It is very young with 42.1 percent of the total in the age group below fifteen (CSO 2001). The majority (79 percent) of the population live in rural areas although the proportion of the urban population is increasing very rapidly. The key objective of the 8th Five Year Plan for the Health Sector was to reduce the population growth rate to about 2 percent. The intensification undertaken in the promotion of reproductive health in the last six years resulted in the decline of population growth rate from 3.1 percent in 1994 to 2.5 percent in 2000 (National Health Survey Report, 2000:9). The continuation of the trend could well result in the achievement of the goal.

This population growth will significantly change the population-resource ratio. Since most land suitable for agricultural production is already under cultivation, bringing new agricultural land into cultivation cannot modify the population-resource ratio. These population pressures can be expected to give rise to environmental pressures that could undermine the viability of the integrated farming systems and have serious impacts on the nation's biodiversity. The accessible forest areas are already intensively exploited and in some areas, extraction rates for fuelwood and timber are approaching unsustainable levels. As agricultural land holdings become smaller and more fragmented, farming will inevitably extend to marginal land and steeper slopes, with heightened risks of erosion and accelerated land degradation. Growing livestock herds will add to the pressures on forest and to the risks of soil erosion. The progressive removal of vegetation cover, especially in critical watershed areas, is already beginning to affect the hydrological balance, leading to the localized drying up of perennial streams and flash flooding.

The RGOB recognized the threats inherent in a continued high rate of population increase and in the 8th Five Year Plan (starting in 1997), it made an unequivocal commitment to reducing the rate of population growth to 2.56 percent by the end of the Plan period. His Majesty King Jigme Singye Wangchuck issued a Royal Message in 1995 urging the population to adopt family planning as a means for safeguarding the very future of the nation. Population growth is the engine, which drives most of the more serious threats to Bhutan's biodiversity. Consequently, reducing that growth must be a central and underlying requirement for achieving biodiversity conservation in the Kingdom.

a) Actions

- Incorporate considerations of population growth and movement in biodiversity planning; and
- Provide all possible support to the RGOB programmes on family planning.

4.2 Domestic Biodiversity

4.2.1 Research and Information

4.2.1.1 Constructing a Comprehensive Information System for Crop Genetic Resources

Many of the Bhutan's biological resources are insufficiently and/or poorly documented relative to what should be known about them for optimal conservation, access and use. Documentation of wild relatives of crops and on-farm genetic resources located in situ is particularly poor. Derived information on where materials have been distributed, pertinent ethno-botanical information, farmer and indigenous knowledge have not been maintained on material conserved in the herbarium and the seed stores. This situation is exacerbated due to the fact that at the national and institutional levels, data management and documentation activities are given an inappropriately low priority in the allocation of funding. There is no standard procedure and systematic data-recording format corroborated by the agencies and institutes concerned with bio diversity issues. In the proper format, data can be used not only to assist

conservation efforts, but also to "add value" to plant genetic resources for food and agriculture.

With the financial support of the WWF Bhutan Programme, the NBC along with various partners involved in biodiversity conservation and sustainable use have developed a 5 year project proposal to integrate the nation's biodiversity related information, including PGRFA information, into one web-based system called the Bhutan Integrated Biodiversity Information System (BIBIS). The project proposal has been submitted to the government in January 2002 for the possibilities of securing funds (for more on BIBS see Section 2.8).

a) Action

- The RGOB should approve BIBIS and provide or seek appropriate funding, including actively seeking donors as necessary, so that BIBIS can be established as quickly as possible.

4.2.2 Utilization of Plant Genetic Resources

4.2.2.1 Expanding the Characterization, Evaluation and Number of Core Collections to Facilitate Use

Genebank collections should enable users to respond to new challenges and opportunities. Typically, most genebank accessions have not been well characterized and evaluated, a situation that leads to the under-use of collections and failure to realise their full value, resulting in high conservation costs in relation to derived benefits. Consequently, a joint programme on characterization and evaluation of germplasm by RNRRCs and NBC is being carried out.

Farmers, plant breeders and most other users are interested in having a manageable number of genotypes that possess or are likely to possess the traits needed for the crop development programme. Identification of those traits through characterization, and the establishment of core collections (a subset selected to contain the maximum available variation in a small number of accessions), are measures that can encourage greater and more efficient use of collections. Evaluation can also aid identification of germplasm potential for more direct use by farmers.

In addition, characterization and evaluation of data as well as the wise use of core collections are important in the overall efficient and effective management of collections.

One staff member has already received training on characterization of field crops for seven weeks from the University of Birmingham, U.K., and another staff member has received training on characterization and evaluation of tropical fruit trees for two weeks from the Indian Institute of Horticulture Research, Bangalore.

a) Long-term Objectives

- To increase and improve the ease of use of conserved plant genetic resources. To facilitate innovative progress in plant breeding through promoting the identification of useful accessions or their component genes for introduction into

genetic enhancement and plant breeding programmes. To promote plant breeding that results in higher levels of genetic diversity in crops and agricultural systems. To identify germplasm of potential value for direct use by farmers in on-farm programmes.

- To promote the co-ordination of conservation, exploration and improvement activities by targeting collecting expeditions, optimizing sampling strategies, optimizing regeneration methodologies, identifying gaps in collections, rationalizing collections, establishing priorities for conservation, forming core collections, and quantifying the relative effectiveness of ex situ and in situ conservation.

b) Intermediate Objectives

- To give high priority to the development of crop specific characterization and evaluation programmes to identify accessions and genes that counter those biotic and abiotic stresses which are limiting production of those crops.
- To improve the efficiency of the evaluation process by developing and adapting new technologies for reliably identifying valuable accessions and detecting valuable genes that have been identified as valuable.
- To establish international core collections for crops of global importance and promote establishment of genebank-based core collections for key national crop collections in national facilities. To promote, improve and test methodologies and technologies for important core collections.

c) Actions

Policy Strategy

The RGOB with the cooperation of the relevant UN bodies and regional, intergovernmental and non-governmental organizations, international agricultural research centres, including the private sector, and taking into consideration views of the scientific community and farmers' organizations and their communities should:

- Define priorities and periodically assess progress in evaluation in relation to the different needs of the various users of plant genetic resources in the arable agriculture system, with emphasis on identifying traits that counter limits to production in staple crops and of crops of national economic importance;
- Promote collaboration and complementarity between breeders, researchers, farmers and genebanks;
- Encourage exchange of characterization and evaluation information;
- Note that access to plant genetic resources in the arable agriculture system is subject to international agreements. In compliance with such agreements, user of plant genetic resources in the arable agriculture system should be encouraged to agree to provisions for sharing relevant evaluation data with source institutes, giving also due regard to the special need of commercial users for appropriate confidentiality;
- Give appropriate financial support for characterization and evaluation programmes for crop species of primary or exclusive importance to food security in their countries, given the importance of medium and long- term financing; and

- Crop networks and genebanks should proceed carefully to develop core collections of crops of major interest to the national system. While core collections provide guidance on the constitution of genebank collections, they do not replace them. Genebanks should not use core collections as an excuse for allowing conservation conditions for other accessions in the collection to deteriorate.

Capacity Development

- Support should be given to begin a step-by-step, targeted characterization and evaluation programme for selected priority germplasm. The characterization and evaluation process would begin with an assessment of current information and an effort to assemble, collate, computerize, and make available existing information contained in notes, reports, punched cards, etc. Much evaluation work needs to be done in a use-oriented, site-specific manner.
- The RGOB and appropriate organizations should identify institutions and individuals who may have the capacity and expertise to carry out germplasm characterization and evaluation for specific stresses and should develop a national portfolio of such expertise, including farmers in high-stress areas who may perform preliminary evaluation to identify subsets of accessions that hold promise for further evaluation under more stringent scientific conditions. The cost efficiency of sub-contracting evaluation work should also be investigated as well as cooperation between national programmes and the private sector.
- National programme staff should receive training in germplasm characterization and evaluation techniques on a crop-specific basis. Such training should begin with crops deemed important nationally, and for which there are current or planned breeding programmes.
- Support training of farmers, including women farmers, participating in on-farm evaluation programmes in the necessary relevant skills. As their responsibilities often extend from the propagation, production and harvesting of crops to the processing, storage and preparation of foods, women's knowledge of the uses and usefulness of plants is often extensive.
- Give appropriate technical and financial support for multiplication of core collection germplasm.

Research and Technology

Various kinds of research must be undertaken if the cost-effective use of collections is to be encouraged. This could include access to the latest technology and support for scientific research to improve characterization and evaluation techniques.

Research priorities relating to core collections include developing:

- Improved methods of germplasm characterization using, inter alia, biochemical and molecular biological methods;
- Improved diversity stratification procedures;
- Methods for validating core collection selections;
- Methods for linking core collection to the main collection (sampling strategies);
- Improved methods of using plant genetic resources in the arable agriculture system, including targeted trait detection; and
- National symposia of germplasm experts to discuss the many technical issues involved in developing and using core collections and to stimulate activity in this area and complementarity with other aspects of the BAP.

Co-ordination and Administration

- Characterization and evaluation efforts should be planned and implemented with the active participation of a central national programme, and local, crop-specific and regional networks. As appropriate, farmers' organizations, private companies and their associations, and others might also be involved.
- Core collections should be developed with the active participation of breeders and crop networks for major crops. Work on core collections must be considered within and integrated firmly in the context of the entire effort to improve utilization.
- Co-operation and exchange of information are needed, especially by genebanks that manage collections of wide species diversity without corresponding specialization among staff for all species; and
- There should be periodic assessments of the use of core collections to guide future work and assist in setting priorities. Such assessments should be made in conjunction with crop researchers, farmers, and seed supply system (DSC) and in consultation with appropriate international agencies, institutions, and NGOs.

4.2.2.2 Increasing Genetic Enhancement and Base-Broadening Efforts

Broadening the genetic base of crops can contribute to increasing stability and performance in crops. However, from the perspective of any individual breeder, company or institute, the costs of incorporating new and diverse germplasm into already adapted material may outweigh the benefits they could realise. Such benefits are often realised only in the long-term and accrue to society in general as well as to other plant breeders. Due to the nature of many genetic enhancement and general pre-breeding activities, international collaboration and public support are warranted.

Approaches to genetic enhancement include:

(a) Introgression of useful agronomic traits identified through characterization or evaluation into locally adapted or elite material for further use in breeding programmes; and

(b) Base broadening of breeders' material through incorporation of wide genetic diversity.

a) Long-term Objectives

- To increase food security and improve farmers' livelihoods through the development of better plant varieties;
- To increase the utilization of genetic resources and thereby provide incentives for their conservation. To reduce genetic uniformity in crop varieties through the utilization of wild relatives, local materials and/or modern varieties; and
- To increase sustainability of agricultural systems and the capacity for adaptation to unexpected environmental changes.

b) Intermediate Objective

- To increase the genetic diversity available in breeders' populations through appropriate strategies of introgression (base broadening).

c) Actions

Policy Strategy

- The RGOB, private sector, community-based groups, non-government organizations and funding sources should recognize the importance of providing long-term funding and logistical support to pre-breeding, genetic enhancement and base-broadening activities.

Capacity Development

- Support should be given to national agricultural systems, networks, non-government organizations, training institutes and other relevant organizations to carry out pre-breeding and genetic enhancement projects. Priority should be given to addressing problems identified by the farmers, other competent scientific bodies and institutions, and farmers' organizations.

Research and Technology

- Crop development and improvement institutions should further develop methodologies for genetic enhancement including pre-breeding, and broadly disseminate these methodologies.

Co-ordination and Administration

- Activities should be planned and undertaken in close collaboration with national programmes with the collaboration of crop and regional networks, other scientific bodies and institutions, and farmers' organizations. Close communication with plant breeders and other scientists in both the public and private sector should be encouraged.

4.2.2.3 Promoting Sustainable Agriculture through Diversification of Crop Production and Broader Diversity in Crops

Many major crops are impressively uniform genetically and impressively vulnerable. Uniformity does not equate with nor necessarily lead to vulnerability. And the lack of perfect assessment and forecasting tools and methodologies means that the degree of vulnerability cannot be precisely identified. Nevertheless, it is important to monitor this situation in order to take remedial or precautionary actions when warranted.

The future agricultural systems will need to incorporate a broader range of crops including crops that produce raw material or are sources of energy. As a precaution, some actions are warranted now to encourage and facilitate the use of more diversity in breeding programmes and in the varieties and species used on farms. Innovative approaches in plant breeding for the purposes of domesticating new crops, the development of new plant varieties and the promotion of higher levels of genetic diversity in crops and on farms, such as planting mixtures of adapted varieties, are recognized as means for adding stability in agricultural systems and promoting agricultural production and food security.

a) Long-term Objective

- To promote sustainable agriculture and reduce genetic erosion and possible genetic vulnerability by diversifying crop production and increasing genetic diversity in crops.

b) Intermediate Objectives

- To review periodically genetic vulnerability in crops and encourage breeders and appropriate groups to take mitigating action nationally and locally, as appropriate; and
- To promote the goal of higher levels of genetic diversity consistent with productivity increase and agronomic needs, including in crop production, plant breeding and biotechnological research and development settings.

c) Actions

The RGOB and relevant organizations in co-operation with crop networks, research institutions, extension agencies, the private sector, farmers' organizations and NGOs, should:

- Monitor regularly genetic uniformity and assess vulnerability in crops;
- Review policies that may affect the level of diversity in agricultural systems, and specifically the degree of genetic uniformity and vulnerability of major crops;
- Increase heterogeneity by planting mixtures of adapted varieties and species as appropriate; and
- Funding agencies should be encouraged to continue to provide support to national agricultural research systems, and other relevant research bodies and NGOs for work aimed at enhancing levels of genetic diversity in agricultural systems. The release by the international centres of unfinished varieties to national research stations for further development, including on-farm improvement, and in accordance with an appropriate strategy, is one measure, which could bring higher levels of diversity, adaptation and stability to crops.

  The selection of high-yielding landraces/farmers' varieties is another measure.

Capacity Development

The RGOB and its national agricultural research system, supported by the International Agricultural Research Centres, and other research and extension organizations should:

- Increase their capacity to develop and use multi-lines, mixtures and synthetic varieties, as appropriate;
- Increase their capacity to use integrated pest management strategies, including the use of race-non-specific (or horizontal) resistance's, the pyramiding of race-specific resistance's, and the strategic deployment of resistance genes;
- Facilitate the strategic use of a range of varieties;
- Explore and, in appropriate circumstances, make use of decentralized and "participatory" plant breeding strategies to develop plant varieties specifically adapted to local environments; and
- Make use of modern biotechnological techniques, as feasible, to facilitate broadening of the genetic base of crops.

Research and Technology

- Support efforts to identify those activities used in plant breeding, plant research and farming systems that foster on-farm diversity. Such research might include a review of non-homogenous farming systems, such as those based on intercropping, polycropping, integrated pest management, and integrated nutrient management, for their possible wider applicability, as well as research to develop appropriate plant breeding methodologies; and

- Support should be encouraged for developing improved tools and methodologies for assessing genetic vulnerability and identifying, if possible, the ideal equilibrium in crops between genetic uniformity and diversity consistent with practical, technical and economic considerations that sustain ecosystems.

Administration and Co-ordination

- A Committee on Genetic Resources in the arable agriculture system, or an appropriate subsidiary body, should be regularly informed of the state of diversity in collections and breeding populations `of major crops of significance to the national food security. The Committee should make such information available to other relevant governmental bodies.

4.2.2.4 Promoting Development and Commercialization of Under-utilized Crops and Species

While a small number of species provides a large proportion of the national food needs, hundreds of other species are utilized at the local level, either through cultivation or harvesting. These under-utilized species contribute substantially to household food and livelihood security; they are often managed or harvested by women. Knowledge concerning the uses and management of these species is likewise often localized and specialized. Many under-utilized plants have potential for more widespread use, and their promotion could contribute to food security, agricultural diversification, and income generation, particularly in areas where the cultivation of major crops is economically marginal. However, current programmes and projects for conservation, research and development tend to neglect these species.

a) Long-term Objective

- To contribute to agricultural diversification, increased food security, and improved farmers' livelihoods; to promote the conservation and sustainable management of under-utilized species and their genetic resources.

b) Intermediate Objective

- To develop appropriate conservation strategies and sustainable management practices for under-utilized species, to improve selected species, to improve the marketing of under-utilized crops.

c) Actions

Policy Strategy

The RNR sector and its national agricultural research system, with the support of the international agricultural research centres, and relevant organizations, and taking into account the views of farmers' organizations and their communities, are encouraged to promote policies consistent with the sustainable use, management and development of under-utilized species, including land use policies, as appropriate, identified as having a potential to make significant contributions to local economies and food security.

Training and capacity building for scientists and extension specialists and for farmers and local communities, with particular emphasis on women, should be provided in:

- Identifying under-utilized species with potential for increased sustainable use;
- Developing and implementing sustainable management practices for under-utilized species of importance to food and agriculture;
- Developing post-harvest processing methods; and
- Developing marketing methods.

Research should be undertaken to:

- Develop sustainable management practices for under-utilized species of importance to food and agriculture and their genetic resources; an
- Develop post-harvest processing and other methods to improve marketing possibilities.

The national agricultural programmes in co-operation with international agricultural research centres and other relevant organizations, should regularly review the status of under-utilized species in the country to:

- Identify possibilities for greater sustainable use;
- Identify common research and development needs; and
- Facilitate and, as appropriate, co-ordinate requests for relevant financial and technical assistance.

4.2.2.5 Supporting Seed Production and Distribution

Farmers benefit from having a wide range of seed varieties and other planting materials. Availability can be constrained by (a) poor harvest, inadequate on-farm storage facilities, insufficient means to multiply quality seed, and (b) poor seed distribution systems. These problems can apply to seed of both local and commercially bred varieties. Parastatal and commercial seed companies sometimes have difficulty supplying seed of varieties specifically adapted to unique and local conditions. Often they cannot offer the range of varieties, or seed of so-called "minor" crops, on which many farmers rely, because of high transaction costs and low purchasing power of farmers. There is thus a need to strengthen local capacity to produce and distribute seed of many crop varieties, including some landraces/farmers' varieties that are useful for diverse and evolving farming systems.

a) Long-term Objectives

- To increase the availability of good quality seed of a wider range of plant varieties; and
- To contribute to the maximization of both agro-biodiversity and productivity.

b) Intermediate Objectives

- To improve the complementarity between governmental (or parastatal), commercial and small-scale enterprises in plant breeding, seed production and seed distribution
- To develop and expand viable local-level seed production and distribution mechanisms for varieties and crops important to small-scale farmers; and
- To help make new crop varieties available to farmers and to make suitable materials that are stored ex situ available for multiplication and distribution to farmers.

c) Actions

Policy Strategy

Taking into account the views of farmers' organizations, local communities and the private sector, the RGOB, through the RNR sector and its RNRRCs with support from IARCs, regional co-operation programmes and others, should:

- Develop appropriate policies concerning governmental, commercial and informal enterprises in seed production and seed distribution to help focus efforts of government supported initiatives on the varietal needs of resource-poor farmers in particular, with attention, where necessary, on the needs of women farmers.
- Encourage the private sector to meet the needs of larger-scale, commercial farmers to complement such an approach. Government involvement with major or minor crops that are inadequately covered by the private sector should not be precluded;
- Provide and promote, as appropriate, an enabling environment for the development of small-scale seed enterprises, including through appropriate incentives;
- Strengthen linkages between genebanks, plant breeding organizations, seed producers, and small-scale seed production and distribution enterprises;
- Consider seed quality control schemes, particularly those appropriate to small-scale enterprises; and
- Consider legislative measures, which allow distribution and commercialization of landraces/farmers' varieties and obsolete varieties, if they meet the same distribution and commercialization criteria for disease, pests, health and the environment as conventional or registered varieties. These measures should meet quality standards of seed distribution and commercialization, in accordance with national legislation or applicable regional agreements.

Capacity development

The RGOB, subject to national laws, regulations and policies as appropriate, and in conjunction with international aid agencies, NGOs and existing seed enterprises, should:

- Encourage existing seed enterprises to improve the range and quality of planting materials they offer;
- Provide appropriate incentives, credit schemes, etc., to facilitate the emergence of seed enterprises, paying attention to the needs of the small farming sector, of women and of vulnerable or marginalized groups;
- Provide support to and strengthen farmers' organizations in order for them to more effectively express demand for their seed requirements, paying particular attention to the needs of women and of vulnerable or marginalized groups; and
- Provide training and infrastructural support to farmers in seed technology in order to improve the physical and genetic quality of farmer-saved seed.

Research and Technology

The RGOB should:

- Assess current incentives and disincentives as well as needs for support to seed

production and distribution enterprises, including small-scale, farmer-level efforts; and
- Develop approaches to support small-scale, farmer-level seed distribution, learning from the experiences of community and small-scale seed enterprises already underway.

Co-ordination and Administration

The RGOB should regularly monitor national capacity for farmers to acquire appropriate seed. The potential for integrating this activity into agricultural development projects should be explored.

4.2.2.6 Developing New Markets for Local Varieties and "Diversity-Rich" Products

Increasingly, diversity is being replaced by uniformity in the agricultural market place. Changes in traditional cultures and in consumer preferences are one explanation. Concentration on productivity, the effects of advertising and the rise of consumer markets leading to stringent requirements being imposed on farmers and the inadvertent disincentives arising from legislation, policies, programmes and other institutional activities offer additional explanations. Farmers nation-wide are losing once-strong incentives to provide an array of varieties. Economic and social incentives could be offered to encourage farmers who continue to grow distinct, local varieties and produce "diversity-rich" agricultural products.

A programme to assist in the creation of specialized niche markets for biodiverse food crops could act as a positive stimulus for farmers to grow landraces/farmers' varieties, obsolete varieties, and other under-utilized food crops. Such a programme should include the identification and removal of systemic institutional barriers and disincentives to biodiversity conservation and production/marketing.

a) Long-term Objective
- Stimulate stronger demand and more reliable market mechanisms for land races/farmers' varieties and related agricultural products.

b) Intermediate Objective
- To encourage farm suppliers, food processors, food distributors, and retail outlets to support the creation of niche markets for diverse foods, varieties and products.

c) Actions

Policy Strategy
- The RGOB should consider and adopt appropriate policies in extension, training, pricing, input distribution, infrastructure development, credit and taxation that serve as incentives for crop diversification and the creation of markets for biodiverse food crops, including standards for labelling of foods which highlights the use of non-standard crop varieties.
- Consideration should be given to developing appropriate niche variety registration systems to permit and promote the perpetuation, trial, evaluation and commercial distribution of local and obsolete varieties, and to monitoring regulations enacted for other purposes to ensure that they do not inadvertently lead to the extinction of varieties.

- As feasible and appropriate, institutions should be encouraged to purchase "diversity-rich" foods for internal use.

Capacity Development

- Processes and activities, which have or are likely to have significant adverse impacts on the conservation and sustainable use of biodiversity should be identified and their effects on crop diversification monitored. Appropriate bodies should promote public awareness in various media and through appropriate mechanisms, such as street fairs, initiatives in schools, etc.

Co-ordination and Administration

- National and local level co-ordination and administration should be developed for maximum effectiveness.

4.2.2.7 Policy Issues on Domestic Biodiversity in Bhutan

The Forestry and Nature Conservation Act establishes a legal framework for the conservation, use and access of biological resources under forest and nature reserve areas. However, in the area of crop and animal genetic resources, similar legal instrument is yet to be put in place to formalize the aims and objectives of conserving, sustainable use and equitable sharing of benefits arising from their uses. Nonetheless, the utilization, access and benefit-sharing mechanism for wild and natural biological resources need to be carefully enshrined in this Act.

The Convention on Biological Diversity (CBD, Rio de Janeiro, 1992) charges national governments with full sovereignty and responsibility over biological resources on their territory. The CBD in combination with the ongoing negotiations within the GATT/TRIPS highlights the need to regulate ownership of and access to biological resources. Legal and moral ownership and rights are now firmly entrenched in international trade agreements.

Differentiation is needed between the various forms of biodiversity natural biodiversity as part of natural ecosystems, agricultural biodiversity as part of agro-ecosystems, medicinal plants (wild and cultivated), plants being harvested in natural ecosystems (vegetables, like mushroom, etc.). Secondly, it is necessary to differentiate between biological material exported from Bhutan and access of Bhutan to biological material from other countries, notably improved varieties of crops.

The primary objective of rules and regulations are to safeguard the interests of Bhutan and those of individual citizens with rightful claims or interests. This includes access to improved varieties from other countries. Following are some general observations on various issues as a first indication to be detailed at a later date.

a) Sovereignty over Biological Diversity

National sovereignty over natural resources is obvious. However, prior to the CBD, biological diversity was generally considered a common good with few or no restrictions on collectors, national or international. This situation has changed. Collectors are now required to obtain official permits.

- A possible course of action for Bhutan could be to declare (by law or another form of regulation) that all biodiversity within Bhutan to be national property. Access to biological diversity could be regulated by a Material Transfer Agreement (MTA) mechanism, stipulating the kind of biodiversity concerned and the conditions under which such biodiversity can be exported and used. The rights of Bhutan on sharing of benefits, if such material is commercially exploited etc., must be fixed in such arrangement. Some standard MTAs could be developed for the different kinds of biological diversity (see above) and different kinds of potential use (taxonomic research, plant breeding, pharmacology, ornamentals, etc.). Genetic resource collecting in the country may be regulated through a code of conduct for collectors.

b) Importing Biological Diversity

There are various reasons why Bhutan might require access to biological diversity from other countries. The most obvious one is to have access to improved varieties of crops of interest to agriculture in Bhutan. Improved varieties from Consultive Group on International Agricultural Research (CGIAR) centres are usually free with out conditions. However, commercial companies generally demand some form of protection of introduced varieties. In industrial countries this is regulated by plant Breeders' Rights (PBR) legislation harmonized in the Union of the Protection of Varieties (UPOV) Convention. There is, however, no immediate need for Bhutan to adopt a formal PBR system until such time that it decides to promote the establishment of commercial plant breeding companies as the main source of seeds for farmers. PBR enforcement may promote local plant breeding capacity, promote access to the latest foreign varieties, and fulfil some prerequisites of WTO resolutions. Till such a time, limited regulations focused on specific situations (so-called Sui Generis regulations) would seem appropriate.

- One possible solution would be specific MTAs on individual varieties. An alternative might be to incorporate certain protection in seed legislation, which could be expressed through issuance of a form of licensing system to give certain control in the seed supply market. The National Seeds Act of MOA deals with variety releases, seed certification and quality control matters.

c) Regulating Distribution of Planting Material to Farmers

When seeds (or other forms of planting materials) are distributed to farmers, guarantees are required that they are true to type (i.e. the named variety), have a good level of germination and are healthy (free of pests and diseases), which are properties that cannot be established from the seed without appropriate tests. It is a form of "consumer protection" regulated by seed legislation. Most countries have seed testing and certification schemes to control the quality of seed produced by either the commercial sector or by government agencies.

Seed testing laboratories should be independent of the seed production organization to insure objective judgement and maintain adequate operational standards. Often, once released to farmers, varieties enter into a farmer-to-farmer distribution system. This system cannot be monitored on quality, but may not need to be. In this system, formal tests are replaced by social control between farmers. Tests carried out in countries such as Indonesia indicate that farmers are well aware of the importance of good seed and generally maintain high standards.

- As in MTAs, seed legislation can be expanded to regulate use and sale of specific named varieties stipulating certain conditions. However, with both MTAs and specific seed legislation, once seed enter into the farmer system, regulating distribution or extracting royalties on behalf of the owner of a variety becomes extremely difficult, if not impossible. Hence, in the case of Bhutan, an MTA would have to be signed between the owner of a variety and the Royal Government of Bhutan establishing central payment of agreed reasonable royalties, or transferring ownership at a certain fee. However, the government must develop measures to recuperate the fee payments from the farmers.

4.2.3 Livestock Resources

4.2.3.1 Research, Education, Training and Services

Agricultural research in Bhutan underwent a radical review between 1991 & 1993. The major result was a change from the previous segregated, departmental approach to an integrated RNR focus that recognizes the essential interaction between crops, livestock and forestry in Bhutan's farming systems. To this end, the separate research responsibilities of the Departments of Animal Husbandry, Agriculture and Forestry were amalgamated into one RNR programme co-ordinated by the Research, Extension and Irrigation Division (now the DRDS) of MOA.

a) Long-term Objectives

- To apply adaptive research to real problems and constraints faced by the farmers: food security, poverty alleviation, and environmental and biodiversity protection;
- To set priorities for more precise research focused on high potential and impact in farmers' fields in diverse production systems. Therefore, incorporation of the farmers concern in the research planning process will be emphasized;
- To use of resources judiciously through project-based management;
- To take into account agro-ecological and socio-economic aspects of the farming systems in technology development, with a strong orientation towards an eco-regional approach;
- To involve extension service resources in problem diagnosis, research planning and on-farm research;
- To provide feedback regarding transferred technologies for necessary adjustment to future technologies;
- To recognize research and extension as two components of the same system; and
- To integrate research into RNR management and promote technologies that:
  - Increase conservation and raise productivity and
  - Use little external output but increase productivity.

b) Policy Guidelines

The RNR research defined as the "Development Research" will make all possible effort to ensure so that doers and users, i.e. the researchers, extension agents and farmers, understand each other. In line with national policy, the research activities will be geared towards planned outputs. On this basis the RNR sector has outlined the following policy guidelines to the RNR research programme:

- Problem orientation: the research programme will identify production constraints in collaboration with extension agents and work on them to contribute to solutions.
- Disciplinary and Inter-disciplinary focus-research programmes will promote excellence in both disciplinary and inter-disciplinary research in view of the complex nature of the production environment and resource management.
- Make research recommendations relevant to farmers, right kind of technology will be developed with high degree of interaction between researchers, extension agents and the farmers.
- Environmental Sustainability: research programme will safeguard against the use of technologies that will hurt sustainability and environmental integrity.
- Institutional Sustainability: the long-term sustainability of the research depends on the resources available to support the an effective and efficient programme.
- Equity: RNR programmes will pay due attention for equitable returns to the farmers located in less favourable environments.

4.2.3.2 Research Programmes on Yaks

a) Actions

- Use rangeland management for increasing the productivity of alpine pasture;
- Study yak crosses (*Dzos* and *Dzoms*);
- Find suitable alternatives to discourage migration;
- Study dairy production and processing techniques; and
- Conduct studies on yak diseases.

4.2.3.3 Extension Policy and Education

The concept of domestic animal genetic conservation has come to the forefront recently and not many people are aware of it. The extension document approved by the MOA reflects its environmental and biodiversity concerns by setting one of its ultimate objectives as "to support and promote the development and use of management strategies by rural households for sustained utilization of natural resources". This policy objective would be attained through its Sub-programme - 8 - Environmental Management, the intervention objectives of which are:

a) Objectives

- To identify with specified farmers in a specified locations biological resource constraints and develop strategies and approaches to address these constraints; and
- To introduce systems of biological resource management in specified locations that promote biological diversity and contribute to sustainable development.

b) Actions

Based on the above policy guidelines, Domestic Animal Genetic Conservation would be promoted through the following:

- Lobby at the ministerial and inter ministerial level.
- Train extension agents through workshops, seminars.
- Initiate awareness-raising campaigns.

4.2.3.4 Strategy, Planning and Basic Services

Organized livestock development began in the 1960s within the broad framework of programmes like breed improvement, dairy development, health coverage, fodder development, sheep and fisheries development, establishment of animal husbandry cum farmers training centres, research and extension development, and human resource and infrastructure development. These programmes have been pursued in successive development plans. Livestock programmes are looked after by a network of 162 livestock extension centres located in *Geogs* and *Dzongkhag* headquarters supported technically by regional livestock farms and laboratories.

The strategies adopted are:

- Breed improvement with the introduction of exotic breeds of cattle like Jersey and Brown Swiss. Where feasible frozen semen is used for breeding through the network of 37 Artificial Insemination centres;
- Dairy development by encouraging farmers to go for small and productive herds;
- Sheep development by introducing better breeds of sheep for increasing the wool production to meet the demand of local weavers;
- Fishery development in potential areas for increasing the cash income as well as the nutritional status of farmers;
- Strengthening of the existing animal health services for providing better coverage to the farmers for controlling and eradicating of animal diseases of economic importance;
- Increasing the feed and fodder resources of the country by encouraging pasture development with the higher-yielding types of fodder seed;
- Strengthening and improvement of the existing animal husbandry farms involved in the production of various types of inputs required for implementation of development programmes in the field; and
- Providing required extension services to farmers by developing up the required trained manpower.

Chapter 5

Additional Sustainable Benefits from Biodiversity

5.1 Options for Action
5.2 Ecotourism
5.3 Non-Timber Forest Products
5.4 Bioprospecting
5.5 Ecosystem Services

5.1 Options for Action

Overview

Bhutan's development is linked to its biological diversity and natural ecosystems to an extent almost unmatched elsewhere in the world. Its biological diversity and relatively undisturbed natural ecosystems represent a unique asset that no other nation in the region enjoys. Moreover, unlike virtually any other natural asset, the value of Bhutan's biodiversity and natural ecosystems is destined to increase with time. Throughout South and Southeast Asia, biodiversity is disappearing in the face of expanding populations, expanding agriculture and poorly planned timber harvest. As this inexorable process unfolds, the relative importance of Bhutan's biodiversity grows.

The previous four chapters have focused on Bhutan's biodiversity, what is being done now and plans of action that should be taken to conserve or sustainably use valuable resources. This chapter presents options for additional actions which Bhutan can take to realise additional substantial but sustainable benefits from its biodiversity. The following discussion is based on "Biodiversity Policy Options for Bhutan" (REID 1996).

Bhutan can benefit from its diversity in three complementary ways. First, the existing natural ecosystems will provide greater benefits to local populations than any alternative uses of most of these lands – and those benefits can be significantly enhanced through careful management. Second, the nation's biodiversity has the potential of providing significant economic returns through international trade and ecotourism. Finally, because conservation of forests and biodiversity is of international value even beyond these domestic benefits, Bhutan stands to benefit from mechanisms for resource and technology transfer established under the Framework Convention on Climate Change and the Convention on Biological Diversity.

But these potential benefits will barely be tapped without increased **investment** in their development. Just as a country must make human, financial and capital investments in its mining, agriculture or power sectors in order to expand the potential development benefits they provide, so too it must invest in its natural ecosystems and biodiversity if it is to enhance the benefits from these resources. We traditionally think of agricultural or urban landscapes as "developed lands" and natural ecosystems as "undeveloped". But this taxonomy makes little sense in a country like Bhutan where the natural ecosystem can potentially provide far more economic and social benefits than the modified ecosystem. With proper investment and management, all of the country's lands will be "developed" – some for their agricultural potential, some for industrial potential, and the vast majority, 70 percent or more, for their biodiversity potential.

What type of investment is needed to increase the social and economic benefits from the country's biodiversity? Overwhelmingly, the key need is investment in the gathering, creation and protection of knowledge about the biodiversity. There are few countries where the priority for biodiversity investment is so clear. For any country to increase the contribution of its biological diversity and natural ecosystems to its social and economic development, it must adhere to the principle of "save it, study it, and use it sustainably" (WRI, 1992). Unless the natural wealth of a nation is protected (save it) it cannot contribute to development goals. Yet unless countries and local communities obtain benefits from that biodiversity (use it

sustainably), there will be no incentive to protect it. And unless the country works to better understand what biodiversity it has, what role it plays in natural processes and how its value might be enhanced, it will not be in a position to either save it or use it sustainably.

Bhutan has taken extraordinary steps to protect its natural wealth, and already is tapping that wealth for sustainable local and national economic benefit. However, it has barely begun to build the knowledge base for better managing and utilising its diversity. The potential social and economic gains from an investment in knowledge creation related to biodiversity are, thus, significant. Building the needed knowledge base is presented in Section 4.1.

5.2 Ecotourism

Bhutan has the potential to be a premier eco-destination in the Himalayas. It is a fine example of the Himalayan ecosystem where the total environment (culture, tradition, religion, and flora and fauna with their intact habitats) has not been overly impacted by modernization and where there is a conscious drive to conserve it.

There is considerable scope for Bhutan to increase its economic gains from ecotourism without threatening that diversity. Jigme Dorji National Park is already a tourist attraction, and Royal Manas Park will become one when conditions permit it to be reopened. But other Protected Areas in Bhutan could also become attractive to tourists with appropriate investment. Bhutan has many of the features of a number of different successful ecotourism destinations – the unique high elevation trekking experiences that draw tourists to Nepal, the "charismatic megavertebrates" that draw visitors to Kenya, and the species richness and scenic beauty that draws tourists to Costa Rica. The potential for ecotourism in Bhutan could be significant. Belize, a country half the size of Bhutan, had tourism receipts of $73 million in 1993 and surveys show that over half of the tourists visiting the country participated in nature based activities. Costa Rica – only slightly larger than Bhutan – reported 684,000 overnight visitors that spent a total of $577 million in 1993. Tourists spend on average $148 per day in Costa Rica (Sizer, 1996). More than 50 percent of the visitors to Costa Rica state that the national parks are their "principal reason" for visiting the country.

However, just as a high volume of tourists can destroy cultural values in a country, so to it can degrade biodiversity. Consequently, it is very important to find the carrying capacity of an area for tourists. Bhutan's current goal of developing "high income/low volume tourism" applies equally to ecotourism. The "quality vs. quantity" issues with tourists will determine whether the numbers of visitors can stay within the carrying capacity yet bring revenue to the country. To a degree, the carrying capacity will be determined by the infrastructure and development of the service industries. If Bhutan chooses to build a more substantial ecotourism industry and increase the country's economic gains from that industry, it would need to consider the following investments and policy changes.

5.2.1 Marketing and Market Survey

If Bhutan chooses to build its ecotourism industry, it should consider conducting basic market research to determine the types of infrastructure, information, trips and accommodations that would be attractive to potential tourists, and to analyse tourists' "willingness to pay" to visit Bhutan. With adequate marketing of the unique attributes of Bhutan as a tourist destination, it is likely that tourists would pay even more than the

current "minimum" cost of $200 per day for visiting Bhutan with little or no decline in the rate of growth of tourism, which appears to be limited largely by capacity and lack of marketing at this stage.

In addition, market surveys, i.e., studying the arrivals of visitors by country, age, sex, and purpose of visit can determine the country's strong and weak points, and indicate what is lacking and where to put more effort to attract and provide for visitors.

Currently, Bhutan is not well known as an ecotourism destination – or even, for most people, as a tourism destination at all. If the RGOB, the local tour industry and international travel agents begin to more aggressively promote this opportunity - and particularly promote the fact that the culture and biodiversity has not been degraded by excessive tourism – then the number of people desiring to visit the country, and their willingness to pay, will grow. Among the areas to be expanded are films, news articles, and write-ups in travel magazines. Promotion of the opportunities, however, must go hand-in-hand with the development of more information about biodiversity, preparation of interpretative materials, training of guides and development of infrastructure. A marketing survey, however, could help the country to more clearly understand the potential for this sector and to identify what specific niches within the ecotourism market Bhutan might best exploit.

The country also has potential for expanding the existing white-water rafting and kayaking tourism industry. Because the presence of such an industry creates economic and political incentives to protect water quality and water flow, it can help to protect freshwater biodiversity and indirectly provide an incentive for maintaining the forest cover in watersheds. This is one of the objectives of the Bhutan Water Partnership of which the Department of Tourism is a member.

5.2.2 Information

The unique diversity of birds and plants in Bhutan could make the country a "Mecca" for wildlife enthusiasts, particularly birdwatchers and amateur botanists. This type of tourist is low impact, tends to be in higher income brackets and thus able to pay top prices to visit unique locations, and often does not demand high-end accommodations. However, to build this type of tourism, Bhutan will need to invest in further development of basic scientific information on the distribution of biodiversity in the country and then provide interpretative materials – particularly field guides and biodiversity tour guides – to interested visitors. WWF Bhutan Programme has published a short book, Birds of Bhutan, listing several dozen of the most common species. Ideally, though, the country should build the knowledge base that would enable the government or private (or non governmental) entrepreneurs to begin to develop a series of field guides to various groups of species in the country – beginning with birds, plants, and butterflies. From this knowledge base, basic information could also be published detailing the types of species that could be seen in various parts of the country. This too could be done through private entrepreneurs, although the RGOB may want to play a role in catalysing the development of such material.

This type of published information would be useful not only for tourism but also for education within the country. Particularly as the country becomes increasingly urbanised, the connection of people with the land and biodiversity will weaken, and field guides, regional species lists or CD-ROMs for use in the classroom could play important roles in

building awareness among school children in the country about their biodiversity. Another way to make information more easily available would be to develop a country website on the Internet, with accurate information, hyperlinked to the tour operators' web sites.

5.2.3 Training

An effective ecotourism industry will require trained guides who could take visitors to specific parks or sites, know what is likely to be seen and be able to identify the biodiversity in the region. These skills can be obtained without extensive formal education - indeed, many rural people in Bhutan probably already have considerable expertise that could be adapted to this purpose if there were prospects of employment. Currently, the large tour operators indicate that the lack of trained guides is a serious constraint to their efforts to respond to potential interest in ecotours.

Over the long-term, one of the best ways to build this capacity will be as an integral part of Bhutan's efforts to build the knowledge base about its biodiversity (Section 4.1). Parataxonomists, for example, trained to help with a biological inventory of the country, would gain the experience necessary to become effective natural history guides.

Over the short-run, it may be worthwhile for the country to encourage natural history trips by organizations that could supply their own guides with some knowledge of the region, and pair those "visiting" guides with local people who could enhance their own skills during the trip. Almost all natural history museums in Europe and North America – such as the Smithsonian Institution, American Museum of Natural History and British Museum of Natural History – run natural history tours for members. In addition, a number of NGOs such as the Sierra Club and Audubon Society run international tours of this sort. The Department of Tourism could send exploratory letters to these groups, explaining that the country's interest is to begin to build more capacity for ecotourism within the country, to explore whether the trips could be run on terms and conditions acceptable to the RGOB. This would also serve effectively to market ecotourism opportunities in Bhutan to a wider audience.

Training in provision of hospitality to tourists is another key need in developing a service industry. The training should emphasize professionalism and quality of service at all levels.

5.2.4 Infrastructure

Growth in ecotourism will require additional development of infrastructure, however this type of tourism demands somewhat less infrastructure than would be the case with expanded cultural tourism. Historically, many countries built elaborate facilities ("lodges") within Protected Areas as a key element of developing an ecotourism industry. Most evidence suggests, however, that a superior approach is to restrict development within Protected Areas to facilities needed for basic management and enforcement, trails or access routes, and basic interpretative facilities in heavily used regions, and to concentrate development of lodging facilities in nearby towns or villages. Development of more extensive facilities within Protected Areas has typically been done by issuing long-term concessions to private developers. However, it has been difficult for governments to capture an equitable portion of the returns from such developments to help pay the costs of the added maintenance and enforcement

requirements that expanded ecotourism requires. Further, the materials needed for more elaborate facilities often cannot be obtained within the country and much of the expenditures thus "leak" outside of the country.

A key consideration is that the more elaborate the facilities, the more impact they – and the increased staffs needed to run them – have on the local natural and cultural environment. Minimal, basic facilities have lower impacts and are more appropriate for wild areas and ecotourism than elaborate ones. Ecotourists are often put off by elaborate tourist facilities that they recognize to be inconsistent with their objectives and with conservation of the environment. If larger, more elaborate tourist facilities are considered for the country they should be sited in appropriate areas, well away from wild areas, and care should be taken to assure that their construction is consistent with Bhutanese architecture and their operation is consistent with other aspects of Bhutanese culture.

In addition, these facilities have not contributed effectively to local economic development in the region near the Protected Area and have often stimulated greater population growth in buffer zones. The greatest benefit to the country is likely to accrue from local ownership. Experience has shown that community-run campsites, local participation and local stakeholders can best ensure a sustainable infrastructure. Multinationals often are opportunistic, remaining only as long as the endeavour is deemed sufficiently profitable.

Expansion of lodging facilities near potential ecotourism destinations is probably best left to the private sector. As visitation grows, the incentive to build new guesthouses will grow. However, the RGOB will need to ensure that the basic Protected Area management and enforcement capacity is developed in parallel to growing use of Protected Areas as ecotourism destinations.

5.2.5 Policy Reforms

Effective tourism policy requires clear and distinct directives from the government, especially with regard to factors such as: revenue, employment, conservation of culture/tradition, religion and environment, identity and role of stakeholders, relative government versus private sector involvement, and the general role of tourism in the balanced development of the country. A clear tourism strategy and action plan is required to develop Bhutan's unique potential for a tourism industry.

A typical scenario for tourism development in a country like Bhutan would be the following. Even in a region with high potential attraction for tourists, like Bhutan, tourist visits would initially be small because of the lack of awareness among potential visitors and the lack of facilities (lodging etc.) even for those desiring to visit. As more information and advertising becomes available and as facilities expand, the number of visitors would increase, enabling still greater investment by tour operators in advertisement and greater investment in improving facilities for visitors. The improved facilities and greater promotion would then attract still more visitors. During the period of industry growth, people would visit because of the cultural or artistic attributes, scenic beauty, unique wildlife, climate, and – uniquely – the relative lack of tourists compared to other more heavily visited regions. As the number of visitors grows, however, some of the attractions begin to decrease in "value". Cultural features become less distinct as the

tourists themselves introduce more of their own culture to the region. The experience of seeing unique wildlife or appreciating the scenic beauty is reduced in value when visitors must experience it shoulder-to-shoulder with other tourists, and the attraction of visiting a rarely visited country disappears. Thus, as tourism grows the marginal benefit to the country of the next tourist begins to fall (the tourist is willing to pay less because the value of the experience is decreasing) and the marginal costs rise (Lindberg, 1991).

The net value to the country is maximised at the point where the distance between benefits and costs is greatest, not where the number of tourists is greatest. Yet as is always the case with open access resources (the tourism "potential" of Bhutan effectively amounts to an open access resource), continued visitation beyond the point of maximum social value still provides benefits for the individual user (and profits for the industry) and so the pressure will be for tourism to grow. The country can act in two ways to limit tourism to the level with the highest social value – either setting a quota or using fees or taxes to raise the cost curve. Many countries have established quotas for visitation to Protected Areas and some countries, like the Seychelles, set overall quotas for tourism to the country. (In the case of the Seychelles, the government sets limits on the number of hotel rooms, limits camping, and does not allow tourists to stay in private houses.) Under its current policy, Bhutan has adopted the approach of setting a fee (a percent of the $200 per person per day fee – currently $65 peak season or $55 low season per visitor day), which raises the total cost curve in an effort to reduce the equilibrium number of tourists.

As noted above, it would be in the country's interest to undertake a market study of the tourism potential to obtain better estimates of the willingness of tourists to pay to visit Bhutan. The potential demand that will be generated once more people become aware of the tourism possibilities in the country, and the approximate range of visitor days that will lead to the greatest social gain for the country. Under the current policy, the incentives for local tour operators, foreign travel agents, and local hotel operators will be to increase the number of tourists visiting the country as rapidly as the capacity and market will bear. The RGOB is thus undertaking an experiment with its current $65-$55 per day fee to see whether that cost is great enough to limit tourism to the socially optimal level. All of the private concerns will benefit from maintaining costs as low as possible (i.e., encouraging the government not to raise the current fee) and bringing as many tourists as possible to the country. There is thus a substantial risk that the level of visitation will overshoot the optimal level. Once past that level it will be extremely difficult to reverse the trend since the capital investments in hotels and other infrastructure would make reductions in tourism visits highly costly and disruptive to the private sector.

The country could substantially reduce the risk of potential over expansion of the tourism industry by maintaining quotas on visitation and slowly expanding those quotas as the demand and capacity warrants. There are three advantages of a quota system. First, the government is in complete control of the total number of visitors, rather than relying on the estimated elasticity of demand of visitors to the fee currently in use. Second, a quota system, by limiting visitors, creates the incentive for visitors to "bid up" the price of visiting Bhutan. Individuals will be willing to pay more, knowing that there are only limited opportunities for access. In contrast, under the existing system, as long as the visitor is willing to pay the minimum "hurdle" price ($65 peak season or $55 low season per day plus expenses), then the incentives are to keep costs low and number of visitors high – just

the opposite of the countries goal of high value/low volume tourism. Third, a user fee results in the government capturing the rent associated with the excess of benefits over costs, rather than the private sector, whereas under a quota mechanism the higher price paid by tourists visiting the country would be captured by the private sector.

The only potential disadvantage of a quota system would be that large tour operators might be able to drive small operators out of business, thereby reducing the opportunities for small businesses and creating a monopoly situation in the industry. This problem could be readily solved, however, by allocating tradable "rights" to the tour operators based on the number of visitor days that they currently are selling. Each operator would thus be guaranteed at least the current business that they are doing (and the profits they would obtain for that number of visitors would increase as the visitors begin to bid up the price). Any operator, however, could sell a certain number of visitor day rights (or sell all their rights) to other operators if they felt that they could earn more through the sale of the right than through the business itself.

The most desirable approach would likely be to maintain the existing fee charged by the RGOB, while setting limits to the total number of tourists visiting the country and allocating tradable rights to the existing tour operators. Operators would thus have to pay the government the current $65 peak season or $55 low season per visitor day fee, but then would be free to charge what the market would bear. Using this approach, the government could also seek to steer tourist visits to other parts of the country or to other seasons of the year through either regional quotas or limits on hotel construction in Paro and Thimphu. The government could expand the number of tourists (the quota) in future years either by allocating additional rights to the operators or auctioning off those rights to the highest bidders.

5.3 Non-Timber Forest Products

Bhutan could increase economic benefits gained from its natural forests through intensified efforts to develop non-timber forest products. With support from UNDP, a project is already underway to expand production and quality of production of lemon grass oil. Other plants have been identified as having high potential for commercial exploitation of essential oils or resins, including *Pinus roxburghii* (chirpine), *Cympopogon distans* (a separate lemon grass species), *Artemesia vulgaris, Gaultheria spp*. (Wintergreen), *Abies densa* (silver fir), *Aquilaria agallocha*, and various lichen species (La, 1996). The RGOB has developed a horticultural action plan as part of the process of developing the 8th Five Year Plan to identify priorities for further development of NTFPs.

NTFP as a source for food security should also be assessed in terms of famine food for rural communities, where food from the forest becomes critical in times of crisis. Edible plant parts such as in fruits, roots, bulb, stem, flower, etc. can be an important source of essential nutrients in the diet regime of people living in close proximity to forest. In a study conducted in the West-central Bhutan, forest plants contributed an average of 21 percent to the total household diet and 19 percent to the household income (Namgyel, 1996). During difficult times, farmers venture out in the field in search of edible tuber; seeds for extraction of cooking oil; fruits and nuts for domestic consumption and sale; bamboo shoots, fern shoots, mushrooms, cane shoots, wild orchid flowers as a substitute for vegetables, etc.

It was proposed on 25 May 1988, to impose ban on the export of medicinal plants and establish cooperation between the DOF (now DFS) and the NITM (now ITMS) for a mechanism of collection and cultivating medicinal plants. Various promotion schemes, as in the waiving of forest royalty and sale tax on bamboo and canes, could promote and encourage production of handicrafts for sale and domestic use and also could also promote lac cultivation in a similar manner.

The lack of NTFP data makes it difficult to assess the carrying capacity of important species found in a particular site. The acute shortage of information has a drastic impact on the management of these resources, which are considered critical for the mostly agrarian population in the country. The lack of qualified manpower in this field further exacerbates the problem. Another constraint lies in the geographical landscape of the country, the steep and abrupt terrain limits trade only to areas where feasible and those connected with road network. Although, road network in certain portions of the country are well developed, the erratic climatic conditions pose yet another deterrent in the trade of products within the country as well as outside the border to India.

Resin tapping, a lucrative industry, is carried out in the five eastern districts. The present method of resin extraction includes the French Cup and Lip methods and studies are underway on the prospect of adopting of the Rill method. Benefit accrues in the form of employment and revenue to buy subsistence goods at the village level.

Economic benefits from medicinal plants could also be increased in Bhutan; however, it will be difficult to expand this potential market while ensuring conservation and equitable sharing of benefits. Naturally grown medicinal plants with high potential for commercial exploitation include *Taxus baccata*, *Swertia chirata*, *Piper spp.*, *Pseudo ginseng*, *Illicium anisatum*, *Cordecep sinensis*, and *Picrorhiza kurooa*. Bristol-Myers Squibb, for example, approached the National Institute of Traditional Medicine Service (ITMS) inquiring about the possibility of sourcing material (*Taxus baccata*) from Bhutan for production of Taxol. The request was denied. Substantial trade is now underway with two plants: *Swertia chirata* (a member of the Gentian family exported to India as a multi-purpose medicinal plant) and pepper or pipla (*Piper spp.*), sold for spice production (the fruits) and pan (the leaves). By one estimate, sales of pipla could expand to about $50,000 per year in Eastern Bhutan (Dorji, 1995).

The conservation risks associated with trade in medicinal plants are already well appreciated in Bhutan. Poaching of medicinal species – including in some cases by Tibetans or Indians in the border regions – is already a problem for a number of species. If markets are developed for additional species, added pressure will be placed on the collection of wild populations and, for some species, this could threaten the populations with extinction. This has been a common outcome of active marketing of medicinal plants in other regions of the world. Major conservation problems exist for wild medicinal plants commercially marketed in Africa (Cunningham, 1993). In Southern India alone, 80 medicinal plants have been labelled threatened by IUCN (Tandon, 1996). Often, the pressure of commercial demand comes from larger markets in other countries. In Nepal, 60-70 percent of the medicinal herbs collected in the early 1980s were exported to India (85-200 tons annually between 1972 and 1980). Merely establishing cultivation of the species involved is not a sufficient solution to the problem (and, for many species, practical methods of cultivation are not yet known and may be difficult to achieve). Even if some people cultivate the species involved, the incentive for others

to collect the species from the wild will still exist unless the cultivated product becomes so abundant that the price of the product drops to the point that benefits to wild collectors are too low.

The Institute of Traditional Medicine Services is hoping to establish a two-tiered pricing scheme for medicinal plants – it will pay a higher price to producers who can 'certify' that their material comes from cultivation. This policy should effectively reduce pressure on wild stocks (for those species suited to cultivation) as long as the ITMS is the primary purchaser of herbal products. Maintaining this exclusivity for species with clear market value, however, will be increasingly difficult as transportation infrastructure is further developed and as local communities establish more extensive trading relationships with others in Bhutan and in neighbouring countries.

Bhutan may want to establish 'pre-emptive' marketing policies for different categories of medicinal plants. The most restrictive category (Category I) would be for species that are relatively rare and which could easily be threatened by over harvesting. It would allow no commercial trade and ITMS would use material only from cultivated sources. Category II would allow commercial trade only if practical means of cultivation have been developed. Category III would allow commercial trade even if the species were only obtained from the wild as long as a management plan has been prepared by the DFS. For example, Taxus would probably fall in Category III – with an effective management plan the species is sufficiently abundant that it would be difficult to threaten with extinction through controlled harvest.

Bhutan should also carefully examine the issue of benefit sharing with local communities and traditional healers for traditional medicines that enter into the commercial trade. Currently, benefit sharing takes place largely through employment opportunities and the involvement of traditional healers in the ITMS. ITMS can be viewed to be strengthening the capacity of these individuals to achieve their public health goals – they are an integral part of the ITMS, rather than a beneficiary of its work. While not all of the traditional healers in Bhutan may be directly involved in the ITMS, it nonetheless provides "implicit" benefit sharing to all of Bhutan's people (including other healers). By virtue of the fact that while it is using traditional knowledge it is repaying society by making the products of that knowledge more readily available across the country. As long as products are not being developed and sold for profit, this appears to be an effective arrangement.

However, if material is introduced into commercial markets, then the issue of benefit sharing becomes more important. It clearly becomes an issue if a private entrepreneur wishes to sell traditional remedies or herbal plants used by many healers in the country. The issue would also be relevant if ITMS – even as a non-profit institution - sells material for use outside Bhutan. In both these cases, the individuals whose knowledge of traditional medicines "created" the product that is being marketed would not all be receiving an equitable share of the benefits from that commercial use.

If traditional products are marketed, the RGOB thus may want to consider placing a small tax on the sale of products and using the funds raised in that fashion to provide benefits to the country's traditional healers, in particular those not directly involved in ITMS. Alternatively, since the initial revenues from a small tax on a new commercial product would be very small, a portion of the Bhutan Trust Fund for Environmental Conservation, say $10,000 per year,

could be allocated to activities that support traditional healers throughout Bhutan. The revenues raised through a tax on sales of traditional medicines would go directly into the Bhutan Trust Fund. A small board comprised of traditional healers from villages and those involved in ITMS could oversee the use of funds raised through either of these mechanisms.

5.4 Bioprospecting

"Biodiversity prospecting" (or "bioprospecting") refers to the research, collection and utilization of biological material and other related resources, for purposes of applying the knowledge derived from there for scientific and /or for commercial applications. In a developing country like Bhutan, which is rich in biodiversity and where traditional local knowledge and practices regarding this biodiversity prevails, bioprospecting can be promoted as a sustainable environmental activity as it provides both economical and ethical incentives for biodiversity conservation.

Bioprospecting fits in fully with the RGOB's sustainable development policy, particularly the "middle path" approach efforts, which support the integration of conservation and economic development. Bioprospecting is particularly important for sustainable development as it represents economic opportunities that are not resource extraction intensive and also helps attach a more precise value to preserving biodiversity that is otherwise difficult to quantify.

5.4.1 Potential Benefits of Bioprospecting for Bhutan

As the population of Bhutan is mostly rural based, bioprospecting can be very important to the local communities who are the stewards of the nation's biodiversity. Bioprospecting has the potential of providing benefits to the local communities by establishing monetary value to the traditional cultural practices and knowledge associated with the natural environment. It can thus create incentives for indigenous people to conserve biodiversity and provides an opportunity to catalogue and revive traditional knowledge and practices. Bioprospecting also has the potential of increasing the development of the urban population particularly the private sector, in Bhutan by providing investment opportunities with potentially high returns. Bioprospecting may also accelerate the development of scientific biodiversity knowledge and provide access to cutting-edge technologies, which would be important to Bhutan, given that we are in an era where globalization and technological advancement are inherent.

The potential benefits of bioprospecting programme can include sustainable technology transfer (particularly in the field of biotechnology), training and education programmes, reaping of the monetary gains of natural product development, intellectual property rights protection and the protection of indigenous rights and knowledge. Also through the proper use of the income created from conserved biodiversity, increased local and national capacity to effectively oversee and co-ordinate the conservation and sustainable utilization of biodiversity could be established.

Bioprospecting can become a useful strategy for achieving the natural resource goals as emphasized by the RGOB with regard to long-term sustainability, self-reliance, national sovereignty and promotion of national happiness. However, this can be accomplished only if the RGOB is supported in its initiatives by the local communities in partnership with the private sector, including international organizations involved in research and development.

5.4.2 Precautionary Measures to be Considered

Bioprospecting is a complex undertaking, as it involves many stakeholders. Moreover, developing countries normally deal with potential partners from developed countries. It is therefore essential that adequate national capacity to deal with the complexities of bioprospecting is built within Bhutan. Currently, this capacity does not exist. Building national capacity in bioprospecting is of paramount importance to ensure that Bhutan benefits from opening its biodiversity resources to the world while averting exploitation in its future bioprospecting ventures.

Experiences from other countries that have established and initiated bioprospecting agreements have shown that bioprospecting can provide greater up-front benefits by adopting the following approaches. (a) High upfront payments that cover more than just the cost of collecting materials, such as the cost of establishing the basic scientific infrastructure for identifying, locating and recollecting species and monitoring their population size; (b) Enhancement of technology for extraction and isolation of active chemicals and preparation of samples. (c) Establishment of the capacity for basic screening of compounds for potential utility as drugs or industrial products; and (d) Training of scientists in chemical analysis, drug discovery and taxonomy (Reid et al, 1995).

5.4.3 Preconditions for an Effective Bioprospecting Programme: Actions to be Undertaken

The preconditions for an effective bioprospecting programme in any country are (1) the presence of basic biological/scientific knowledge about the resource; (2) presence of effective laws regulating access to biodiversity and the human and scientific capacity to enforce the laws. These preconditions are not yet met in Bhutan but are in the process of being addressed. Thus, investment in these areas would establish the basic groundwork in case the RGOB ventures into commercial bioprospecting in the near future.

5.4.3.1. Biological/Scientific Knowledge

Like any commodity, the trade in genetic or biochemical resources will contribute most to development if the country "adds value" to the raw material. Even so, most countries still are involved almost exclusively in the trade of raw materials – often simply sending plant samples to firms without even performing basic chemical extractions within the country. Countries have an opportunity to multiply the benefits they obtain from biodiversity, if they choose – as part of a broader technological development plan – to build technological capacity related to biochemistry, biotechnology, agriculture or pharmaceuticals.

Bhutan should explore the merits of establishing the capacity to add value to biodiversity. Bhutan can also explore the opportunities to establish joint ventures with institutions in other countries like India, Costa Rica or even developed countries such as the United States – that would enable Bhutanese scientists to work directly with the partner institutions.

Whether a country ends up only trading raw material or developing a value added capacity, the core scientific knowledge needed is the same: What species are present? Where they are located? What is the status of their population? What is their ecological role? How they are used by traditional cultures? How do they interact with predators and pests? For a country like Bhutan, developing this core information is no

small undertaking. Specific approaches for building this knowledge base and the human capacity associated with it are needed actions since this information cuts across many of the potential economic opportunities associated with biodiversity.

Preliminary actions taken since BAP I regarding scientific knowledge

As BAP I indicated, the presence of basic knowledge on the country's biodiversity is a prerequisite for an effective bioprospecting programme. Given the importance of establishing a core information base for the sustainable use and management of biological diversity in the nation, the WWF Bhutan Programme provided financial assistance to the RGOB to develop a project proposal to address this issue. The NBC in collaboration with other stakeholders developed a project proposal called the "Bhutan Integrated Biodiversity Information Systems (BIBIS) Project" to be implemented in the 9th Five Year Plan. The project, which is awaiting donor funding, will assist in documenting and creating inventories of all the biological resources in Bhutan and the information is to be presented through BIBIS. This inventory and information will play a key role as the scientific/biological knowledge base for implementing bioprospecting in Bhutan.

The need for human capacity development and technological training for implementing bioprospecting in the country will be addressed during the 9th Five Year period of the RGOB.

5.4.3.2 Effective Bioprospecting Laws and Regulations

As discussed in Chapter 4, Bhutan may want to allow access for biodiversity research by foreign scientists as part of a broader effort to build its human capacity and scientific knowledge of biodiversity. However, until Bhutan has built the capacity for negotiating equitable contracts and enforcing access legislation and has increased the information base regarding its biodiversity, the best policy may be to continue to disallow certain forms of commercial bioprospecting. It is difficult, however, to draw a line between types of commercial bioprospecting that should be allowed and those that should not. For example, a no-commercial-bioprospecting policy would presumably seek to prevent a local entrepreneurs from making extracts of biodiversity and selling them to a pharmaceutical company. But should it also prevent a local entrepreneur from making extracts and selling those as essential oils? Would this latter case be "commercial bioprospecting," or "development of a non-timber forest product"? And, if the latter case is allowed because it better fits the NTFP model, should the government seek to prevent the local entrepreneur from growing the species in India where the conditions may be better for production?

Technological advances will make it increasingly difficult for Bhutan to draw the line identifying acceptable commercial uses of biodiversity. For example, consider the different ways that one extract from a plant in Bhutan might be used for commercial purposes. The extract might be found to contain a valuable oil, creating a new "non-timber forest product" for Bhutan. Alternatively, it might be the source of a new fragrance of value to the perfume industry. This industry does not patent the chemical (it instead synthesizes a different compound that produces the same fragrance) but firms are willing to pay for exploration of new biodiversity-based fragrances. (INBio in Costa Rica has had contracts with the perfume industry, for example.) Alternatively, the same sample might contain a chemical that could be used as a pharmaceutical product.

Pharmaceutical companies do patent the chemicals involved, although the final drug often is synthesized and typically is somewhat different in structure from the original chemical. Finally, the sample might show activity as a pesticide, leading genetic engineers to search for the gene that produced the chemical involved, patent the gene, and introduce it into a new crop.

A no-commercial-bioprospecting policy is, thus, too broad to protect the nation's economic interests. Instead, Bhutan should consider establishing a policy with criteria for access that would prevent specific types of biodiversity uses. For example, Bhutan may choose to prevent: a) patenting of a chemical or gene obtained from the country; and b) shifting of the source of production of a material produced by a Bhutanese species to another geographical location.

Thus, in the examples given above, Bhutan would want to avoid export of material that would lead to the new drug and the genetically engineered crop. It would also want to ensure that if a new essential oil was developed from a species endemic to Bhutan that the producer could not establish a plantation in India thereby cutting Bhutan out of the benefits. On the other hand, the country would allow research to develop a new fragrance or the production of a new essential oil as long as the production was based in Bhutan.

In addition to these criteria setting the terms for the type of access that the country allows, several other elements of access legislation, national environmental law or formal government policy will form an important part of the country's efforts to regulate access and ensure the equitable sharing of benefits of the use of biodiversity.

a) Focal point contact

The Ministry, Commission or Agency with responsibility for reaching a decision and issuing or disallowing a collecting permit (or a permit enabling transfer of biological samples) should be clearly identified for users both within Bhutan and internationally. Any such focal point would need to consult broadly with potentially affected Ministries, Commissions and Agencies, and would need to be aware of all issues related to Bhutan's biodiversity.

b) Scope of restriction

Bhutan should determine whether restrictions on commercial bioprospecting apply only to non-Bhutanese "prospectors" or to citizens as well. In other words, should a private business that makes extracts of local species and then sells those extracts to pharmaceutical companies be allowed to be established in Bhutan? Under a strict no-commercial-bioprospecting policy, both local entrepreneurs and foreign researchers would have to apply for permits.

c) Activities requiring permits

To protect against material being used in a manner that would lead to new patents on chemicals or genes or the loss of material to producers outside of Bhutan, the country should consider establishing a requirement for an export permit. Anyone – Bhutanese citizen or foreign national – would need to obtain this before exporting any biological material or material derived from biological material. Existing commodities exported

from Bhutan (such as agricultural or timber products, resins, oils, etc.) would be exempt from this permit requirement and exemptions could be granted for other commodities in the future.

The permitting procedure would have two basic purposes. First, it would ensure that the material exported could be used only for the stated purpose and any use of the mate rial for developing other products would not be allowed without obtaining permission from the RGOB. Standard language could also state that the material could not be used as the basis for establishing populations of the species outside of Bhutan (e.g., through tissue culture or planting cuttings or seeds) without consent of RGOB. Second, the permit requirement would enable the authority responsible to prevent those activities clearly directed at commercial exploration for new chemicals or genes that could potentially be subject to patent. The permit process should be simple and efficient – since most applications are likely to involve activities related to the development of NTFPs which the RGOB may want to encourage. But it would provide the basis for preventing activities that held the potential of commercial exploitation before Bhutan is in a position to ensure that it gains an equitable share of the benefits.

d) Benefit sharing with local communities

Either through the permit process described above or through other mechanisms, Bhutan's policy should specify that the prior informed consent of local communities (or individuals such as traditional healers) must be obtained before using information from them for either collecting biodiversity or developing potential products. The policy should also specify the mechanism for ensuring equitable sharing of potential benefits from the use of that knowledge.

Preliminary Actions Taken regarding bioprospecting laws and regulations

A project proposal addressing these needs, called the "Biodiversity Prospecting Management", has been developed by the NBC. In order to develop this proposal, as well as to increase the awareness of biodiversity prospecting among the concerned institutions of the RGOB, the NBC along with the NCD and the Planning and Policy Division of the MOA, organized a multi-stakeholder bioprospecting workshop/training session in Bhutan in May 2001. As bioprospecting is a relatively new field of study in Bhutan, external technical assistance was sought from the World Foundation for Environment and Development, an institution renowned for their work and with leading global experience in the field of biodiversity management.

To ensure the development of effective policy and legal framework for Bhutan, the activities of the biodiversity prospecting management project are to be carried out in two phases. The first phase is for the development of the policy, and the legal framework and the institutional capacities that are essential for sustainable implementation of bioprospecting management activities in the nation. As bioprospecting is a new venture to be undertaken by the RGOB, there is a great need for specialized training in the fields relevant to bioprospecting, in particular in biotechnology and its applications accordingly. On successful completion of the first phase, and in order for the RGOB to evaluate and assess the effectiveness of the developed bioprospecting rules, regulations and laws, a pilot biodiversity-prospecting

project will be formulated and initiated for implementation, with the support of external assistance and donor funding. The bioprospecting management project will be ready for implementation in the 9th Five Year Plan period.

5.5 Carbon Storage

Bhutan is in a somewhat paradoxical situation in regard to its potential to capture greater economic value from the carbon content of its forests. Despite the fact that Bhutan is heavily forested and those forests play an important role in sequestering carbon from release in the atmosphere, any mechanism established for financial transfers to pay for carbon offsets – either through Clean Development Mechanism (CDM) or carbon trading – will hinge on the principle of incremental costs. Funds through CDM, for example, would be available to pay for additional storage of carbon beyond what is already in the country's economic interests. In Bhutan's case, loss of forest cover would be extremely damaging to the country's economy (due to the extensive erosion, degradation of hydropower potential, and loss of locally important biodiversity that would result). It is difficult to make a case that funds from CDM or carbon trading should help to pay for the cost of protecting the forest.

Even so, opportunities do exist to take advantage of these sources of funding. Two of these opportunities are outlined below.

5.5.1 Fuelwood Offsets

CDM funds could be used to help pay for the cost of hydropower developments that would lessen pressure on fuelwood supplies in areas that are facing fuelwood shortages. As long as fuelwood is not over harvested, it does not represent a net addition of carbon into the atmosphere. But where it is over harvested, leading to forest loss, then a case can be made that substitution of hydropower for fuelwood as an energy source will help prevent net additions of carbon into the atmosphere. Given current fuelwood consumption of 1,200,000 cubic metres and assuming that roughly one third of that consumption is now in areas facing fuelwood scarcity and that hydro development could reduce that demand by two thirds, the net carbon contribution would be the carbon equivalent of about 266,650 cubic metres of wood yielding a net value of 26,600 tons of carbon. Damage costs per ton of carbon released into the atmosphere are usually taken to be about $20 per ton; however, alternative carbon offset projects involving fuel conversion yield carbon savings at a value of $5 per ton. A rough estimate of the market value of the carbon offset associated with reduced fuelwood consumption, based on the above assumptions and a price of $5 to $ 10 per ton offset, would be about $125,000 to $250,000 per year.

5.5.2 Reforestation

CDM funds could be used to pay for reforestation in areas where the forest has been degraded. Successful reforestation efforts have been undertaken in the area surrounding Thimphu and Wangdue, for example. CDM could be used to support such reforestation efforts, as long as a strong case could be made that reforestation of a particular region was not simply displacing pressure to other forests that would then be cleared more quickly.

Bhutan recently rejected a proposal for a $20 million project from the Forest Absorbing Carbondioxide Emission Foundation (FACE) of the Netherlands out of concern over the potential loss of sovereignty implied in the project. Based on the lessons learned through

the negotiation with the FACE foundation, and through consultation with other countries such as Costa Rica that are actively implementing projects, the RGOB may wish to develop a set of criteria to help guide its future considerations of carbon offset proposals or to identify specific proposals it wishes to make to donors.

For any revegetation project to be considered as a target for CDM funding, the donor will need long-term assurance that the carbon will remain sequestered. These criteria can be met in a manner that does not undermine the country's sovereignty over its resources. In effect, the country financing the CDM project is paying for a long-term lease on land in Bhutan, just as the country might allow a long-term lease for a mining operation by a private company. In neither case is the sovereignty of the country placed in question – a particular right to the land has simply been purchased for a specified period of time.

The donor would also need assurance that the restoration of a forest will not simply lead to the loss of an adjacent forest. This issue of carbon "leakage" can be difficult to address. As a rule of thumb, however, unless the proposed project has the effect of stopping the pressures that led to the original loss of the forest, then the result of the project is likely to be leakage. Thus, if the forest was degraded due to expansion of agricultural land, then revegetation of the forest will simply shift the pressure of expanding agriculture elsewhere. On the other hand, revegetation of the hills surrounding Thimphu was achieved in part by fencing that kept cattle out while the forest was being established. Once the forest was re-established, the cattle could be allowed back into the forest without difficulty. Thus, there is less reason to expect that revegetation of this forest would lead to carbon leakage to other areas.

5.6 Ecosystem Services

The maintenance of natural ecosystems in Bhutan provides economic benefits that fall into three general categories: market and non-market values associated with particular species (NTFPs, bioprospecting, genetic resources); aesthetic values that draw ecotourists to see the diversity of species or particularly charismatic species, and values associated with ecosystem services. Ecosystem service values have traditionally been least well appreciated by policymakers world-wide – probably because of the difficulty in capturing their full economic value – but they are likely to prove to be one of the most important sources of economic revenue associated with the maintenance of natural ecosystems in Bhutan.

Some examples of services provided by ecosystems are air filtration, water purification, maintenance of soil fertility, pollination of crops, flood control, erosion control, maintenance of stream discharge rates, protection of coastlines and so forth. Many of the services that an ecosystem provides are altered when changes are made to its species composition or structure, as, for example, when a forest is replaced with cropland or pasture. Sometimes the effects on ecosystem services are intentional, as, for example, filling a wetland to reduce the threat of disease transmission by mosquitoes. Other times, the effects are inadvertent, such as the filling of that same wetland the next flood runoff that is exacerbated, destroying downstream settlements.

The maintenance of forest cover in Bhutan provides two critical ecosystem services for the country: a) protection from erosion; and, b) maintenance of water discharge patterns. Without

extensive forest cover, the steep slopes and highly erodable soils in much of the country would be subject to extensive landslides, slumps and surface erosion. This would have both local and regional impacts. Locally, it would create water quality problems, threaten settlements and agricultural lands with landslides, and reduce the potential economic benefits from hydropower development either by shortening the effective life of reservoirs or increasing the maintenance costs of run-of-the-river hydro developments. Regionally, the added sediment load would accelerate the build-up of natural levies in low-lying areas in Bangladesh and India, raising the risk of massive devastation when natural levies break flooding low-lying areas.

Forest cover also evens out the discharge pattern of Bhutan's rivers. During wet periods, forests retain more moisture, lessening peak discharge rates and increasing discharge during periods with lower rainfall. A more uniform discharge rate provides substantial economic benefits for hydro development, since the pattern of power generation then more closely matches baseload power needs. And, because peak discharge rates are lessened when forest cover is maintained, the risk of devastating downstream floods is reduced. This again has regional implications-protection of forest cover in Bhutan diminishes flood threats in India and Bangladesh.

As critical as ecosystem services may be to the sustainable development of a region, they are not something that can be commercialized for direct, expanded economic returns. Countries typically experience an economic cost when a service is lost, but the benefits provided by ecosystem services do not appear on a nation's economic ledger as revenues. For example, if the mangroves protecting a coastline from erosion are destroyed, the country has to pay to build an artificial barrier to protect the coast from erosion. The mangroves thus provide an economic benefit at least equal to the cost of the replacement of that service, but that benefit does not show as revenue in the budget of the forest manager responsible for protecting the mangroves.

How then are countries to pay the costs associated with protecting these important ecosystem services? The answer is straightforward – the cost of maintaining the services should be built into the price paid for the ultimate product of the service. If mangroves are protecting a coastline from erosion, then a tax should be placed on the value of the property protected and the revenue should be used to maintain the mangroves. If a wetland is helping to clean a town's sewage, then a fine should be placed on water use with the revenues used to help maintain the wetland. And, if the presence of forested watersheds increases the economic returns from downstream hydro development, then the cost of protecting those watersheds (or the opportunity cost of that forest if that value is greater) should be built into the price of electricity produced by the power plant. In effect, the opportunity cost of alternative uses of a forested watershed is as much a cost of development of a hydropower plant as the concrete and labour required for construction. And the cost of maintaining that forest cover is as much an operations and maintenance cost as the cost of replacing worn-out equipment.

Costa Rica is perhaps the first country to build the cost of maintaining ecosystem services directly into the costs of the final product. Costa Rica depends on hydroelectricity for 99 percent of its electricity needs and a large portion of the water "fuelling" that hydropower production – estimated to be 50 to 80 percent – flows from the country's Protected Areas (GCR, 1992). In 1995, the country placed a small tax on users of water and electricity in the country. The revenue generated from that tax is then returned to the Conservation Areas. These

revenues, combined with a small endowment and the revenues from park entrance fees, will be able to cover 80 percent of the operating costs of the Protected Areas.

This same approach could be applied to planned hydro development in Bhutan. For example, consider the pre-feasibility study for the Kholong Chhu hydroproject. Development of this project is not planned for the 8th Five Year Plan, so this example is strictly hypothetical.) The hydro project would have an installed capacity of 290 MW and the continuity of its power production would rely heavily on the maintenance of the integrity of the upstream catchment area (an estimated 1,134 sq. km or about 2.5 percent of Bhutan's land area). The pre-feasibility study states:

"Significant upstream catchment changes are not presently planned or expected, as no major population changes or infrastructure developments are anticipated for this area. However, it appears that the major change in the upstream catchment which could potentially have an impact on the project would be road construction and associated logging activities. This might affect the project hydrology in that the timing and magnitude of low and high flows and floods could change thus altering the project design parameters and operation characteristics. Likewise, extremely heavy logging, vegetation clearing or earth moving activities could cause a greater sediment load and inflow to the project." (IBRD, 1993; p. 6-7)

The economic evaluation of a project like this hinges on the cost of construction, the cost of operation and maintenance, and the price at which electricity will be sold. Electricity can be produced through Bhutan's hydropower projects at a much lower cost than the current market price in India. Market prices for energy in India in 1993 were 10.5 cents/kWh (peak), 7 cents/kWh (firm), and 3.5 cents/kWh (seasonal) – these form the "ceiling" price for electricity sales from Bhutan. As long as Bhutan can cover the capital, financing, and operation and maintenance (O&M) costs at prices lower than these, then it stands to make a profit. (The pre-feasibility study estimated the unit cost of supply to be 2.34 cents/kWh; the 1993 tariff for domestic sales in Bhutan was 1.3 cents/kWh.) Typically, the actual electricity costs are set through negotiation with India at a level between the cost of production and the "ceiling" price (and because India has financed past hydro development, it has additional leverage on keeping the costs low).

In the pre-feasibility study, capital expenditures for the project were estimated to be $215 million with operation and maintenance costs (O&M estimated to be about $2 million per year for the 25-year life of the plant. The capital expenditure for the site, however, does not include the opportunity cost of other uses of the catchment area (e.g., for timber harvesting) and the O&M costs do not include the cost of protecting and sustainably managing the forests in the catchment area. In the future, the RGOB may want to include both of these costs in the economic evaluation of specific hydro projects. A substantial fraction of these costs could logically be covered as part of the O&M costs for various hydropower developments.

For an initial approximation of the value of this service, the RGOB could consider the costs of maintaining the forest cover to be equal to the DFS budget. The annual FSD budget for the 8th Five-Year Plan is projected to be about $6 million. Since the catchment of this planned project covers about 2.5 percent of the country, a rough allocation of the Forest Services Budget to the O&M costs for the project would be 2.5 percent of $6 million, or $150,000 per year – an increase of only 7.5 percent in the O&M costs for the project. The net effect would be to

slightly increase the O&M costs of the project thereby increasing the unit cost of electricity supply. Through negotiations with the power purchaser, the effect would be to slightly raise the minimum cost and slightly raise the final negotiated price. Bhutan would then obtain greater revenues from electricity sales, and some of those revenues could then be channelled back to support the Protected Areas and to support forest management.

In principle, to the extent that Bhutan protects more forest cover than is justified from its own economic self-interest, but which serves to lessen flood damage in Bangladesh or India, those countries should contribute to the cost of forest protection. In practice, capturing these economic benefits is likely to be difficult. First, the same issue of incremental cost arises here that bedevils the Clean Development Mechanism issues. Protecting natural forest is largely justified in Bhutan simply because the costs of logging or converting the forest exceed the benefits that would be gained. Second, the actual link between forest cover in the Himalayas and flood risks in the lowland area is poorly understood. It would be in the interest of all three countries – Bhutan, India, and Bangladesh – to expand research on this issue. At the outset, it may be more appropriate to pursue the goal of support from India for research in Bhutan. Eventually, however, Bhutan may wish to consider seeking watershed protection grants from India, or building additional watershed protection costs into the electricity tariff charged to India and Bangladesh. In effect, India and Bangladesh would pay an additional "tax" on electricity which would help to justify (and pay for the management of) the maintenance of forest cover in Bhutan, since the loss of that forest cover would have serious economic consequences for India and Bangladesh.

Annex 1: Bibliography

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Annex 2: Protected Species

SCHEDULE – IA

Sl.No.	Common Name	Scientific Name
1.	Asian Elephant	*Elaphus maximus*
2.	Clouded Leopard	*Neofelis nebulosa*
3.	Golden Langur	*Presbytis geei*
4.	Musk deer	*Moschus chrysogaster*
5.	Pangolin	*Manis crassicaudata*
6.	Pigmy Hog	*Sus sylvanicus*
7.	Snow Leopard	*Panthera uncia*
8.	Takin	*Budorcas taxicolor*
9.	Tiger	*Panthera tigris*
10.	Wild Buffalo	Bubalus bubalis
11.	Black-Necked Crane	*Grus nigricollis*
12.	Monal Pheasant	*Lophophorus impejenus*
13.	Peacock Pheasant	*Polyplectron bicalcaratum*
14.	Raven	Corvus corax
15.	Rufous-Necked Hornbill	*Aceros nepalensis*
16.	Golden Masheer	*Tor tor*
17.	Spotted Deer	*Axis axis*
18.	Gaur	*Bos gaurus*
19.	Leopard	*Panthera pardus*
20.	Leopard Cat	*Felis bengalensis*
21.	Himalayan Black Bear	*Selenarctos thibetanus*
22.	Red Panda	*Ailurus fulgens*
23.	Serow	*Capricornis sumatraensis*

SCHEDULE – IB

S.No.	Local Name	Common Name	Botanical Name
1.	Agar/agaru	Eagle Wood/ Indian Aloe Wood	*Aquilaria malaccensis*
2.	Yartsa-guenboop	Chinese Caterpillar	*Cordyceps sinensis*
3.	Pang-gen metog		*Gentiana crassuloides*
4.	Snow Down Lily		*Llyodia yunnanensis*
5.	Tsher-ngeon	Blue Poppy	*Meconopsis grandis*
6.	Kirang-shing	Yew	*Taxus baccata*
7.	Bhreeng-gee ra dza	Ginseng	*Panax pseudo-ginseng*

The first Biodiversity Action Plan for Bhutan (BAP) was published in 1998 and submitted to the United Nations Convention on Biological Diversity (CBD) in the same year as the country's first national report on biodiversity. It has been referred to as BAP I in this document. This Biodiversity Action Plan for Bhutan, 2002, is the first revision of the earlier document and is being referred to as BAP II. It is the country's second national report on biodiversity submitted to the CBD. BAP is a living document and its revision will be an on going process with the changing times, conditions and priorities of the Royal Government of Bhutan.