CHAPTER-I

INTRODUCTION

All life on earth is part of one great, inter-dependent system, which interacts with and depends upon the physical and biological components of the environment. The variety of genes, species and ecosystems which encompass the variations existing among and between genotypes, species, populations, communities and habitats constitute the biological diversity which is essential for maintaining the basic processes on which life depends and is a key to sustainable development. They not only provide food, medicine and products of commercial and non-commercial use but also maintain life by providing environmental services like, air & water quality, soil fertility, pest and disease control, waste disposal, etc. Human beings are also an integral part of the biogeosphere and depend upon it in totality. Since the advent of civilization human actions have affected the environment, but in the past these actions were trivial when set against the dominant processes of nature. This however, is not so now. Increasing human population, industrialization, intensive agricultural and animal husbandry practices and over exploitation of natural resources to meet the goals of so called 'development' have threatened the availability of both, physical & biological resources. This has resulted in the need for looking afresh into the inseparable links between development and conservation and it is being increasingly recognized that unless we use the earth's resources prudently, and conserve our biological diversity, development will fail. Not only would essential life support systems and ecosystems stability be affected but people would also be denied their future.

Scientists believe that there are several million species which are yet to be identified. Out of those which are known, we are still learning on how they relate to each other and their physical environment. Thus we cannot predict the affect of loss of one species on other or the ecosystem. What we do know is that certain species, called keystone species, play a critical role in their ecosystem by influencing the health and abundance of many other species. It is also important to realize that even without human actions, a few species naturally become extinct over time. However, the rate of extinction now is several times greater than the natural rate, thus, causing a void in the natural system. Hence, the need to take a closer look at the existing

environment, the impact of human actions on biological diversity and to extrapolate the trends for the future.

It was the World Conservation Strategy which first stressed upon the need for conservation based development. Subsequently the United Nations Conference on Environment & Development at Rio de Janeiro in June,1992 highlighted the concept of biodiversity and resulted in the Convention on Biological Diversity (which came into force in 1993). Under the Convention, it is mandatory for all contracting parties to prepare Biodiversity Conservation Strategies and Action Plans at national level and promote biodiversity conservation. It is in this context that the process for preparation of National Biodiversity Strategy and Action Plan was initiated by the Government of India in 2000 which envisages preparation and merger of ecoregional, state level and sub-state level plans and thematic documents.

The present document defines the State Biodiversity Strategy & Action Plan for the State of Punjab. This strategy establishes a general framework for the State's policy on conservation and sustainable use of biological resources, define its current status and identify the processes which are leading to its deterioration. It sets out, both, guidelines for future action and specific programmes aimed at ensuring compliance with the proposed goal. The strategy should therefore be regarded as a bridge between the National Strategy & Action Plan as well as the role of the State Government for application of measures and actions at the ground level. It, therefore, has to strive to be consistent with the former and provide a framework for the latter.

Punjab is one of the smaller states of India with an area of 50362 sq. km located between 29°30′ and 32°32′N latitude and 73°54′ and 76°50′ E longitude. Physiographically, it is situated in the north western part of India sharing a 300 km long international border with Pakistan in the west. Its north eastern side is bounded by the States of Jammu & Kashmir and Himachal Pradesh and the South Eastern by Haryana and Rajasthan. Due to its strategic location, the state has witnessed several upheavals and invasions in the historical past and has been partitioned first in 1947 into East and West (in Pakistan) Punjab and subsequently reorganized into the present Punjab, Haryana and Himachal Pradesh in 1966. This has adversely affected its natural resource availability. The state which was once named 'Punjab' after its five rivers ('Punj' meaning five and 'Ab' meaning water) now has only two major rivers (Sutlej & Beas) flowing through it and one major river (Ravi) touching its

northern border. Inspite of these upheavals, the state has achieved tremendous success in the economic and food front. It enjoys the distinction of being the food bowl of the country and has the country's highest per capita income. However, this has not been without a price.

The state comprises 17 districts, 120 towns and 12342 villages. The area is generally plain (180-320 m above sea level) except for the Sub-Himalayan Shivalik foothills in the North Eastern Border (300 to 800 m above sea level). The climate is typically sub-tropical with hot summers and cold winters. The annual rainfall is around 532mm in plains and 890mm in the Northern sub-mountanous regions in the lower Shivaliks.

Punjab is primarily an agrarian state with 84% area under intensive cultivation (and a cropping intensity of 184%). The soil in the plains is mainly alluvial and suitable for cultivation. However, the monotony of its well mended fields is broken in patches by water courses, wetlands and sand dunes besides an elongated green, undulating elevated stretch of Shivalik hills. These are the areas which harbour natural biodiversity and provide a home to several rare animals like Pangolins, Chital etc.

This document not only tries to identify and inventorise such areas but also assess the diversity in the state's agricultural fields and define guidelines and actions to promote its conservation. The utility of this document would, therefore, depend upon the degree of influence it would have on the range of social contexts, state planning, development of education, research, culture and above all, attitudes which the government and the society must adopt.

1.2 Scope

The document tries to cover the following levels of biodiversity in context of the issues of conservation, sustainable & equitable use and scientific, economic and cultural dimensions besides socio-economic & cultural ways of relating to nature:

1. Natural ecosystems: e.g. forests, wetlands, grasslands, semi-arid areas, sub-montane zones, etc.
2. Wild species and varieties: an attempt has been made to collect and collate all available data on species of plants & animals (and to some extent micro-organisms).
3. Agricultural ecosystems: including historic changes in land use pattern, farmlands, horticulture, aquaculture & silviculture practices

4. Domesticated species and varieties: varieties/species of crops, livestock, fishes (native and introduced) including genetic variation wherever possible

1.3 Objectives

The principal objectives of the SBSAP are to:

- Assess the existing status of biodiversity in Punjab,
- Identify causes of its deterioration, if any,
- Promote conservation and sustainable use of the state's biological resources,
- Promote awareness and dissemination of information amongst government departments and the public for realizing peoples' involvement and participation in conservation activities,
- Create mechanisms required to plan for natural resource management and long term conservation,
- Promote cooperation between all stakeholders including government, public institutions, social & economic groups and the masses,
- Incorporate principles of restoration, conservation & sustainable use of biodiversity in planning & execution of sectoral and cross-sectoral policies,
- Stimulate education, training & research in the area,
- Identify legal & financial instruments to achieve these objectives, and
- Promote regional, inter-state, national and international cooperation through multilateral programmes and joint initiatives.

1.4 Guiding Principles

The SBSAP is guided by the following cross-sectoral concepts:

1.4.1 Conservation and sustainable use

- Recognizing the right of survival of each species
- Identifying root causes of biodiversity loss in the state and taking corrective action for mitigation of disturbances in the natural environment.
- Integrating and coordinating biodiversity with sectoral and distt. level plans embracing ecological, social & economic aspects which encourage sustainable development.
- Maintaining compatibility of use of certain biological resources (by people and govt.) with maintenance of ecosystems to ensure their potential long-term usage.

- Restoring degraded habitat components to recover dwindling species; this generally be based on the 'Polluter pays Principle'.
- Promoting in-situ & ex-situ conservation of particular species.
- Particular attention to agro-biodiversity.
- Adopting the 'Precautionary Principle' and taking immediate action when there is a threat of substantial reduction of biodiversity in an area (Lack of scientific proof should not be used as justification to delay these actions, rather should be used as a stimulus to promote research and generation of new knowledge).
- Defining short, medium and long term plans for biodiversity conservation.

1.4.2 Public participation and coordination

- Ensuring that the strategy and action plan is based on the principles of shared responsibility by all stakeholders (meaning thereby, involvement of all social & economic sectors of the state in planning and implementation).
- Ensuring that NGOs (including Panchayats, Mahila Mandals, Youth groups, etc.) are recognized and accepted as fundamental participants in execution of all conservation based programmes.
- Creating awareness & disseminating information on biodiversity and conservation issues to sensitize societies to participate in conservation action.
- Promoting coordinated action within and between government and public groups.
- Defining responsibility of various sections of society in conserving their biological resources.

1.4.3 Equity

- Ensuring the share of local communities in the benefits obtained from use of natural resources which they have helped to conserve over long periods of time. Also empowering people to conrol & manage these resources by promoting suitable practices for their management.
- Defining a mechanism to secure the informed consent of local communities for economic/commercial use of a bioresources in an area.

- Ensuring sustenance of Common Property Resources through local institutions.

1.4.4 Planning

- Channelising natural resource planning based on conservation objectives.
- Promoting interdepartmental coordination during planning of development projects.
- Dynamic diagnosis of the status of conservation of biodiversity and taking preventive action.
- Institutionalising environment impact assessment in all major developmental projects.

1.4.5 Environment Education, Training & Research

- Educating each section of our society, specially our children, about the value of biodiversity and how it can be protected for future generations. Educating government agencies, NGOs, academic institutions, scientific bodies, women organisations, etc. for providing scientifically based environment information to citizen to help them make informed decisions.
- Promoting Biodiversity education as a lifelong process among literates, neo-literates and non-literates.
- Generating Biodiversity databases and developing a biodiversity information mechanism. Also developing Peoples' biodiversity registers and providing them legal protection against biopiracy.
- Adopting a multi-disciplinary approach in biodiversity research.
- Addressing IPR issues at research level and incorporating recognition of gender differentiated knowledge of local women and men.

1.4.6 Economic & Legal aspects

- Taking up economic evaluation of bioresources. This be based not only on market value of products and services, rather intangible benefits be also included.
- Ensuring IPR benefits during commercial use of bioresources.
- Enforcing compliance of legislations pertaining to ecosystem conservation, biodiversity use and pollution control using both, stimulatory and coercive measures.

1.4.7 Ethical & cultural issues

- Recording existing religious and cultural practices and looking into their scientific links.
- Encouraging local populations and socio-economic agents to maintain environment friendly traditional uses of bioresources and promote traditional knowledge and techniques (especially with rural communities) to promote biodiversity conservation.
- Promoting ethno-biological studies.

1.5 Methodology

A multi-pronged approach was adopted for preparation of this document.

1.5.1 Steering Committee

A meeting was taken by National Project Director on 26-8-2000 (minutes of the meeting at Annexure-1) and a State level Steering Committee was notified which met on 10.10.2000 (List of Steering Committee members and Minutes of the meeting placed at Annexure-2a&b). Subsequently the following four Sub-committees were constituted to discuss details:

- Sub-committee for Agriculture
- Sub-committee for Wild Diversity
- Sub-committee for NGO inputs
- Sub-committee for University & R&D inputs

Only the former two sub-committees actively co-opted members, held meetings and provided inputs (Annexure-3a&b). The draft document was circulated to all steering committee members, concerned departments, co-opted members, NGOs, and experts besides National Project co-ordinator, TPCG members, MoEF and BCIL for comments. It was also put up on the NBSAP website (http//:sdnp.delhi.nic.in/nbsap). It was also discussed in the Northern Region NBSAP meeting held at Chandigarh from 18th - 20th October, 2001 (Plate 1a). Comments recieved were discussed in the second state steering committee meeting and sensitization workshop and relevant portions modified (Plate 1b).

1.5.2 Primary data collection

Primary data was collected through the following:

- Questionnaires (in English & Punjabi) were circulated to the public through NGOs & schools for collecting information on traditional farming & conservation systems and related religious, ethical, cultural & social aspects. (Annexure-4).
- One State level public hearing was organized for NGOs and experts for dissemination of information on NBSAP on 21.11.2000 (Annexure-5). This was expected to have a multiplier effect as these NGOs further took the message to the grassroots (Plate 1c).
- Five sub-state public hearings were organized with the help of local NGOs covering all the 17 districts (Plate 1 d and e).

Districts Covered	**Date, Time, Venue**	**Nodal NGO**	**No. of participants**
Amritsar Jalandhar Kapurthala	18.01.01, 11AM, Guru Nanak Distt. Library, Near NamDev Chowk, Jalandhar	'Pahal', 36 New Viveka Nand Marg, Maksudan, Jalandhar Tel.0181-200784	46
Ferozpur, Gurdaspur Faridkot Amritsar	24.01.01, 11AM, Raja Karmi Mahajan Hall, Ramlila Ground, Pathankot	Institute of Ecology & Env, Opp. SBI, Ramlila Ground, Pathankot Tel. 0186-30269	33
Ropar Patiala Fatehgarh Sahib	03.02.01, 10AM, Mata Gujari Niwas Gurdwara, Fatehgar Sahib	Voluntary Health Assoc. of Punjab, SCF 18/1, Sector 10-D, Chandigarh Tel. 0172-743557	50
Nawashahar Hoshiarpur Moga, Ludhiana	09.02.01, 11AM, Govt. High School, Pojewal, Nawashahar	ASRA, Vill. Dher, Distt. Ropar Tel. 01887-63611	48
Sangrur, Mansa Bathinda Ferozpur	10.02.01, 10AM, Teacher's Home, Near Bus Stand, Bathinda	Voluntary Health Association of Punjab, SCF 18/1, Sector 10-D, Chandigarh Tel. 0172-743557	36

Records of the public hearings are placed at Annexures-6-10.

- Discussions & interviews were held with representatives from various departments, academic institutions, NGOs, some village Panchayats & knowledgeable local persons identified during public hearings or through references from experts.

- Field visits to areas of ecological interest like, Harike, Kanjli & Ropar wetlands, Shivalik Forest Ecosystem, Abohar Sanctuary, other protected areas & Sanctuaries, etc. were conducted and relevant data collected.

1.5.3 Secondary data sources

Literature available at Central and Departmental libraries and through personal communication with experts of all the four universities of Punjab, relevant R&D bodies and govt. departments was reviewed. This included books, reports, journals & published papers, departmental files, Working Plans, Administrative orders & communications, recommendations of Technical Committees, etc. Information was also culled out from Ph.D, M.Phil & M.Sc Theses. The following institutions/departments were referred:

- Panjab University, Chandigarh – A.C. Joshi Library, Deptts. of Botany, Zoology, Microbiology, Biotechnology, Anthropology, Pharmacy, Geography, Geology, Sociology, etc.
- Punjabi University, Patiala – Main Library, Deptts. of Zoology, Botany, Microbiology, Pharmacy, Biotechnology, etc.
- Guru Nanak Dev University, Amrtisar – Main Library, Deptts. of Life Sciences – Botany, Zoology, Microbiology, Biotechnology, etc.
- Punjab Agriculture University, Ludhiana – Main Library, College of Basic Sciences – Deptts. of Botany, Zoology, Microbiology; College of Fisheries; College of Veterinary Sciences; College of Agriculture – Deptts. of Agronomy, Horticulture, Floriculture, Vegetable Crops, Seed Technology, Plant Breeding, & Landscaping; College of Entomology - Deptts of Ecology, Biotechnology, Microbiology, Forests & Natural Resources; College of Extension Education
- Krishi Vigyan Kendras – Bathinda & Jalandhar;
- Sugarcane Research Station - Jalandhar
- Punjab Remote Sensing Centre, Ludhiana
- National Bureau of Animal Genetic Resources, Karnal
- National Bureau of Plant Genetic Resources, New Delhi
- Indian Agricultural Research Institute, New Delhi
- Botanical Survey of India, Dehradun
- Zoological Survey of India, Dehradun
- Indian Institute of Remote Sensing, Dehradun

- Forest Survey of India, Dehradun
- Central Soil & Water Conservation Research Institute, Chandigarh
- State Government Departments:
    - O/o Economic & Statistical Adviser, Govt. of Punjab
    - Deptt. of Forests & Wildlife
    - Deptts. of Agriculture, Horticulture, Animal Husbandry & Fisheries
    - Deptt. of Industry

Besides, Punjab govt website www.punjabgovt.nic.in and other relevant websites were also visited.

1.5.4 Data validation

As mentined above the draft was circulated to all relevant departments, R & D bodies and experts for validation of data and necesary corrections were made. These include comments from departments of Forest and Wildlife, Department of Industries, Agriculture, PAU, Ludhiana, Panjab University, Chandigarh, Punjabi University,Patiala and GNDU, Amritsar. The action projects were submitted by the concerned departments along with their comments.

1.6 Key Participants

The following are the key actors in preparation of this document:

- Punjab State Council for Science & Technology - Nodal Agency
- Technical & Policy Core Group (TPCG) members
- Department of Forests & Wildlife, Govt. of Punjab
- Departments of Agriculture, Horticulture, Animal Husbandry & Fisheries, Govt. of Punjab.
- BSI, Dehradun and ZSI, Dehradun & Solan
- PAU, Ludhiana
- Panjab University, Chandigarh
- GNDU, Amritsar
- Punjabi University, Patiala
- NGOs (eg. Voluntary Health Association of Punjab; Society for Education, Environment & Protection of Animals, Amritsar; Institute of Ecology & Environment, Pathankot; ASRA, Ropar & PAHAL, Jalandhar)
- Individuals (eg.Sh. H.S.Gujral, Sh.M.S.Chhibber, Deptt. of Forests, Govt. of Punjab; Dr. M.S. Tiwana, Dr. G.S. Dhaliwal from PAU, Ludhiana; Dr.

H.S. Rose, Dr. Tarlok Singh, Dr. S.S. Bir, Dr. Devinder Singh from Punjabi University, Patiala; Dr. K.K.Tandon, Dr. S.M. Handa, Dr. M.S.Johal, Panjab University,Chandigarh; Dr. Anish Dua,Dr. Avinash Nagpal, Mr. Chander Parkash, Guru Nanak Dev University, Amritsar; Sh. Surinder Kumar, Science Teacher, Govt. High School, Kartarpur Momian, Patiala; Sh. Narinder Singh, Ghoman Charitable Trust, Ghoman, Gurdaspur; Sh. Harbans Singh, Civil Veterniary Dispensary, Kartarpur Momian, Patiala; Sh. Dinesh Kaushik, Incharge, Govt. Middle School, Barwala, Patiala; Sh. Rajpal Singh, Sh. Khuswant Singh, Tarksheel; Sh. Pawan Kumar, Lecturer, S.S.S.S. School, Bargari, Faridkot; Sh. Ashok Chawla, Shahid Bhagat Singh Blood Donors Club, Kotakapura, Faridkot; Mahila Samaj Kalyan Smiti, Chamkaur Sahib, Ropar; Sh. Jalaur Singh Kheewa, Govt. Barjindra College, Faridkot; Sh. Purushotam Betab, Advocate, Faridkot;Sh. Hazara Singh,Fatehgarh Sahib;Sh. Parmjit Singh,Fatehgarh Sahib;Sh. Nirmal Singh, Malwa Hospital, VPO Lambra, Jalandhar; Sh. Shailandra Singh, Green Express, Hoshiarpur and many others)

CHAPTER-II

A PROFILE OF PUNJAB

2.1 Geographical Profile

2.1.1 The State of Punjab occupies only 1.53% of the geographical area of the country. It can be divided into 3 physiographic regions :

- The Sub-mountainous Himalayas, the Shivaliks
- Central & Eastern alluvial plains
- Western Semi-arid area

The characteristic features of these regions are as under:

Physiographic region	**Shivalik (nothern & north eastern hilly tract)**	**Moist plains (central part of state)**	**Semi arid plains (mainly southern Punjab)**
Altitude	300-800m	230-300m	205-230
Average Rainfall (per annum)	90 cm	60 cm	43cm
Major soil types	Fine to moderate	Alluvial	Sandy (at places saline & alkaline)
Vegetation	Mainly forests	Croplands	Desert vegetation esp. thorny bushes
Water availability	Catchment areas of rivers, choes	Major rivers & canals	Originally dry, now fed with canals

The first and third regions are not only 2 disjunct zones, but also show differences in topography and climate.

2.1.2 Climate

The climate of Punjab is typically sub-tropical with hot summers (temperature reaches as high as upto 47°C in certain areas) and cold winters (temperature dropping down to 0°C in others). There are also considerable differences in weather from season to season as well as from year to year. The state has 3 distinct seasons (winter, summer & monsoon) and average annual rainfall is around 532mm in plains and 890mm in the northern sub-mountainous regions characterized by the lower shivaliks.

2.1.3 Land use

Land in Punjab is shared by activities like agriculture, water resources, wetlands, forests, living spaces, industrial & commercial purposes, transportation network, pastures, etc. (Fig. 2.1). Some land is left as waste and barren land and some of it is used for other

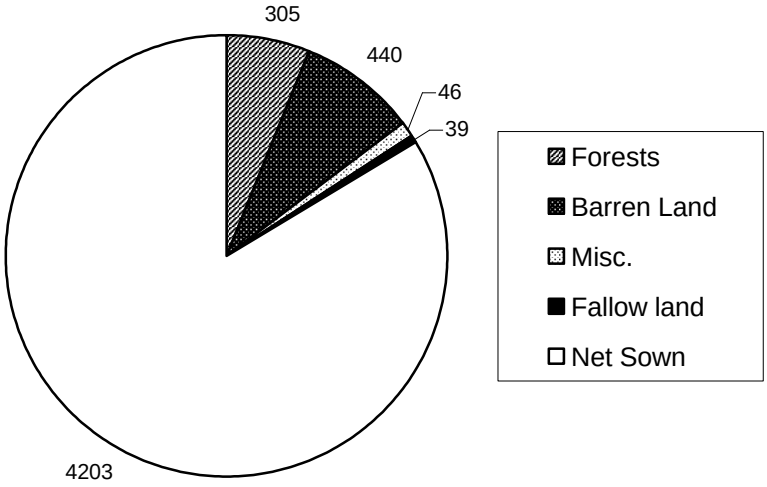


Fig. 2.1 Land use Plan (000'ha)

miscellaneous activities. 84% of the state's area is under agriculture out of which some part has been utilized in developing canal and drainage irrigation system. The state contributes 9.2% rice and 21.4% wheat production in the country.

About 5.7% of the area is under forest as per records of the Forest Department. Out of this 55.8% is privately owned. The state has 134 urban settlements out of which master plans for 58 towns have been prepared but none has been approved so far. Amongst these 113.26 sq. km. area has been designated for industrial use. Only 40 sq. km land is reported to be under pastures and 300 sq. km. identified as waste and non-cultivable land.

The details of agriculture and forest land are discussed separately.

2.1.4 Air Quality

The ambient air quality in industrial zones and major cities of Punjab (Ludhiana, Amritsar, Jalandhar, Mandi Gobindgarh & Batala) have higher than permissible ranges of suspended particulate matter. Sulphur di-oxide & Nitrogen oxides are usually within limits. This has adversely affected floristic & faunistic composition in urban areas. Vehicles and industries are major contributors to urban pollution. The total vehicle population has increased 16 times between 1975-76 to 1999-2000 out of which the maximum increase has been observed in population of 2/3 wheelers (Table 2.1).

Table: 2.1 Increase in Vehicular Population in Punjab

Year	Buses	Cars & station wagons, Jeeps & Taxies	Three Wheelers	Two Wheelers	Goods Vehicles	Tractors & other vehicles	Grand total
1975-76	3708	23944	1939	80105	12629	51110	173435
1980-81	5850	33250	2897	176555	22092	119510	360154
1990-91	9470	82799	13550	877837	54411	291415	1329482
1999-2000	15708	200101	26664	1954764	92698	426715	2716650

Source: Statistical Abstract of Punjab,2000.

Punjab also has an extensive road network. The total road length amounts to 44,060 km. Cent percent villages are connected with reasonably good roads. Hence, these are the major means of transportation in the state. Fly ash generated from the thermal power plants also poses a major air & land pollution problem. Coal based industries (especially SSI units) also contribute to air pollution. Use of rice husk, a major source of agro-based fuel for industry, has been responsible for increase in suspended particulate matter in the atmosphere but its use has been banned in loose form from April 1995..

In rural areas burning of stubble in the fields after harvesting, fertilizer & insecticide spraying, threshing operations, use of wood and coal as household fuel and large scale use of tractors, harvester combines and diesel operated tubewells are major factors contributing to deteriorating air quality.

2.1.5 Water resources

The state is rich in water resources and is traversed by four major rivers i.e. Sutlej, Beas, Ravi & Ghaggar. The total stretch of these rivers is about 1830 km. (Sehgal, 1984). The Ravi runs along the Indo Pakistan boundary in districts of Gurdaspur & Amritsar before entering Pakistan. The Beas enters Punjab from the Kangra valley and joins Sutlej at Harike. The Sutlej is deflected at several places in the Shivaliks and enters Punjab near village Bhakhra (where the famous Bhakhra Dam is constructed and the Gobind Sagar Lake has been formed), moves on to plains at Ropar & passes through district Ludhiana (where the notorious Budha Nallah merges with it) and joins Beas at Harike before crossing over to Pakistan. The Ghaggar originates in the Shivaliks in Himachal Pradesh and enters Punjab at

Dera Bassi. Traversing through district Patiala, Sangrur & Bathinda, it re-enters Haryana before crossing over to Rajasthan.

In addition, several seasonal rivers/rivulets known as 'choes' are found in the Shivalik area. They are mainly responsible for soil erosion in districts Hoshiarpur, Nawansher & Ropar. As many as 93 'choes' are reported to flow in Hoshiarpur district alone. It has been reported that these seasonal rivulets bring down approx. 35 tonnes/ha/annum of soil. This has been reduced now to about 18 tones/ha./annum with the efforts of soil conservation and Forest Departments. As many as 17 small dams have been constructed as water harvesting structures in the Shivaliks.

The total stretch of canals, distributaries, etc. is approx. 14500 kms (Fig 2.2). The main canals from River Sutlej are Anandpur Hydel Channel and Bhakhra Main Line (BML). BML further bifurcates into Narwana branch and Bhakhra main branch. At Ropar again two main canals, Sirhind canal and Bist Doab canal originate. At Harike, Sutlej feeds water to Rajasthan feeder Canal and Ferozepur feeder at Hussainiwala. One main canal from Beas originates at Shah Nehar Barrage called Mukerian Hydel Channel or Shah Nehar. The major irrigation canal originating from Ravi at Madhopur is Upper Bari Doab Canal (UBDC).

The drainage system is also complementary to the canal irrigation system. The drains between Ravi and Beas are Shakki Nallah, Hudiara Nallah, Kasar Nallah and Patti Nallah. The drains between Beas and Sutlej are West/Kali Bein & East/Safed Bein. Other major drains falling in river Sutlej are Jalalabad drainage system and Budha Nallah. These drains help in quickly dealing with heavy run off and in preventing water logging.

Further, about 4400 ha. of continuous strips of depression run along the canals. About 1200 ha of land is under backwaters. The total standing water area in the state is about 8700 ha which is expected to increase since the completion of Ranjit Sagar Dam on the Ravi.

Village ponds & tanks cover an area of about 3100 ha. in Punjab. They have played a major role in defining the ecology of rural areas providing natural drainage, acting as groundwater rechargers and providing habitat to the local flora & fauna. However, most of these ponds are now used for discharge of sullage water and some of them are infested with water hyacinth. In some areas these ponds & tanks

are being filled up for so-called 'developmental activities', thus adversely affecting the local ecology and biodiversity.

The state is well known for its large dams - The Bhakhra Dam at Bhakhra, Ranjit Sagar Dam at Thein and part of Pong Dam near Talwara (river Beas) and barrages - at Harike, Ropar, Madhopur, Kanjli, Hussainiwala, Shahpur Kandi, Tajewala, Shahnehar, etc. which have been constructed to facilitate hydro power production and irrigation in the state. The Beas-Sutlej Link has been helpful in diverting excess water of Beas to Sutlej. Work on the Sutlej-Yamuna Link was also taken up but the project has not been completed due to water-share problems with neighboring state. The reservoirs of these dams and barrages have submerged large tracts of land in Punjab and H.P and caused displacement of people and loss of natural ecology. The total reservoir area amounts to 157 sq. km. However, with emerging concerns for the environmental suitability of large dams, attention is now being focused on development of micro and mini hydel facilities.

The state is also rich in natural wetlands. With construction of dams and barrages, several manmade wetlands have also emerged on the state's land scape. About 147.39 & 8.39 sq. km. area is under manmade & natural wetlands in Punjab respectively. Out of these the Harike, Ropar, Kanjli wetlands have been identified Ramsar sites in India. Details are discussed separately under Para 3.3.2. Besides the above mentioned water resources,

9.25 lac tubewells have been installed to meet the drinking & irrigation water requirement of the state. This is adversely affecting the ground water balance (Table 2.2)

Table 2.2 Ground water exploitation in Punjab State

S.No	Distrcit	Ground Water Recharge/ Extraction
1	Gurdaspur	Recharge20-50% of extraction
2	Hoshiarpur	Recharge20-50% of extraction
3	Ropar	Recharge Higher than 50% of extraction
4	Amritsar	Recharge Equal to extraction (+ 20%)
5	Kupurthala	Extraction exceeding Recharge by more than 50%
6	Jalandhar	Extraction exceeding Recharge by more than 50%
7	Ludhiana	Extraction 20-50% of Recharge
8	Patiala	Extraction exceeding Recharge by more than 50%
9	Ferozepore	Recharge higher than 50% of extraction
10	Bathinda	Recharge higher than 50% of extraction
11	Faridkot	Recharge higher than 50% of extraction
12	Sangrur	Extraction exceeding Recharge by more than 50%

Fig. 2.2 The canal system in Punjab

On an average the water table is declining @ 0.2m/year. The depth of groundwater in sweet ground water area is :

- 0 – 3m : 20% area
- 3 – 10m : 55% area
- 10m or below : 25% area

The ground water in South Western districts is saline and unfit for agriculture.

It is also pertinent to point out here that water and electricity are free for farmers in Punjab since 14th Feb'1997.

2.1.6 Soil quality

The soil in most parts of the state is alluvium and is of highly permeable nature. The textural map is presented at fig. 2.3. However, the soils in some hilly tracts are coarse textured (Fig. 2.4). About 50% of the state's soil is low in nitrogen, 25% has low phosphorous content but potassium content is generally sufficient (Fig. 2.5) Organic carbon content is low. Problems like, soil erosion, salinisation, water logging and pollution have led to soil degradation. About 10% of the state's soil face water erosion (Fig. 2.6). Wind erosion also occurs in several parts. Further, several districts are effected by salinisation (Bathinda, Faridkot, Muktsar, Ferozepur, Sangrur, etc.) and water logging (Amritsar, Ferozepur, Sangrur, parts of Gurdaspur, etc.) (Fig. 2.7). A number of industries like, paper & board mills, textile & dyeing units, distillery wastes, etc. are also releasing their effluents (treated/untreated) on land for irrigation resulting in soil pollution. Another major source of soil pollution is disposal of sewage from municipal and commercial activities. None of the cities have a sewage treatment plant except Nangal.

Fig. 2.3 Textural map of Punjab Soils in Punjab

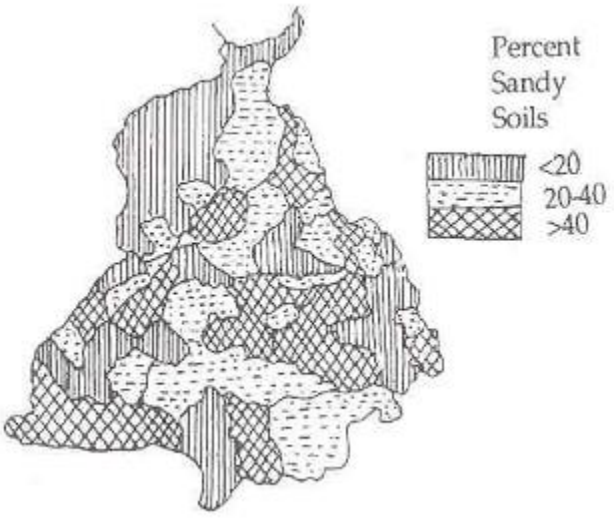
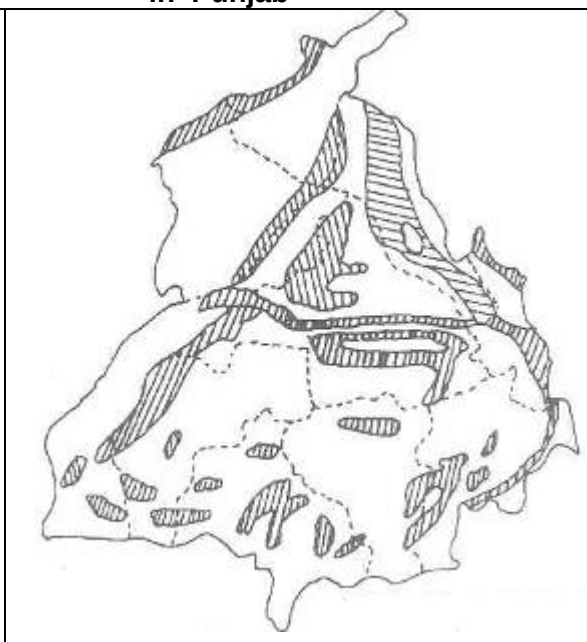
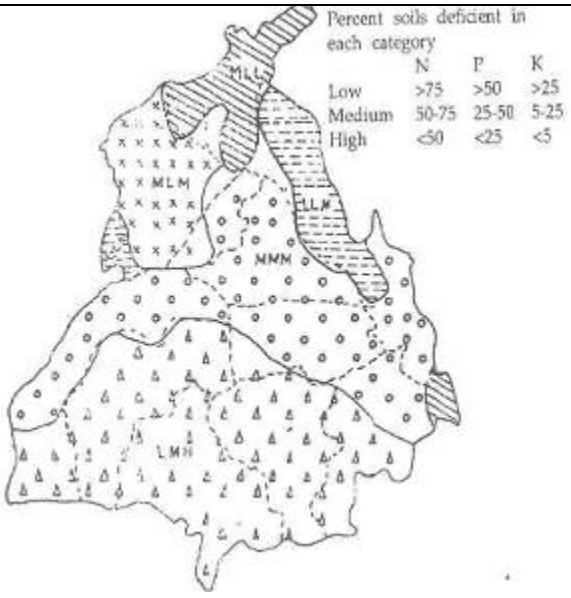


Fig. 2.4 Coarse Textured Soils in Punjab





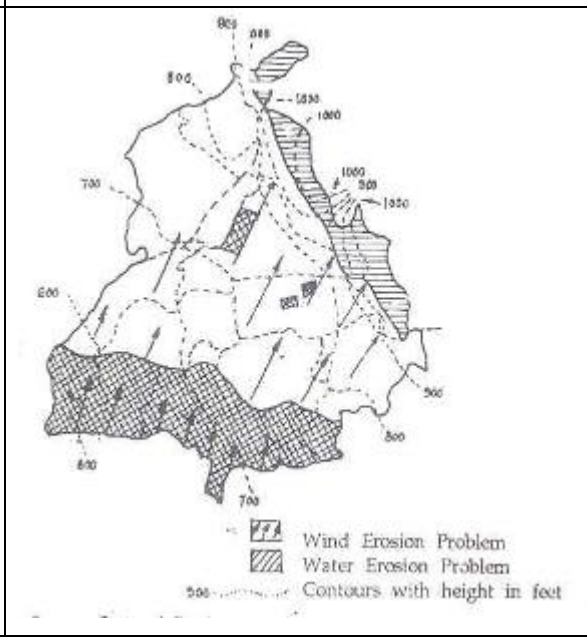


Fig. 2.5: Status of Major nutrients in Punjab Erosion in Soils

Fig. 2.6:Problem of Soil Punjab

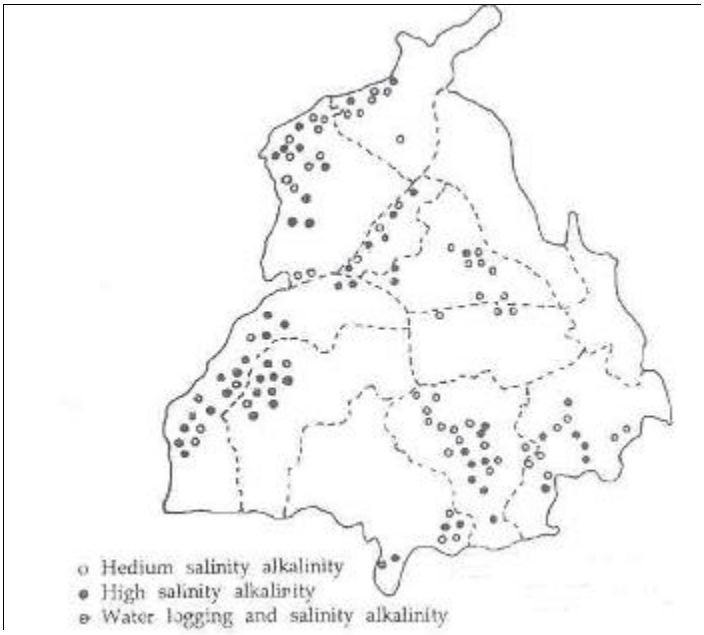


Fig. 2.7: Salt affected and High water table areas in Punjab

2.2 Socio-economic Profile

2.2.1 Demographic & Social Parameters

As per Census of India, 2001, the total population of the State is 24,289,296 which is 2.36% of the National population. The various demographic parameters are presented at Table 2.3.

Table 2.3: Demographic Parameters of Punjab w.r.t. India

Parameters	**India**	**Punjab**
Population (Total)	1,027,015,247	24,289,296
Male Population	531,277,078	12,963,362
Female Population	495,738,169	11,325,934
Sex Ratio (females/000 males)	933	874
Total Literacy rate (%)	65.38	69.95
Male Literacy rate (%)	75.85	75.63
Female Literacy rate (%)	54.16	63.55
Density per sq km	324	482

The percentage increase in population is presented below:

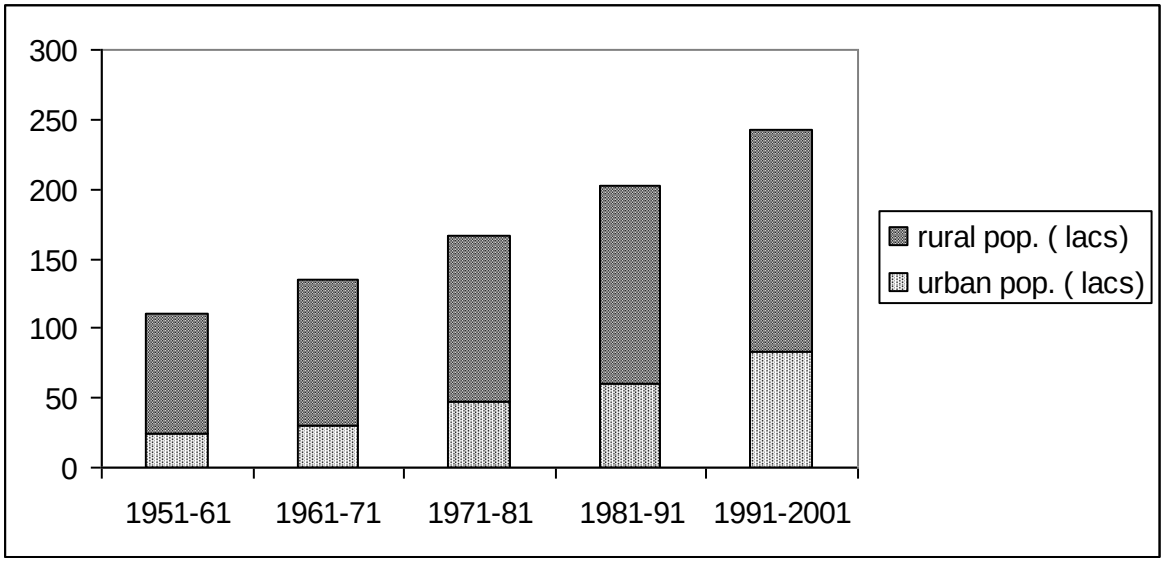
1961-71 :	21.70
1971-81 :	23.89
1981-91 :	20.26
1991-2001:	20.30

The population density of the state is also 48.7% higher than the national average. There has also been an appreciable increase in urban population in the state from 29.22% in 1991 to 33.95% in 2001 (Fig. 2.8). The sex ratio has declined from 888 females per thousand males in 1991 to 874 in 2001 (especially due to decline in sex ratio in urban areas). The sex ratio of child population, is however, a more disturbing factor as per Table 2.4.

Table 2.4: Rural vs Urban Demographic Parameters of Punjab

Parameter	**Total**	**Rural**	**Urban**
Population	24,289,296	16,043,730	8,245,566
%age Population	100	66.05	33.95
Sex Ratio	874	887	848
Sex Ratio of Child Population (0-6 yrs)	793	795	789
Total Literacy rate (%)	69.95	65.16	79.13
Male Literacy rate (%)	75.63	71.70	82.97
Female Literacy rate (%)	63.55	57.91	74.63

Figure 2.8: Increase in Urban Population in Punjab



The Major occupations of the people of Punjab are presented at Table 2.5:

Table 2.5: Major Occupations (by %age) in Punjab

Categories	**% of male workers in total population**	**% of female workers in total population**
Cultivators	17.5	0.24
Agricultural Labourers	12.8	0.68
Workers in live stock, forestry,fishing,hunting and plantation,orchards & allied activities	0.43	0.03
Minning & Quarrying	0.0052	0.00003
Manufacturing, processing & repairs	6.70	0.28
Construction	1.42	0.029
Trade & commerce	5.85	0.13
Transportation & Communication	2.15	0.026
Other workers	7.10	1.37
Total main workers	**54.11**	**2.79**
Marginal workers	0.97	1.6
Non-workers	45.78	95.67

Source: Statistical Abstract of Punjab,2000.

The major religions are Sikhism and Hinduism although Muslims & Christians are also found in small numbers. The major regional dialects are 'doaba', 'majha ', 'malva' and west Punjab migrants.

2.2.2 Key Ethenic Groups

There is no tribal population *per se* though certain local communities have been identified (usually based on their past or present occupation). Some important ones (based on information complied by Voluntary Health Association of India-Punjab Chapter) are:

1. Bishnois-followers of Guru Jambeshwar, concentrated in Abohar area of Punjab.
2. Gaddis – nomads from Himachal Pradesh & Jammu & Kashmir who visit Punjab Shivaliks during winters
3. Gujjars – nomads from plains visiting Punjab Shivaliks during rabi harvest.
4. Chirimaar– locals thriving on bird trade
5. Choohamaar – expert in killing rat populations from fields
6. Ad-dharmi – local religious sect
7. Kabirpanthi, Julaha - spinners
8. Balmiki- an important scheduled caste

9. Bazigar – nomads making a living through performing arts & tricks
10. Nat-residents making a living through performing arts & tricks
11. Banjara – nomads earning a living by singing & dancing
12. Chamar, Jatia Chammar, Rehgar, Raigar, Ramdasi, Ravidasi-important scheduled castes
13. Mazhabi-a sikh sect
14. Sansi, Bhedkut, Manesh – a community notorious for crimes
15. Sapala – locals who use snakes to make a living
16. Sikligar- roaming tribe which make and sell utility items made of iron like iron platters used in cooking
17. Bauria, Bewaria- scheduled caste of Punjab who help in agriculture
18. Deha, Dhaya, Dhea- scheduled tribes which collect waste materials like polythene bags etc.
19. Dumna, Mahasha, Doom- a tribe which usually sings during wedding ceremonies
20. Dhanak- a tribe working in grain markets for cleaning of grains

Other communities about which not much information is available are :

-Pasi
-Parna
-Pheera
-Sanhai
-Sansoi
-Sareta
-Ganadhila Gadeil
-Sirkiband
-Bangali
-Barar, Burar or Berar
-Batwal
-Chanal
-Dagi
-Darain
-Dhogri, Dhangri, Siggi
-Gagra
-Khatik
-Kori- Kori
-Marija, Marecha
-Megh
-Sanhal

Most of these are , however, dwindling and have adopted other professions now. These can, however be involved actively in biodiversity conservation efforts e.g.

- Bishnois	Conserving blackbucks and khajeri trees
- Gujjars & Gaddis	For preservation of cattle breeds
- Sapolas	Identification of snakes' habitats and their conservation
- Bazigars, Nats & Banjaras	Identification and conservation of medicinal plants Public awareness of biodiversity conservation
- Choohamaars	Identification of rodents' habitats
- Chirimaars	Identification of bird sites and their conservation

2.2.3 Agriculture

As already pointed out, agriculture is the back bone of Punjab's economy. Almost 84% area is under agriculture. The cropping intensity is 184%. Fig. 2.8 presents a district wise breakup of area under agriculture in the state. Data indicates that except for district Ropar the total cropped area exceeds the total geographical area of a district indicating multiple cropping.

Kharif and Rabi are the two main crops harvested in early winter and summer respectively.

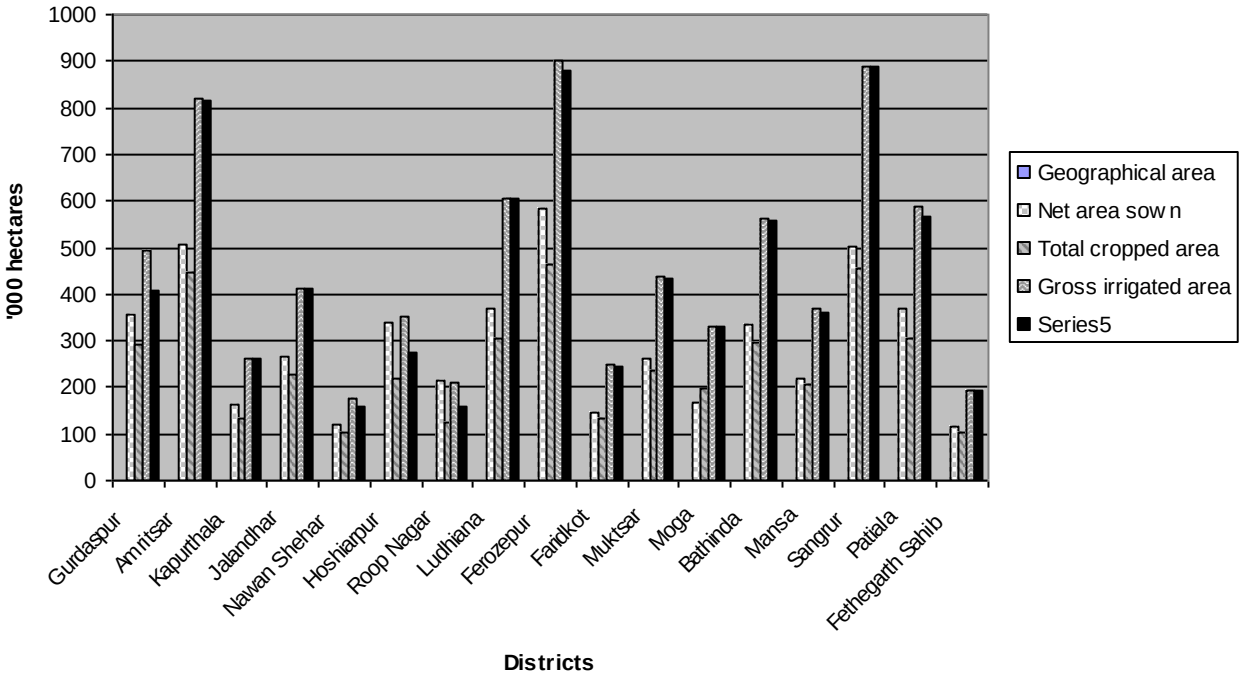


Fig. 2.9: District wise breakup of area under agriculture in Punjab.

Crop pattern is determined by availability of irrigation water. 50 cm Isophyet divides the region into western cotton and wheat growing area and eastern wheat, rice, maize, rape seed, mustard and sugarcane growing area. The cropping pattern has, however, changed considerably due to green revolution which has resulted in emphasis on monoculture farming due to introduction of HYVs with emphasis on wheat-rice rotation, high fertilizer and pesticide inputs (fertilizer consumption has increased from 1,75, 000 Nutrient tons in the early seventies to 10,86,000 Nutrient tons in 2000 and chemical pesticide use has increased from 3,200 Metric tons to 7,400 Metric tons from 1980 to 2001). Use of traditional organic manure has

decreased with cattle dung being increasingly used as fuel (cowdung cakes) in rural areas. Water and electricity are provided free for agricultural purpose. However, as per the general perception mostly farmers with large farm holdings are benefited by this facility as the facility is not adequately available at all times to benefit small farmers.

The changes in crop pattern are discussed in the chapter on Agric Biodiversity. Several species of vegetables & fruits are also grown besides the main cereal crops.

2.2.4 Industry

Though Punjab is mainly an agricultural state, it has made considerable progress at the industrial front also. Since 1991, industrial investment has increased by 38%, production by 85% and exports by 73% (Statistical Abstract of Punjab, 2000). In all 1,97,344 small scale units with a fixed capital of Rs. 3361 crores (employing 8.7 lac. persons) and 602 large & medium scale units with fixed capital of over Rs. 14040 crores (employing 2.3 lac persons) are in operation in the state (figures upto 1998-99). Out of these, maximum people are employed in cycle & cycle parts industry, sewing machine industry, hand tool industry, sugar industry, rice shellers, automobile parts & sports goods. Ludhiana is also the centre of hosiery industry, Amritsar is famous for textile & dying units and Mandi Gobindgarh is known as the Steel town of Punjab.

2.2.5 Energy Scenario

The state is dependant on hydro and thermal power for its major energy requirements. Cent percent of the state's villages are electrified. The total installed power capacity is presented below (Table 2.6):

Table 2.6: Installed Power Capacity in the Punjab (MW)

Year	Total Installed capacity	Hydro	Thermal
1967	552.637	539.000	13.637
1970	670.495	661.000	9.495
1975	878.386	706.486	171.900
1980	1537.238	1083.158	454.080
1985	2335.300	1454.740	870.560
1990/91	3049.804	1769.804	1280.000
1999-2000	3975	1845	2130
2000-2001	4458	2328	2130

Source: Statistical Abstract of Punjab, 2000, Punjab State Electricity Board, 2001

However, the demand in energy has also doubled in the past 2 decades. The maximum demand has increased in the agricultural sector. A comparison of the connected and pending load (Table 2.7) indicates the gap between demand and supply.

Table 2.7. Connected & Pending Load (KW) in Punjab.

	Year	General	Industrial	Agricultural	Bulk & others	Total
Connected	1999-2000	61,16,537	44,90,014	27,25,014	1,71,705	1,35,03,270
	2000-2001	70,81,128	47,34,267	29,19,203	1,96,902	1,49,31,500
Pending	1999-2000	2,20,903	2,56,485	9,98,315	33,672	15,08,375
	2000-2001	2,58,312	2,26,640	9,99,600	31,058	15,15,610

Source: Punjab State Electricity Board, 2001

This has led to increased efforts for production of additional power, both, through conventional and non-conventional means, thus affecting natural resources. Solar power, biogas and smokeless chullahs are being promoted in the state. Although community biogas plans are installed, a number of them do not operate efficiently due to lack of community cooperation, whereas family size biogas plants usually operate successfully.

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2.2.6 Punjab's economy

The per capita income in Punjab (at current prices) was Rs. 23,040 in 1999-2000. The gross & net state domestic products at current prices were Rs. 62700 crores and Rs. 54960 crores approx., respectively in 1999-2000 (quick estimates, Statistical Abstract of Punjab, 2000). Out of this agriculture accounts for the largest percentage followed by manufacturing and trade as presented at Table 2.8. Contribution of forestry, fisheries and other biological resource based sectors towards GDP and GNP is minimal.

Table 2.8: State Income (1999-2000)

Sr. No	Sector	Gross State Domestic Product at Factor Cost by Sectors in Pb. At Current Prices	%age distribution of Gross State Domestic Product at Factor Cost by Sectors in Pb. At Current Prices	Gross State Domestic Product at Factor Cost by Sectors in Pb. At Constant Prices (1999-2000)	%age distribution of Gross State Domestic Product at Factor Cost by Sectors in Pb. at Constant Prices (1999-2000)
1	Agriculture and Livestock	25615.44	40.85	15946.70	40.16
2	Forestry and Logging	128.14	0.21	45.09	0.11
3	Fishing	165.04	0.26	158.23	0.40
4	Mining and Quarrying	5.38	0.00	1.40	0.01
5	Manufacturing	8678.83	13.84	6044.93	15.22
6	Electricity, Gas and Water Supply	2978.36	4.16	1089.74	2.74
7	Construction	3742.83	5.97	2507.21	6.32
8	Trade, Hotels and Restaurant	6205.91	23.97	4630.87	11.67
9	Transport, Storage and Communication	2817.92	9.90	1946.58	4.90
10	Banking and Insurance	2846.38	4.54	2103.45	5.30
11	Real Estate, ownership of Dwellings and Business Services	2238.28	3.57	1676.30	4.22
12	Public Administration	3351.08	5.35	1922.56	4.84
13	Other services and Sanitary Services	4295.99	6.85	1631.05	4.11
14	Total Gross State Domestic Product	62700.23	100.00	39704.11	100.00

Source: Statistical Abstract of Punjab,2000.

2.3 The Political & Administrative Scenario

The state has an elected democratic government. The Panchayati Raj institutions are in place with elected Panchayats in rural areas. There are also about 8000 mahila mandals in villages out of which some play an active role in economic upliftment of women. Activities of mahila mandals are coordinated by Women Development Officers at district level which are further coordinated by Dy. Director (Women) in the State Department of Rural Development and Panchayats.

Administratively, with respect to biodiversity, the departments of Agriculture, Horticulture, Fisheries & Animal Husbandry are under the control of Financial Commissioner (Development). He/She is also the administrative head of various agriculture related procurement agencies like Markfed, Punjab Agro Industries Corporation, PUNSUP, PUNSEED, etc. besides Punjab Agriculture University and Punjab Remote Sensing Centre. The Departments of Forests & Wildlife and Science, Technology & Environment and Non-Conventional Energy are under the administrative control of separate Principal Secretaries. The State is divided into 17 districts, each under the control of a Deputy Commissioner.

CHAPTER-III

ECOLOGICAL PROFILE OF PUNJAB

The major ecological components especially w.r.t. biodiversity are discussed below:

3.1 The Cropland ecosystem:

As stated above 84% land area is under agriculture. This has been facilitated by adoption of mechanized farming and wide scale use of tractors, threshers & combine harvesters for agricultural operations. This has been further facilitated by consolidation of land holdings in the sixties at the time of advent of green revolution in the state - a major factor recognized for loss of wild diversity found in/around agricultural fields and decrease in native varieties of fruit and other trees associated with traditional agro-forestry systems. The details are discussed under Paras 2.2.2 and 4.3.

3.2 Forest Ecosystem

The forest map of India indicates that Punjab has a very small area under forest cover. Large chunks of forest land went to the state of Himachal Pradesh (and to some extent to Haryana) at the time of reorganization. Out of 20 thousand sq km of total forest area of composite Punjab, only 1875 sq km area came within the boundary of present Punjab, most of which was in form of tree belts along railway tracks, canal banks, road sides, etc. Further, trees were cut due to suitability of the plains for agriculture and at the time of consolidation of land holdings. As per FSI (2000) the forest cover based on satellite data in 1996 is 1412 sq km. This amounts to only 2.8% of the State's geographical area. Out of this 517 sq km is dense forest cover and 895 sq. km is open forest.

Previous satellite data collected by National Remote Sensing Agency shows that the forest cover had declined between 1972 to 1975 by about 30%, whereas an increase of 51.1% was recorded during 1985-87.

As per Forest Department records the total forest cover is 3045.28 sq.km which amounts to approx. 6% of the total geographical area (source : Forest Department, Punjab). The percentage of actual forest cover to geographical area is 2.8 vs. 19.27 for India. The district wise distribution of forest area is presented at table 3.1.

Out of the existing forest cover 47% area is government owned and classified as protected forest. The details are as under (Table 3.2).

Table 3.1. District wise distribution of forest area (sq. km) in Punjab-1999-2000.

District	Reserved	Protected	Unclassed	Total	Under Section 4& 5 Punjab Land Preservation Act, 1990	Under Section 38 of the Indian Forest Act, 1927	Total	Total area under Forests (4+7)	Percentage to total area in Punjab
Gurdaspur	1	194	18	213	155	2	157	370	10.36
Amritsar	10	96	41	147	--	1	1	148	2.91
Kapurthala	--	11	9	20	--	--	--	20	1.22
Jalandhar	1	23	22	46	--	--	--	46	1.74
Nawan Shehar	-	16	9	25	209	--	209	234	18.60
Hoshiarpur	27	153	21	201	891	--	891	1092	32.99
Rupnagar	--	56	13	69	444	1	445	514	24.28
Ludhiana	1	74	25	100	--	--	--	100	2.66
Firozpur	4	94	19	117	--	--	--	117	2.20
Faridkot	--	20	--	20	--	--	--	20	1.36
Mukatsar	--	38	--	38	--	--	--	38	1.46
Moga	--	20	--	20	--	--	--	20	0.91
Bathinda	--	67	8	75	--	--	--	75	2.21
Mansa	--	27	--	27	--	--	--	27	1.26
Sangrur	--	69	1	70	--	--	--	70	1.39
Patiala	--	127	26	153	--	1	1	154	4.25
Fetehgarh Sahib	--	10	--	10	--	--	--	10	0.85
Total	44	1095	212	1351	1699	5	1704	3055	6.07

Source: Statistical Abstract of Punjab, 2000.

Table 3.2 Government and private forestlands in Punjab.

Category	Sub-category	Area (in sq. km)
Government forests	Reserve forests	43,36
	Protected forests	379.58
	Blocks	702.82
	Strips along roads, rails, canals & drains	213.77
	Unclassed forests	1339.53
Total Govt. forests		
Private/community forests	Area closed under section 4 & 5 of Land Preservation (Choe) Act of 1900	1699.00
	Area closed under Section 38 of I.F.A.,1927	6.75
Total Private Forests		1,705.25
Grand Total of Forest area		3045.28

Source: TERI,2001.

Only 133 villages of the state have 'forest' as land use. Out of these only 20 villages have more than 500 ha forest area, 29 villages have forest area between 100-500 ha and 84 villages less than 100 ha forest area. The major forest areas in the state are as under:

- Shivaliks Forests : especially in the districts of Ropar, Gurdaspur and Hoshiarpur (Plate 2).
- Bir Forests: district Patiala.
- Mand Forests : Primarily around wetlands in districts Amritsar, Kapurthala, etc.

3.2.1 Shivaliks Forests

As per IIRS (Roy *et al.* 2001 – unpublished), the total Shivalik area covers 1137 sq km out of which dense forest, open forest & scrub forest comprises 6.4%, 11.64% & 0.98% area respectively. The natural forest categories are as follows:

- Tropical Moist Mixed Deciduous Forests (3C/C3)
- Northern Tropical Dry Mixed Deciduous Forests (5B/C2)
- Dry Deciduous Scrub Forests (5B/DS1)
- Dry Grasslands (5B/DS4)
- Khair & *Dalbergia sissoo* (5/iS2)
- Shivalik Chir Pine Forests (9/C1a)

3.2.2 Bir Forests

These are protected forests mainly in Patiala district and are characterized by species of *Butea, Cassia, Citrus, Ziziphus, Dalbergia and Morus* in the north western parts and Acacia, Eugenia, etc. in the south-eastern parts of the state. A small area under Bir Forests is present in Kapurthala district also. Besides a large chunk of bir forests called "Rakhs" are present in Amritsar district also.

3.2.3 Mand Area Forests

This is flood plain area characterized by wetlands. The natural forests are characterized by presence of *Acacia*, *Dalbergia* & *Ziziphus* .

3.2.4

The forest areas in Punjab, are, however, under serious threat due to a number of factors. Prior to the 19th century these forests were protected by local rulers but the vegetation cover started declining due to unrestricted felling and over grazing when these areas were transferred to villages. The enactment of the Punjab

Land Preservation (Choes) Act, 1900 provided power to the government to temporarily regulate, restrict or prohibit certain activities in forest areas (expect in mund areas where this act has not been enforced) and take up reforestation and soil conservation programmes. Poor enforcement of the act has, however, lead to deterioration of forests in Punjab. Further, large displacement of population and its re-settlement in the wake of partition of Punjab also lead to diversion of large tracts of forest areas for habitation and agriculture. The improvement of irrigation facilities also helped divert certain forest areas to agriculture.

As per FSI (as cited in Jerath, 1995) a comparison with previous year data indicated that 10.4% of the Shivalik forest area had been diverted to other uses. Dense forest cover (with canopy density of more than 70%) was found in 1.5% area only and 46.5% area was found to have canopy density between 30% to 69%. Further, 63.37% of total accessible forest and scrub area was subjected to heavy to moderate erosion. The survey has also identified that 65.5% of the total Shivalik area was potentially plantable. On the basis of this survey Integrated Kandi Area Development Project has been initiated by the Forest Department.

No systematic reports exist on the wild flora & fauna found in the forests of Punjab. Hence, a major project has been initiated by Punjab State Council for Science and Technology with BSI, ZSI & Punjabi University, Patiala to study the Shivalik forests in detail. Remote sensing studies have been conducted with the help of Indian Institute of Remote Sensing, Dehradun (Fig. 3.1a-h). The study highlights that the Shivalik Forests are extremely prone to biotic pressures and large areas are infested with *Lantana*.

3.3 Sites of In-situ Conservation in Punjab

3.3.1 Protected Areas in Punjab

There are 10 Wild Life Sanctuaries and 1 Protected Area with a total area of 316.74 sq. km in the state. All areas are wildlife sanctuaries (including Harike Wildlife Sanctuary). Three sanctuaries (Abohar, Harike and Takhni-Rehmanpur) are notified u/s 26A of Wildlife Protection Act, 1972. All others are 'deemed sanctuaries' and all provisions of the Wildlife Protection Act, 1972 apply to them. As per the deptt. of Forest & Wildlife rights of people living in/around and dependent on these sanctuaries have been settled. There is no National park in the state. The list of protected areas and their important features are as below (Table 3.3).

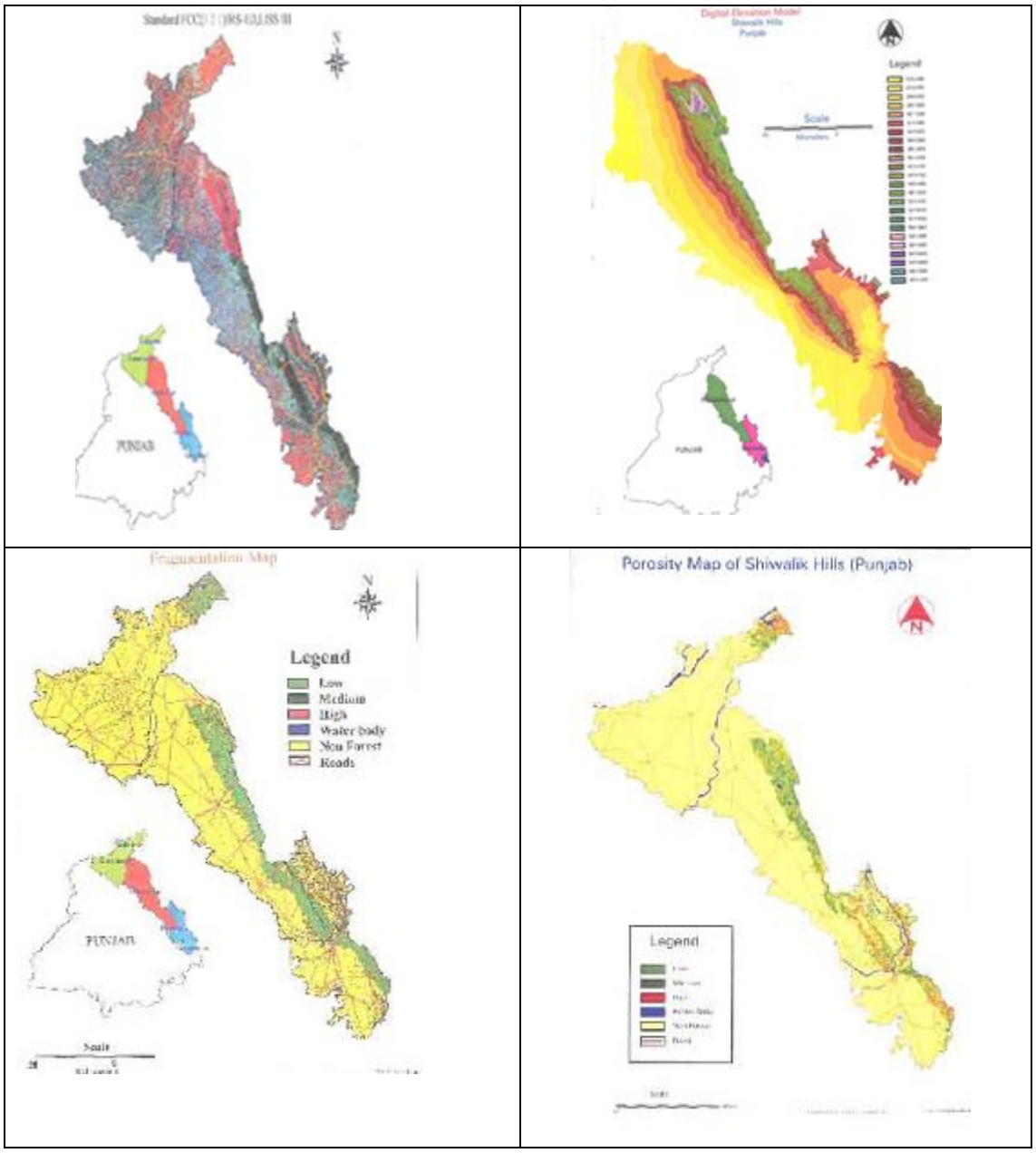
Table 3.3: Protected areas of Punjab.

S.No	Existing PA/WLS	Area (ha)	Key faunal species	Key floral species
1.	Abohar WLS, Ferozpur, (13 villages in Abohar area)	18650	Blackbuck, Neelgai, Wild boar	Dry arid vegetation
2	Harike WLS, Ferozpur	8600	Smooth Indian Otter, Fishing cat, Hog deer, wild boar, Turtles, 361 spp. of migratory& local resident birds (eg.Great crested Grebe,Eastern purple Heron,Brahminy Shelduck, Pintail, CommonTeal, Mallard, Gadwall,Wigeon, Shoveller, Common Pochard etc.), 74 spp.of fishes (eg. *Labeo, Catla, Channa,Cyprinus, Mystus, Notopterus* etc.)	Islands: *Typha, Saccharum, Ipomea*, other aquatic vegetation- water hyacinth dominant
3	Bir Aishwan WLS, Sangrur	467.41	Neelgai, Hare, Jungle cat, Jackal, Rhesus monkey	Mixed plantation and natural forests.
4	Bir Bhadson WLS, Patiala	1022.63	Neelgai, Hare, Jackal, Jungle cat, Rhesus monkey	Saline/alkaline vegetation
5	Bir Bunerheri WLS, Patiala	661.66	Blackbuck, Neelgai, Sambar, Russel viper	Thorn and scrub forests
6	Bir Dosanjh WLS, Patiala	517.59	Neelgai, Hare, Jungle cat, Rhesus monkey	do
7	Bir Gurdialpura WLS, Patiala	620.53	Neelgai, Hare, Hog deer, Jackal, Rhesus monkey	Shisham, Kikar, Darek, Poplar etc.
8	Bir Maheswala WLS, Patiala	122.43	Neelgai, Hare, Jungle cat, Rhesus monkey	do
9	Bir Motibagh WLS, Patiala	654.37	Blackbuck, Neelgai, Hog deer, Jungle cat, Jackal, Rhesus monkey, Rat- snake	Amla, *Prosopis julifera* Shisham, Kikar
10	Takhni-Rehampur WLS, Hoshiarpur (Shivalik Area)	382	Sambar, Red jungle fowl, Barking deer, Wild boar, Python, Pangolin, Cobra, 88 spp. Of birds	Khair, Shisham and Subabul
11.	Jhajjar Bacholi Protected area, Ropar	116	NA	Khair and Shrubs

Source: Department of Forest & Wildlife, Govt. of Punjab, 1999.

Fig. 3.1: Biodiversity characterization of landscape of Shivalik hills in Punjab (IRS – ID, LISS III)

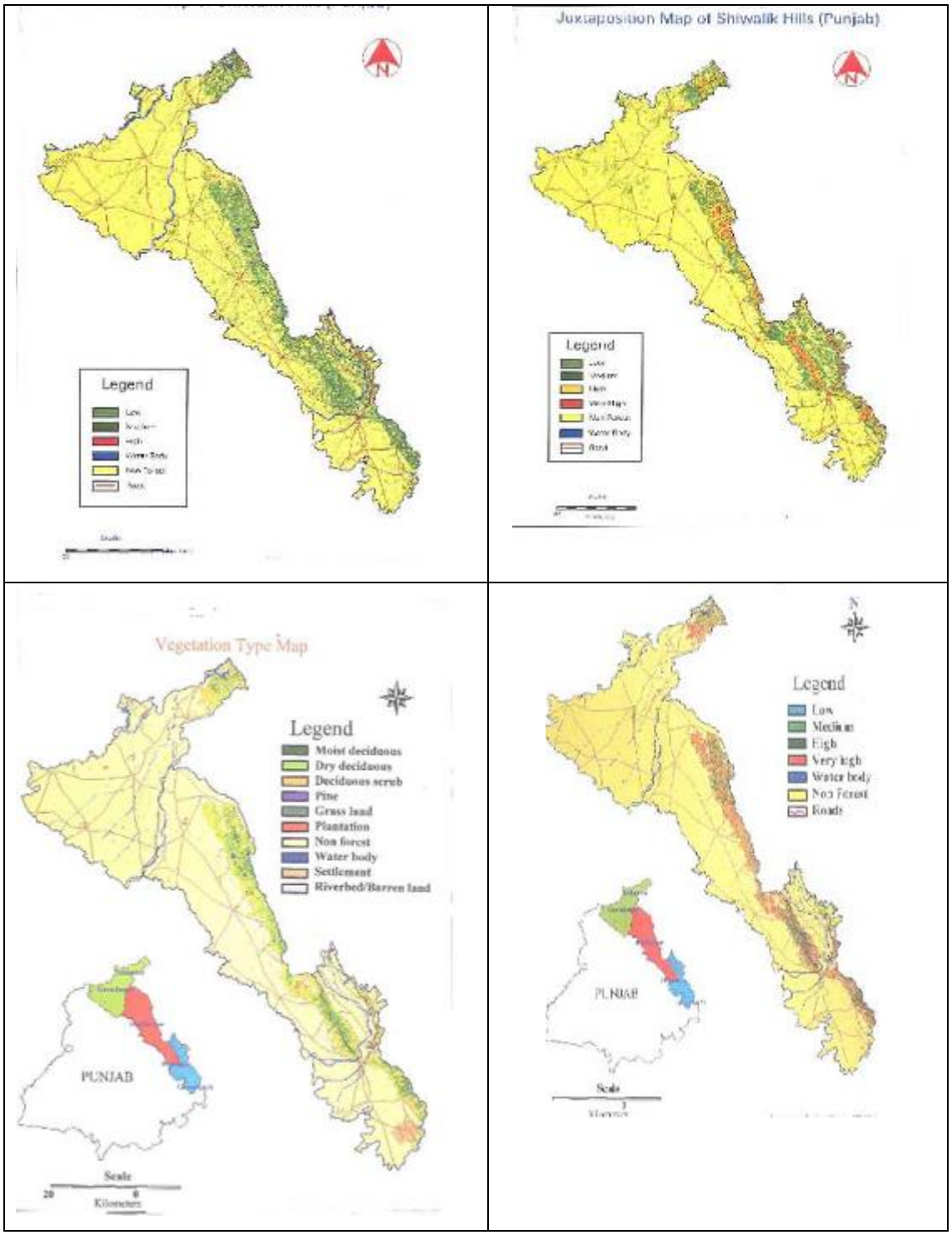
a) General Profile **b) Digital Elevation Model**



c) Fragmentation map **d) Porosity Map**

Fig. 3.1: Cont. Biodiversity Characterisation of landscape of Shivalik Hills in Punjab (IRS – ID, LISS III)

e) Patchiness Map **f) Juxtra Position Map**



g) Vegetation type map **h) Disturbance Index Map**

Out of the Wildlife Sanctuaries mentioned at Table 3.4, the Abohar Wildlife Sanctuary, Harike Wildlife Sanctuary and Takhni-Rehmanpur sanctuary are of special importance due to their characteristic features. Important features of these three sanctuaries are discussed below:

(a) The Abohar Wildlife Sanctuary:

The Abohar sanctuary is the state's largest sanctuary lying in dry arid area close to Rajasthan border. It is spread over the 13 villages of Bishnois (Raipur, Rajanwali, Dotaranwali, Sardarpur, Sukhchain, Khairpur, Mehrana, Sitoguno, Bishanpura, Himatpura, Narainpur, Rampur and Bajidpur) where Blackbuck and Neelgai herds and other wild flora & fauna are being traditionally protected by the local community (Plate3).

Abohar sanctuary is unique as it is on private land. Another interesting feature is that most of the areas surrounding these 13 villages (except village Haripura, Panniwala & Gumzal) are devoid of blackbucks. As per TERI (unpublished) other important species present in the area include Jackal, Indian Gerbil (*Tatera indica*) & wild dogs. However, as per Deptt. of Forest and Wildlife, Govt. of Punjab presence of Indian Gerbil is doubtful. The blackbuck population ranges between 3000 to 4000 blackbucks. The Neelgai population is, however, increasing rapidly leading to man-animal conflict situation. The sanctuary has been notified under the Wildlife (Protection) Act, 1972 but all rights of people except for hunting, shooting, killing or capturing wild birds & animals have been allowed to continue. This sanctuary is a prime example of a community reserve.

(b) The Harike Wildlife Sanctuary

The Harike Wild Life Sanctuary is within the Harike wetland. The wetland is spread over an expanse of about 148 sq km, of which 41 sq km is of open water (now reportedly reduced to 28 sq km on account of siltation and encroachment). The Punjab State Council for Science and Technology is responsible for coordination of management activities in the wetland. The sanctuary is under the control of Department of Forests & Wildlife. The sanctuary is a haven for migratory birds. 361 species of migratory & resident birds have been recorded from the area. The details are discussed under Para 3.3.2.i.

(c) Sanctuaries in the Shivaliks:

The Takhni-Rehmapur sanctuary near Mahngrowal village in district Hoshiarpur is an important sanctuary located in the Shivalik area. It was declared as wildlife sanctuary in 1993. Further, the Jhajjar-Bacholi Protected Area in Anandpur Sahib in district Ropar is also present in the Shivalik area. The natural vegetation is Khair-Sissoo type with dense natural re-generation of subabul. Pangolin Sambar, Barking deer, Blue Bull, Wild Boar, Porcupine, etc. are recorded in these areas. There are also occasional sightings of leopard, which are presumed to wander into this area from Himachal Pradesh. Important bird species & reptiles (including Python, common Cobra, Rat snake, Garden & Monitor Lizards, etc.) have been recorded in the area.

3.3.2 Wetland ecosystems in Punjab

About 0.31% of the state's area is under natural and manmade wetlands. The state has 12 natural wetlands covering a total area of 8.39 sq km and 10 manmade wetlands covering an area of 147.39 sq km (Plate 4). Table 3.5 and 3.6 present a list of existing natural and manmade wetlands in Punjab.

Table 3.4. Existing natural wetlands in the state of Punjab

Name of Wetland	Nearest Town Area	District	Area	Category Temporary (seasonal)/ Permanent
Jastarwal Jheel	Jastarwal/Ajnala	Amritsar	135 Acres	Permanent
Aliwal Kotli	Aliwal/Ajnala	Amritsar	25 Acres	Permanent
Bareta	Bareta	Mansa	50 Acres	Temporary
Kahnuwan Chhamb	Kahnuwan/Man Chopra/Chhawarian Banghar	Gurdaspur	315 Acres	Permanent
Keshopur – miani Jheel	Keshopur, Miani Jhamela	Gurdaspur	1000 Acres	Permanent
Mand Bharthala	Bharthala	Hoshiarpur	150 Acres	Permanent
Narayangarh - Terkiana	Terkiana/Dasuya	Hoshiarpur	200 Acres	Permanent
Sital Sagar	Mansar	Hoshiarpur	Major part in H.P.	Permanent
Rababsar	Bharowana	Kapurthala	100 Acres	Temporary
Lobana	Nabha	Patiala	28 Acres	Temporary
Lahail Kalan	Lehail	Sangrur	50 Acres	Temporary
Gobindgarh Khokhar	Gobindgarh Khokhar	Sangrur	20 Acres	Temporary

Source: Punjab Environment Status Report,1995.

Table 3.5: Manmade wetlands and lakes in Punjab

Name of Wetland/Lake	Nearest Town	District	Area under Water	Status
Harike Lake	Harike	Amritsar, Kapurthala Ferozepur	4100 ha.	Ramsar site. Large scale conservation & management measures in progress as per perspective plan.
Kanjli Lake	Kanjli	Kapurthala	44 ha.	Ramsar site. Conservation measure in progess as per perspective plan.
Ropar Lake	Ropar	Ropar	1365 ha.	Ramsar site. Perspective plan being implemented.
Hussainiwala Reservoir	Ferozepur	Ferozepur	688 ha.	Nominated to Ministry of Env. & Forests for inclusion in the list of national wetlands.
Ranjit Sagar	Shahpur Kandi	Gurdaspur	8000 acre in Punjab on completion of project.	Consturction work completed in 2000.
Dholbaha Dam	Dholbaha	Hoshiarpur	132 ha.	Earth filled dam. Provides water facilities, protects from floods but is threatened due to siltation.
Maili Dam	Maili	Hoshiarpur	72 ha.	Heavy siltation taking place
Mangrowal Dam	Mangrowal	Hoshiarpur	70 ha.	Heavy siltation taking place
Nangal Lake	Nangal	Ropar	400 ha.	Nominated to Ministry of Env. & Forest for inclusion under National Lake Conservation Programme.

Source:Punjab Environment Status Report,1995.

The important wetlands are discussed below (Plates 5,6 and 7):

i) The Harike Wetland:

This is an Internationally important wetland and a Ramsar site under Ramsar Convention, 1971. The Harike lake came into existence in 1952 due to construction of barrage at the Sutlej River at Harike and covers an area of approx. 148 sq km out of which 41 sq km is open water. The area was notified as Wildlife Sanctuary in 1982 as it attracts a large number of resident and migratory water fowl. The wetland offers a variety of habitats to about 361 bird species out of which 59% are migratory birds. These include 13 rare, 8 threatened, 9 vulnerable and one occasional visitor species. Interesting bird records include more than 200 birds of Penduline Tit (*Remiz pendulinus*) observed near the headworks and *Prinia burnesii* providing first record of these birds in Punjab. The Syke's Nightjar is also found to breed at Harike. Other rare species include white headed duck, European golden plover, long billed Dowitcher, Buff breasted Sandpiper, Little Gull, Mew Gull, Black Tern, Chaffinch, Eurasian Linnet & Corn Bunting (Kazmierczak *et al*., 1998). Long

tailed duck and Horned /Slavonian Grebe have also been sighted (as cited in TERI, 2001 – unpublished).

Further, 21 protozoan, 61 rotifier, 27 crustacean, 34 insect, 9 annelid, 4 nematode, 41 molluscs, 74 fish, 7 turtle (out of which 4 spp. are listed in schedule-1 of Indian Wildlife Act, 1972 and one spp. has been listed in category V – Vulnerable – of Red Data Book), 4 snake, 6 amphibian (including 3 spp. of frog, 2 spp. of toad and one spp. of salamander) & 12 mammal species (including Smooth Indian Otter which is listed in the IUCN Red List of threatened animals) have also been recorded (Jerath,1992; Ladhar *et.al.,* 1994; Dhillon *et al*., 1996 & Prakash *et al.* 1997). An important observation by Dua & Chander (1999) indicates that the wetland supports 65 fish spp. and 0f these 14 have high commercial importance. Further, Population sizes of indengious species like *Labeo calbasu, Catla catla* and *Notopterus* sp. have greatly reduced. Also, an exotic spp. *Cyprinus carpio* now constitutes 28. 36% of the total annual catch whereas *Labeo calbasu* constitutes only 3.59% of the catch.

The aquatic vegetation includes 41 spp. of macrophytes (Ladhar *et al*., 1994, Dhillon *et al.* , 1996; Prakash, 1999 as cited in Vishwakarama 2000) and 31 spp. of microphytes (Dhillon *et al*. 1996). The important vegetation types includes vegetation in open water; shallow water areas; water hyacinth patches; *Ipomea, Nelumbium, Typha & Phragmites* patches; patches of *Saccharum* & over hanging trees. Water hyacinth is a major problem which, inspite of repeated removal, reoccurs in the area and calls for a long term and cost effective solution. There is no record available of what existed before and what got destroyed through creation of wetland. The ongoing conflict of the local villagers whose land was submerged is not due to any lack of compensation but because of their renewed interests in acquiring upland areas for cultivation. The locals, therefore, intend try to encroach upon govt. land under Harike wetland.

ii) Kanjli Wetland

The wetland covers an area of 44 ha and has been recently (on 2.2.2002) recognized as a wetland of international importance (Ramsar site) by IUCN. Dhillon *et al.* (1996) have reported 92 bird spp. from the area. The BNHS has designated it as an IBA site (Important Bird Area) due to sightings of Indian

Skimmer, a Red Data spp. (BNHS,1999). Several biome restricted/representative species have also been reported. The wetland is rich in submerged rooted, free floating and emergent hydrophytes. Water hyacinth infestation is a major problem.

iii) Ropar wetland

The Ropar wetland has also been identified as a wetland of International importance (Ramsar site) on 02-02-2002 by IUCN. Spread over an area of 1365 ha (out of which the pond area is 230 ha), the area provides habitat to 9 species of mammals, 35 species of fishes, several reptiles, amphibians and aquatic invertebrates and about 154 spp. of birds. The floral diversity includes 10 spp. of aquatic plants, 13 shrub & grasses and 19 tree spp. The floral diversity, however, needs to be studied in detail as the area includes 30 ha of lush green Class- II forest (PSCST – undated).

Most of the wetlands in Punjab, however, face threats of silitation, weed infestation, illegal encroachments and population pressure, water pollution and over fishing and poaching. Conservation programmes have been initiated in the three major wetlands. These include survey and mapping of the area, fencing, afforestation and wildlife development, control of water hyacinth through manual and biological means, water pollution monitoring, soil conservation and education & public awareness.

3.3.3 Community conserved areas in Punjab

Inspite of drastic pressures on land in the state, there still exist islands of conserved areas maintained by traditional communities known for their tradition of *Kar Seva* or self help. Some important community conserved areas are as under:

i) The most striking example of a community conserved area is the Abohar Wildlife Sanctuary which exists on private land of 13 villages and 3 closed areas in Abohar. The Bishnoi community has been responsible for protection of black buck, Neel gai (Blue bull) & Khajeri (*Prosopis julifera*) trees. The Bishnois are disciples of Guru Jambeshwar who propogated 29 tenets (giving his followers the name 'bees-nois' or 'twenty-niners'). The Bishnoi history indicates that women & children have laid down their lives in order to protect trees from felling. The community allows blackbuck to feed on their fields considering it as a religious donation. Infact they believe that the crops grow

better if grazed by blackbuck. However, increasing pressure on land (due to increased requirement of food grains for the growing population, conversion of crop areas into orchards and division of land holdings with increasing family size) have led to conflict situation with animals, especially blue bulls, for which there is no natural predator in the area. Effective strategies for controlling blue bull population needs to be evolved.

ii) Protection & equitable use of 'Shamlat' areas (village common lands) in northern Shivaliks by locals and 'gaddi' & 'gujjar' tribes (Plate 8a). The gaddis migrate to upper Himalayas in summer and visit the area every winter. The Gujjars come to the area from the plains during Rabi harvesting. Both Nomads share pasture lands & existing forest resources in the Shamlats with locals. Traditionally the rights of the locals and the nomads on common property resources have also been recognized. This has promoted a rich heritage of conservation combined with sustainable use of these resources. However, over the years, commercialization of agriculture and encroachment of Shamlats has led to deterioration in community-conserved lands and this tradition.

iii) Preservation of peacocks in 5 villages of district Ropar (Todar Majra, Makrian, Chunni Khurad, Makar and Majatri) where about 400 peacocks have been conserved in an area of about 2.5 km through public participation. The villagers protect the bird out of religious sentiments and for its utility (it eats away small snakes & other harmful insects from fields) and consider them as residents of the village.

iv) Improvement of aquatic biodiversity in Kali Bein rivulet (feeding the Sutlej) by removal of water hyacinth through public participation in Sultanpur Lodhi area (extending from Gurdwara Sant Ghat to Gurdwara Ber Sahib). This has been promoted through the initiatives of a local religious leader who has also taken up developmental activities benefiting the locals like, construction and maintenance of roads linking various villages, management of municipal waste, etc.

v) Improvement of biodiversity in hilly catchment areas in the Shivaliks by community water shed management projects in villages Rel Majra & Nada. The villagers have been organized to form a Water Users Association and a dam for water harvesting has been constructed with their help (by providing

free labour). The Water Users Association includes one representative from each family residing in the village and helps in equitable distribution of water besides taking up soil conservation, tree plantation and village welfare activities.

vi) Small forest areas around 'Mahantan Wala Choe' (1700 acre) and 'Rodian da Dera' (1500 acre) between Maili & Jaijjon in Ropar Shivaliks where a religious code of conduct prohibits locals from using bioresources from a small part of area. Hence, this area harbours rich biodiversity. However, this tradition is also dwindling with time.

vii) In Gurdaspsur there are many places of worship which are maintaining gardens/tree groves rich in biodiversity. The Pandori Mahantan, Dina Dayanand Math and Jandi Chaunta are worth mentioning which are repositories of Medicinal herbs, shrubs and trees. The trees have been preserved at places out of religious faith and dedication.

Such community-conserved areas are usually sites of rich biodiversity and need to be promoted.

3.3.4 Additional areas of ecological/biodiversity importance

In addition to the above-mentioned sanctuaries within the protected area network of Punjab, the following areas (some of which lie within protected forests) are areas of high biodiversity value:

- Siswan-Dulwan area, Ropar spread in 2044 ha in Shivaliks. The major problem of the area is proliferation of various species of Lantana.
- Narangpur Forest area, Ropar spread in 422 ha in Shivaliks. *Lantana, Ageratum & Parthenium* are the major menace.
- Nara Forest, Hoshiarpur spread in 3807 ha (of forest & Panchayat land) in Shivaliks. The important aspect is abundance of fruiting *Zizyphus* leading to increased bird activity.
- Dholbaha area spread in 2083 ha located in Shivaliks with important Avifauna. Chir pine species amidst dry deciduous vegetation are also reported to occur in the area.
- Dada forest area, Hoshiarpur spread in 4700 ha is the largest forest area of natural vegetation (Khair-sissoo with Phallahi-*Acacia modesta)* in the district but is facing denudation.

- Bindraban and Nandi Bir areas in Dasuya division, spread in 1462 ha area is a scrub forest. The civet cat and leopard cat have been sighted in the area (Bajwa, 2000 as cited in TERI, 2001 – unpublished). The population of jackals and vultures has shown a decline in the region.
- Siali Dhar area in Gurdaspur is spread over 1457 ha. It is a lush green forest comprising dry deciduous vegetation interspersed with chir pine and bamboo. The area is very rich in mammal, reptile & bird species.
- Nag Dhar area in Gurdaspur runs parallel to Siali Dhar with similar vegetation and exhibits a rich biodiversity. Most of it is Shamlat forest under ownership of a number of Panchayats.

  The construction of Ranjit Sagar Dam in village Thein has lead to submergence of large forest areas of the Dhars leading to loss of habitat for wildlife. The area has also suffered several landslides. Degraded hillsides and biotic pressures have lead to soil erosion. The forest is grazed by cattle and goats of migratory pastoralists (the Gaddis from Ladhakh, the Bakarwals from J&K and Gujjars from the plains) who were earlier dependent on community controlled pasture lands (which have now been lost, due to their conversion into agricultural fields).
- Other important areas (as compiled from information gathered from the Deptt. of Forests and Wildlife, surveys of ZSI and TERI -2001-unpublished) are:
  - Bir Bhore Agual, Patiala, spread over 1177 ha
  - Rakh Sarai Amanat Khan, Amritsar, spread over 495 ha
  - Rakh Grewal, Amritsar, spread over 211 ha
  - Chak Sarkar, Ferozpur, spread over 438 ha
  - Matewara, Ludhiana, spread over 731 ha with abundance of Kahi & Kana
  - Bir Badbar, Sangrur, spread over 139 ha etc.

  All these areas depict representative vegetation and are a home to several wild animals. Various recommendations have been made by experts (Rodgers & Panwar, 1989; Rodgers *et al.* 2000) and the State Forest Department for declaring them as sanctuaries.

3.4 Sites of Ex-situ Conservation

3.4.1 Zoological Gardens in Punjab

Ex-situ conservation of wildlife in Punjab is institutionalized with the establishment of Zoological Gardens & Deer Parks. The important ex-situ conservation sites are as follows:

- M.C. Zoological Park, Chhat Bir

-Tiger Safari, Phillaur

-Deer Parks – Bir Motibagh, Patiala

Bir Talab, Bathinda

Neelon, Ludhiana

Nine mini-zoos also existed in the past but they have been officially closed (CZA, 2001) now. These zoological gardens play an important role in conservation of species and as centers of education and recreation.

(i) Mahendra Chaudhury Zoolgical Park, Chhat Bir

Established in 1977, this is the largest zoo in Punjab situated at Chandigarh-Patiala road. It is spread over an area of 202 ha in Bir Reserve Forest on the right bank of River Ghaggar. Currently it houses 42 spp. of birds (out of which several are rare & endangered spp.), 37 spp. of mammals & 4 spp. of reptiles (TERI 2001 – unpublished). The area has a mix of natural vegetation & plantation. The animals are located in 2 safaris (lion safari & deer safari), open moated enclosures and cages. The lion safari is an area of major attraction and is one of the biggest of its kind in the country housing 77 individuals. It is spread over 24 acres of land with dense natural vegetation. The zoo also houses a shallow lake spread over 5 acre land adjoining Ghaggar river which is a home to many resident and migratory birds. Although cases of water pollution in the canal feeding the lake have been reported, howver, the Zoo authorities have informed that the use of canal water for filling lakes in the zoo has been stopped.

The zoo has been successful in promoting breeding of Saras Cranes (which are usually not bred by many zoos in the country) and mating of Asiatic Lion, Tiger & Leopard. The Lion tailed Macaque is, however, not breeding successfully.

(ii) Tiger Safari, Phillaur

This is the only Tiger Safari in the state. It is spread in 10 ha out of 213 ha area in a reserve forest. The number of animals has increased from 7 to 11 since 1993.

(iii) Deer Parks

The Bir Motibagh Deer Park, Patiala was established in 1968 within the Bir Motibagh Wildlife sanctuary in 14 ha area. It houses 12 spp. each of mammals and birds. Blackbuck, Chinkara & Crocodiles are endangered species (under Schedule 1 of Wildlife Protection Act, 1972) found in the park.

The Deer Park, Neelon is spread over 5.5 ha area near Samrala in District Ludhiana. Besides deer, it houses some rabbits also.

The Deer Park at Bir Talab in Bathinda extends over 52 acres of land. It houses 6 spp. of mammals and 4 spp. of birds.

These Zoological gardens are, however, facing a number of financial and management problems. There are several reports in the local newspapers of poor animal health, illegal trade of products obtained from wild animals (e.g. exhuming of dead tigers for tiger bones-The Hindustan Times, dt. 30.08.2001) and lack of adequate manpower. However, as per the Zoo administation there are no financial and management problems and the newspaper reports are baseless. The deptt. denies these reports.

The detailed list of floral and faunal species in these zoos are available with Deptt. of Forests and Wildlife, Punjab and are, hence, not being reproduced here.

3.4.2 Botanical Gardens in Punjab

Botanical gardens are an important means of ex-situ conservation of species. A number of important gardens dating back to the time of the Moghuls exist in the state. Almost all major towns had beautiful gardens in the past designed for their aesthetic and recreational value. However, only some are still existent. The important ones are discussed below:

(i) Aam Khas Bagh, Fatehgarh Sahib: This is one of the oldest & best planned gardens of Punjab and was built by emperor Jahangir for stay of Mogul rulers during visits to Srinagar & Roza Sharief, Sirhind. The garden has important fruit, ornamental, shade giving & medicinal tree species. Wild Phalsa is also reported to occur in this area although it has generally been lost from other parts of the state. The garden has now been converted into a Tourist Resort.

(ii) Rambagh, Amritsar: Also known as Company Bagh, it is the biggest historical garden in Punjab. It was originally developed by Maharaja Ranjit Singh in 1818 and is spread over 84 acres of land. It is enriched with rare species and very old specimen of plants like*, Gingko biloba, Barringtonia, Cinnamomum,*

Diospyros, Sterculia & Sweitania. The garden also has a collection of 55 varieties of roses, 50 varieties of Chrysanthemums and 52 varieties of Bougainvillea. It is, hence, an important natural heritage site.

(iii) Baradari Gardens, Patiala : The garden was developed by Maharaja Rajinder Singh (1876-1900). It is situated in the center of the city and serves as its lungs. The garden is spread over 40 ha land and has about 100 native and exotic tree species. The list of trees, shrubs & climbers occurring in the garden is placed at Annexure-11.

(iv) Shalimar Garden, Kapurthala: This garden was planted by the then Maharaja Kapurthala and comprises several species of plants having ornamental, botanical & medicinal value. A list of important trees, shrubs & climbers is placed at Annexure-12.

(v) Banasar Garden, Sangrur: This is one of the important gardens in the semi-arid regions. The dominant tree species is *Acacia nilotica.* Dry thorny vegetation is represented.

(vi) Company Bagh, Hoshiarpur: The garden was primarily a large mango orchard. Several desi varieties of mango besides other trees & shrubs of the Shivalik area are present.

Though these gardens are important natural heritage sites, very little attention has been paid to their conservation. Detailed studies need to be taken up.

Besides the above, all universities in the state have established Botanical gardens,usually administered by the Department of Botany. The Botanical Garden of PAU, Ludhiana is managed by the Deptt. Of Landscaping & Floriculture. A garden of Medicinal Plants, managed by Deptt. Of Pharmacy exists at Panjab University, Chandigarh. Besides, some colleges also have small Botanical gardens. Most of these gardens are repositories of endemic, rare & endangered plant species.

3.4.3 Preservation Plots:

Representative areas set aside in various forest types for permanent protection are known as preservation plots. The main objective of these plots is to preserve samples of existing forests, as far as possible in their present form and to promote conditions which lead to the formation of climax community. As per information gathered from local communities a few (exact number not known) preservation plots existed in the reserve forest areas in Shivaliks which represented both, climax & seral stages of the representative ecosystems. However, most of

these were lost during the 19th century, due to partition and resettlement of refugees, re-organization and pressures of agriculture & urbanization. As per official records no preservation plots currently exists in the state.

The above data indicates that though Punjab is primarily an agricultural state, but several oasis of biodiversity rich areas exist. However, economic development, increasing agriculture, industry & urbanization have taken their toll on the state's natural resources. The expansion of canal irrigation, has though facilitated agriculture, but it has also lead to conversion of large tracts of wilderness into agricultural lands, thus adversely affecting the state's natural ecosystems, floral & fauna. This can have an ecological backlash.

Overexploitation of land through double and triple cropping, & promotion of monoculture is already leading to excessive withdrawal of nutrients from the soil causing nutrient imbalance which adversely affects soil health. Experts believe that the productivity of land will decrease unless corrective actions are taken up now. Maintaining the state's economic prosperity in future will, therefore, require concerted measures to protect and enhance remaining forests & biodiversity, restore ecosystems wherever possible and promote sustainable use of natural resources.

CHAPTER-IV

STATUS OF BIODIVERSITY IN PUNJAB

A review of the various components of the state's physical environment indicates that intensive and extensive agriculture, high human population density and increased urbanization and industrialization has adversely affected the natural habitats in the state. Diverse historical events, frequent reorganizations, overexploitation of soil and water resources & consolidation of land holdings have also contributed to habitat & biodiversity loss. The principal habitats found in the state are:

- The cropland & grassland ecosystem - dominant
- The fresh water aquatic ecosystem
  - Wetlands
  - Rivers and canals
  - Seasonal rivulets (choes in Shivalik)
- Forest ecosystem
  - Open scrub forests – parts of Shivaliks and Bir forests
  - Chirpine forests in northern Shivaliks
  - Bamboo plantations in parts of Shivaliks
- The semi-arid ecosystem (characterized by sand dunes)
- Saline & water logged areas
- Areas under Plantations

There is, however, a lack of unified criteria for measuring & evaluating biodiversity for which parameters for assessment of the natural character of ecosystems need to be established through an integrated and interdisciplinary approach.

A: Wild Biodiversity

4.1 Wild Flora

Based on its floristic diversity the state of Punjab can be divided into four main zones. These are:

- The grassy plains which constitute the major part of the State and represent the grassland ecosystem modified to croplands.

- The Shivalik woodlands, which are a part of the foothills of new fold Himalayan mountains and are spread at the northern end of 3 districts (Ropar, Hoshiarpur & Gurdaspur). Spread out in a 5966 km^2 long area , this is the only natural area in the state with high biodiversity.
- The semi-Arid region spread in the districts of Bathinda, Ferozepur, Sangrur, Mansa, Muktsar, Faridkot and parts of Moga.
- The State Wetlands, which comprise a total area of 8.39 sq. km. of natural wetlands and 147.39 sq. km. of manmade wetlands and lakes. These areas are not only a source of fresh water but also act as ground water rechargers and are home to a wide variety of wild flora & fauna. The State has the distinction of having one Ramsar site (Harike) and two National wetlands (Ropar & Kanjli).

4.1.1 Fossil records

Palaeontological records of the area (especially Tatrot & Pinjore formations in Shivaliks) indicate that the area was floristically rich in the geological past as not only a variety of floristic samples have been recorded but the area is believed to provide habitat to a large number of well developed mammalian species including elephants & rhinoceros. The recorded fossil flora from Upper Shivaliks near Chandigarh (Gaur 1987) is as under:

- Charophytes - 8 spp.
- Pteridophytes - 6 spp.
- Gymnosperms - 7 spp.
- Angiosperms - 11 spp.

The details are at Annexure-13.

4.1.2 Existing Floristic diversity

Due to its strategic position, the State of Punjab has witnessed several invasions and its geographical boundaries have been redefined many a times in the past. Before partition the state covered the Himalayan foothills (Shivaliks) as well as the major Himalayan ranges (Dhauladhars) in the north, the Satluj and Indus plains in the center and the semi-arid areas bordering the Thar in the south. The State's flora was studied in the eighteenth century by workers like Hooker (1872-1888), Duthie (1960), etc. along with the flora of other parts of the country. Royle (1833-1840- as cited in TERI-2001) reported 60 species of plants from the plains of Punjab. Edgeworth (1838-1842) provided a botanico-agricultural account of the

area, Aitchison (1864-1869) studied the flora of Punjab & Sindh and Cleghorn (1864) published a report on the forests of Punjab. However, the first detailed floristic account of the state was published in 1869 by J.L. Stewart as 'Punjab Plants' which listed 821 species of angiosperms and provided their botanical and vernacular names.

Subsequently, the forest flora for Punjab (with territory west to river Yamuna) was published by Parker in 1915 and updated in 1921 and 1956. He has reported 1121 floral species but does not present an account of the grasses in the area. Family Poaceae covers only the bamboo group for which 3 genera have been reported (as cited in TERI 2001 – data submitted to Forest Deptt., GOP, unpublished). Weeds of Punjab' have been separately published by Luthra (1937). Subsequently, the 'Flora of Punjab Plains and associated hill region was prepared by Sabnis in 1940 (Annexure-14). In some cases, however, clear information on habitat and exact locality of plants has not been mentioned in his publication. Hence, only those species where specific localities have been clearly mentioned falling within the present jurisdiction of the state have been listed in this document for comparison with existing flora. Individual workers have published floras of selected districts also during this period.

With the partition of the country, the state was divided into east and west Punjab. Studies on the flora of east Punjab, falling within the territory of India were conducted by BSI after its re-organisation in 1956. The 'Flora of Punjab Plains' was published by Nair (1978) based on his studies during 1963-66 (i.e. prior to re-organisation of the state; hence, in this case too only those species have been listed at Annexure 4.2. which clearly indicate localities).

The political boundaries of the state were again re-defined under the Punjab Re-organisation Act, 1966. A new state i.e. Haryana was carved out and some areas of Punjab lying in or around Himachal Pradesh (then UT) were annexed and Himachal State was formed with the present Punjab state left with an area of 50362 sq km only. Major floristic studies in the present Punjab especially with regard to angiosperms have been carried out by Prof. M. Sharma of Punjabi University, Patiala since 1966 onwards. A "Check list of Punjab Plants" was published in 1990 which included pteridophytes and gymnosperms in addition to angiosperms. Other floristic groups have been studied by individual researchers. An attempt has been made to

collect & compile all available relevant information to assess the floristic biodiversity of Punjab.

Based on available data, the diversity of flora in the state of Punjab is summarized as under:

Group	No. of reported spp.	% of total No. of spp. reported in India *
Algae	371	5%
Fungi	448	3.15%
Bryophytes	10	0.48%
Pteridophytes	26	2.44%
Gymnosperms	21	37.1%
Angiosperms	1939**	10.7%
- Grasses	132	
- Weeds	350	
- Medicinal Plants	291	
-Economically imp. plants	218	
- Forest trees	203	

*****Source: MoEF, 2000
** Sharma (2002,Personal Communication)

Sharma & Rajpal (1995) have also analyzed the floral elements (1119 wild & naturalized species of spermatophytes) of the Punjab state based on phytogeographic regions (Table-4.1)

Table 4.1: Analysis of Major Phytogeographic Regions of the Flora of Punjab

No.	Region	No. of species	Percentage
1.	Endemic	3	0.27
2.	India	83	7.42
3.	Indo-Malaya	263	23.51
4.	North Africa India Desert (Saharo-Sindian)	106	9.47
5.	Tropical & North African-Indian Desert (Sudano-Deccanian)	50	4.47
6.	Tropical Africa-India	43	3.84
7.	Tropics of the Old World	209	18.68
8.	Pantropical	114	10.19
9.	Warm countries	13	1.16
10.	Subtropical & temperature	7	0.62
11.	Mediterranean	22	1.97
12.	Orient	11	0.98
13.	Europe	62	5.54
14.	Cosmopolitan	30	2.68
15.	Americas	53	4.73
16.	Himalayas	31	2.77
17.	Temperate	19	1.70
	Total	1119	100.00

These have been further grouped into four main classes (Table 4.2), i.e. the Indian, eastern, western & general elements:

Table 4.2: Analysis of the Floral Element Classes of Flora of Punjab State

No.	Floral elements	No. of species	Percentage
1.	Indian a) Endemic (1)* b) Indian (2)*	117	10.46
2.	Eastern (3)* (Indo-Malayan)	263	23.51
3.	Western a) N. African-India Desert (4)* (Sudano-Sindian) b) Tropical and N.African-Indian Desert (5)* (Sudano-Deccanian) c) Tropical African – Indian (6)* d) Mediterranean – Oriental European (11,12,13)*	294	26.27
4.	General a) Tropical (7,8, 10, 15)* b) Warm countries (9)* c) Temperate (17)* d) Cosmopolitan (14)*	445	39.76
	Total	1119	100.00

*Numbers within parentheses corresponde to the no. of Table 4.1.

The class wise distribution in the three floral regions of the state is also presented (Table 4.3).

Table-4.3: Comparative Analysis of the Floral Element Classes of different Floristic Regions of Punjab State

Floral element	Punjab State (Sharma & Rajpal, 1995)		Punjab Shivaliks (Sharma & Rajpal, 1995)		Semi-arid Punjab (Sharma et.al. 1987)	
	No. of species	Percentage	No. of spp.	Percentage	No. of spp.	Percentage
1. Indian	117	10.46	75	12.36	47	9.89
2. Eastern	263	23.51	175	28.83	59	12.42
3. Western	294	26.27	99	16.32	145	30.54
4. General	445	39.76	258	42.49	224	47.15
Total	1119	100.00	607	100.00	475	100.00

Data indicates that the Indian element is the least represented in all the three floral regions. Out of the 134 dicot genera reported to be endemic to India (Chatterji, 1939), only 5 spp. (*Ougeinia* Benth., *Butea* Willd., *Caesulia.,* Roxb., *Glossocardia* Cass. & *Aechmanthera* Nees) are reported to occur in Punjab. Further, 3 endemic spp. are reported from the state (*Hibiscus hoshiarpurensis* Paul &

Nayar, *Argyrolobium album* Bhattacharyya & *Rumex punjabensis* Vaid and Naithani) out of which the former two have been reported from the Shivalik area.

The western element, comprising of African, Mediterranean – Oriental – European species, is fairly well represented in the flora of the state. One important reason for this could be the lack of an effective barrier on the western boundary of India allowing free exchange of genetic material. However, the general element is by far the most conspicuous and includes the cosmopolitan, temperate and tropical species. The cosmopolitan species are, in general, either naturalized from cultivation or are aquatic in nature (The state of Punjab being rich in water resources like natural wetlands ponds and lakes which attracted migratory birds, the wide distribution of aquatic plants could be due to their dispersal by these birds). Sharma & Rajpal (1995) consider the state largely as a transition zone from tropical areas to semi-arid regions and opine that as the area became denuded (for agriculture & due to invasions), the original species had to compete with the introduced ones which colonized in the exposed areas due to availability of suitable climate and displaced the previous established species of the Indian subcontinent. They quote the recent example of *Parthenium hysterophorus* Linn. in this regard which was recorded in the late seventies and has now become an obnoxious and gregarious weed.

Sharma and Associates (Meenakshi & Sharma, 1985; Sharma, 1990; Sharma & Rajpal, 1995; Sharma 1996 – as cited in TERI,2001) have also classified the flora based on life forms as per Raunkier (1934). The data are summarized in table 4.4.

Table 4.4. Distribution of different Life Forms in Punjab

Life Form Class	No. of Species	Percentage
Phanerophytes	**243**	**21.72**
Chamaephytes	**049**	**4.38**
Hemicryptophytes	**083**	**7.42**
Cryptophytes	**215**	**19.21**
Therophytes	**529**	**47.27**

Detailed information on various components of micro & macro flora of Punjab as available from secondary data sources is presented below::

4.1.2a Algae

Available records indicate that 371 species have been reported from the state by Pandhol (1974), Rattan (1985-89), Dhillon *et al.* (1996) Sarma & Rattan (1990), Sarma & Kanta (1978) & Majeed (1935). These include **71 new records for India**

and 62 new records for Punjab. The studies extend to all districts except Bathinda and include 109 spp. of Phylum Cyanophyta, 235 spp. of Phylum Chlorophyta & 13 spp. of Phylum Xanthophyta, 2 spp. of Charophyta,12 spp. of Bacillariophyta (Diatoms),, 1 sp. of Euglenophyta, Phaeophyta (Brown Algae) & Rhodophyta. The detailed list is at Annexure-15.

4.1.2b Fungi

In all 448 spp. of fungi (Annexure-16 a & b) have been reported from Punjab by Singh (1970, 1971, 1974, 1975, 1976), Sawhney (1979), Prashar (1980), Singh & Jhooty (1984) from PAU, Ludhiana ; Gulati (1982), Kaur (1982), Chawla (1986), Sahajpal, (1987) & Sharma (1995) from GNDU, Amritsar; Atri, et al. (1992a & b, 1995,1996a & b), Saini, et.al. (1988, 1989a & b, 1991,1992,1997), Saini & Atri (1995) from Punjabi University, Patiala. These include 396 spp. of pathogenic fungi reported from various districts of Punjab and 52 species of non-pathogenic fungi reported from district Amritsar only. Record on lichens is not available.

4.1.2c Bryophytes

Kashyap (1936) has reported 10 species of bryophytes mostly from districts Gurdaspur, Ropar & Hoshiarpur in the Shivalik area and districts Jalandhar & Amritsar along river courses. Out of these two spp. are rare in Punjab. *Riccia sanguinea* is, however, very common along rivers in the entire state. Detailed list is at Annexure-17.

4.1.2d Pteridophytes

In all, 26 spp. of Pteridophytes have been reported from the state. These include 16 spp. reported by Sharma (1990, 1997) and 6 additional spp. reported by Khullar (2000) from Distts. Patiala, Hoshiarpur & Amritsar. Subsequently, Vasudeva (2001 – oral communication, unpublished data) has informed the occurrence of 4 more spp. (*Christella parasitica, Equisteum diffusum, Marsilea indica* & *Nephrolepis exaltata*) from the state. The details are at Annexure-18.

4.1.2e Gymnosperms

Parker (1918) & Sharma (1990) had reported 21 spp. of gymnosperms from the area falling within the present Punjab. Subsequently, Sharma (1990) has reported 20 spp. which include 11 new spp. not reported by Parker earlier. However, 2 spp. reported by the former worker have not been reported by the latter. The details are at Annexure-19.

4.1.2f Angiosperms

In all 1939 spp. of Angiosperms have been reported from Punjab by various workers (Annexure-14). Sabnis (1940) has reported 368 spp. from the State and Nair (1978) has reported 685 taxa. Sharma (1990) has reported 1879 of angiosperms from the present re-organised Punjab. 22 species reported by Sabnis have not been reported by Sharma (1990). Similarly, 66 species reported by Nair (1978) have not been reported by Sharma (1990). This could possibly indicate loss of certain flora due to loss of habitat as large chunks of land had been brought under the plough during this period.

Out of the 1879 angiosperms reported by Sharma (1990), 1406 spp. are dicots and 437 spp. are monocots belonging to 184 families and 964 genera. The dominant families are Gramineae (82 genera, 163 spp.) Compositeae (92 genera, 142 spp.) Papilionaceae (54 genera, 137 spp.), Euphorbiaceae (25 genera, 62 spp.), Cyperaceae (6 genera, 62 spp.), etc. The following new texa from Punjab have also been reported as **new taxa to Science:**

- *Argyrolobium album* Bhattacharyya (Bull. Bot. Surv. India 14 175. 1972) (Plate 9 a and b).
- *Rumex punjabensis* Vaid & Naithani (Ind. For. 105 : 802. 1979).
- *Hibiscus hoshairpurensis* Paul & Nayar (Bull. Bot. Surv. India **25 :** 188. 1983) (Plate 9c).
- *Polypogon monspeliensis* (Linn.) Desf. Var. indicus Bhattacharyya & Jain (Bull. Bot. Surv. India **25:** 208 1983) (Plate 9d).
- *Panicum maximum* Jacq. subsp. *pubescens* M Sharma (J. Econ. Taxa Bot. **7:** 106.1985).

The following species are also **new reports for India** recorded from Punjab though some of them extend to adjoining states as well:

Sagina apetala Ard.

Urtica urens Linn.

Hypecoum pendulum Linn. Syn. H. procumbens auct.

Crotalaria sessiliflora Linn. subsp. hazarensis Ali

Nothoscordum inodorum (Ait.) Nicholson

Geranium carolinianum Linn.

Oenothera Laciniata Hill.

Oldenlandia umbellata Linn.

Further 201 wild species have been reported as new plant introductions most of which are exotics.

Although no systematic studies have been carried out to identify the rare or endangered flora of the state, a reference to Red Data Book of Indian Plants Vol. I (Nayar & Sastry 1987) indicate that *Acer oblongum* Wall, ex. D.C. var *membranaceum* Bannerji (Fam. Asclepediaceae) is an **endangered species** and *Ceropegia pusilla*. Wight *et.* Arn. (Fam. Asclepediaceae) is **rare**. IUCN has recommended insitu conservation of these species by declaring their habitat as protected, preventing their uprooting, attempting their regeneration in similar ecological habitats and preservation of their seeds. Further, Sharma & Cheema (1993) have published data with regard to Families Ranunculaceae– Elatinaceae, Malvaceae – Moringaceae and Fam. Papilionaceae respectively where they have identified 44 plant species within these families as **rare in Punjab** (this does not necessarily mean that these species are rare in India as well). Out of these, 15 species occur in Shivalik area only. Sharma & Cheema (1993) have further identified *Polycarposs prostraturn* (Forssk.) Aschers. & Schweinf. (Fam. Caryophyllaceae) (Plate 10d), *Waltheria indica* Linn. (Fam. Bombacaceae), *Zoxyphylla* Edgew. (Fam. Rhamnaceae) and *Campylotropus ericarpa* (DC.) Schindl. (Fam. Papilionaceae) as **very rare** (only one specimen recorded in Punjab). Some common angiospermic species are presented at Plates 11 and 12.

4.2 Wild Fauna

The diversity in flora also provides suitable habitat for diversity in fauna, as discussed below:

4.2.1 Fossil records

As per Paleontological records the State was rich in vertebrate fauna in the past. Data indicate the presence of the following species (Gaur, 1987):

- 69 spp. of mammals
- 10 spp. of reptiles
- 2 spp. of fishes

The detailed list is at Annexure-20.

4.2.2

Faunal studies have been conducted by various workers in the re-organised state. Though sufficient work has been done with respect to vertebrate fauna, information on invertebrate fauna is scanty. The diversity of reported fauna in the State with respect to data for the entire country is summarized below:

Invertebrate Diversity

Group	No. of spp.	% of India
Protozoa	84	3.3%
Porifera	Not available	
Coelentera	Not available	
Platyhelminthes	41	2.9%
Nematoda	157	1.8%
Annelida	34	3.6%
Arthropoda	1147	1.8%
Molluscsa	85	1.7%
Echinodermata	Not found in Punjab	

Vertebrate Diversity

Pisces	112	5.2%
Amphibia	15	6.7%
Reptilia	35	6.6%
Aves	442	37%
Mammalia	43	7.7%

The details are discussed in the succeeding paras:

4.2.3 Invertebrate Diversity

4.2.3a Protozoa

Very few studies have been conducted on Protozoans in Punjab. Data compiled from M.Sc. & Ph.D Theses of Punjabi University, Patiala and PAU, Ludhiana indicate work on 84 species in the state out of which 44 free living species have been reported (Satwant, 1989) and the rest are parasites of fishes (Chand, 1992) and amphibians (Masandrai, 1977). The study covers only 9 districts in the state. The detailed list is at Annexure-21.

4.2.3b Platyhelminthes

Only one worker (Duggal, 1972, 1981, 1984 & 1987) is reported to have worked on Platyhelminthic spp. in the state. He has reported 41 species parasitic on some fishes, amphibians, reptiles and birds. One free living species (*Planaria* sp.) and 3 mammalian parasites (*Fasciola hepatica, Taenia solium* & *Schistostoma haemotobium*) are also known to occur in the state. The detailed list is at Annexure-22.

4.2.3c Nematoda

Data on Nematodes is also grossly inadequate. In all 157 species have been reported by various workers in Punjab out of which 74 Nematodes are plant

parasites (Chhabra, 1965; Mahajan & Chhabra, 1979) and the rest are animal parasites. These include 47 parasites of domesticated animals (Toong, 1972; Kaur, 1978, 1979 a & b; Gupta, 1979; Brar, 1981; Singh, 1991), 12 parasites of reptiles (Bakshi, 1977; Kaur, 1979), 6 parasites of amphibians (Kaur, 1979), 9 parasites of fishes (Mehta, 1971) and 9 parasites of one arthropod (*Periplaneta americana*) (Duggal, 1985). Work on plant parasitic nematodes has been carried out at PAU, Ludhiana whereas animal parasitic nematodes have been studied at Punjabi University, Patiala only. The detailed list is at Annexure-23.

4.2.3d Annelida

Amongst Annelids 34 species have been recorded from the State from water bodies and soil (Rani, 1975; Sharma, 1993; Kaur, 1994 & Dhillon *et.al*. 1996). Out of these, **seven species are new records from Punjab** by Rani (1975). The detailed list is at Annexure-24.

4.2.3e Arthropoda

Studies have been conducted on 2 sub-phylums of Arthropoda only i.e. Mandibulata and Chelicerata. No studies have been done on phylum Onychophora.

- Sub-phylum Mandibulata – Two classes of phylum Mandibulata i.e. Crustacea & Insecta have been studied to some extent. Studies are currently being conducted on classes Chilopoda & Diplopoda in the Shivalik area under a project initiated by Punjab State Council for Science and Technology in association with ZSI.

  Till date 124 species of *Crustaceans* have been reported from 7 districts of the state (Battish, 1978; Grover, 1983; Brar, 1988, 1993; Bath & Kaur, 1997). Major studies have been done by Dr. S.K. Battish from PAU, Ludhiana. The detailed list is at Annexure-25.

  Class-insecta is a major class of arthropods. Out of 20 orders from 2 sub-classes (Apterygota & Pterygota) studies have been reported only on 8 orders.

  - Under order Coleoptera 296 spp. of Beetles have been reported (Singh *et al*., 1985; Mehta, 2001 – unpublished data). Major information has been collected from Shivalik belt of Punjab by ZSI, Solan during 2000-01 under Shivalik Biodiversity project. The detailed list is at Annexure-26. No studies have been reported for the weevils of this order.

- For order Hemiptera 35 spp. have been reported from the Shivalik belt of Punjab only during 2001 by ZSI, Solan (Mehta, 2001 – unpublished data). The detailed list is at Annexure-27.
- For order Hymenoptera 30 spp. have been reported from the Shivalik belt of Punjab during 2000-01 by Singh 2001 (unpublished data). Out of these one species (*Apis dorsata*) is reported to have very high frequency of occurrence whereas 5 spp. have low frequency of occurence. The detailed list is at Annexure-28.
- 24 spp. of dragon flies (order Odonata) have also been reported from Shivalik belt of Punjab (Kumar, 2001 – unpublished information) and Kanjli wetland (Kirti & Singh, 2000). The detailed list is at Annexure-29. No information is available on Damsil flies of this order.
- 52 spp. of Orthopterans have been reported from the Shivalik belt of Punjab only by ZSI, Solan during 2000-01(Mehta, 2001 – unpublished data) The detailed list is at Annexure-30.
- 14 spp. of thrips (order Thysanoptera) have been reported from Patiala district only by Gupta (1979 a). The detailed list is at Annexure-31.
- 45 spp. of Dipterans have been reported from the state. The detailed list is at Annexure-32 a & b. Out of these, 30 spp. are mosquitoes (Paul, 1971; Sagandeep, 1990,1997; Kirti & Kaur, 1999), out of which 7 spp. occur in all the districts of the state. One species of sawfly has been reported by Saini (verbal communication, 2001) from Mustard Plant and all other members of family Crucifereae.
- 198 spp. of moths (order Lepidoptera) have been reported from 2 districts (Bathinda & Patiala) and the Shivalik belt of Punjab (Rose, 2001). The detailed list is at Annexure-33. In addition, 142 spp. of butterflies (Plate 13) have also been reported by Verma (1974), Rose *et al.* (1994), Rose (1997) & ZSI, Solan (2000). The detailed list of butterflies is at Annexure-34.
- No studies are available on orders Dictyoptera (Roaches & Mantis), Phasmida (Stick leaf insects), Dermaptera (Earwings), Placoptera (Stoneflies), Mallophagia (Bitting Lice), Anopleura (Sucking lice), Homoptera (Aphids), Neuroptera (Ant – Lions) & Siphonaptera (Fleas) belonging to sub-class Pterygota.

- Studies are, however, being conducted currently on orders Isoptera (Termites) and Ephemeroptera (Mayflies) in the Shivalik area.
- For sub-class Apterygota no studies have been conducted on any of the two orders i.e. Collembola (Spring tails), Thysanura (Silver fishes)

Most of the data presented above has been compiled from reports submitted to PSCST by ZSI and Punjabi University, Patiala under the above mentioned project.

- Sub-phylum – Chelicerata

  Out of 2 classes (Merostomata & Arachnids) of this sub-phylum studies have been reported only on 2 sub-classes (Araneae – spiders & Acarina – ticks & mites) of class Arachnida. 43 spp. of spiders (sub-class Araneae) have been reported only from two districts (Ludhiana & Patiala) of the State (Kumari, 1982, 1984). The detailed list is at Annexure-35.

  Similarly, 114 species of mites from sub-class Acarina have been reported from the entire state by workers at PAU, Ludhiana (Bindra, 1971; Kaur, 1975; Gupta, 1979 b; Singh, 1987a; Kapoor & Sood, 1990). The detailed list is at Annexure-36. Further, 30 species of ticks have been reported from the state by Kaur (1975), Singh (1975) and Gill & Gill (1977) from PAU, Ludhiana. The detailed list is at Annexure-37.

4.2.3f Mollusca

In all 85 species of Molluscs have been reported from 9 districts of Punjab by workers from PAU, Ludhiana (Khanna, 1974; Singh, 1987 b; Sharma, 1993;). Out of these **2 species are new records for India, 9 species are new records from Northern India and 5 species are new records from Punjab**. Family Lymnacidae is the dominant family with 7 species. The detailed list is at Annexure-38.

The above data indicates that the state is rich in invertebrate fauna which plays an important role in ecosystem function and dynamics and hence warrants a detailed investigation.

4.2.4 Vertebrate diversity

4.2.4a Pisces

Various workers (Johal & Tandon, 1979,1980; Ladhar *et al.* 1994; Prakash, 1999 – as cited in Vishwakarma, 2000 & Deptt. of Fisheries, GOP) have reported 112 species of fish from the state. Some common species are at Plate 14. Major

work has been conducted at Panjab University , Chandigarh. The detailed list is at Annexure-39. This includes introduced varieties also.

4.2.4b Amphibia

Only 15 species of amphibians have been reported from the state by Battish (1986), Dhillon *et al*. (1996) & Ladhar (2000). Out of these 8 spp. are most common throughout the state. The detailed list is at Annexure-40.

4.2.4c Reptiles

Very few studies have been conducted on reptiles in Punjab (Plate 15). As per inf

ormation collected from local people, crocodiles and alligators were reported to occur in fresh water bodies in the past but no scientific records exist. As per Annexure-41. 35 species have been reported from the state (Bakshi, 1997; Dhillon *e al*. 1996 & Ladhar, 2000) These include 6 turtle species from Harike which are included in Schedule I of the Wildlife (Protection) Act, 1972 (*Kachuga smithi, K. tecta, Lissemys punctata andersoni, Trionyx gangeticus, Hardella thurji* and Chitra *indica* as reported by Singh, 1990 and cited in Jerath, 1992).

4.2.4d Aves

The state is especially rich in bird population (Annexure-42) and 328 species of birds were recorded in Punjab by the Department of Forests and wildlife in 1993. Some Birds are placed at Plate 16. It has reported three rare ducks (Scaup duck, Stiff tailed duck and Bronze capped teal) from Harike wetland. Other rare, vanished or occasional spp. from Pb. include yellow wattled lapwing, painted stork, crested honey buzzard, golden eagle, king vulture, horned owl etc. (Plate 17).

Some species reported earlier in the state but now extinct include great Indian bustard, pinheaded duck and Salara Pigeon (Jerath, 1995). Further, as per the department of forest and Wildlife Adjutant Stork, Flamingo, Himalayan golden Eagle, Black or king Vulture, Indian long billed Vulture, Himalayan Griffon, Eastern peregrine Falcon, Shaheen Falcon, Red headed Merlin, Little Botton quail, Indian Bustard quail species have not been sighted by the deptt. in the state since a long time.

However, in 2001, Dr. H.S. Mehta, ZSI Solan has reported 382 species of birds from Shivaliks (Mehta, 2001). Information available with PSCST indicates presence of 361 species from Harike Wetland, which includes 13 rare species (Para 3.3.2 i).

4.2.4e Mammals

Lamba (1984) has reported that 87 species of Mammals existed in Punjab during the beginning of this century but only 43 spp. have been recorded in present day Punjab by Lamba(1984) and 38 spp. have been recorded by Prasad (1984) (Annexure-43). Two species- Desert cat and Caracal have been identified as **endangered** and 7 species- Pangolin, Wolf, Clawless otter, Leopard cat, Panther, Blackbuck and Chinkara as **vulnerable** by ZSI (Plate 18 and 19). Out of these 39 species are under different schedules of Indian Wildlife Protection Act, 1972 **and 9 spp. are under CITES**. Indian pangolin, wolf, chital, Chinkara otter and smooth Indian otter are reported to be **rare** and long eared Hedgehog, Flying fox, Indian porcupine, Indian fox, Hog deer, Barking deer etc have low populations (Parshad, 1984). Infact, as per Chief Wildlife Warden, State Department of Forests and Wildlife the existence of Chinkara, Flying Fox, Wolf, Clawless otter, Leopard cat, Long eared hedgehog, Long tailed tree mouse species in the state is doubtful now. Further, black buck, sambar, etc. are restricted to certain specific areas only.

4.3 Rare & Threatened Species

A summary of rare, threatened and vulnerable species of flora and fauna is presented below:

Table: 4.5. Rare, threatened & vulnerable species of flora and fauna.

Group	IUCN 2000	CITES 2001	WLPA, 1972	Red Data Book	ZSI	Sharma (Pb. only)
Plants						
Angiosperms				En: 1,R : 1		VR:4, R: 44
Animals						
Fishes	CR: 2, E: 12, VU:20 NT: 32					
Amphibians	VU:1,NT: 2	Ap.I:1,Ap.II:2	Sch.IV:4			
Reptiles	VU: 6 NT: 12	Ap.I: 5 Ap.II: 5 Ap.III: 2	Sch.I:6 Sch.II:5 Sch.IV:1			
Aves	CR: 2, R: 13, E: 3, VU: 10,Th: 8,NT: 7	Ap.I: 3 Ap.II: 49	Sch.I:6 Sch.IV:75			
Mammals		Ap.I: 3 Ap.II: 6 Ap.III:6	Sch.I: 8 Sch.II:5 Sch.III:7 Sch.IV:9 Sch.V:10		VU: 7 EN: 2	

Source : TERI, 2001 – unpublished; ZSI – personal comm.; Sharma, 1990

B. Domesticated Bio-diversity

4.4 Domesticated Flora

The ushering in of green revolution in the sixties has replaced traditional agricultural practices with high input intensive agriculture in Punjab. The data regarding the agriculture diversity for the state has been collected from the Punjab Agriculture University, Ludhiana, Deptt. of Agriculture, GOP, NGOs and experienced farmers.

4.4.1 Change in Cropping Pattern

Data indicates a considerable change in areas under cultivation (Table 4.5) & production (Table 4.6) and varietal changes (para 4.3.2) in different crops (wheat, rice, cotton, sugarcane, maize, pulses, millets, oil seeds, soyabean, bajra, barley etc.). The information is tabulated at Table 4.5.

Table 4.6. Change in area under cultivation of major crops in Punjab. (000' hectares)

Year	Rice	Maize	Wheat	Gram	Pulses	Ground-nut	Total oil seeds	Cotton	Sugar-cane	Bajra	Jawar
1960-61	227	327	1400	838	65	67	185	447	183	123	6
1970-71	390	555	2293	358	56	174	295	397	128	207	5
1980-81	1183	328	2812	258	83	83	238	649	71	69	1
1990-91	2015	188	3273	60	83	11	104	701	101	12	*
1998-99	2518	154	3278	13	60	6	160	563	103	5	*

*: >500 ha Source: Statistical Abstract Punjab,2000

Table 4.7. Change in Production of major crops in Punjab ('000 MT).

Year	Rice	Maize	Wheat	Gram	Pulses	Ground-nut	Total oil seeds	Cotton	Sugar-cane	Bajra	Jawar
1960-61	229	371	1742	681	28	62	121	709	486	58	*
1970-71	688	861	5145	284	24	169	233	818	527	243	3
1980-81	3233	612	7677	150	54	104	187	1175	392	86	1
1990-91	6506*	333	12159*	45	60	9	93	1909*	601	13	1
1999-2000	8716	427	15910	6	35	5	104	950	676	4	*

*: >500 MT Source: Statistical Abstract Punjab,2000

**Revised*

Note: Production of Sugarcane is in terms of gur
Groundnut is nuts in shell
Cotton is cleaned cotton and is in terms of thousand bales of 170 kgs. each.

Data indicates that whereas the area under wheat has increased by 2.42 times, area under rice has increased by 11.5 times from 1960-61 to 1999-2000. The area under Bajra has, however, decreased by 24.6 times (from 123 th.ha. to 5 th.ha.), area under Barley has decreased by about half & area under Jowar is less than 500 ha now (from 6000 ha in 1960-61).

Similarly, the area under gram and other legumes has decreased considerably. Area under oil seeds especially, groundnut, rapeseed & linseed has also decreased considerably. Though sunflower cultivation was introduced and promoted in the early nineties in the state but it has decreased now probably due to low market support and allelopathic impacts of the plant. Area under cotton & sugarcane is almost stable whereas area under potatoes has increased. Hence, not only the diversity of domesticated crops in the state has decreased, it has also resulted in the recent glut in the market with respect to some crops (especially wheat, rice & potatoes) where farmers have not been able to get remunerative prices.

4.4.2 Change in Varietal Diversity

Considerable varietal changes have also taken place since the introduction of green revolution in the State. Prior to Green Revolution 41 varieties of wheat, 37 varieties of rice, 4 varieties of maize, 3 varieties of bajra, 16 varieties of sugarcane, 19 varieties of pulses, 9 varieties of oil seeds & 10 varieties of cotton were reported to be in use and propagated through pure line selection by various workers.

Research on Crop improvement and pure line selection (Anand, 1972; Singh, 1972) in undivided Punjab was first undertaken on Wheat at Lyalpur (now in Pakistan) in 1907 by D. Milne which was followed up by Choudhry Ramdhan Singh in 1925. Subsequently, research on wheat was taken up at Gurdaspur in 1941 and Jalandhar in 1947. A millet section was also established in 1927 for studies on Bajra which was later shifted to Ferozpur. Gurdaspur was the Centre for sugarcane varietal testing in 1911. Work on oil seeds (mustard, linseed and sesamum) was carried out in 1929 at Lyalpur and subsequently on groundnut in 1933 at Samrala. Research on cotton was initiated at Lyalpur in 1912 by Dobbs. Work on pure line selection of rice was started in 1926 but intensified after independence in 1950. A

rice research station was established at Gurdaspur which was later shifted to Kapurthala in 1960. With the establishment of Punjab Agriculture University at Ludhiana in 1962 most of the work related to agricultural crops was shifted to PAU.

The list of the 41 varieties of **wheat** used in pre-green revolution period is placed at Annexure-44a. Reports (Gill, 1972; Singh, 1972) indicate that D.Milne (1907) surveyed wheat areas and classified the material in to 25 types/varieties out of which 18 belonged to broad wheat (*Triticum aestivum*) , three to compactum group (*Triticum aestivum* var. compactum) and four to Wadanak group (*Triticum durum).* Out of these type 8A had very wide adaptability and 9D was recommended for growing under rainfed conditions. Similarly, varieties C 518 and C 591 (developed by Singh, 1933 & 1934 as cited by Singh, 1972) remained popular for two decades. Further, at that time, varieties commonly grown in fields consisted of mixture of various types of grain. In certain areas both, bearded & beardless wheats were grown together and were given commercial names like, Sharbati, Darra, Safaid Pissi, Lal Pissi, Ghandausi, Lal Kanak, etc. Bansi, Kathia, Khandwa & Malwi were common durum wheats. Varieties such as Pakwani were preferred for making sweet dishes, Dawatkhani for parties and Sharbati for soft chapattis (Anand, 1972). Most of the indigenous wheats however, were prone to lodging under heavy doses of fertilizers. This led to the introduction of semi-dwarf & dwarf varieties. Some of these indigenous varieties were however, used by breeders to develop better quality dwarf varieties.

The work on **rice** started in Punjab 1926. As per reports (Saini, 1972; Singh, 1972) more than 37 pure line varieties were propagated in the state before independence (Annexure-44b). These included 9 varieties specifically suited for hills. The varieties were selected by pure line selection to produce homozigus populations. All Basmati varieties were fine grain varieties (including 2 varieties from hills-Lal basmati and desi basmati) Varieties for medium fertility and low fertility areas were also identified. However, since 1968 emphasis shifted from indigenous tall varieties to high yield dwarf varieties.

Research on **maize** was initiated in 1945 (Khera, 1972; Singh 1972). The native varieties were identified as sweet corn, flour corn, waxy corn, etc. but no detailed list of indigenous varieties is available. 4 hybrids were, however, released before green revolution (Annexure-44c). Similarly 3 hybrids of **bajra** were released

before the green revolution (Annexure-44d). Information on desi varieties from which these hybrids were developed is not available.

Pulses have been important crops of Punjab. Mung & mash are Kharif crops whereas gram & lentil are winter crops. Information on local varieties of most of the pulse species is not available. However, as per Singh, KB (1972) & Singh,S. (1972) 19 hybridized varieties were released prior to green revolution (Annexure-44f). Similarly Pure Line Selection of 9 varieties of **oilseeds** (Annexure-44e) were released prior to green revolution. Brown sarson selection A, yellow sarson selection A & toria selection A were developed through mass selection before 1947. Raya L-18 was also a Pure Line Selection released in 1937 and recommended for a long time. Groundnut was first introduced as a field crop in Punjab in village Takhran, Samrala, distt. Ludhiana in 1930 and groundnut No. 1 was developed through Pure Line Selection by Dalal, 1953 (as cited in Singh, 1972).

Katha & Dhaulu were indigenous varieties of **sugarcane** reported in Punjab in 1922 (Singh, 1972). These were however, thin, reed like and with extremely poor yield. Hence, new canes were developed by inter-specific cross between *Saccharum officinarum* & *Saccharum spondaneum* by Barbar in 1914 (as cited in Singh, 1972). Varietal improvement work was taken up subsequently and 7 varieties were released before partition (Annexure-44g). The emphasis was on high sugar content and early maturing.

Mollisoni & Sanguineum were the indigenous desi **cotton** varieties traditionally being grown in Punjab (Singh T.H, 1972; Singh, S.1972). Six varieties were developed from indigenous varieties up to 1959. American cotton (*Gossypium hirsutum*) was introduced in Punjab in 1853 in Shahpur district (now in Pakistan). Pure line Selection variety 4F was identified which is the mother of present day varieties of cotton in the state. Up to 1958, eight varieties were developed from the mother variety for release in various areas in the state. Some of these were early maturing varieties (variety 320F selected by Sikka & Sehgal in 1951 & LL 54 developed by Aujla from cross of 45F & L.S.S. in 1958 as cited in Singh , 1972) (Annexure-44h).

Several **fodder** crops were also grown traditionally in the state. The list is at Annexure-44i(PAU, 1972).

4.4.3 Post Green Revolution Scenario

Since the advent of green revolution in the state as per available data (Verma, 1992), 38 varieties of wheat, 17 varieties of rice, 37 varieties of pulses, 10 varieties of sugarcane, 18 varieties of maize, 9 varieties of bajra, 27 varieties of oil seeds, 5 varieties of barley and 14 varieties of cotton have been released by the PAU since 1964 (Annexure-45). These include HYVs developed by PAU and in other parts of the country or abroad. The current number of **varieties in use** include 11 varieties of **wheat** out of which HD 2329 released in 1985, PBW 343 released in 1995, PBW 542 released in 1993 are widely used. Similarly, 5 varieties of **rice** are currently in use out of which PR 106 released in 1976 has found vide acceptance with the farmers. Four varieties of **Basmati rice** i.e. variety 385 released in 1982, Pusa Basmati-1 released in 1990, Basmati 370 released in 1993 and Basmati 386 released in 1994 are favoured by the farmers. Information provided by farmers indicates that besides these varieties desi basmati and sharbati basmati is also widely grown by farmers especially in Sangrur area. Parmal variety of rice which was once grown in Punjab is not grown now as the basmati varieties attract better market value.

Amongst **maize** varieties, 'composite Navjot', 'composite Partap 1' & 'composite Prabhat' released in 1982, 1983 & 1987 respectively are widely grown. As per information provided by farmers, other varieties being used are 'Prakash' & 'Partap' varieties of winter maize and 'Mehkok' and 'Kanchan' varieties of summer maize. However, generally desi maize is favoured by farmers.

Bajra is grown in a very small area in the state. Out of 9 varieties released till date 5 varieties are being grown. Information from farmers indicates that desi variety is still being grown in certain areas.

Amongst **pulses**, 37 varieties of moong bean, urd bean, pigeon pea, rice bean, chikpea & lentils have been released by PAU. Out of these 24 varieties are being grown currently which include 5 varieties of moong bean, 4 varieties of urd bean, 4 varieties of pigeon pea, one variety of rice bean, 7 varieties of chik pea, 3 varieties of lentil and 2 varieties of field pea.

A list of germplasm collection of various crops at PAU is placed at Annexure-45a.

The Green revolution in Punjab has been most successful in districts like Ludhiana, Jalandhar, Amritsar & Kuparthala and least successful in Ropar,

Hoshiarpur and Gurdaspur districts (Lahiry, 2001). Whereas on the postive side it has increased food production, accelerated the pace of modernization and urbanization, increased value of land and helped in increasing the educational level of farmer's children, on the negative side it has created imbalances in cereal production, partial pauperisation of marginal and poor peasants and resulted in heavy influx of migrant labour from other states (The agricultural labour has increased from 9.6 % in 1961 to 22.76% in 1991. The share of cultivators as proportion of total workforce in agriculture has decreased from 82.7% in 1961 to 31.44% in 1991. This indicates transformation of a portion of rural population into landless agricultural workers-Lahiry, 2001). Further, with green revolution reaching a saturation point, the importance of agriculture in Punjab's Net State Domestic Product (NSDP) has gone down to 24.52% in 1997-98 as compared to 34.69% in 1991 and 48.62 % in 1961.

4.4.4 Weed Flora & Pest Fauna

Change in cropping pattern has also resulted in change in weed flora (Plate 20 and 21) & pest fauna in the fields. Annexures-46 & 47 give lists of Rabi & Kharif weeds & pests respectively. Data indicates (Sidhu, 1991;Sodhi, 1985; Kohli, 1994) the occurrence of 350 spp. of weeds in agricultural fields of Punjab. Out of these, 78 spp. have been found to be associated with wheat crop, 71 spp. with Paddy, 39 spp. with Maize, 41 spp. with Fibre crops especially , cotton, 56 spp. with Sugarcane, 22 spp. with groundnut and 25 spp. with Brassica. Further 47 weed spp. are reported to be associated with fodder crops. This is inspite of high doses of chemical weedicides being used by the farmers.

The data of pest fauna associated with principle crops indicates the presence of 88 pest species(Deol, 1974; Sharma, 1976; Singh, 1976 a & b; Kumkum, 1976; Anand, 1977; Sandhu, undated; Kuthiala, 1977) inspite of large scale use of chemical pesticides. The overdozing of these pesticides have, infact, led to high pesticides content in soil, water, crops (especially vegetables) and bovine milk. Though use of DDT and BHC is banned in Punjab for use in agriculture, however, still the residual quantities of these pesticides in bovine and mother's milk are reported to be highest in the state (Singh & Dhaliwal, 1992).

4.4.5 Change in Horticultural & Vegetable crops

Fruit production in the state has been considerably promoted during the past decade. In all 35 species of fruit trees are being commercially grown in the state

(Department of Plant Breeding, PAU Ludhiana). The commonly grown varieties are listed at Annexure-48. The data indicates the varietal changes from 1971 to 1999-2000 as per Package of Practices, PAU and Deptt. Of Horticulture, GOP. Efforts were made to collect information pertaining to a large number of desi varieties (especially that of mango, guava etc.) but no authenticated information/data was found. Currently, 15 varieties of citrus fruits, 5 varieties of grapes, 14 varieties of mangoes & 6 varieties of ziziphus are being grown. The cultivation of Papaya has also increased considerably and 5 varieties are grown throughout the state. Emphasis has been on promoting improved varieties of a limited number of species and a large number of wild varieties have been largely ignored.

Further, 37 species of summer and winter vegetables are grown in the state (Annexure-49). The list includes varieties of each vegetable in use as per package of practices, PAU. The maximum diversity is available in potato, brinjal & cauliflower vegetables. Information obtained from the farmers indicates that cultivation of several varieties of beans and cucurbits (which were earlier available) have been discontinued in the state due to lack of demand in the market. Similarly, the demand for leafy vegetables (which usually grow as weeds around fields) like, *Chenopodium, Anethun* (soya), *Aloe* etc. has also gone down especially in urban areas.

203 species of forest trees have been recorded by the Deptt. of Forestry and Natural Resources, PAU Ludhiana (Annexure-50), out of which 15 species of trees are used for both, commercial and floriculture purpose in Punjab and 28 species of trees are fruit trees. 116 species of trees are used for landscaping in the state (Arora,1998 – Project supported by Punjab State Council for Science & Technology). These include 8 drought resistant trees, 29 trees resistant to air and water pollution, 32 trees suitable for growing in dust prone areas and 30 trees suitable for growing in industrial & sewerage water. Further, 13 tree species are recommended for use in Agro-forestry system in Punjab (PAU, Ludhiana). About 218 species of ornamental plants (Annexure-51) have been recorded in Punjab by Deptt. of Forestry and Natural resources, PAU, Ludhiana, (2001). These include 58 species of Annuals, 81 species of shrubs, 24 species of climbers and 31 species of potted and bulbous plants. 291 species of medicinal plants and 218 species of economically important plants have also been in the state (Annexure 52a and b)

4.5 Domesticated Fauna

Data on domesticated fauna indicates that the total population of domesticated animals in the state has increased by 8.7% in the past two decades. The population of buffaloes and poultry has increased by about 43.8 percent but the population of other animals like cows, sheep, goats, horses, donkeys, pigs, camels, etc has decreased during this period (Table 4.6).

Table 4.8. Livestock and Poultry in Punjab: 1997 (thousand)

Total	Cattle	Buffaloes	Horses & Ponies	Donkeys	Mules	Sheep	Goats	Camels	Pigs	Total	Poultry
1977	3,311.8	4,110.0	75.9	60.9	14.8	497.5	722.1	74.4	128.7	8,996.1	5,539.2
1990	2,832.3	5,577.7	32.9	36.0	15.4	507.7	536.6	43.3	96.4	9,678.3	15,275.6
1997	2,639.0	6,170.7	34.2	22.5	17.4	436.0	414.1	29.7	93.7	9,857.3	11,456.8

Source: Director, Land Records, Punjab and Director, Animal Husbandry, Punjab.

Regarding the number of breeds of individual livestock (Annexure-53) in the state (Deptt. of Animal Husbandry, GOP), only one Desi breed of **cow** has been reported by the Animal Husbandry Deptt. However, the pure Desi breed is now not available in most of the districts (except the breed 'Sahiwal' which is still reported in certain areas of districts Bathinda, Mansa, and Moga) as it has been cross bred with Jersey and Holstein breeds (exotic) in an effort to increase the fat & milk content respectively (Plate 22a-d). The deptt. has also recently established 8 farms for the breeding of sahiwal in the state.

Three out of 8 native breeds of **buffaloes** reported from India are found to exist in Punjab. These include Nili Ravi (native to north western distts. of Amritsar, Gurdaspur & Ferozepur) (Plate 22e), Murrah (native to southern distts. of Bathinda, Sangrur, Patiala, Mansa, Faridkot, Moga & Amritsar) (Plate 22f) and Desi breed found in central & eastern parts of the state which has now been cross bred with Murrah to develop Murrah graded (found in distts. Ropar, Hoshiarpur, Nawansher, Fatehgarh Sahib, Ludhiana, Jalandhar & Kapurthala). Out of these Nili Ravi is already reported as a threatened breed.

Three local breeds of **sheep** namely Lohi, Nali and Desi, are found in the state Plate 23). However, cross breeding experiments with exotic Corridale/ Rambullet breeds are being carried out to increase the meat content which can affect the population of the local breeds. Lohi has been reported as a threatened breed

(MoEF, 1998).However, the best carpet wool is still obtained from Desi breed which is one of the reasons of its propagation in the state.

Two local breeds of **goat** namely Desi & Beetal/Amritsari are being bred in the state in addition to Barhari breed which is native to Uttar Pradesh. In addition, 2 breeds of **pigs** (Desi & cross-bred), 1 breed of **horse** (Bhutia) and 2 breeds of **Poultry** (white leg horn and Desi) are also being reared in the state. The white leghorn however, enjoys a better market and is reared in large poultry farms due to its high meat content and larger egg size. The Desi breed is usually reared in rural areas basically due to the local belief that the eggs of this breed have medicinal properties.

A summary of the indigenous and threatened breeds of domesticated animals is presented below (Table 4.7):

Table 4.9: Indigenous & Threatened Breeds of Domesticated Fauna of Punjab

Domestic Animal	Indigenous	Threatened
Cattle breeds	Hariana, Sahiwal	---
Sheep	Lohi, Nali	Lohi
Horse	Bhutia	Bhutia
Buffalo	Murrah, Nili - Ravi	Nili - Ravi
Goat	Beetal	Beetal
Poultry	Punjab Brown	----

4.6 Elements of biodiversity in the Religion & Culture of Punjab

The data in the preceeding part of this chapter indicates the range of wild and domesticated biodiversity in this small state. Information collected from NGOs and public at large also indicates its value in religion and culture.

4.6.1 Religious practices linked to biodiversity

It is note-worthy that almost all Gurdawaras & Temples in the state are associated with specific trees. The 'dukhbhanjani beri' at Harmandir Sahib (Golden Temple) is one such example. The people are linked to biodiversity through the following rituals-

- Wheat & Barley are sowed as a ritual in earthern pots before the start of any religious sermon, both among Hindus and Sikhs.
- Coconut & Mango leaves are worshipped before any religious sermon or wedding.
- Trees like Peepal, Banyan, Jand, Bel & Banana are worshipped.

- The presence of Tulsi in every house is considered sacred and it is revered daily.
- Turmeric Tika is considered the most sacred of all.
- Green leafy vegetables and raddish are placed with the Puja Thali at several festivals.
- Wood of Mango and Butea is used during Yajna.
- The 'Gugga Naumi' festival is celebrated to worship snakes in the month of August. Ziziphus (Beri) and is also worshipped on the same day.
- The 'Gau Dhoor' festival is celebrated in October/November when cows are fed with sweet dishes and worshipped.
- Barley is sown during Navratras and worshipped at Dussehera.
- Sugarcane is worshipped at Dussehera.
- 'Gwara Phali' (a local variety of Beans) and Ziziphus is worshipped at Karvachauth festival as well as during 'Jhakri' (celebrated for the health of children).
- Banana trees are an important part of the wedding mandap.
- A toran of Mango leaves is hung on the door of a house where any joyous celebrations are taking place.
- All marriages begin with cleaning of Urd Pulse. A handful of it is also dumped in the soil to prevent interruption by rains.
- A new bride is welcomed in the house with Peepal & Calotropis leaves, cotton thread and a pot of grain.
- Sticks of Mulburry are used to perform several marriage rituals.
- Torans of Neem leaves and Lime are hung on the doors of a house where child birth has taken place.
- The sighting of Kingfisher is considered as a sign of good luck.
- A garland of grasses is put around necks of cattle at the time of solar/lunar eclipse.
- The first locks of hair cut during Mundan ceremony are tied up in Doob Grass (*Cynodon dactylon*) as a good omen.
- Ziziphus tree is worshipped and watered after recovering from chicken pox.

4.6.2 Culture and Biodiversity

Punjab is a land of festivals most of which are related to agriculture (Baisakhi) and seasons (Basant Panchmi, Sawan teejan etc.). Punjabis are also known for their love for music and bhangra. Elements of biodiversity reflect in the songs sung by men and women during happy/sad times. About 100 couplets, which refer to various biological elements, have been collected by the Missionary Educational Society, Amritsar and are placed at Annexure-54. They reflect the intertwining of biodiversity with common life. However, the introduction of green, white and blue revolutions have changed life styles and food habits of the society, thus affecting native biodiversity. This is reflected in recent cultural aspects also.

CHAPTER-V

STATEMENT OF PROBLEMS RELATING TO BIODIVERSITY

From the advent of agriculture to the initiation of resource–intensive industrial processes, human actions have been affecting the environment and its biodiversity. The repercussions, have, for the most part been negative especially because most 'developmental' models are usually based on productivist criteria. Both, lack of awareness and vision and a callous attitude towards nature, as well as, lack of criteria for economic evaluation of bioresources constitute the core from which the many negative impacts on biodiversity conservation emerge. It is, therefore, important that the processes affecting biodiversity and the activities which entail these processes are identified before looking for solutions for its preservation and promotion.

5.1. Processes affecting Wild Biodiversity

The following processes have had a negative impact on wild biodiversity in the state:

Sector	**Process**	**Effects**
Intensive & Extensive Agriculture	- Change in land use - Removal of natural plant cover - Overuse of land & water - Soil erosion - Wetland drainage - Encroachment of specialized ecosystems - Change in cropping pattern - Introduction of exotic & genetically modified species - Excessive use of farm chemicals	- Decrease in population of wild flora & fauna. -Disappearance of species - Population fragmentation - Destruction of habitats - Loss of Landscape diversity - Breakdown of inter-dependence between settled cultivators & nomadic communities and CPR management institution
Forestry & Plantations	-Diversion of forest areas for non-forest uses. - Monoculture plantations in place of mixed native trees - Introduction of exotics - Blanket ban on green tree cutting - Identification & notification of protected	- Impact on ecosystem functions - Loss of livelihoods & alienation of local communities - Loss of natural under-storey vegetation & hence,

	areas (often without consent of local communities) -Low emphasis on under-storey vegetation - Plantation of Lantana in eroded areas	wildlife - Low natural re-generation
Urban Planning	- Change in land use - Rural – urban migration - Change in natural habitats - Increase in Demographic pressures in urban areas -Degradation of peri-urban areas - Sub-urbanisation of countryside - High impact infrastructure - Vehicular access to natural areas - Increase in municipal waste generation in a limited area	- Population Movement & fragmentation - Habitat loss - Disappearance of local species - Loss of Aesthetic value
Industry	- Overuse of resources - Air, water, soil & noise poll. - High impact infrastructure - Waste generation (incl. hazardous wastes) - Increased introduction of substances into the natural env -	- Destruction of species & Population reduction - Loss of genetic diversity - Population fragmentation - Alteration of natural ecosystems & habitats - Decrease in assimitative/ buffer capacity of air, water & soil -Global warming & climate change
Transport	- High impact infrastructure - Occupation of natural areas - Pollution -Alteration in atmosphere/ ecosystem - Climate change	- Destruction of species & Population reduction - Loss of genetic diversity - Pop fragmentation - Alteration of natural ecosystems & habitats - Landscape impact
Trade	- Resource overuse - Trade in endangered sps - Import/export (& possible release of alien sps) - Poaching	- Population reduction - Over exploitation of certain spp & loss of genetic diversity - Demand vs supply imbalances
Aqua-culture	- Introduction of exotics - Resource overuse - Mortality of sps not liable to be fished - Water pollution - Possible introduction of pathogenic agents	- Population reduction - Disappearance of spp at regional levels - Loss of natural diversity - Movement/exit of natural sps due to competition with introduced spp
Hunting & Poaching	- Mortality of animal sps - Illegal Trade	- Population reduction of spp - Extinction of sps & sub-spp

Water use	- Overuse of water - Reduction in quality - Alteration to natural river systems (incl. Course of river, minimum water flow, change in river basin etc.) - Wetland drainage	- Loss of aquatic biodiversity - Habitat change & ecosystem alteration - Socio-economic impacts
Energy	- High impact infrastructure for hydel & thermal projects -Overuse of non-renewable resources - Solid waste production (eg. Fly ash) - Pollution - Release of radioactivity	- Change in natural ecology - Sub-mergence of large areas under reservoirs & population displacement - Habitat loss - Genetic alterations
Tourism	- Change in land use - High impact infrastructure development - Waste generation & pollution - Behaviours incompatible with conservation aspects	- Loss of habitat - Population reduction - High impact on landscaping
Health System	- Overuse of resources (specially medicinal flora & fauna) - Pollution by pharmaceutical/chemicals - Exploitation of local knowledge for commercial benefit	- Population decrease & local extinction of species - Loss of benefits to local communities resulting in less interest in conservation efforts.

5.2 Processes affecting Domesticated Biodiversity

Sector	**Process**	**Effects**
Intensive & Extensive Agriculture	- Land overuse and high impact agriculture - Change in cropping pattern & intensity - Erosion - Nutrient depletion - Pollution of soil & water (non-point) due to farm chemicals - Consolidation of landholdings	- Disappearance of native sps - Loss of traditional knowledge & management techniques - Loss of crop diversity & nutritional value - change in weed flora & pest fauna - Reduction in tree cover - Reduced access to subsistence foods to poorer households
Animal husbandry	-Breeding with exotics -Over grazing - Commercialization	- Loss of genetic diversity - Forest denudation - Disappearance of native varieties and breeds - Loss of traditional knowledge - Reduction in women's control over household nutrition & food security
Forestry & Plantations	- Introduction of exotic species - Resource overuse - Loss of Carbon sink by deforestation/logging operations	- Introduction of alien sps - Loss of natural species - Erosion due to wind & water and loss of fertile soil

		-Change in fertility status and water availability
Aquaculture, horticulture, floriculture, etc.	- Introduction of exotic species - Resource overuse	- Population reduction of native species - Disappearance of sps from local areas
Trade	- Selective promotion of crops - IPR issues	- Narrow spectrum of traded products. Hence, only some species favoured, others lost. - Loss of equity - Biopiracy
Urbanisation, transport, tourism, etc.	- High impact infrastructure - Waste generation - Degradation of peri urban areas - Global warming	- Loss of native varieties/ breeds - Change in yields
Water	- Overuse of water resources - Pollution of water resources - Subsidies on water & power - Wetland drainage - Creation of dams & reservoirs	- Emphasis on water intensive crops. Therefore, change in cropping pattern & varieties - Loss of native varieties - Water imbalances i.e. low water tables in certain areas and water logging in other areas - Submergence & displacement
Industry	- Air, water & soil pollution - Global warming & climate change - Over exploitation of resources	- Loss of genetic diversity - Change in traditional cropping pattern

5.3 Other causes

These include:

- Unsustainable development models like promotion of wheat, paddy monoculture
- Lack of peoples' participation in planning & implementation of developmental projects
- Lack of awareness amongst development departments, workers, industry, etc. on issues of biodiversity and lack of internalization of environmental costs during cost-benefit anylsis of development projects, lack of EIA (especially with regard to biodiversity aspects etc.)
- Inappropriate policies e.g. addressing productivity enhancement for selected crops/species only
- Over centralization of decision making without addressing local issues and concerns
- Lack of administrative coordination amongst development departments
- Social, political & economic inequalities especially amongst land owners and influx of agriculture and industrial labour most of which is from others states of the country
  (e.g. UP and Bihar)
- Ethical changes
- Policies unmindful of peoples' requirements & rights

CHAPTER-VI

MAJOR ACTORS AND THEIR ROLES IN BIODIVERSITY CONSERVATION

All sections of society are stake holders in biodiversity. Hence, all have a role in its conservation. The major actors and their roles are discussed below:

6.1 The Government

The government is a major stake holder and actor on the issue of biodiversity. Activities of the following departments are directly concerned with the issue –

6.1.1 Deptt. Of Forests & Wildlife

The department is responsible for protection of existing wild biodiversity of the state. In an effort to achieve the target of 33% (or atleast 20% as specified for plains) forest cover in the shortest possible time, the deptt. has been promoting Eucalyptus plantations up to 1970s. This has played havoc with the local ecology as the tree has allelopathic impacts and does not support under-storey flora & fauna. The need to shift from exotic monoculture plantations back to mixed plantations of native species has been realized in the past decade. Further, in previous years major emphasis has been on production of timber and minor forest produce has been neglected.

However, positive steps have been taken by the deptt. to protect the wild fauna in the state by establishing zoos, sanctuaries, deer parks, etc. Major success has been achieved in captive breeding of Saras cranes, Asiatic lion, Tiger & Leopard (in Chatbir zoo). Several schemes (Integrated Watershed Development Project with assistance of World Bank and Punjab Afforestation Project assisted by OEFC, Japan) have also been initiated. Working plans of all forest divisions have been prepared where an attempt has been made to list existing flora & fauna of the area. These plans, however, require updating. A special study on the status of wild biodiversity has been conducted by Tata Energy Research Institute, New Delhi. The report is under finalisation.

6.1.2 Department of Agriculture

The department has played an active role for increasing agricultural production in the state. However, its role has been rather passive on the issue of conservation of agricultural biodiversity. In fact, in an effort to produce more grain, the department has indirectly acted against the interest of biodiversity in agriculture. The policy of promoting a few crops by providing a good support price for them, mechanization of agriculture, promotion of HYVs and intensive use of chemical fertilizers and pesticides are major causes of loss of floral faunal diversity. The statement does not, however, intends to negate the need to produce grain to feed the hungry at the time of need (and the department needs to be commended for this) but it now needs to look at issues of sustainability in agriculture & improvement in soil health. The policy of providing subsidies in agriculture & free water & electricity has benefited large farmers only and, in fact, have led to over exploitation of water.

The major environmental relevance of the current Agricultural policy of Punjab is as under:

- Change in land use – As per the World Conservation Strategy prime agriculture land has to be retained for agriculture. However, marginal lands should not be over-utilized by bringing them under the plough. In Punjab even marginal lands are being used for multiple cropping.
- Due to better support price of rice & wheat, the cropping pattern has changed drastically with reduction in legume crops (important for improving soil fertility as well as household nutrition for the poor). Continuous wheat – rice rotation is depleting the soil of macro & micro nutrients. Scientists report that paddy & wheat rotation removes 248 kg Nitrogen, 50 kg Phosphorus & 330 kg Potassium per year from 1 ha of soil (Singh, 1991 as cited in Jerath, 1995). Since their replenishment does not take place by natural means farmers resort to chemical fertilizers. However, micro nutrient depletion is not being looked into. As per experts, Punjab soils are deficient in about 15 micro nutrients (personal communication with PAU & HAU experts) which can act as limiting factor in future crop productivity. The agriculture department is silent on the issue (Ref: Govt. of Punjab Work Plan (under Macro Management Mode) for 2000-01 for development of Agric & Allied Sector, Punjab).

- Besides chemcial fertiliziers, the excessive use of pesticides has led to pollution of soil and water and pesticide poisoning of crops. Further, certain pests have become resistant to these pestcides over time resulting in crop loss inspite of heavy pesticides doses. This has adversely affected productivity and biodiversity (see box).The issue needs to be addressed.

PUNJAB VILLAGES DEVASTATED BY PESTICIDES

KHETI VIRASAT, a voluntary organization, conducted a survey of three villages (Mandikhurd, Ramanvas and Harkishanpura) where some farmers had committed suicides. The team presented the following report.

- Prior to 1985-86 the farmers sowed indigenous 'narma' (cotton), which needed no pesticides.
- In 1985-86 hybrids like A-846 (by PAU) were introduced in its place.
- In 1988 first attack of American bollworm was reported but it was controlled. However, in 1992 farmers lost their entire crops due to devastation caused by the same pest.
- Money spent on pesticides increased from Rs. 500 per acre to Rs. 10,000 per acre after 1992 & the farmers got a return of Rs. 2000-3000 against an investment of Rs. 10,000, but Amercian bollworm could not be controlled.
- The farmers even tried to shift to wheat, rice or groundnut crops but this practice could not be sustained in the absence of adequate irrigation and unsuitable ground water.
- At present each family in Mandikhurd and Harkishanpura villages is under an average debt of Rs.3 lacs and 7 cases of suicides committed by farmers have been reported since 1999.
- Excessive use of pesticides has also had an extremely harmful effect on the region's environment and health of the people.
- 41 cancer caused deaths have occurred in the last 8 years in these villages and a high number of people are suffering from diabetes, skin problems, breathing problems & congenital defects.
- Peacocks, earthworms, fireflies, butterflies, vultures & small birds are no more found in this region.
- The population of traditional trees Khejri, Karir, Babool & Neem has decreased drastically.
- The groundwater in this region is saline containing fluoride, bicarbonates, calcium, magnesium and has been declared as unfit for consumption.

The present condition of these villages is a burning example of the neglect of erosion of traditional agriculture. The actions suggested by Kheti Virasat are:

1. Sustainable organic agriculture
2. Water Conservation & Management
3. Afforestation
4. Cottage industries

The actions in other states

- A farmer in Adilabad district of Andhra Pradesh has completely opted out of using pesticides and is emphasizing on a number of time-tested cultivation practices like deep ploughing, manuring, weeding,, pruning of plants, intercropping, etc. He is consistently harvesting 2-3 quintals of more cotton per acre than the usual yield in that area. The Agricultural officer of this area estimates that an area of 3000 acres of cotton is now pesticide free.
- In Dharwad district of Karnataka, a farmer has been cultivating cotton in his 7 acres dry land organically for the past 10 years and getting substantial productivity & economic benefits.
- SRISTI has documented 3 farmers in Sabarkantha district in Gujrat, who have successfully demonstrated the effect of herbal pesticides from 10 plants on pests of cotton.
- Several dozen farmers in Vidarbha region of Maharashtra are generating good revenue by growing & exporting organic cotton.

- Further, 90% cultivated area in the state is irrigated by canals and tubewells (9.25 lacs). Withdrawal of water for irrigation has not matched with its replenishment in several areas leading to decline in water table.

On the other hand excessive canal irrigation has led to water logging in certain areas. The issue needs to be addressed by the agriculture department and the policy of providing free water needs to be carefully & scientifically looked into.

- The department also needs to address the problem of glut in the market in certain crops and the lack of ability of procurement agencies to lift and protect bumper crops. The issue is specifically important with respect to wheat, rice and potatoes where the farmers are at times not even able to retrieve the total cost of inputs and have to resort to distress sales. The recent example of destroying of bumper potato crop by farmers themselves in absence of the promised market support is an eye opener.
- Another disturbing trend is the issue of 'crop diversification' which does not address the issue of crop diversity but rather, seeks to promote hybrid high yielding varieties of crops under controlled conditions for the western markets. Though this is expected to help in elimination of non-point pollution from the agricultural sector (as fertilizers and pesticides would be provided in optimal quantities), however, this could lead to industrialization/corporatization of agriculture and could potentially convert land cultivators to farm labourers if proper caution is not exercised. This issue needs to be carefully studied and discussed before major projects are taken up.
- In its 2000-2002 Work Plan (under Macro Management Mode) the State Agriculture Deptt., however, proposes to promote organic farming, green manuring & vermi-composting. This is a positive trend.
- The impact of introduction of genetically modified and hybrid crop varieties on environment in general, and biodiversity in particular, also needs to be assessed (e.g. Bt-Cotton is being promoted in the State. However, its impact on biodiversity needs to be carefully studied before large scale introduction - See box)

- The Nanjing Institute of Environmental Sciences, China under the Chinese Govt.'s State Environment Protection Administration conducted a study which concluded that :
  - The population of American bollworm decreased in Bt-cotton fields initially but studies indicate that it developed resistance to Bt-Cotton within 8-10 years.
  - In Bt cotton fields diversity of insects decreased & incidence of pests increased.
- Gene campaign presented a report on Bt cotton which states that:
  - The economics of Mahyco-Monsanto's Bt cotton look very unfavourable for the farmer as the total inputs for the cultivation of Bt cotton would be Rs. 3600 (Rs. 3200 for seeds + Rs. 400 for pesticides) per acre as against Rs. 1800 per acre in the old system (Rs. 800 for seeds+ Rs.1000 for pesticides) and higher yield can not be obtained due to lack of proper irrigation facilities.
  - Illegal seeds are being sold openly in the state of Punjab, Haryana, Gujrat, Andhra Pradesh & Maharashtra but the Genetic Engineering Approval Committee (GEAC) of GOI had failed to take any action against them. These seeds are being sold at Rs. 100 per bag, which works out to be Rs. 200 per acre & appears to have a better return than officially sponsored Monsanto varieties. But after few seasons when the varieties would fail (because boll worm becomes resistant to Pesticides, like mosquitoes did to DDT) nobody would be responsible leaving unsuspecting farmers in the lurch.
- According to researchers wayward pollen & seed from genetically modified crops can affect other crops in neighbouring fields. There is also a concern that transgenics will also be picked up by weeds & make them even hardier.
- The Mexican Scientist, Dr. Ignacio Chapela of University of California at Berkeley shocked the world by his study revealing that GM material had contaminated the native species of maize in Mexico. Nature first published his paper then retracted the same. Chapela's supporters say that Nature was responding to pressure from industry-funded scientists, indicating the politics behind GM Crops.

6.1.3 Department of Animal Husbandry

This department also has, in an effort to bring the white revolution in the state, played a negative role in conservation of farm animals. The population of desi breeds has dwindled. In fact, the department could not provide sufficient information on native breeds of livestock & poultry in the state for the purpose of this strategy although information on high yielding cross breeds was sufficiently available.

6.1.4 Department of Fisheries

The Fisheries department is also promoting exotic species of fish in an effort to introduce blue revolution at the cost of native species. Four exotic sps have been introduced as a result of which several native sps (especially Mahseer which was a common & delicious native fish of Punjab) have been lost/threatened. Data indicates that 32 sps of fish are near threatened, 20 sps are vulnerable, 12 sps are endangered and 2 sps are critically endangered.

6.1.5 Department of Horticulture

The department has provided information on existing vegetable & fruit species being cultivated in the state. The department admits that in an effort to increase productivity, hybrid varieties have been introduced at the cost of desi varieties. A stark example is the loss of a large number of desi varieties of mango (especially varieties of 'tapka') from Districts Hoshiarpur, Nawanshahar, Gurdaspur, etc. The loss of a large variety of beans from the vegetable basket of a household is also a cause of concern.

6.1.6 Department of Industry

In view of the recent WTO regime the industries department has a major stake in the bioresources of the state. Though several bio-resource based industries exist in the state, but the department does not have any compiled information on the same. Neither have any special efforts been made by the department to promote biodiversity protection from pollution impacts of industries. The only effort could be in ensuring EIA before setting up of large industry in the state (even here, the aspect of biodiversity is the least studied & understood).

6.1.7 Department of Irrigation and Power

The state has two large dams and several barrages which have affected both, the terrestrial and aquatic environment. Large reservoirs have been constructed which have led to inundation of areas rich in biodiversity leading to its loss. Further, absence of fish ladders in certain barrages have led to loss of migratory fish species. Furthermore, the dams have lead to decrease in release of water in the river systems during summer months leading to low water availability in down stream areas. As a result, the buffering and self purification capacity (due to pollution) of these rivers is reduced, adversely affecting aquatic life. Thermal pollution is also a major factor affecting Dissolved Oxygen content (D.O.) in water and hence, adverse impact on biodiversity. Further, entry of excessive fertilizers into the water bodies as run off from fields (non-point pollution) results in their eutrophication. These aspects need to be carefully addressed.

6.1.8 Department of Science, Technology & Environment

The department has initiated some projects for biodiversity conservation. Some important ones are:

- Publication of Punjab Environment: Status Report
- Conservation & management of wetland ecosystems of Punjab (with MoEF in association with various State Departments)
- Study of biodiversity in Shivalik ecosystem of Punjab (with ZSI, BSI, IIRS & Punjabi University, Patiala)
- Analytical studies of Aquatic ecosystem of Punjab (with Punjabi University, Patiala)
- A study of Allelopathic impact of Sunflower on weeds & crops of Punjab (with Panjab University, Chandigarh)
- A study of Ornamental Trees of Punjab for their use in landscaping (with PAU, Ludhiana)
- Pilot projects for promotion of duckweed technology for cleaning of village ponds.
- Promotion of Vermicomposting
- Promotion of pollution control technologies in SSI units spread over the state
- Creation of awareness through NGOs institutions

Further, though actions to control air, water & soil pollution are being taken through the State Pollution Control Board, a major dent still needs to be made with respect to habitat/ecosystem conservation. The State Policy for Environment & Guidelines for Development Departments has remained in the draft state since the past decade and needs to be notified. The Department is, however, following the National Conservation Strategy & Policy on Environment & Development till that time.

6.1.9. Other Departments

Other departments which have a stake in or impact upon biodiversity include the Department of Town and Country Planning, the Department of Public Works, the Department of Rural Development and Panchyats, the Department of Urban Development and Local Government, Department of Tourism, Department of Transport, etc.

6.2 Academic Institutions and R&D Bodies

The Panjab University, Chandigarh, Punjabi University, Patiala & Guru Nanak Dev University, Amritsar have taken up several taxonomic studies in the region. Major contributions on the study of angiosperms and some invertebrates have been made by Punjabi University, Patiala; on diversity of fish & insects by Panjab University, Chandigarh and on other flora & fauna by PAU, Ludhiana.

PAU, Ludhiana has also played a major role in domesticated biodiversity studies in the state. Plant & animal breeders and geneticians have been involved in identifying pure lines, improved varieties/hybrids of major crops like wheat, rice, maize, legumes, oil seeds & cotton. Germ plasm collection work has also been taken up. The university has played a major role in encouraging crop productivity and improving animal husbandry practices in the state.

However, the university does not seem to have addressed the issue of agricultural biodiversity. No effort has been made in involving farmers, particularly women, in managing native germ plasm through on-farm conservation.

Some efforts are recently being taken up towards promotion of organic farming and integrated pest management. However, the university needs to look into the issue of crop diversification vs farm diversity and suggest appropriate policies for the same.

6.3. Local Communities

The local communities are the major stake holders in biodiversity conservation. Several community conserved areas have existed in the state in the past some of which are still active contributors towards biodiversity conservation. The most striking example is that of the Bishnoi community which has been single handedly responsible for conservation of Black buck (the state animal) in Punjab. Other examples are those of conservation of Peacocks in 5 villages of Ropar district, efforts for cleaning & consequently restoring biodiversity of Kali Bein rivulet in/around Seechewal in Kapurthala district, community participation for watershed management in Relmajra & Nada villages in the Shivaliks & small conserved forest areas around ‘Rodian da dera’ and ‘Mahantan wala choe’ in Ropar district. Such community conserved Shamlat areas also existed in Dhar & Dunera areas of Gurdaspur which were managed by the locals and gaddi & gujjar tribes but these

have been lost with the passage of time. The details of these initiatives have already been discussed in Chapter-IV. However, given appropriate leadership, the Punjabis have a very strong element of 'Kar Seva' (self help) which can be effectively used for biodiversity conservation and for preparation of peoples' biodiversity registers.

The farming community of the state also has a strong relationship with agricultural biodiversity. Information on reasons of biodiversity loss in the state have primarily been collected from the farmers themselves during public hearings. However, they usually find themselves helpless to address the issue of increase in agricultural biodiversity. As per information gathered from interactions during public hearings, the farmers in Punjab are totally dependent on the government & PAU extension services for decisions on crops/varieties to be grown in their fields and the quality & quantity of farming inputs required. Further they are driven by market forces and unless the government comes up with better support price for other farm crops they are unwilling to change the existing cropping pattern.

The role of women also needs to be specifically recognized as women are repositories of traditional information and have a profound knowledge of local ecosystems. They are also important protectors of biodiversity as kitchen gardens are maintained by them. Women groups (like Mahila Mandals) play an important role in maintaining common property resources.

The role of Gram Panchayats is also important as Panches usually have an influence on the local community and can help mould their attitudes.

6.4 The NGOs

The number of NGOs working in the field of environment in Punjab has increased from 3 in 1988 to about 50. The National Environment Awareness Campaign has been a major contributing factor. However, very few NGOs have interest in issues pertaining to biodiversity. The important ones are All Indian Jeev Raksha Bishnoi Sabha, Abohar; WWF-Nature-India, Chandigarh branch; Voluntary Health Association of Punjab; The Environment Society, Kapurthala, Phagwara Environmental Association, Phagwara, Society for Environment Education & Protection of Animals, Amritsar and Institute of Ecology & Environment, Pathankot in the field of wild biodiversity and Social Work & Rural Development Centre, Nurpur Bedi; Adarsh Seva Samiti, Ropar; Rural Association for Human Interest, Ropar; Kheti

Virasat, Nabha; PAHAL, Jalandhar and Voluntary Health Assocation of Punjab in the field of agricultural biodiversity. However, these NGOs have not been able to make a major dent in biodiversity awareness (except All India Jeev Raksha Bishnoi Sabha) in the state.

Conservation of Agricultural biodiversity by Kheti Virasat

- Kheti Virasat proposes to conduct trials on organic Paddy in 21 villages in districts Firozepur and Patiala.
- It is also trying organic cotton in Bathinda and Fazilka .
- It is trying to obtain seeds of native varities of Wheat and Paddy.
- The organization proposes to file a PIL in Punjab and Haryana High Court on the issue of depleting ground water in Punjab.

6.5 Industry & Corporate Sector

The Corporate sector has hardly ever contributed towards wild or agro-biodiversity conservation generally due to ignorance and a callous attitutde towards the environment. Industries set up on prime agricultural land have rather led to pollution of air, water & soil thus contributing towards biodiversity loss. The corporate sector, however, can greatly benefit from sustainable use of bioresources especially with respect to food based industry and herbal, medicinal & cosmetic products.

6.6 The Armed Forces

Areas under the Armed Forces are the ones with least human interference & hence, generally undisturbed. Hence, such areas are good repositories of natural biodiversity. However, these areas need to be surveyed in detail for biodiversity characterization and assessment. Further, most projects taken up by the forces are usually well implemented due to inherent discipline amongst their personnel. A pilot project was taken up with the army in Punjab for clearing Harike Lake of the menace of water hyacinth in July 2000 (Operation Sahyog) which was successfully completed. More such projects can be taken up for biodiversity conservation within and outside army areas.

6.7 Religious & Cultural Groups/Individuals

Religious and cultural groups have played an important role in conservation of biodiversity and specific species in certain parts of Punjab as religious leaders

generally have a great impact on the local population. These include the religious beliefs of Bishnois (for protection of Blackbuck & Khejari trees) and cleaning of Kali Bein by Baba Balbir Singh at village Seechewal (refer para 3.3.3). Bhai Manjeet Singh, Jathedar Takht Sri Kesgar Sahib, Anandpur Sahib has also started distributing plants as 'prasad' at important occasions. Such traditions need to be enhanced as these will lead to voluntary involvement of people in biodiversity conservation.

CHAPTER-VII

ONGOING BIODIVERSITY INITIATIVES

7.1 Current status of conservation instruments

A well defined conservation policy needs to articulate instruments required to materialize the process of conservation and resource management. These instruments are:

i. Social instruments
ii. Legal instruments
iii. Scientific instruments
iv. Economic instruments

7.1.1 Social instruments

One of the important goals of the strategy is to identify and tackle the causes at grass root level that lead to environmental deterioration due to repercussions of human actions. The basic requirement therefore, is to identify such actions and bring about a change in human attitudes. Social instruments can help to understand the way, the community and its constituent groups perceive conservation issues and can be a powerful tool for change. They can be used to encourage and improve public participation in preparation of projects aimed at achieving the goals of conservation.

Public sensitivity to nature related issues has grown considerably in recent decades. However, the record of actions taken by organizations for nature conservation has a short history. At the government level, the Ministry of Environment & Forests, Govt. of India and the Deptt. of Science, Technology & Environment, Govt. of Punjab through PSCST, has initiated actions for increasing awareness on the relevant issues by mobilizing NGOs and institutions by participation in some of the following programmes:

- National Environment Awareness Campaign (NEAC)
- Eco Clubs in schools (now modified to green army project)
- Environment Awareness Programme
- Paryavaran Vahini Scheme
- Children Science Congress
- Science Popularisation Programmes

Under NEAC (which is implemented by PSCST in the State), organizations and institutions generate awareness at both, urban & rural level on specific themes identified by the government. Biodiversity issues have featured directly or indirectly in the years 1990, 1992, 1994, 1996, 1997, 1999, 2000 & 2001 under which several awareness programmes have been taken up for various target groups. Similarly 'nature' has been a focal theme for many environment and science popularization programmes.

Environment Education (EE) has also been formally included in the Punjab School Education Board syllabus as a cross curricular subject as per recommendations of NCERT. Similarly, environment education has been made mandatory as a part of university curriculum as per UGC guidelines (though, presently implementation is poor). However, in all areas, EE lacks an applied approach and no biology department offers 'conservation' as a core subject.

Another good indicator of awareness of biodiversity issues is the number of television programmes on flora & fauna (the Jalandhar Kendra of Doordarshan has started a special programme on environment in Punjabi titled 'Chaugirda') and the increased number of visitors to zoological & botanical gardens (the number of visitors to Chatbir Zoo exceeds 4 lac persons per annum as per TERI, 2001 – unpublished). However, most of these parameters show only an interest in or curiosity aroused by nature. If the lifestyle pattern of the current society are to be changed an action oriented approach beyond curiosity is required. This would include reduction in consumption patterns as well for eg. promoting recycling & reuse, rejecting excessively packaged products, etc.

7.1.2 Legal Instruments

Several biodiversity laws at international & national level are in vogue at the state level also. Further, certain laws specific to the state also exist. The list is as below:

1. International Conventions

Name	Year
Convention of Biological Diversity	1993
The Ramsar Convention	1971
Convention on International Trade in Endangered Species of Flora & Fauna (CITES)	1973 (amended in 2001)

2. National Conservation Policies/Acts

The Wild Birds & Game Protection Act	1887
Indian Fisheries Act	1897
The Wild Birds & Animal Protection Act	1912
The Indian Forest Act	1927
The Wildlife (Protection) Act	1972 (amended in 1991)
The Forest (Conservation) Act	1980 (amended in 1988)
The Forest (Conservation) Rules	1981(amended in 1992)
The National Wildlife Action Plan	1982
The Environment (Protection) Act	1986 (amendments during 1987-93)
The Environment (Protection) Rules	1986
The National Forest Policy	1988
National Conservation Strategy & Policy Statement on Environment & Development	1992
The Environment Impact Assessment Notification	1994
Biodiversity Bill (yet to be passed)	2000

3. State Legislations & Policies

The Cattle Tress Pass Act	1871
The Punjab Land Preservation (Choe) Act	1900
The Punjab Forest (Sale of Timber) Act	1913
The Punjab Fisheries Act	1914
The Punjab Wild Birds & Wild Animals Protection Act	1933
The East Punjab Agricultural Pests, diseases & Noxious Weeds Act	1949
The Punjab Land Improvement Schemes Act (for Rural Land use and Planning)	1963
The Punjab Public Premises and Land (Eviction and Rent Recovery) Act	1973
The Wildlife (Protection) Punjab Rules	1975
The Joint Forest Management Notification	1993
The Punjab Apportionment of Trees Rules	2000

7.1.3 Scientific Instruments

Conservation has to be based on scientific principles and science must be placed at the service of conservation. However, in the past scientists & technologists have not always respected conservation issues, primarily due to lack of awareness, pressures of development and scientific analysis of environmental issues being an arduous task.

Conservation biology is a new emerging field and generation of knowledge and information about nature and its functions is currently on the crest of a vigorous growth process. An inventory of the existing habitats and species is a basic step

required to organize any concerted action to preserve the state's biodiversity. Some important studies have been taken up by the various universities of the State which are listed in the Reference section of this strategy. The important major cross sectoral R & D projects taken up by the Deptt. of Science, Technology & Environment are discussed under Para 7.2:

R&D projects taken up by Forest Department include:

- Micro Watershed Studies through Remote Sensing by Punjab Remote Sensing Center.
- Status of biodiversity conservation in Punjab (for wild biodiversity) by TERI.

R&D projects taken up by Central Soil & Water Conservation Research & Training Institute includes:

- Water shed management project in Relmajra & Nada in Punjab Shivaliks.

7.1.4 Economic Instruments

On the environmental front, the State Government's priority has been to improve environmental quality by management of pollution of air, water & soil and promote afforestation activities in urban & rural areas. A separate budget provision has been made in the state budget for Department of Forest & Wildlife, technical secretariat for Environment (in PSCST) and Pollution Control Board. However, hardly any amount has been set aside specially for biodiversity and landscape protection (except for provision of approx. Rs. 20 lacs as 50% funds for study of Shivalik Biodiversity).

Some joint funding facilities with the MoEF and International bodies like, World Bank are also available for certain projects taken up by Deptt. of Science, Technology & Environment as well as Deptt. of Forests & Wildlife, Govt. of Punjab.

Market instruments also play a fundamental role in maintenance of biodiversity especially in the agricultural system.

7.2 On-going Initiatives

The following studies have been taken up in Punjab for identification of status and loss of biodiversity & its replenishment:

7.2.1 Preparation of Status of Environment Reports, 1984 & 1995 – by PSCST and Department of Science, Technology & Environment.

7.2.2 R&D Projects

i) Projects taken up/sponsored by State Deptt. Of Environment & PSCST:

- Study of Biodiversity in the Shivalik ecosystem of Punjab - The project envisages preparation of biodiversity profile of the Shivalik Sub-Himalayan ecosystem within the geographical boundaries of Punjab. An inventory of existing biodiversity is under preparation. The project is taken up by PSCST with association of ZSI, Solan and Dehradun, BSI, Dehradun and Punjabi University.
- Analytical studies on Aquatic ecosystem of Punjab - The major rivers and water bodies in the state and their biodiversity has been studied under this project (by Punjabi University, Patiala)
- Remote sensing studies in the Shivalik area taken up by Indian Institute of Remote sensing on the behest of PSCST.
- Study of aquatic weeds in Kanjli wetland area (study conducted by NEERI).
- Economic evaluation of Harike wetland (study taken up with wetland International – South Asia).
- Survey of Ornamental trees of Punjab for use in landscaping (with PAU, Ludhiana).
- Effect of Budha Nallah Pollution on river quality & reproductive biology of some fishes (with PAU, Ludhiana).

ii) Projects taken up by various universities & R&D Bodies – Reports listed in the reference section.

iii) Conservation and Management Programmes

- Conservation and Management of Harike Wetland in Punjab – funded by MoEF-GOI
- Conservation and Management of Kanjli Wetland– funded by MoEF-GOI
- Conservation and Management of Ropar Wetland– funded by MoEF-GOI

iv) Projects by Forest Department

- Integrated Watershed Development Project in Kandi area – with financial assistance of World Bank.
- Punjab Afforestation Project – with financial assistance of OEFC, Japan (renamed Japan Bank for International Cooperation).
- Status of Biodiversity Conservation in Punjab (with TERI).

v) Projects by other Departments

- Water Shed Management Projects by Central Soil & Water Conservation Research Centre
- Soil Conservation Programmes by Deptts. of Soil Conservation & Agriculture, Govt. of Punjab
- Operation Sahyog in Harike Wetland with Army for PSCST
- Micro Watershed studies through Remote Sensing by Punjab Remote Sensing Center, Ludhiana

CHAPTER-VIII

GAP ANALYSIS

Based on the data presented in the preceeding chapters, gaps in information, vision, policy & legal structure, institutional & human capacities and awareness & education have been identified.

8.1 Gaps in Wild Biodiversity Conservation

8.1.1 Gaps in Information

i) Information gap exists between scientific knowledge available with researchers, local knowledge systems of people and information available with the Department of Forest & Wildlife. The data available with each agency is neither integrated nor coordinated and there is no mechanism of regular information exchange.

ii) Inadequacies exist in information on base line data on both, spieces and genetic diversity, micro and macro habitats, species distribution and Importance Value Index, population studies, status of endemic and key stone species, etc. Profiles of biologically important areas (both, rich and eroded) need to be worked out.

iii) The district gazetteers present incomplete information on existing flora & fauna of each district. Most gazetteers need updating as they were prepared at least 20 years ago. A lot of changes in the geographical boundaries of the districts have taken place since then besides change in biodiversity profile. Further, even the existing working plans of various forest divisions need updating.

iv) Information on lower plants & animals is scanty. Most work is concentrated on angiosperms, mammals, birds & fishes. For example, Arthropods is a large group which plays an important role in ecosystem dynamics and functions but only a few classes have been studied in selected districts. Hence, there is lack of coordination amongst research programmes.

v) Review mechanisms to assess the impact of developmental activities on biodiversity are absent. Further, there is a lack of ecological models for monitoring and forecasting habitats change.

vi) Information on wild biodiversity in cropped areas needs to be generated especially with respect to change in weed and pest population due to change in cropping patterns especially cropping patterns that are detrimental or conducive to wildlife.

vii) Information dissemination mechanisms are poor.

viii) Work on economic evaluation of natural resources needs to be taken up.

8.1.2 Gaps in Vision

i) Most government programmes for wild biodiversity conservation concentrate on short term benefits and do not look at the issue of ecosystem stability vs environmental security.

ii) The economic and ecologic benefits of non-timber forest produce (especially availability of medicinal plants from wild areas) have not been looked in to.

iii) The destruction of Mand areas and reclamation of wetlands/ponds for agriculture indicate lack of appreciation of the ecological importance of these areas leading to ecosystem destruction.

8.1.3 Gaps in Policy and Legal Structure

i) The policy of promoting industries in areas considered 'unfit for agriculture' and 'backward areas within Shivaliks' has led to destruction of wild biodiversity. These areas are, infact, repositories of diverse flora and fauna and need to be conserved.

ii) Though legal systems exist, but there is lack of implementation and awareness.

iii) The policy of promotion of large dams and construction of barrages has led to inundation of large biodiversity rich areas and large scale displacement of local communities leading to pressure on natural resources in other areas.

iv) There is no policy on protection of biodiversity rich areas and community conserved areas outside protected areas.

v) No legal structure is available for conservation of biodiversity in wetlands in the state.

vi) Lack of specific policy for promoting eco-tourism in specific areas and ensuring equitable benefit sharing with local communities.

8.1.4 Gaps in Institutional and Human Capacity

i) General lack of understanding of importance of biodiversity conservation in all Development Departments and projects. Trained personnel are also not available.

ii) Lack of appreciation of biodiversity issues especially at the level of politicians, administrators and government departments.

iii) Lack of scientific records of medicinal plants, their active principles, utility under different dozes, distribution, etc. and non-recognition of role of vaids & hakims on information available with them in this respect.

iv) Lack of ethnobiological data.

v) Lack of cross-sectoral research studies.

vi) Lack of trained personnel for EIA

vii) Non appreciation of role of women in understanding biodiversity, conserving such areas & knowledge of traditional system.

viii) Very few NGOs concentrating on biodiversity issues.

8.2 Gaps in Domesticated Biodiversity Conservation

8.2.1 Gaps in Information

i) An information gap exists between local knowledge systems available with farmers & plant breeders and researchers, extension workers, etc. There is a lack of awareness about benefits of crop diversity & local solutions employed by the farming community to increase soil fertility.

ii) Information on nutritional value of traditional crops is scanty.

iii) Diversity of cropping pattern as means of managing climatic risk and mixed cropping as means of protecting crops from diseases is not recognized at official level. This has resulted in extensive use of farm chemicals.

iv) The cultivation of legumes for improving soil nutrients and hence, soil health, has been ignored.

v) Watershed management technologies remain unused and have not reached the farmers.

vi) No information is available on areas where traditional crops are still being grown (although to a limited extent) e.g. it was brought up during some public hearings that a few farmers (especially in the Kandi area) still cultivated local drought tolerant varieties of maize(especially on soils with low fertility).

vii) Lack of information on women & mens' different priorities for managing agrobiodiversity w.r.t. maintaining household food security.

8.2.2 Gaps in Vision

i) The vision of agricultural policy makers has been to offer short term benefits instead of long term security of farm lands and health of humans and cattle. Hence, the government driven agricultural policies have led to ecological destruction through increasing nitrates, pesticides & other chemicals in soil & food.

ii) The emphasis of the government has been to assess productivity as single crop yield vs. the traditional vision of farmers which assesses productivity of the entire farming system holistically based on productivity of a variety of crops, livestock & trees. The traditional farming systems have been ensuring security against total crop failure and hence, food security.

iii) There is a lack of appreciation of nutritional & medicinal byproducts from crop fields e.g. plants like *Chenopodium* (Chaulai), *Amaranthus* (Bathua), *Anethrium* (soye) and other leafy vegetables collected by women for food and plants like *Solanum nigrum*, *S. surratense, Boerhhavia diffusa*, etc. are collected for their medicinal value. This has jeopardized peoples' nutritionally balanced diets and self-reliance in health care and has resulted in an increased dependence on purchased drugs.

iv) The importance of fallowing of fields has been ignored in modern agricultural practices and the emphasis has been on multiple cropping only.

v) Most IPM projects currently being promoted apply to single crops. A holistic ecosystem based approach is necessary.

8.2.3 Gaps in Policy and Legal Structure

i) There has been an emphasis on trade of a narrow range of products. The policy of providing support price to selected crops by the government has led to discontinuation of cultivation of other crops by farmers.

ii) Only wheat & rice and a few other crops are promoted through the public distribution system. This has also led to higher demand of these crops and hence discontinuation of cultivation of other crops not procured by the government agencies due to lack of assured markets.

iii) Emphasis on a few crops has also led to their over production. The policy on food stock management and tackling the situation of over production is weak and loosely implemented. Large amounts of food grains are being wasted or rot due to inappropriate storage, although still there are several parts of the country where there is shortage of food grains.

iv) The policy of free water & electricity has led to wastage of these important resources. Further, the general perception as per information gathered from public hearings is that the small farmer is usually not benefited by this policy because of poor quality of services and usually the facility is not available when it is required and its availability at other times of the year leads to its mis-utilization.

> As per a recent newspaper report (The Tribune, 18-05-2002) The State Govt. is considering 8 hours unintrupted power supply to farmers to be charged at flat rate to facilitate sowing of kharif crop.

v) The extensive promotion of canal irrigation has led to change in cropping pattern with more emphasis on rice cultivation than traditional crops causing water related problems (e.g. water logging in certain areas and decrease in ground water table in others).

vi) Crop insurance policies are not extended to minor crops.

vii) There is a lack of procedure & expertise for EIA for domesticated biodiversity as well as biotechnology processes & products.

viii) No policy/law exists to protect and encourage domesticated biodiversity.

8.2.4 Gaps in Institutional & Human Capacity

i) The traditional knowledge of farmers about seed selection, preservation, storage, etc. has been largely disregarded. Plant breeders have failed to acknowledge the capacity of farmers for selection of useful varieties and preservation of genetic diversity in the fields and as a result of neglect and displacement this knowledge is itself eroding.

ii) The role of women in maintenance of crop diversity has been largely ignored.

iii) Institutions need to document the contribution of biodiversity to sustainable agriculture. Participatory research programmes are currently lacking.

8.3 Gaps in Linkages

There is a distinct lack of coordinated efforts by various departments in implementation of their programmes. Each stake holder has adopted a narrow vision so that at times certain actions are repeated (resulting in wastage of resources), whereas other actions are left out. Further, in some cases, actions by one department are antagonistic to that of another. Hence, inter and intra-department coordination needs to be promoted through regular meetings & joint evaluation of projects.

8.4 Gaps in Awareness & Education

i) Most educational programmes lack biodiversity content. No information exists on importance of biodiversity in ecosystem stabilization and agriculture.

ii) There is a lack of practical orientation in formal education.

iii) No efforts have been made to link environment education with livelihoods of people.

iv) There is low participation of NGOs in biodiversity conservation programmes perhaps due to both, lack of awareness as well as, perhaps, lack of scientific understanding of issues.

vii) Specific trainings & orientation programmes need to be taken up for development department personnel to ensure that the importance of biodiversity conservation is appreciated while planning developmental projects.

CHAPTER-IX

STRATEGIES & ACTION PLANS FOR BIODIVERSITY CONSERVATION

Since biodiversity conservation is essentially related to conservation of life support systems and encompasses various sectors, a multi-pronged and cross sectoral approach needs to be adopted for its promotion. The approaches delineated below are based on combined perceptions of the public at large, NGOs, GOs, academicians, scientists and researchers, farmers, professionals, and the industrial sector as gathered from public hearings, questionnaire responses, personal interviews, meetings and discussions and are prioritized accordingly .

9.1 General Strategies & Actions to be promoted/ implemented by the State Deptt. of Science, Technology and Environment

The following Strategies & Actions are proposed:

9.1.1 Strategy:

Creation of Nodal Department (or State Biodiversity Authority) for Biodiversity conservation in the state for :

- facilitating better inter and intra governmental coordination.
- promotion of policies & schemes which link wild and domesticated biodiversity elements.
- inclusion of biodiversity conservation criteria in all developmental programmes.
- promotion of policies that ensure that the degree of use of a resource remains at a sustainable level and does not exceed natural renewal rate.

Action Plans:

Conservation of biodiversity is based on preventing unacceptable environmental deterioration and adjusting anticipatory policies. Given the importance of issues discussed in the preceding chapters that cut across the jurisdiction of various departments and to facilitate the conservation of both, wild and domesticated biodiversity, a nodal deptt. be designated at the state level which would not only be responsible for coordinating major biodiversity conservation

programmes at state level, but also help in conflict resolution, if any. The State Deptt. of Science, Technology & Environment or an agency identified by it (working under its aegis) would be an appropriate body for the purpose. The Punjab State Council for Science & Technology has already been identified by the Punjab Govt. as nodal body for issues related to biodiversity and its conservation.

Further, under the proposed National Biodiversity Bill setting up of a State Biodiversity Authority is being proposed. The Authority would include members from departments concerned with biodiversity conservation, NGOs, academic institutions & community representatives. This centralized system would help inter-departmental coordination within the various departments of the government, as well as, coordination between GOs, NGOs, industry, academicians and R & D scientists. The following specific actions are proposed to be taken up by the nodal Deptt. :-

- Since, PSCST under the aegis of the Environment department, is already notified as a nodal department for biodiversity issues, it should take up the responsibility of biodiversity conservation and management in the state and help establish Inter and Intra departmental coordination with all relevant Deptts. like Forests & Wildlife, Agriculture, Horticulture, Animal husbandry, Fisheries, various Ministries of Govt. of India, R & D bodies, public groups, etc. It may also promote operationalization of the National Biodiversity Bill by the State Govt. on its notification.
- The council should establish liaison with the State Planning Board and Deptt. of Finance to ensure adequate funding of biodiversity programmes. This is possible by creating a specific budget head by the finance Deptt. It is proposed that a small percent (may be 1%) of the budget of all departments in the state, which either benefit from biodiversity conservation, or affect biodiversity, be diverted and pooled for biodiversity conservation, awareness, training & research programmes.
- To integrate biodiversity in government planning & projects the nodal department may request all relevant government departments/academic institutions/NGOs to identify nodal officers (preferably out of existing staff) to look at biodiversity related issues in projects and plans of their respective departments/institutions/areas at their own level. These nodal officers can remain in constant touch with the state nodal Deptt. Further, district level nodal officers who could assess district plans and programmes from

biodiversity conservation angle and facilitate in dissemination of information on biodiversity, as well as, preparation of peoples' biodiversity registers, be identified.

- Mandatory provisions for carrying out prior strategic assessment for all plans & programmes and reorienting development models & processes so as they are fully sensitive to biodiversity concerns be adopted.
- Legislative reforms for ensuring economic incentives for biodiversity conservation be taken up by the Council/State Deptt. of Environment as per national policies.

Specific Action Points/ Projects:

Name	Funds required	Funding/ Implementing agency	Priority/Remarks
Formal notification of nodal Deptt. by State Deptt. of Science Technology & Environment at Govt. level.	Nil	DSTE, GOP	Immediate
Discussion with State Planning & Finance Departments for inclusion of biodiversity conservation in State Plans.	Nil	DSTE, GOP & PSCST	Immediate
Strengthening of State nodal Deptt.	Rs. 100 lacs for 5 years	Jointly by GOI & GOP	Immediate (Project Proposal1)

9.1.2 Strategy:

Preparation of State level data base for wild and domesticated biodiversity and traditional knowledge systems

This would help to:

- Assess the status of existing biological resources and defining of criteria for economic evaluation of resources (including of intangible benefits in the accounting system) and;
- Promotion of multiuse functions of ecosystems and integration of sustainable use of these resources in various production sectors.

Action Plans:

The following actions would be required:

- Projects to determine existing status of wild & domesticated biodiversity including assessment of population status, habitat fragmentation, inter and intraspecific genetic variability, identification of key-stone and endemic species as well as rare, threatened and vulnerable species, risk factors etc.

  Also, Project to promote sustainability in agriculture and animal husbandary practices & conservation of native species/varieties/breeds. Analysis of data to seek solutions.
- Based on the above a state level data bank on existing biodiversity resources be prepared both, district wise & ecosystem wise. This can be done with the help of departments of forests, agriculture, fisheries & horticulture, existing universities & research institutions, NGOs & local communities. ZSI, BSI, IIRS, NBAGR, NBPGR & PRSC must also be involved. Based on the collected data, groups of plants & animals on which information is lacking or scanty be identified to promote R&D projects in this area. Besides preparation of inventories, these projects should also take up population dynamics studies to assess current status of availability of bioresources and ethno-biological studies to record their existing uses by the communities.
- The above data bank be computerized for easy access to information and an Environmental Information System on 'biodiversity', to provide information on biodiversity to general public both, in English & Punjabi be setup. The information could be put up in the state govt. website also. However, care has to be taken on how much information is to be disclosed for public use and how much of it is to be selectively disseminated to ensure that IPR benefits accrue to the state and its people on the basis of a policy which may be formulated at the national level.
- Biodiversity monitoring projects be taken up to identify parameters to assess the changes/ factors affecting bio-diversity and assessing current trends of loss/gain and to develop guidelines for use and management of natural resources. Issues such as assessment of unsustainable farming

methods, ways of conserving abandoned (or relatively less grown) crops, reduction in excessive use of water & farm chemicals, incentives for conservation, etc. also need to be studied.

Specific Action Project:

Name	Funds required	Funding/Implementing agency	Priority/Remarks
Development of data bank on existing biodiversity in the state and recording the change in wild and domesticated diversity overtime.	Rs. 100 lacs for 5 years	GOI	Project proposal 2 Details to be worked out

9.1.3 Strategy

Capacity building for biodiversity conservation and incorporating of biodiversity issues in formal and non-formal education through:

- Training/orientation programmes on biodiversity issues for all sections of society (including farmers, industry, government personnel, NGOs, students, women, etc.).
- Adequately linking biodiversity issues with livelihood issues at the non-formal level and promoting EE programs at formal education level.

Action Plans:

- A time targeted action plan be devised to promote pre-service and in-service training of government personnel, teachers, farmers, panchayats, NGOs and other target groups on issues related to biodiversity. Necessary investment be made in this area in the interest of long term benefits and appropriate training facility/center within the aegis of the Department of Science, Technology and Environment be set up. This will ensure that biodiversity aspects are considered at the time of conceptualization of developmental projects.
- Integrated awareness programmes with NGOs with special focus on Local community knowledge and folk media be initiated.

- A programme for cooperation and exchange of experts in the field of Science & Technology, Environment, Law, IPR, etc. be initialized and cooperation with National and International experts, R & D and training bodies be fostered.
- Environmental education is already an important component of the National Education Policy which is in vogue in the State of Punjab as well. However, to create sensitivity towards environment and biodiversity issues the State nodal Deptt., in consultation with the State Education Department, should identify and ensure incorporation of relevant biodiversity issues in syllabi at School & College level (especially local examples be incorporated in the syllabi so that students can relate to their immediate environment). Further, to provide a practical orientation to education, field exposure (including in-depth stays in places of biodiversity interest) be promoted through specific schemes for students.
- Biodiversity issues be included in higher education curriculum including that of professional colleges (e.g University and Engineering students be exposed to Biodiversity & EIA).

Specific Action Projects/ Points:

Name	Funds required	Funding/Implementing agency	Priority/Remarks
Setting up of Centre for training in biodiversity	Rs. 300 lacs for 3 years	GOI	1-3 Years Project Proposal 3
Setting up Environment Education Centers in biodiversity rich/ecologically important sites	Rs. 300 lacs @Rs.100 lac per center for 2 years	GOI	3-5 Years Project Proposal 4
Development of locale specific biodiversity literature for schools and colleges in Punjab	Rs. 10 lacs for one year	GOI	With one year Project Proposal 5

9.1.4 Strategy:

Fostering public participation in policy decisions, identification of locale specific projects and implementation of the same.

Action Plans:

This will involve:

- Promoting public participation in planning, implementation and monitoring of development programmes (especially those having an impact on biodiversity).
- Fostering NGO participation in biodiversity conservation through sponsoring awareness and action projects.
- Fostering participation of private sector in implementation of education and awareness activities (eg. Taking up joint publicity programmes for children and masses).
- Enhancing dissemination of locally relevant information to local communities and farmers through Panchayats and NGOs through special rural training programmes/camps.
- Identification of community conserved areas in the state to assess their current status and inventorization of components of biodiversity in these areas. Factors which have motivated the community for taking up conservation activities be recorded for subsequent use in motivating additional communities.
    - Development and participation in National and International networks on biodiversity and livelihood issues (eg. International networks like enn.com & bionet and national networks like SASEANEE etc. It is also proposed to establish SANISELE with the help of UNESCO. The network can be used for information sharing).

Specific Action Projects/ Points:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
Capacity building of NGOs and Panchayats for natural resource conservation in Punjab	Rs. 10 lacs for 1 year	GOI	To be clubbed with Project Proposal 3

Project on community conserved areas in Punjab	Rs. 11 lacs for 2 years	GOI	Project Proposal 6 (Detailed project submitted to GOI)
Establishment of network for information sharing.	Nil		Action already being taken up

9.1.5 Strategy:

Fostering research programmes:

- for inventorisation of existing biodiversity and its known uses.
- identifying appropriate technologies for its management and criteria for evaluation.

Action Plans:

- Assigning specific funds for biodiversity research and establishing a team of experts to assess suitability and priority of R & D projects relevant to the state.
- Promoting inter-departmental research on biodiversity elements on which data is low/lacking.
- Setting up of scientific reference collections in gene/seed banks for local and wild biodiversity in existing institutions.
- Motivating corporate houses to jointly fund biodiversity research projects.
- Promoting specialist-training programmes at state, national and international levels.
- Organizing interactive meetings and symposia.

Specific Action Projects:

Name	**Funds required**	**Funding/ Implementing agency**	**Priority/ Remarks**
Notifying team of experts for assessment of R & D projects related to biodiversity	Nil	GOP	Within 1 Year
Promoting inter departmental research programmes	Covered under 9.1.2	PSCST	5-10 Years

9.1.6 Strategy:

Conservation of ecologically important sites

Action Plans:

- As pointed out in the proceeding chapters, several ecologically important sites exist in the state. These include—

a) Three Ramsar Sites (Harike, Kanjli & Ropar)

b) Several Wetlands & Lakes of national & state importance

c) The Shivalik foothills

d) The Birs and Mand areas.

Concerted efforts to conserve the natural ecology of these areas need to be made. These include:

- **Conservation of Wetlands**: The wetland management and conservation project in the state is being implemented by the Department of Environment. Projects for inventorisation of biodiversity in all wetlands and wetland evaluation studies need to be taken up. This would also help to recommend additional wetlands as Ramsar sites/national wetlands. Further, efforts be made to remove encroachments from wetland areas (special mention needs to be made of large chunks of Harike wetland being encroached by a religious institution). Remote sensing studies of important wetland sites be also taken up on priority to assess trends in change in wetland area.
- **Conservation of Shivalik Ecosystem:** A project to study the biodiversity in the area has already been initiated. Information of ethnobiological data needs to be generated.
- **Conservation of Birs:** These Birs fall under the jurisdiction of the Deptt. of Forests & Wildlife & specific actions for protection of these areas is already being taken up.

Specific Action Projects:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
The Wetland conservation and management project is being implemented since 1988. The project is taken up with active support of several State Govt. Deptts.	Year wise funds sanctioned as per demand for participating Deptts.	Funding agency:- GOI Implementing agency:- PSCST	Ongoing PSCST

A project of study of biodiversity in the Shivalik ecosystem of Punjab is ongoing.	Rs. 43.45 lacs for 3 year	Funding agency :-GOI & GOP	Ongoing PSCST

9.1.7 Strategy:

Creation of regulations for access to genetic resources to allow their sustainable use. Also to define a fair and equitable system to ensure distribution of benefits to all stake holders from use of bioresources of an area (including transfer of technology) and creation of mechanisms which ensure collective intellectual property rights of communities on the local bioresources and traditional knowledge.

Action Plans:

- In consonance with the spirit of Convention on Biological Diversity which relates to access, sustainable utilization and benefit sharing of resources, specific regulations be drafted. Project for documenting traditional knowledge to ensure IPR rights of locals through community or People's Biodiversity Registers that are given legal protection be taken up and database to identify potential resource users e.g. pharmaceutical companies, biotechnology companies, etc. and regular assessment of patents filed by these companies in India and abroad be developed. Documenting existing/traditional uses of bioresources will help check biopiracy and ensure that intellectual property rights of locals are not mis-apportioned by outsider agencies. The bottom line has to be equitable benefit sharing. For this, the department in consultation with the Central Ministry, may identify all stakeholders (it may be noted that in a broader sense, not only the inhabitants residing in an area/state will be stakeholders but also people residing outside the state, be it within or outside the country, could claim to be stakeholders. The issue, therefore, needs critical attention at Govt. of India level). Further, equitable benefit sharing should also entail sharing of costs and responsibilities for biodiversity conservation by all 'Stakeholders'. Wherever required, the state nodal agency, in consonance with the Ministry of Environment & Forests and State Government, may conduct trainings for the purpose.

- Criteria for economic evaluation of resources (including intangible benefits) in the accounting system need to be defined.
- Further, the farmers right to benefit from their knowledge of varieties, which are a part of the heritage of selection and improvement work done by their predecessor farmers over generations, needs to be protected. Also, it may be made mandatory to seek their prior consent before their knowledge and resources are used by outsiders.
- A system to assess commercial and non-commercial uses of bioresources needs to be devised.

Specific Action Point:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
Identification of stakeholders as defined in the National Biodiversity Strategy & Action Plan	Nil	GOP to follow GOI guidelines	Immediate

9.1.8 Strategy:

Developing resource efficient technologies and optimizing application of environmental impact assessment (with due emphasis on biodiversity issues) in all developmental projects.

Action Plans:

- Identification and inventorization of biodiversity based/related projects/industries, assessing bioresource utilization and promoting/developing low resource intensive and Low Waste No Waste (LWNW) technologies.
- Taking up EIA of all major developmental projects at district level. The EIA may include biodiversity assessment and ensure transparency in public participation.

Specific Action Project:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
Action proposed under 9.7.1			To be taken up with industries Deptts.

9.1.9 Strategy:

Removing perverse economic incentives (such as subsidies), promoting positive incentives (such as awards and compensation for retaining traditional biologically diverse agriculture) and providing social incentives (eg. public recognition, appointment of honorary biodiversity wardens, etc.).

Action Plans:

This would involve:

- Review of existing Agriculture, Water, Environmental policies of the state and their modification, if necessary.
- Promotion of schemes for public recognition especially for communities and voluntary workers.

Specific Action Project:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
Policy Review	Nil	Interdepartmental Review under CS, GOP	Immediate

9.1.10 Strategy:

Ensuring institutional and financial support for biodiversity based programmes.

Action Plans:

It is proposed that:

- A small percentage (about 1%) of existing budgets of various departments related to or having an impact upon biodiversity be mandatorily diverted to this head and specific conservation projects taken up.
- Scheme for providing financial incentives to farmers following traditional farming practices, communities actively conserving specific areas/species and land owners promoting habitat conservation on private lands be introduced. (Please refer para 9.3.2 also)
- Crop insurance policy be extended to traditional crops. (Please refer para 9.3.3 also)
- Crop Insurance & Compensation Scheme for farmers suffering from crop damage by wild animals like neelgai, wild boar, monkeys & porcupines be

introduced to reduce man-animal conflicts. Such schemes already exist in some states (e.g. in UP a farmer is provided Rs. 25,000/acre for destruction of wheat crop and Rs. 1000/acre for destruction of other crops-TERI, 2001 - unpublished). Specific animal wise compensation packages can be designed. (Please refer para 9.2.7 also)

Specific Action Project:

Name	Funds required	Funding/Implementing agency	Priority/ Remarks
Interaction with the State Deptts. of Forests & Wildlife & Agriculture on the above	Specific requirements placed under paras 9.2 and 9.3	GOI & GOP	Immediate

9.1.11 Strategy:

Inclusion of women in biodiversity conservation programmes.

Action Plan:

Women play a major role as custodians of native flora & fauna and have a profound knowledge of existing wild and domesticated species/varieties. This information may be used beneficially by involving them in biodiversity conservation programmes through Social Welfare and Women & Child Development Deptts. Specific actions would involve:

- Documentation of women's knowledge and issues related to their livelihoods.
- Promotion of kitchen gardens.

9.1.12 Strategy:

Legislative reforms and establishment of Green courts (responsible specifically to deal with offences concerning Forest & Wildlife issues in the state).

Action Plans:

- Operationalization of National Biodiversity Bill after it is notified by the Central Government.
- Enforcement of existing environmental laws to control point & non-point sources of pollution and existing Acts specifically related to biodiversity conservation, like the Wild Life (Protection) Act, (1972) and Forest (Conservation) Act, 1980.

- To facilitate quick disposal of environment related cases green courts be established. The actions need to be taken up at the national level first.
- Reforms to ensure economic incentive for biodiversity conservation be introduced.

9.2 Strategies for Conservation of Wild Biodiversity & Action by State Deptt. of Forests & Wildlife.

Data presented in the preceeding chapters indicates that with increase in area under agriculture and habitat degradation, the wild flora and fauna has been adversely affected in the state and unless specific actions are taken up for its conservation, its future existence/preservation will be in doldrums. The following strategies are proposed to address this situation:

9.2.1 Strategy:

Augmenting forest resources:

Action Plans:

The forest resources of the state need to be augmented by :

- Making efforts to restore original ecosystems in all available vacant, marginal and waste lands, including community lands, by promoting appropriate vegetation. Wherever tree plantation is taken up, it is important that native trees, especially the dominant ones in the area, be promoted with a fair mix of fast growing & slow growing species. Further, it is important to prepare a data bank that may also include wood balance data in the state to find out the additional requirement of forest resources and devise suitable mechanisms to augment these (including high production forestry in selected govt. forest areas).
- Mature forest with climax communities be declared as closed forest areas.
- Efforts may be made to improve canopy density in existing forests especially in the Shivaliks. Natural regeneration of native species needs to be promoted besides promotion of under-storey herb and shrub vegetation which provides habitat to a variety of wild flora. The spread of *Lantana* has to be checked and alternatives to *Lantana* which can grow on degraded lands under stress conditions be identified.

- Social and farm forestry be promoted to reduce pressure on natural forests. Further, a proper marketing policy be devised to encourage farmers to raise plantations.
- An integrated approach also needs to be developed to grow medicinal plants through inter-departmental consultations (between Forest, Health, Horticulture, Agricultures, Environment Departments). For this, the existing flora and fauna be screened for assessing its economic/medicinal value. Also comparison of existing flora with prepublished floras be taken up and the socio-economic reasons of change in vegetative patterns be assessed.
- Protection/regeneration/introduction of dwindling species (eg wild Phalsa is reported only in Aam Khas Bagh, Sirhind) be taken up.
- Joint Action Committees with Forest Deptts. of the governments of neighboring states be constituted to check illegal felling of existing forest trees (especially Khair), medicinal plants and wild animals & their products. Routes of such illegal trade be curbed.

Specific Action Projects:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
Establishment of biodiversity Cell in the Deptt. of Forests & Wildlife	Rs. 2 crore	GOP	Within one Year. Project Proposal 7
Training of Forest staff and Wildlife managers	Rs. 20 lacs	GOP	Project Proposal 8
Constitution of Interstate Joint Action Committees to curb illegal harvesting and Trade of forest produce.	Nil	---	Immediate

9.2.2 Strategy:

Holistic approach for ensuring the enhanced availability of local bioresources for the continuation of local livelihoods through micro watershed planning and community involvement

Action Plans:

Actions would include:

- Identification of all stakeholders in biodiversity conservation in consultation with Department of Environment and Ministry of Environment and Forests and ensuring eqitable sharing of costs, benefits and responsibilities.

- Identification of natural resources used for livelihoods by the local population and promoting efforts to enhance their sustained supply through micro watershed based planning and promotion of soil conservation, afforestation and reforestation in these areas.
- Promotion of small scale decentralized water harvesting projects (instead of large dams which lead to other environmental problems). Specific action needs to be taken up in the Shivalik area through vegetative and small sized engineering measures for Soil and Water conservation in the Shivalik tract. This information needs to be shared with neighbouring states as well (as the entire area is contiguous) and joint studies be taken up.
- Involvement of Local communities, especially women, in protection of forests making them important components of forest management (Punjab has a good example of Bishnois). Also linking forestry with livelihood issues and conducting economic evaluation of biological resources conserved by communities and promoting schemes to provide incentives in the form of community assets (like, hospitals, schools, etc.) on the basis of equitable benefit sharing. Excessive lopping/grazing/harvesting of non-timber forest produce can be regulated with joint participation of these communities. (Since there is a ban on tree cutting, local communities either cut trees illegally or lop them excessively. This can affect tree growth and canopy density.) Further, legal backing be provided for conservation oriented practices of locals.
- Regulation of nomadic pastoralists in the Shivaliks and resolving common issues jointly with State Govts. of Haryana & Himachal Pradesh.
- Expansion of JFM and eco development schemes.
- Plantation of Bhabbar and fodder grasses in the Shivalik tract for use by the local population. Further, growth of *Lanatana* and *Parthenium* needs to be controlled to conserve native grasses like *Eulaliopsis binata* (Bhabar- an important commercial grass), *Chrysopogon fulvus* (Dholu- Fodder grass), *Heteropogon contortus* (Spear grass-Fodder grass) and *Acacia* trees. This action may be taken jointly with neighbouring state also.
- Public awards for tree plantation and wildlife protection by communities/individuals may be instituted.

Specific Action Projects:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
Project to promote microwatershed are already being implemented under the World Bank Project on Integrated Watershed Development (Hills) Punjab and Forestry Development Project in Kandi area by JBIC, Japan.	Rs. 5988 lacs for 2001-02 Rs. 408 crore for 8 years	World Bank JBIC, Japan	Funds provided Project Ongoing Ongoing
Discussions with neighbouring states for control of certain weeds and issues pertaining to nomadic pastoralists especially in Shivaliks.	Each State/UT (May identify funds as per its need)	State Govt./UT	5-10 Years

9.2.3 Strategy:

In-situ conservation of wild diversity.

Action Plans:

- Notification of all Wildlife Sanctuaries U/S 26A of Wildlife (Protection) Act, 1972 if required (as per forest department, all provisions of Wildlife Act, 1972 are already applicable to these sanctuaries).
- A Project be taken up to promote protection of specific habitats through protected area network as well as identification and establishment of additional protected areas after duly assessing the needs of the local people in the area. Also impact of various developmental activities in these protected areas be assessed. Zonation of protected areas into 'core zone' & 'buffer zone' and notification of activities in each zone be taken up and such notifications be displayed for public benefit. The PAs could also be used for biodiversity awareness. Further, wherever, applicable transboundary management strategies for protected areas be developed in consultation with neighbouring states.
- Specific projects be taken up for recovery and rehabilitation of rare and threatened species and their reintroduction in their natural habitat by providing appropriate conditions.

- The coverage of representative ecosystems and species assemblages needs to be increased. For this, additional protected area sites be identified (in consultation with local communities) and community be mobilized for active conservation efforts (on lines of black buck conservation by Bishnois) for protecting the total range of flora and fauna. Further, collection of natural genetic material especially for research and commercial use needs to be regulated to ensure Intellectual Property Rights of the local population. Guidelines be developed in this respect.
- Further, the existing forest and wildlife resources also need to be protected from theft/ fire and encroachments. Community participation be mobilized to facilitate this.
- Joint projects be taken up with Deptt. of Environment and Remote Sensing Institutes for regular assessment of existing biodiversity, habitat management and developing conservation/afforestation programmes based on microwatershed assessment. Also GIS and other R & D studies for key stone species and other important species to assess their distribution, possible areas of re-introduction and development of corridors (if applicable) be taken up.

Specific Actions Points:

Name	Funds required	Funding agency/ Implementing	Priority/ Remarks
Habitat Improvement in Protected Areas	Rs. 100 lacs every year	GOI	Project Proposal 9
Preparation of Management of Plans	Rs. 1 crore for 10 years (Plan for every year)	GOI	Project Proposal 10
Census operation of Wild animals in the state	30 lacs	GOP (as it is a routine activity)	Project Proposal 11
Establishment of GIS/MIS labs	Rs. 50 lacs for 2 years	A lab is already being set up. However, it can be strengthened by GOI funding	Project Proposal 12

9.2.4 Strategy:

Ex-situ conservation of Wild Biodiversity:

Action Plans:

- Establishing core collections (including maximum available variations within populations) within existing protected areas.

- Setting up and promotion of germplasm banks (including seed, semen, egg and embryo banks) in existing academic and R & D institutions. Also, encouraging seed banks at community level, managed by village institutions and womens' group.
- Data indicates that the existing stock of certain zoos/botanical gardens in the state consists of dominant species. Some of these could be replaced with endemic, rare & threatened species by adhering to the statutes of the Central Zoo Authority for animal collection policy. This will also help develop linkages between ex-situ & in-situ conservation.
- In view of financial resource constraints ex-situ conservation of only critically endangered, vulnerable, threatened /extinct in wild & conservation dependent species may be promoted. For this, it is first necessary to identify endangered status of species.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Establishment of Breeding Centers for rare & threatened species	Rs. 100 lacs for 5 years	GOI	Project Proposal 13
Establishment of Rescue & Quarantine Centres	Rs. 1 lac	GOP	Project Proposal 14

9.2.5 Strategy:

Conservation and study of bird fauna.

Action Plans:

Since Punjab harbours a rich diversity of bird fauna (37% of the total National Bird fauna) which includes several rare, threatened & vulnerable species, there should be a special emphasis on conservation and management of wetlands in the state (which attract migratory water fowl)and their use as environment education centers. As of now, the attention of the government & researchers is focused on conservation of mammals & higher plants. This needs to be extended to other plant & animal species (especially lower groups) also as they are important components of the ecosystem. The following actions be taken:

- The Shivalik area be declared as an IBA site.

- Bird ringing experiments be re-introduced with the help of expert agencies at Harike Wildlife Sanctuary and initiated at other important migratory bird sites in the state.
- The Red Jungle Fowl is an important species reported to be occurring in the Shivaliks. In certain pockets its pure breed is available. Such areas need to be mapped and protected (jointly with neighbouring states).

Specific Action Project:

Name	Funds required	Funding/ Implementing agency	Priority/ Remarks
Liason with Bombay Natural History Society to address the above issue- Actions to declare Shivalik area as an IBA site has already been initiated and relevant bird data (collected under Shivalik project by PSCST) has been passed on to BNHS.	No immediate funds required.	BNHS can be approached for identifying potential funding agencies	Immediate

9.2.6 Strategy:

Controlling illegal hunting & poaching.

Action Plans:

Illegal hunting, poaching and wildlife trade has been reported from certain areas of the Shivaliks. The issue needs to be addressed at political and administrative level. The following actions need to be taken up:

- Project to assess the status of hunting and poaching in the state (especially wild areas) and extent of trade in wild species (especially birds and mammals), including plants (especially medicinally and commercially important species) be taken up.
- Local people may be involved in protection of wildlife against illegal hunting and poaching especially in areas with meagre forest/wildlife staff; for which incentive schemes for informers be divised.
- Establishment of data bank on illegal wildlife trade and establishing inter state linkages with Punjab, Haryana, Himachal Pradesh & U.T. Chandigarh to jointly curb the menance. Linkages may also be established with Traffic-India.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Establishment of Anti-poaching Cell	Rs. 50 lacs	GOP	Immediate. Project Proposal 15 Token funds are already provided in the State budget for providing arms & ammunition to Wildlife staff.
Modernization of communication network	Rs. 50 lacs for 2 years	GOI	2-5 years Project Proposal 16

9.2.7 Strategy:

Curbing increasing man-animal conflicts.

Action Plans:

Increasing population of certain animals (like blue bulls & wild boars) has led to man-animal conflict in certain areas. In some areas, this conflict has arisen due to protection to certain species where as in other areas it has arisen due to excessive habitat loss (due to expansion of area under agriculture) leading to wild animals regularly intruding into fields and destroying crops. The issue needs to be addressed by:

- Policy for selective culling/sterilization of animals based on sex and age wise population be adopted in areas of high human-animal conflict.
- Introduction of compensation scheme for farmers affected by crop damage due to wild animals. (Please refer para 9.1.10- Action plans also)

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
Formulation of methodology for compensation	Rs. 50 lacs	GOI	Immediate. Project Proposal 17

9.2.8 Strategy:

Changing agricultural patterns.

Action Plan:

- Agricultural production patterns that support wild biodiversity (by providing food, shelter, nesting & roosting site and migration corridors) need to be promoted.

9.2.9 Strategy:

Promotion of urban biodiversity.

Action Plans:

Urbanization leads to decrease in species diversity of an area. However, carefully planned urban areas in the state can provide unique habitats for certain species of flora and fauna. This can be promoted by:

- Assessment of existing biodiversity in urban areas of the state and adoption of measures to protect it.
- Intensive projects for taking up plantation activity (using indigenous species) in urban and semi-urban areas especially Shamlat lands (village common lands) and Phirnis (village peripheral roads) with community participation.

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
Several schemes have already been initiated for plantation in cities, towns & villages including roadsides, garbage dumps, schools, etc.	Project based	GOI & GOP	Ongoing

9.2.10 Strategy:

Information Dissemination on Wild Biodiversity

Action Plans:

To promote public participation, the Deptt. needs to promote awareness and educational activities. These would include:

- Information dissemination through internet, posters, pamphlets, etc.
- Establishment of Interpretation centers at international and national wetland sites, important sanctuaries and district headquarters. The Harike & Ropar wetlands have a good potential in this.
- Promotion of Eco tourism in buffer zones of protection areas, wetlands and other biodiversity rich areas.
- Use of botanical and zoological gardens for biodiversity education.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/ Remarks
Establishment of Wildlife extension cell	Rs. 50 lacs for 2 years	GOI	2-5 Years Project Proposal 18
Establishment of interpretation centers in and around Protected Areas	Rs. 200 lacs	GOI	2-5 Years Project Proposal 19
Designing of web page and developing linkages globally through internet	Rs. 10 lacs for 1 year	GOP (Should be taken up on the existing Punjab Govt. website)	1 Year Project Proposal 20
Establishment of Eco tourism cell (Project be taken up jointly with tourism deptt.)	Rs. 200 lacs for 2 years		5-10 Years Project Proposal 21
Nature Awareness Camps	Rs. 20 lacs for 1 year	GOI	1 Year Project Proposal 22

9.3 Strategies for Conservation of Domesticated Biodiversity and Actions by Deptt. of Agriculture.

Agriculture is one of the production sectors which has the closest relationship with biodiversity conservation. Activities of this sector have influenced the nature of the country side, both, positively and negatively. Agricultural activities entail a transformation of the natural systems giving rise to habitats and development of varieties and livestock breeds that did not previously exist in the natural ecosystems. Mechanization and intensification of agriculture and promotion of genetically engineered high yielding crop varieties in Punjab have led to loss of traditional varieties (primarily to enhance production and maintain market competitiveness). However, the consequences have been negative due to homogenization of large areas which initially fostered high levels of biodiversity. Large scale habitat destruction, soil and water pollution, high nitrate and pesticide levels in food crops, damage to soil flora and fauna, are a few adverse impacts. The policy of intensification of agriculture has led to disappearance of traditional agricultural systems which had developed with the collective evolution of local communities and contained agricultural varieties and livestock breeds best adapted to their environment as well as their management techniques. There is, therefore, a dire

need to reframe current agricultural policies and practices and take up suitable measures to restore biodiversity in agriculture as well as local habitats.

Interaction with the State government departments and local farmers, women and NGOs indicates that the brunt of ecological backlash due to intensive farming is already being felt. However, the priority of the state government continues to be increase in productivity, whereas the farmers feel that they are already helplessly entrapped in the existing government policy of selective subsidies & loans and support price for selective crops. Though the farmers indicated a meek desire to abolish use of chemical fertilizers and pesticides during the public hearings but they are not willing to switch over to organic farming without government support and guidance of PAU. Increasing input costs due to deterioration of soil health leaves them with no option but to resort to only those crops where market support is available. Unsustainable life styles are also an important contributory factor. The public hearings have been an eye opener with regard to the various social problems which are being faced by the middle level and marginal farmers in the state.

In one of the public hearings held at Fatehgarh Sahib by VHAP, Mrs. Darshan Kaur from Ferozpur village (Distt. Patiala) informed that farmers kept inferior grain for household use and sold superior ones in the market for economic reasons. Mrs. Manjit Kaur, representative from Nagar & Mahila Gram Sudhar Society, Rajpura informed that

women were maintaining small kitchen gardens for vegetables and could raise awareness about biodiversity in agriculture but the men usually did not cooperate.

Mr. Surinder Bedi informed that consolidation of land holdings in Punjab was the major causes for destruction of old trees growing in fields (leading to loss of biodiversity) as most of the farmers whose land was affected during consolidate harvested these trees for timber and other uses.

Mr. Santokh Singh from Nurpur Bedi discussed the ego problem in Punjabi farmers and said that since bajra was considered as poor people's food, farmers had stopped eating and cultivating it.

Mr. Kulwant Singh, Ex-chairman, Morinda Sugar Mill said that the Punjabi farmer was hardworking but was totally dependent upon feed back from government and PAU on the crop varieties. He told that farmers were ready to grow any crop provided the seeds was supplied by the government. He also highlighted the problem of agricultural training. He felt that training was being provided to selected candidates of cities with whom rural children were unable to compete. These trained personnel usually did not return to the fields.

9.3.1 Strategy:

No diversion of prime agricultural land and restructuring of State Agriculture Policy :

Action Plan:

To achieve high levels of production, best lands need to be retained for agriculture. Hence, prime agricultural land should not be allowed to be diverted for other users like industry and urban settlements (this is presently being done in several districts). Also, the food and agricultural policy of the state needs to be based on collective wisdom of Punjabi farmers. The present agricultural policy is following the western pattern of industrialized agriculture focusing on intensification and mechanization of agriculture (with an eye on increase in productivity), support for only a few marketable crops (thus promoting mono-culture instead of diversity in agricultural practices) and subsidies on farm inputs. This needs to be changed. Support price of diverse crops needs to be fixed which should be commensurate with productivity potential of these crops to ensure that on-farm biodiversity is promoted. The basic difference between 'diversity' and 'diversification' needs to be clearly understood. Further, the effect of consolidation of land holdings at the time of ushering in of green revolution on biodiversity is already well known (Refer Para 4.4.2). Hence, the corporatization of agriculture needs to be stopped to protect the interest of small & marginal farmers as it could reduce their ability to manage their lands in an ecologically sustainable manner. The following actions need to be taken in this respect:

- Identification of prime agriculture lands in the state and developing appropriate rules to prevent its diversion to other uses. Also ensuring adequate fertility status of these lands through appropriate agricultural policies.
- Organizing debates on the New Agriculture Policy and issues like, traditional vs modern farming practices, IPM, crop diversity vs diversification, organic farming, market support for traditional crops, removal of subsidies from high input agriculture (to allow farmers to carry out an actual cost benefit analysis of modern vs traditional farming), etc.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Review of Agriculture Policy. Neighbouring states may also be consulted.	Nil	--	Immediate
Establishment of Agricultral biodiversity cell	Nil	--	The cell may be created out of existing staff by designating a nodal biodiversity officer at state Head Quarters
Policy for crop diversification	Details to be worked out	GOP	The state Govt. is already initiating action in this direction. However, the present policy for diversification promotes only cash crops & other hybrid varieties. This needs to be changed for which appropriate guidelines be developed at the National level.

9.3.2 Strategy:

Promotion of traditional farming systems, Integrated pest management, bio-fertilizers & bio-pesticides, etc.

Action Plans:

Traditional, time tested farming systems have promoted sustainable agriculture since ages. As the negative impacts of green revolution are becoming evident, the wisdom underlying some of these systems is becoming apparent. Efforts need to be made for the revival & scientific documentation of these system. Specific actions include:

- Promotion of ecological farming through use of organic manure and integrated pest management systems.
- Promotion of environmentally safe biopesticides and biofertilizers. This would include assessing efficacy of existing biopesticides and biofertilizers and improving the same through R & D.

- Establishing extensive soil testing and pesticide testing facilities & promoting its use by farmers.
- Promotion of traditional compost pits (rooris) after proper sorting of biodegradable & non-biodegradable wastes and management of animal dung for producing organic manure (traditionally animal dung was composted in pits where as now, the waste material and dung is left to mature on open lands). Also training to farmers for vermicomposting.
- Documentation of success stories of farmers who are following traditional agriculture successfully and disseminating this information to others (in Punjab very few farmers are following this practice. Only two examples could be collected during public hearings
    - S. Makhan Singh of Machhiwara and
    - S. Paramjit Singh Grewal of Fatehgarh Sahib)

  Financial incentives for farmers following traditional agriculture be devised (Please refer para 9.1.10 also).
- Facilitating marketing of organically produced food/traditional crop varieties by establishing direct links between such farmers and consumers (e.g. providing marketing infrastructure, quality checks and certification, subsides transport, etc.).
- Ban on burning of stubble in fields under the Air (Prevention & Control of Pollution) Act, 1981
- Strengthening of extension activities and use of IT in agriculture to promote information dissemination through the internet on soil & weather conditions, crop diversity and package of practices.

Specific Action Projects:

Name	**Funds required**	**Funding agency**	**Priority/Remarks**
Documentation of success stories on traditional farming	Rs. 10 lacs for 2 years	GOI	Project Proposal 23
Establishment of soil testing labs at block level	Rs. 187 lacs for 1 year	GOP	Project Proposal 24 Funds are already being provided under scheme for staff at distt. level by GOP
Setting up of new bio-control labs at Sangrur and Kapurthala,	Rs. 2.50 lacs for 2 years	GOI	Project Proposal 25 The scheme has been

Strengthening of existing labs at Mansa			covered under new centrally sponsored macro management work plan of the Deptt. of Agriculture, GOP . This involves 90% GOI funding & 10% GOP contribution.
Setting up new Pesticide testing labs	Rs. 21 crore for 10 years	GOP	Project Proposal 26 The project could be included under World Bank aided Agriculture Extension & Administration
Strengthening of existing 3 state pesticides testing lab	Rs. 4.16 crores for 10 years	GOP	Project Proposal 27 The project could be included under World Bank aided Agriculture Extension & Administration
Establishment of Agricultural Information Cyber Extension Centres at block level	Rs. 9.66 crores for 2 years	GOP	Project Proposal 28 The Project is included under state 'Second Push to Punjab Agriculture' Rs, 16.5 lacs was provided in 2001-02
Promotion of Composting & Vermicomposting bioferilizers, etc.	Ongoing	GOI & GOP	Projects for awareness & training have been taken up by PSCST with funding from DBT, GOI
Facilitating direct links between producers of organic/traditional crops and consumers.	Details to be worked out	GOP	3-5 Years

9.3.3 Strategy:

Establishing social security system for farmers growing traditional crops/following traditional farming practices and extending the scope of PDS

Action Plans:

This would include:

- Taking up the issue of crop insurance with insurance companies to extend it to several crops especially those requiring less water, pesticides and other farm inputs.(Please refer para 9.1.10 also).

- Further, the public distribution system should reflect food & crop diversity to increase demand of diverse crops. The scope of PDS be extended by promoting distribution of millets, pulses and crops other than wheat & rice only. This would act as a motivational tool for farmers to grow diverse crops. This has been recommended in other areas also. (see box).
- Promoting commercial enterprises (including post harvest technology) which support traditional crops (e.g. maize, oat & barley based products).

The Deccan Development Society conducted a series of meetings with local farmers and conducted a biodiversity yatra. One of the major causes identified for destruction of millets & sorghum in farming system was supply of cheap rice through PDS.

The DDS has recommended that:

- The Govt. must introduce jowar in PDS. This will open a huge market for traditional jowar farmers of the Deccan and rekindle interest in their own cropping practices while enhancing biodiversity in the fields
- Sorghum & millets be introduced in the diet system of govt. hostels & ICDS schemes. This would not only open up a large market for millet farmers but would also be decisive in reshaping the food tastes of the new generation besides improving their nutritional status & health.
- The aggressive commercial media campaign in favour of processed foods needs to be reversed through early education and the issue of agro-biodiversity and safe food be included in the curricula of schools & colleges
- The govt. media should run a well organized campaign in favour of traditional millets & sorghum

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Policy discussion on expanding scope of PDS in consultation with Ministry of Agriculture,GOI & experts	Nil	---	Immediate
Rashtriya Krishi Bima Yojna	Rs. 116 lacs for 3 years	GOP	Project Proposal29 Details to be worked out. Hence, token provision has be made in state budget

9.3.4 Strategy:

Developing appropriate storage facilities.

Action Plans:

The existing policy of food grain storage be carefully looked into in wake of recent incidents of damage to existing stocks due to insufficient storage capacity and

inefficient management. Actions would include:

- Developing policy for food grain management and storage at village/community level. Also, the agricultural policy should address the problem of excessive production through value addition by promotion of post harvest technologies (some farmers, in a public hearing, suggested setting up of dry port in Punjab for export of surplus grain).
- Developing better storage mechanism for crops especially at times of bumper harvests.

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
Promotion of Agro processing industry in Punjab			To be taken up with Industries Deptt.

9.3.5 Strategy:

Addressing IPR & trade related issues:

Action Plans:

Intellectual Property Rights & trade related issues in agriculture need to be looked into. For this, efforts be made to:

- Record genetic pure lines of species/varieties of important crops (especially wheat and rice) and project for identification and in-situ conservation of wild relatives of crop plants.
- Establish community seed banks and cultivar registry system to ensure IPR benefits to local farmers.
- Defend farmers rights to seeds, oppose the proposal for introduction of terminator genes and other IPR issues which do not respect contribution of farmers in development and identification/ propagation of locally adapted plant varieties.
- Take up literacy campaigns for farmers on farmers' rights, breeders' rights, plant variety protection, sui-genesis system, etc.
- On the issue regarding introduction of GMOs, the National Policy on GMOs should be followed in Punjab and all information on manipulation, transfer, risks and use of modified living organisms be mandatorily made public to allow local populations to accept/reject introduction of such organisms in their specific areas. Full and long term EIAs, and public

hearings, before introduction and use of GMOs should be mandatory. Further, monitoring of impact and movement of such organisms in the environment be assessed prior to introduction.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Arranging literacy campaign for farmers on farmer's rights, breeders' rights, plant variety protection, suigensin, system	Rs. 276 lacs	GOI & GOP	Project Proposal 30 Project be taken up jointly with PAU & PSCST
Establishment of community seed banks & cultivar regulatory systems to ensure IPR benefits to local farmers	Rs. 93.98 lacs for 5 years	PAU	Please refer para 9.18.2
Establishment of Govt. Seed Banks (PUNSEED)	Rs. 1.6 crores for 5 years		Project Proposal 31

9.3.6 Strategy:

Rejuvenation of land:

Action Plans:

- Due importance be given to the fallowing of land. For this, schemes for promoting land fallowing to restore soil health naturally be devised. One such scheme could be promotion of 'set aside' land scheme as in certain western countries. Appropriate financial packages for the same need to be devised.
- Cropping intensity needs to be decreased.
- Pastures need to be revised.
- Mulching of soil needs to be promoted.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Improvement of soil health in Punjab	Rs. 183 lacs for 3 years	GOP	Project Proposal32 The project is included in the state plan under 'Second Push to Punjab Agriculture'. Rs. 16.7 lacs were provided in 2001-02.

Promote use of straw reapers & rotavator for harvesting the straw for mixing in soil & left after cutting of wheat crop by harvest combines	Rs. 6 crores	GOP	Project Proposal 33 The project is included under 'Crop Demonstration Training Camps Extension of Improved Agric Machinery' Head of the state plan.

9.4 Strategy and Actions by Department of Animal Husbandry

Activities of this department are closely related to that of Agriculture because traditionally the farmers take up both, cropping and animal rearing practices. In an effort to introduce the white revolution and produce more meat and other animal products, wide scale hydridization experiments have been taken up in the state resulting in loss of desi varieties of domesticated animals which, at times, are perhaps better adapted to local stress conditions. The following actions are suggested:

9.4.1 Strategy:

Conservation of local breeds:

Action Points:

- Protection & propagation of desi breeds of domesticated animals as these are more tolerant to local stresses and for their potential use in future breeding programmes.
- Special emphasis on on-farm conservation of the threatened Nili Ravi breed of buffaloe (endemic to District Ferozpur), Beetal breed of goat (endemic to Distt. Gurdaspur) and Lohi breed of sheep (endemic in Punjab). This should involve collection of relevant information and a time bound programmes to increase their population. Appropriate economic and social incentives be defined by the Animal Husbandary Deptt. to promote this.
- Presently systematic records of animal populations and breeds are maintained in some organized farms only. These do not include inventories of animals in their breeding tract reared by farming community

or some 'goshalas'. Hence, a project for systematic breed survey, information on geographic and demographic population distribution, genetic evaluation, performance traits, socio-economic levels of breeders, agro climatic conditions of the breeding tract and management practices be taken up. Further, superior germ plasm and rare variants of threatened breeds be identified and strategy for in-situ and ex-situ conservation of these breeds be formulated.

- Setting up in-situ breed conservation centers and support breeders' association.
- Publishing of breed wise information and its importance for awareness of local public and farmers.
- Adoption of practices that support the sustainable development of livestock population.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Identification of Nodal Biodiversity Officer in the Deptt.	Nil	-	Immediate. An existing senior officer be designated to coordinate biodiversity issues.
Conservation of threatened species of domesticated animals in Punjab	Rs. 200 lacs for 5 years	GOI	- Details need to be worked out. - Project in consultation with PSCST

9.5 Strategies and Actions by Department of Fisheries

Activities of this sector include the use of components of biodiversity for propagation of aquaculture. In an effort of bring about blue revolution in the state, several exotic species have been promoted to increase fish production without looking into the ecological impacts on the aquatic ecosystem and impact on native species. In order to minimize these impacts the following actions are proposed:

9.5.1 Strategy:

<u>Protection of fish fauna</u>

Action Plans:

The following actions are required within the time frame specified in brackets:

- Strict enforcement of ban on fishing in certain areas and in certain seasons in coordination with the wildlife deptt. (1 Year)
- Construction of fish ladders in all barrages & dams to ensure fish migration and inter departmental coordination between irrigation and fisheries department for conservation, maintenance of fish ladders (1 year).
- Interaction with local pollution control board and industries to make them aware of important waterways which provide habitat to fish and to seek their cooperation in protecting these water bodies from pollution (1 Year).
- Assessment of sand and concrete mining activities around water ways/river beds and action for their control to protect aquatic biodiversity (1 Year).

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Idnetification of Nodal Biodiversity Officer in the deptt.	Nil	--	Immediate. An existing senior officer be designated to coordinate biodiversity issues.
Action needs to be taken on all the above on priority (time frame indicated in bracket)	Details need to be worked out.	GOI & GOP	1 Year

9.5.2 Strategy:

Conservation of Native fish species

Action Plan:

- According priority for encouragement of native fish species instead of exotics and identification & phasing out of all exotics(e.g. *Oreochromis mosambicus, Ctenopharyngodon idella, Hypophthalmicthys molitrix, Cyprinus carpio var. communis,* etc.) which compete with the native varieties. Also, re-introduction of natives(e.g. *Labeo rohita, Labeo calbasu, Rita rita, Wallago attu, Channa punctatus, Aorichthys seenghala,* etc.) (2-5 Years).

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Study of impact of Exotic species on Native species in the natural waters of the State	Rs. 10 lacs for 2 years	GOI	2-5 Years Project Proposal 34

9.6 Strategy and Actions by Department of Horticulture

Activities of this department are closely related to those of the department of Agriculture. Hence, all actions need to be coordinated with those of the Agriculture Department:

9.6.1 Strategy:

Conservation of native horticultural species

Action Plans:

- Assessment of fruit & vegetable varieties traditionally maintained by women in rural areas for household use (1Year).
- Promotion of traditional leguminous green vegetables (eg. Various types of beans to replenish soil health and their mixed culture with cereals and other major crops) (1 Year).
- Assessment of existing native/desi varieties of fruits and vegetables (especially mango – several varieties of desi mangoes existed in districts Ropar, Nawanshahar, Hoshiarpur & Gurdaspur. The diversity of cucurbits is also high) (2-5 Years).
- Re-introduction of desi varieties along with hybrid/grafted varieties (2-5 Years).
- Promotion of kitchen gardens (1 Year).

Specific Action Projects:

Action needs to be initiated on all issues listed above in a time frame specified within brackets besides the actions listed below:

Name	Funds required	Funding agency	Priority/Remarks
Strengthening biological diversity in Govt. Garden, Bara Dari, Patiala, Camarabagh, Kapurthala,	Rs. 30 lacs (Rs. 10 lacs for each garden) for 10	GOI	Submitted already Project Proposal 35

Aam Khas Bagh, Sirhind (Fetehgarh Sahib)	to 20 years		
Identification of Nodal Officer for biodiversity	--	--	Immediate. Out of exisiting staff

9.7 Strategies and Actions by Department of Industries

The interaction of this sector with biodiversity conservation is broad and varied due to its varied range of activities. This sector has some negative effects on biodiversity especially due to its high impact infrastructure, pollution of air, water & soil (especially introduction of non-biodegradable synthetic chemicals), irreversible change in land use, high energy consumption, scant reuse and recycling of wastes and climate change. Further, the activity of certain industrial sectors is based on utilization of biodiversity. Hence, in such cases the starting point should be conservation and rational use of such components. In Punjab industries like pulp and paper, leather, textiles, food processing industries (e.g. rice shellers, sugar mills, flour mills, etc.) and tannery units are based on bioresources and directly impact their conservation. Other industries have an indirect impact on biodiversity of the state.

The Industries Deptt. can play a pro-active role in taking up these issues with respective industries through their industrial associations and in regulating environmentally detrimental activities through appropriate policies & action. The important actions proposed are:

9.7.1 Strategy:

Assessment of bioresource utilization in Industrial sector

Action Plans:

- Identification & inventorisation of all biodiversity based/related industries in the state.
- Assessment of bio-resource availability and utilization (including economic assessment of resource utilization).
- Adoption of fiscal measures to generate revenue from biodiversity based industries.

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
Project for inventorisation of industries consuming bioresources in Punjab	Rs. 40.04 lacs for 1 year	GOP	1 Year Project Proposal 36

9.7.2 Strategy:

Promotion of environment and biodiversity conservation

Action Plans:

The following actions need to be promoted, time frame for which is indicated in brackets.

- Promotion of resource efficient and low waste technologies. (Action in this regard has already been initiated through setting up of Consultancy Cell in Punjab State Council for Science & Technology and Punjab Cleaner Production Centre (PCPC) to promote LWNW technology) (5-10 Years).
- Promotion of both, persuasive and punitive approach for motivation of industries and facilitation for pollution control. Persuasive action is being taken by PCPC & punitive by PPCB.
- Regular training of managerial and work staff on environment and biodiversity issues. The deptt. has desired that Punjab State Council for Science & Technology may conduct regular training programmes. (2-5 Years)

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Technical Assistance to support the successful execution of Punjab Cleaner production Centre in Punjab	US$ 1,48,910 for 2 years	Project already submitted to GOI & UNIDO	Immediate Project Proposal 37

9.7.3 Strategy:

Ensuring coverage of biodiversity issues in EIA

Action Plans:

The following actions are proposed:

- Adoption and instrumentalisation of pre-project and post-project EIA. Help of environment department be taken in the process. Site clearance

for industrial projects is given by Competent State Authority-cum-site appraisal committee & clearance to install & operate is given by Punjab Pollution Control Board. The CSA may ensure EIA at all appropriate levels and a biodiversity expert be included in CSA.

- Allowing restricted access to bioresources used commercially and special tax on biodiversity based enterprise. The funds thus generated can be pumped back for conservation of these bioresources as well as towards royalty sharing with locals.

Specific Action Point:

Name	Funds required	Funding agency	Priority/Remarks
Notification of biodiversity expert in CSA	Nil	--	Immediate

9.8 Strategy and Actions by Department of Commerce & Trade

Though this sector cuts across many other sectors already dealt with, it has its own functions which may have repercussions on biodiversity e.g. the demand of certain products can lead to imbalance between production and use of renewable resources. The following actions need to be taken up:

9.8.1 Strategy

Promotion of sustainable resource use:

Action Plans:

- To define stakeholders and ensure equitable benefit sharing by local communities for the resources derived from their area.
- To regulate access of corporate business/industrial houses to natural resources of an area and ensure that IPR benefits rest with the state and its people.
- To ensure sustainable use of renewable resources by market regulations
- To effectively curb trade in threatened species and poaching induced by high market prices.

Specific Action Points:

Name	Funds required	Funding agency	Priority/Remarks
Consultative meetings with Deptt. of Environment, Forest & Wildlife, Agriculture, Industries, etc.	Nil	--	Meetings need to be preceeded by orientation programs for biodiversity awareness. To be linked to para 9.1.3

9.9 Strategies and Actions by Department Of Irrigation And Power

The department has a direct impact on biodiversity, its conservation and sustainable use due to the fact that water itself is the habitat for a wide variety of flora and fauna. The policies and actions of this department, therefore, cut across several other departments. Hence, the need of integrated planning and sustainable use of water resources. The following strategies need to be adopted:

9.9.1 Strategy:

Conservation of aquatic ecosystems

Action Plans:

- In view of the extensive system of irrigation and drainage canals in Punjab, a comprehensive water use plan needs to be developed for the state. This plan may specify an appropriate water pricing system for agricultural, industrial and municipal use.
- Since aquatic ecosystems are greatly affected by alterations in water courses, all water related projects need to be carefully evaluated for their impact on biodiversity and planned accordingly. Though invertebrates, micro flora and microorganism have, in general, scarcely been considered as something liable to be studied or conserved, many of these are important species which regulate ecosystem dynamics and warrant conservation. The deptt. has expressed its lack of expertise in this field. Hence, interdepartmental consultation with deptt. of environment and biodiversity experts needs to be facilitated besides promotion of training to the departmental staff.

- The impact of large dams, irrigation canals and drains on the biodiversity be studied. This would include an assessment of the effect of barrages, reservoirs and low water flow in the rivers during summer months on the biodiversity of an area. Further, minimum flow of water in downstream areas be ensured through appropriate policy for the same. An interstate river basin authority be set up in consultation with neighbouring states to address this issue. This authority can also address the issue of protection of catchment areas of dams and control of aquatic weeds like water hyacinth. Organisations like Bhakra Beas Management Board may also be involved.
- Non-point pollution in aquatic bodies may be appropriately controlled with cooperation of Deptt. of Agriculture.
- In certain areas ponds and wetlands are being drained and filled up to use the land for farming and /or town planning. This is affecting local drainage system and natural ecology. Strict action needs to be taken to reverse this trend.
- Gravel and sand extraction from river basins needs to be checked as it damages local biodiversity.
- Construction of Rain water harvesting structures and development of micro water sheds needs to be further promoted. This will also promote wild flora and fauna.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Preparation of a comprehensive water use policy and action plan to minimize impact of activities of irrigation deptt. on bioresources of the state.	Nil	--	Action be taken up in consultation with Ministry of Water resources. GOI
Identification of Nodal Biodiversity Officer	Nil	--	Immediate.
Setting up of Interstate River basin Authority	Nil		Action be taken up in consultation with Ministry of Water resources. GOI & respective State Govts.
Inter-departmental meetings with Deptt. of Agriculture, GOP to minimize non point pollution	Nil	--	PPCB may also be involved

EIA for large dams & Irrigation canals	Rs. 2 crores for 2 years	GOI	Action be taken jointly with PSCST and PRSC. Details need to be worked out.
Training of personnel on biodiversity issues	Details to be worked out		To be clubbed with 9.1.3

9.9.2 Strategy:

Environmentally sound development of energy resources.

Action Plans:

- Emphasis on microhydel projects instead of large dams.
- Developing good practices for energy production & transmission.
- Promoting technologies/practices contributing to energy conservation.
- Promoting renewable energy sources.
- Developing biodiversity indicators and integrating them into EIA, clearance & siting procedures, etc.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Promotion of microhydel & renewable energy sources	Action already being taken	---	Punjab Irrigation Deptt. & Punjab Energy Development Agency are the nodal deptts. for microhydel & renewable energy dev. respectively.

9.10 Strategies and Actions by Health Department

This sector is related with biodiversity especially with respect to use of medicinal plants in the pharmaceutical sector and the health impacts of release of genetically modified organisms. Several medicines are derived from nature in traditional societies. The pharmaceutical industry has currently indicated a lot of interest in traditional medicinal knowledge systems, herbal medicines and cosmetics resulting in their commercial utilization. Hence, the need to ensure that these plant and animal resources are used sustainably (especially those with limited distribution).

Besides, the health sector also releases untreated/partially treated dangerous wastes into the environment including pathogenic micro organisms, radio active products and genetically modified organisms which are a potential risk to existing bioresources. . The department, therefore, needs to take up appropriate actions.

9.10.1 Strategy:

Assessment and conservation of medicinal bioresources

Action Plans:

- Inventorisation of existing medicinal bioresources of the state and assessment of their availability/rarity.
- Documentation of medicinal value of these resources linked to various diseases and developing scientific basis/proofs for known facts to ensure IPR rights to local practitioners.
- Encouraging ayurvedic, homeopathic & other traditional systems of medicine by providing benefits and opportunities to practitioners of these systems at par with allopathic doctors.
- Strengthening of pharmacy departments in universities and polytechnics and linking them to biodiversity conservation and sustainable use issues.
- Joint studies/R&D programmes to link traditional systems of medicine with allopathic system to provide it a strong scientific base.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
A Vanaspati Van Yojna be initiated to ensure supply of raw drugs.	To be worked out	GOI	3-5 Years
Mobile ayurevedic & homeopatheic dispensaries be set up.	- do-	GOP	3-5 Years
Atleast one state drug testing lab and 4 R & D Centres be set up at divisional level to assess the medicinal properties of some existing biodiversity resources	- do -	GOP	5-10 Years

9.10.2 Strategy:

Appropriate treatment of medicinal wastes prior to their release into the environment to ensure ecosystem protection.

Action Plans:

Strict implementation of Medical Waste Rules notified by the Government of India to ensure treatment of medical waste (at present these rules are hardly being implemented in the state).

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Development/Promotion of appropriate waste treatment technologies (especially incineration of hazardous and infectious medical wastes).	To be worked out.		Some action has already been initiated.

9.11 Strategies and Actions by Department of Town and Country Planning

9.11.1 Strategy:

Defining biodiversity sensitive land use plans

Action Plan:

The department can play a major role with regard to biodiversity conservation as it is responsible for designing land use plans in the state (especially identifying industrial areas). The following actions can be taken up :

- Identification and notification of prime agricultural lands and forest lands and ban on their diversion (in association with Deptt. of Agriculture & Forests and Wildlife).
- Control on unregulated urban development and defining plans for conservation of peri urban areas.
- Identification of biologically important areas and specifying industrial zones away from such areas.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Promotion of interdepartmental consultations & Identification of Nodal Biodiversity Officer	Nil	--	Immediate

Training of personnel on biodiversity issues	To be clubbed with 9.1.3	--	1-3 Years

9.12 Strategies & Actions by Department of Rural Development & Panchayats

Rural communities have been closer to nature and have traditionally protected biodiversity. They are still the highest repositories of information on local biodiversity and its use. However, increased materialization, westernization of society and economic considerations are taking their toll on the rural environment. The Department needs to take up the following activities:

9.12.1 Strategy:

Conservation of biodiversity in rural areas

Action Plans:

The following actions need to be taken up:

- Special emphasis on protection of common property resources and community conserved areas in/around villages.
- Promotion of biogas and fuelwood plantations around villages to ensure availability of fuelwood to decrease dependence of rural communities on forest resources.
- Initiation of water shed management, soil conservation and biodiversity conservation projects in collaboration with the community.
- Prevention of sand and gravel mining around villages/water bodies with cooperation of local residents.
- Specific training programmes for panchayats, women, farmers and the public at large for environmental and biodiversity conservation.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Study of community conserved areas	To be clubbed with 9.1.4	GOI	1-3 Years
Promotion of watershed management projects with community participation		--	Action has already been initiated
Identification of Nodal Biodiversity Officer at States H/Qs & Capacity building of	To be clubbed with 9.1.3 and 9.1.4		1-3 Years

NGOs and Panchayats for natural resource conservation in Punjab			

9.12.2 Strategy:

Conservation of traditional knowledge systems

Acton Plan:

This can be achieved by:

- Inventorisation of existing knowledge and culture.
- Developing legally implementable guidelines for selective disclosure of such information.

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
Preparation of peoples' biodiversity registers. (In consultation with PSCST)	Details to be worked out	GOI	3-5 Years

9.13 Strategy & Actions by Department of Urban Development

9.13.1. Strategy:

Conservation of Urban biodiversity

Action Plans:

The urban areas not only encroach upon useful land, but also create several environmental problems (e.g. waste generation, pollution, etc.) which are transferred to peri urban areas with utter disregard to the effect these may have on quality of human and animal life in such areas. The department can, therefore, contribute towards biodiversity conservation as follows:

- Defining urban limits and ban on further proliferation of urban areas. Further, management of urban wastes within urban limits and not transferring them to peri urban areas.
- Promoting urban greening.
- Identifying and inventorising urban biodiversity and protecting areas of high biodiversity within urban limits (the Delhi Ridge and the Parakeet Sanctuary in Chandigarh are good examples).

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Projects to promote urban greening are already been taken up by GOI & GOP	Project based	GOI & GOP	Ongoing
Identification of Nodal Biodiversity Officer	Nil		

9.14 Strategy & Actions by Department of Transport

9.14.1 Strategy:

Control of Vehicular Pollution especially in biodiversity rich areas

Action Plans:

The transport sector has made great strides in the past three decades in the state. The communication network in Punjab is very strong and all villages of the state are linked by pucca roads. However, this has led to pollution, diversion of land for road construction and habitat fragmentation. To curb the menance of vehicular pollution some actions have already been initiated by the State Transport Deptt. which includes setting up of 187 Pollution Control Centers (PCC) to issue Pollution Under Control Certificates (PUC) under Central Motor Vehicles Rules, 1989. The department, However, needs to ensure the following:

- EIA of all major communication projects and ensuring compensatory forestry (though this will not restore original habitats it will atleast act as a buffer). Within 2-5 years
- Avoidance of roads and railways in areas of high biodiversity.
- Promotion of Pollution free/electrical vehicles in biodiversity rich zones. Specific Actions need to be defined .

9.15 Strategy & Actions by Department of Tourism

9.15.1 Strategy:

Promotion of eco tourism

Action Plans:

This is a very important sector with respect to conservation and use of biodiversity. On one hand, its conventional development has usually entailed important alterations to biodiversity, while, on the other hand, over the last two

decades, eco tourism, nature tourism and adventure tourism has been propagated the world over, which is based on using the economic potential of some components of biodiversity and has become globally important. The actions required include:

- Promotion of recreational features like, parks & nature trails in the country side and in the buffer zones of areas of ecological importance to help people come closer to nature, but, at the same time, ensuring regulation of those activities which can have an adverse impact on biodiversity e.g. waste generation, overuse of biological and water resources, control of vehicular pollution, regulation of construction activities, especially high impact infrastructure, etc.
- Dissemination of biodiversity information through interpretation programmes.
- Regulation of activities which effect biodiversity in all tourist centers (whether directly related to biodiversity or not).

Specific Action Project:

Name	Funds required	Funding agency	Priority/ Remarks
Establishment of Eco- tourism cell and identification of Nodal Biodiversity Officer at state H/Qs	200 lacs for 2 years	GOI	To be set up consultation with Deptts. of Environment and Forests & Wildlife Project Proposal 21

9.16 Strategies & Actions by Department of Education

Education and awareness play an important role in promoting knowledge, moulding attitudes and developing necessary skills for biodiversity conservation. The department (both, at school and higher education level) can, therefore play a very important role in promoting and preserving biodiversity in the state. The major strategies are:

9.16.1 Strategy:

Greening of Syllabii

Action Plans:

- To promote biodiversity education at school level the Education Deptt., through School Education Board, may take up action for modifications in existing syllabii by introducing environment and biodiversity issues related to

conservation and sustainable use. Local examples may be incorporated. The content and class/stage where such issues need to be incorporated be decided through brain storming meetings/workshops jointly with department of Environment.

- Similar action be taken up a higher educational level also.

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
A major project has been initiated by Ministry of HRD and MoEF for Greening of Syllabus at School level. Middle school text books have been greened and field tests are being conducted	Rs. 70 lacs for 1 Year	GOI	Action already initiated

19.16.2 Strategy:

Promotion of nonformal biodiversity education through practical/participatory approach

Action Plans:

- Promotion of field work & projects related to biodiversity.
- Involving children in plantation work in school premises/neighbourhood, developing tree nurseries with the help of local forest officials and study of local ecosystems.
- Assigning separate funds for developing/procuring activity books.
- Promotion of non-formal Environment Education activities.

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
Promotion of formal & non-formal biodiversity education in schools - Green surroundings - Gifts of Nature - Funds for developing special activity books for high school and senior secondary schools - Funds for printing of activity books for libraries of all senior	Rs. 69 lacs for 1 year	GOI	2-5 Years Project Proposal 38

secondary schools and high schools (approx. books= 6000) - Funds for procuring general biodiversity books for libraries of 1300 senior secondary schools & 1750 high schools @ Rs. 2000/- per school.			

9.17 Strategies & Actions by Universities and R&D institutions

University education acts as a link between school education and adult life. It prepares students for future action as a potential workforce. Hence, inculcation of appropriate attitudes and skills at this stage will lead to better implementation of developmental projects in future. Important strategies include:

9.17.1 Strategy:

Education/Awareness of biodiversity related issues

Action Plans:

Priority actions along with requisite time frame (in brackets) are deleniated below:

- Implementation of UGC guidelines for introduction of compulsory environment education course at undergraduate level (1 year).
- Promotion of action oriented conservation projects by youth (especially involving NSS volunteers) especially those involving local communities including understanding of traditional community systems (2-5 years).
- Creation of awareness on Intellectual Property Rights amongst the research fraternity (Immediate).
- Close cooperation with the government departments to provide a scientific basis to government policies and action programmes (Immediate).
- Publication of scientific information in popular magazines and newspapers (and not just in scientific journals) to take the benefits of research to the grass roots (On going).
- Special training programmes for own staff as well as staff of other departments (On going).

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
- As per Supreme court orders environment education course has already been initiated in some universities and efforts are being made in others to introduce the same.	Details being worked out	GOI/UGC	Immediate
- Training/ Awareness programme on IPR	Project based	DST-GOI (Through TIFAC and PIC-PSCST)	One awareness programme each for all the four universities have already been conducted by PSCST

9.17.2 Strategy:

Promotion of R & D

Action Plans:

- Promotion of inter-departmental projects for assessment of bioresources of the state – both, wild & domesticated, especially on plant and animal groups where information is lacking or scanty. (2-5 years)
- R&D projects for assessment of existing habitats and their current status of protection/degradation and identification of mitigation measures. (2-5 years)
- Promotion of R&D in pharmaceutical sciences. (2-5 years)

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
-Biodiversity of Dermoptera (Earwigs) and Dictyoptera (Cockroaches & Mantids) of Punjab with particular reference to Shivalik Region	Rs. 1.6 lacs for 2 years	GOI	To be clubbed with 9.1.2 Project Proposal 39
- Systematics of the Aquatic and Terrestrial Arthropod fauna of Wetlands of Punjab (India)	Rs. 62.80 lacs for 5-10 years	GOI	To be clubbed with 9.1.2 Project Proposal 40

9.18 Strategies & Actions by Punjab Agriculture University:

The Punjab Agriculture University, Ludhiana has played a major role in bringing about the green, white and blue revolutions in Punjab. However, in view of the ecological backlash of wide scale application of some of these activities, it has also initiated research in the fields of ecological farming, use of bio-fertilizer and bio-pesticides, integrated pest management, marketability of crops, etc. The university can therefore, also play a very important role in biodiversity conservation in the state.

9.18.1 Strategy:

Infusing biodiversity issues in agricultural education

Action Plans:

- To sensitize future farmers to adopt biodiversity based agricultural practices it is important that issues related to biodiversity in agriculture & its conservation be included in the curriculum of all departments.
- Specific field projects for promotion of biologically diverse agriculture & animal husbandry, bio-fertilizers, bio-pesticides, green manuring, organic manuring and integrated pest management need to be taken up.
- Also the Universities needs to generate and disseminate information in the area of biodiversity by organizing seminars/symposia/kisan melas, etc. through its extension education department & through Krishi Vigyan Kendras.

Specific Action Projects:

Name	Funds required	Funding agency	Priority/Remarks
Review and modification of existing syllabi of all Deptts. to make them sensitive towards biodiversity issues.	Nil	--	Immediate
To promote R & D related to agriculture biodiversity	Rs. 152 lacs for 5 years	GOI	3-5 years Project Proposal 41

9.18.2: Strategy:

Conservation of Agricultural Biodiversity

Action Plans:

- Assisting the state government in modifying the state agriculture policy by incorporating an environmental/ecological content.
- To maintain germ plasm of indigenous varieties/breeds.

- To take up specific training programmes for farmers, women & panchayats on the issue of agricultural biodiversity.

Specific Action Project:

Name	Funds required	Funding agency	Priority/Remarks
Establishment of community seed bank and cultivar regulatory system to ensure IPR benefits to local farmers	Rs. 93.98 lacs for 5 years	GOI	5-10 Years Project Proposal 42

9.19 Role of Armed Forces

The Armed Forces can play a major role in protecting the biodiversity within and outside areas under their jurisdiction. An eco task force has already been established. The following actions can be taken up:

- Promotion of biodiversity conservation within army areas with help of experts from Department of Forests, Deptt. of Environment and Academicians.
- Collaboration with local government departments and communities for specific pilot projects on biodiversity conservation.
- Awareness projects with army personnel and local communities.

9.20 Role of NGOs, Farmer Groups and Masses

No conservation programmes can be successful without the active participation of people. People can be both, protectors & destroyers of the environment and their perceptions and priorities can play an important role in the success of any conservation effort.

NGOs, community based organizations and farmer groups can work as active partners of the government in achieving this objective. They are nearer to the grassroots, understand local problems & priorities better and are able to communicate in a more effective way. The following actions can be taken up:

- NGOs may equip themselves with necessary information through interaction with experts, researchers and government bodies while simultaneously building up understanding of local knowledge systems and priorities.
- They need to participate in all resource planning activities in these areas and actively take up locale specific projects with the concerned government

departments. Since a lot of NGOs are self reliant and at times, have better technical skills than government personnel, they need to share their expertise with government departments.

- NGOs should prepare locally relevant awareness materials and discuss local issues with the masses in public camps/workshops and through A/V means. They can also play an important role in mobilizing people & children and spur them into action for biodiversity protection.
- Under EPA, 1986 it is mandatory to hold public hearings for EIA of large projects. The relevant documents are usually available with the local district authorities and the notice of public hearings is issued in newspapers. It has been observed that NGOs seldom participate in such public hearings but raise their concerns on specific projects later on. This needs to be improved as usually this is the best time to vouch for/oppose a project.
- The public can resort to PILs wherever required.
- There should be a special emphasis on understanding womens' view points regarding biodiversity conservation and addressing their specific needs.

9.21 Actions by Religious & Cultural Groups

Religious groups play an important role in promoting mass awareness and action. The NGOs could take up relevant issues in association with State nodal agency with local religious leaders who could influence public opinion on particular issues.

Similarly, the Deptt. of Culture and individual cultural groups may be involved in creating public awareness in public on biodiversity issues (several cultural groups like, 'The Punjab Sahitya Kala Manch', Ludhiana; Amritsar Natak Kala Kendra, Chandigarh, Bharat Jan Gyan Vigyan Jatha, etc. are already helping to translate specific concepts and promote environmental awareness through street theatre, debates & declamation in Punjab and can be used for creating awareness on biodiversity issues also).

9.22 Actions by Media

Last, but not the least, the most important contribution towards generating public awareness and moulding peoples' attitudes towards conservation issues can be made by the media. It can play a pro-active role by designing

programmes which reach out to a wide section of people (literates, neo-literates & illiterates). For this, it needs to:

- Equip itself with necessary information through interaction with experts, government bodies and the people at large and present a fair view of each section of society for public scrutiny. For this, interaction between State Public Relation Departments, local journalists and nodal agency may be promoted. Periodic media briefings by nodal agency on state biodiversity issues could be facilitated through this process.
- Publish/present relevant information and success stories for benefit of general public
- Take up special awareness drives on issues of common interest for both, children and masses.
- Environment and Biodiversity issues could be included in curricula of Deptt. of Journalism and Mass Communication in each University.
- Network of environmental journalists be established.
- The State may institute an award for environmental journalism.

The above strategies and suggested actions were discussed in the 2nd State Steering Committee meeting also and modified accordingly (Annexure-54). Comments of the public were invited through newspaper advertisements (Annexure-55a) & articles in the council's newsletter and Punjabi magazine 'Nirantar Soach' (Annexure-55b). Certain school teachers provided their comments in response to the same. Further, as per decision in the 2nd State Steering Committee meeting a sensitization workshop was organized for certain development departments of the Govt. of Punjab following which Action Plans of these deptts. were finalized. Proceedings of the sensitization workshop are placed at Annexure-56. The strategies and actions proposed above also reflect the concerns raised at the Northern Region meeting organized at Chandigarh from 18th to 20th October, 2001 for 8 States, 3 Eco-regions and 4 Sub-states sites (Annexure-57). This document has also been evaluated by experts and TPCG members and their comments incorporated (Annexure-58).

CHAPTER-X

OPERATIONAL IMPLEMENTATION OF THE ACTION PLANS & FOLLOW UP

The action plans specified in the strategy must not remain mere desirations, but must be implemented within specified time limits. It is proposed that implementation agencies may incorporate their own implementation schedules based on availability of financial, technical and human resources but these should be effective within the framework of the current strategy i.e. within 2020. The agencies may also identify and prioritize short term (5 years), medium term (10 years) and long term (20years) actions and discuss these at the next Steering Committee meeting.

Further, the participating departments must establish district level and local fora where proximity to the territory and socio-economic conditions will enable them to be more specific and help them identify action points within the broad framework of this document.

The following mechanism is proposed for proper operationlisation of these plans:

10.1 Actions at State level:

1. Establishing State Biodiversity Board with members from relevant departments. Presently, the Environment Division of the Punjab State Council for Science and Technology has been identified by the State Govt. as the nodal agency for biodiversity conservation and awareness programmes in the state. A state level Steering committee has also been notified. Till the Biodiversity Board is established the nodal agency, in consultation with the steering committee may coordinate with all participating departments to ensure incorporation of biodiversity issues in their departmental plans.
2. All relevant departments in consultation with the state nodal agency should also seek cross sectoral inputs for their departmental plans from other relevant departments. The state nodal agency should facilitate coordination, collaboration and exchange of information amongst various participating bodies.

3. The Nodal Agency/Board may ensure regular organization of State level steering committee meetings and seminars from time to time to monitor biodiversity initiatives by various departments, assess progress of action projects and their impact on biodiversity and incorporate mid term corrections wherever required.
4. It should facilitate organization of public hearings and training programmes for various departments/target groups to promote action for biodiversity conservation. For this, it should develop/establish training facilities for capacity building for the purpose.
5. To these ends, it is essential to have sufficient human, material and economic resources and appropriate budgets need to be allocated by central and state governments. Hence, the state nodal agency also needs to impress upon the state government the issue of provision of adequate funds, as well as, liase with the Central Ministry of Environment and Forests for provision of funds through national/international funding agencies.

For establishment of training facilities the MoEF, GOI should facilitate this by providing core support whereas specific training based funds could be obtained from the state government/ trainees, wherever possible

10.2 Actions at Departmental level:

1. Each participating agency may set up a technical unit/cell (with inhouse and external experts) to monitor the drawing up and implementation of sectoral plans. The unit's first mission should be to draw up its own work schedule & identify personnel required for detailed drafting of action projects.
2. Secondly, it should establish monitoring criteria and schedule to assess implementation of the plan.
3. The departmental technical units should also assess financial and capacity building requirements and take up the same with the government within their specific departmental level as well as with the nodal agency.

CHAPTER-XI

PROJECT PROPOSALS BY KEY PARTICIPATING DEPARTMENTS/INSTITUTIONS

Project Proposal-1

1.	Name of Project	:	**Strengthening of State Nodal Department (PSCST) for Biodiversity (within the aegis of State Department of Science, Technology & Environment**
2.	Strategy addressed	:	Creation of nodal department (9.1.1)
3.	Implementing Agency	:	Punjab State Council for Science & Technology
4.	Purpose	:	- To facilitate inter & intra governmental coordination - Promotion of policies & schemes which link wild & domesticated biodiversity elements - Inclusion of biodiversity conservation criteria in all developmental programmes - Promotion of policies that ensure that the degree of use of a resource remains at a sustainable level and does not exceed natural renewal rate.
5.	Brief description	:	A nodal officer or Director (Biodiversity) with scientific, technical & support staff be appointed/designated
6.	Time frame	:	5 years
7.	Other Departments involved	:	State Department of Science, Technology & Environment
8.	Resources available	:	Infrastructure of PSCST is available. The same can be further augmented. Some scientific staff is also available.
9.	Additional resources required, if any (including funds)	:	Rs. 100 lacs for 5 years towards salaries of additional staff & infrastructure.
10.	Expected benefits	:	The nodal officer and his staff will help to promote inter departmental coordination for biodiversity conservation, help develop a data bank, take up capacity building

programs and promote biodiversity awareness, education and R&D. Conflict resolution if any between various departments would also be facilitated.

11. Any other comments : - A biodiversity Authority would be required to be constituted once the Biodiversity Bill is passed by the Parliament. PSCST can function as the State Biodiversity Authority at this event.
- A separate Biodiversity department has already been set up in Madhya Pradesh

Project Proposal-2

1.	Name of Project	:	**Development of data bank on existing biodiversity in the state and recording the change in wild & domesticated diversity overtime**
2.	Strategy addressed	:	Preparation of State level data base for wild & domesticated biodiversity & traditional knowledge systems
3.	Implementing Agency	:	Punjab State Council for Science & Technology
4.	Purpose	:	- To assess the status of existing bioresources - Integration of sustainable use of these resources in various production sectors - Information dissemination
5.	Brief description	:	Existing bioresources of Punjab will be inventorized, keystone species, rare & endangered species identified and population status will be studied. Gaps in information will also be worked out and R&D projects will be promoted accordingly.
6.	Time frame	:	5 years
7.	Other Departments involved	:	All State universities, Department of Forests & Wildlife, Agriculture, Fisheries and BSI, ZSI, IIRS, NBPGR, NBAGR, etc.
8.	Resources available	:	Existing staff & infrastructure of the above departments will be used
9.	Additional resources required, if any (including funds)	:	Rs. 100 lacs for 5 years initially for inventorisation and R&D studies.
10.	Expected benefits	:	Documentation of states' bioresources & formulation of strategies for their conservation & sustainable utilization.

Project Proposal-3

1.	Name of Project	:	**Centre for Training in Biodiversity**
2.	Strategy addressed	:	Capacity building for biodiversity conservation & incorporation of biodiversity issues in formal & non-formal education.
3.	Implementing Agency	:	Punjab State Council for Science & Technology
4.	Purpose	:	To conduct training programme on biodiversity for all sectors of society. To help link biodiversity issues with livelihood issues and promote appropriate environment education programs.
5.	Brief description	:	The center would conduct trainings (one day to one month programs) for various target groups like govt. department, industry, NGOs, teachers & students, etc. on issues related to biodiversity conservation. The center will have certain core staff. Specialized topics for training would be taken up with the help of guest faculty.
6.	Time frame	:	The center will be fully operational in 3 years and will be made self sufficient through course fee.
7.	Other Departments involved	:	Nil
8.	Resources available	:	PSCST infrastructure & staff
9.	Additional resources required, if any (including funds)	:	Rs. 300 lacs for 3 years for various training programs.
10.	Expected benefits	:	It will help to sensitize personnel from govt. departments, industry, NGOs, teachers, etc. to biodiversity issues & help promote biodiversity conservation. It will lead to capacity building of biodiversity cells/officers proposed to be set up in each department to ensure ecologically sound planning in state.

Project Proposal-4

1.	Name of Project	:	**Setting up of Environment Education Centres in biodiversity rich/ecologically important sites**
2.	Strategy addressed	:	Capacity building for biodiversity conservation & incorporation of biodiversity issues in formal and non-formal education
3.	Implementing Agency	:	Punjab State Council for Science & Technology, Deptt. of Forests & Wildlife and NGOs
4.	Purpose	:	To provide information to general public on biodiversity issues To promote non-formal biodiversity education amongst children, NGOs & masses.
5.	Brief description	:	Education centers would be set up in hired/govt. provided infrastructure. The centers will have audio visual facilities, activity books, charts, posters & models for exposure to general public & children on biodiversity issues. It is proposed to set up 3 centers at 3 places in the first phase. A small ticket would be put on these facilities to make them partially self sustaining.
6.	Time frame	:	Rs. 100 lacs per center for 2 years initially.
7.	Other Departments involved	:	Department of Forests & Wildlife, Centre for Environment Education, NGOs, District Administration
8.	Resources available	:	Nil
9.	Additional resources required, if any (including funds)	:	Rs. 300 lacs
10.	Expected benefits	:	The centers will attract tourists / visitors to these sites and sensitize them on issues related to biodiversity and make them conscious of their responsibilities towards biodiversity conservation.

Project Proposal-5

1.	Name of Project	:	**Development of locale specific biodiversity literature**
2.	Strategy addressed	:	Capacity building for biodiversity conservation & incorporation of biodiversity issues in formal & non-formal education
3.	Implementing Agency	:	Punjab State Council for Science & Technology
4.	Purpose	:	To create biodiversity awareness amongst students
5.	Brief description	:	Posters and pamphlets/booklets on importance of biodiversity, its role in the ecosystem, uses of bioresources and their conservation will be published and distributed to schools & colleges in Punjab. The literature will be in Punjabi to reach out to rural schools & colleges also. 20,000 posters & pamphlets @Rs. 50/- will be published & distributed.
6.	Time frame	:	6 months to 1 year
7.	Other Departments involved	:	Department of Education (for dissemination)
8.	Resources available	:	Nil
9.	Additional resources required, if any (including funds)	:	Rs. 10 lacs
10.	Expected benefits	:	The literature will be provided to the schools for display & use in library and will be accessible to students. It will help to create awareness on importance of biodiversity conservation.

Project Proposal-6

1.	Name of Project	:	**Project on Community Conserved Area in Punjab**
2.	Strategy addressed	:	Fostering public participation in biodiversity conservation
3.	Implementing Agency	:	Punjab State Council for Science & Technology
4.	Purpose	:	To identify community conserved areas in Punjab and to assess their current status
5.	Brief description	:	Punjab has a very good tradition of community conserved areas like, Bishnois in Abohar and the Gaddis & Gujjars in Gurdaspur. However, these traditions are deteriorating with time. The project will help to identify similar other such pockets of community conserved areas and recorded factors which motivate communities to take up conservation activities. It will also help to identify the benefits which these communities are entitled to as rewards for their efforts for conservation to ensure equitable benefit sharing.
6.	Time frame	:	2 years
7.	Other Departments involved	:	NGOs
8.	Resources available	:	Nil
9.	Additional resources required, if any (including funds)	:	Rs. 11 lacs
10.	Expected benefits	:	The project will help to motivate other communities to participate in biodiversity conservation efforts. It will also motivate them to participate in planning, implementation and monitoring of developmental programmes in the state.

Project Proposal-7

1	Name of Project	:	**Establishment of Biodiversity Cell (Wildlife)**
2	Strategy addressed	:	Strengthening Forest Department for augmenting wild biodiversity resources.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To make the facility as model cell for all the information in Wildlife Biodiversity. Also to make the cell interact with other cells - nationally & internationally.
5	Brief description	:	Suitable officer/official will be posted in the cell. Lateral co-operation for NGOs/other Deptt. will be taken. Experts on contract/deputation will be also be inducted.
6	Time frame	:	Within one year.
7	Other Departments Involved.	:	Not applicable.
8	Resources available	:	Nil
9	Additional resources required, if any (including funds)	:	- Adequate manpower. - Adequate infrastructure facilities. - Training for HRD. - Funds: Rs. 2 crores.
10	Expected benefits	:	Since the biodiversity cell will be the model cell for interaction with other cell nationally & internationally it establishment will help to achieve the various objectives of biodiversity conservation.
11	Any other comment	:	--

Project Proposal-8

1	Name of Project	:	**Training wildlife Managers.**
2	Strategy addressed	:	- Strengthening Forest Department for augmenting forest resources. - Identification of trainers/training institutes.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To enhance the Wildlife Management skills.
5	Brief description	:	The staff needing training will be identified and will be categorized for different levels of training. Training institutes will be contacted to train the officers/officials.
6	Time frame	:	It will be a continuous process.
7	Other Departments Involved	:	Wildlife institutions/State Universities.
8	Resources available	:	Not applicable.
9	Additional resources required, if any (including funds)	:	Funds : Rs. 20 lacs.
10	Expected benefits	:	It enhances the management capabilities.
11	Any other comments	:	The Government cannot afford to leg behind is training the wildlife managers since it may lead to habitat deterioration resulting into ecologoical imbalance causing devastating effects on society.

Project Proposal-9

1.	Name of Project	:	**Habitat improvement in Protected Area.**
2.	Strategy addressed	:	In-situ conservation of wild diversity. Identification of food sink/deficit zones in PA's. Identification of causes for encroachment and find out strategy to eliminate the same.
3.	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4.	Purpose	:	To improve and conserve the existing habitat in PAs.
5.	Brief description	:	Identified species beneficial to wildlife will be planted in PA's. Encroachments if any be removed and area be demarcated and fenced. The principle theme will be to provide food, water and shelter to wild animals.
6.	Time frame	:	It will be carried out every year because it is a continuing process.
7.	Other Departments involved	:	Department of Police and Revenue.
8.	Resources available	:	Nil
9.	Additional resources required, if any (including funds)	:	- Machinery: Tractors gypsy, electric motor, engine, tanker etc. - Materials: Seeds, fertilizers, tools, oils & lubricants etc. - Funds: Rs. One Hundred Lac.
10.	Expected benefits	:	a) Ecological balance. b) Education and awareness. c) Reducing man-animal conflict. d) Intangible benefits to whole society.
11.	Any other comments	:	The project will be essential for biodiversity conservation in the State.

Project Proposal-10

1	Name of Project	:	**Preparation of Management Plans.**
2	Strategy addressed	:	- In-situ conservation of wild diversity. - Survey and inventorization of resources in the PA's. - Preparation of Data base. - Analysis of data to propose prescriptions for the future.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	Management of PA's is very technical and sensitive job. Any decision based on unauthenticated and wrong information may prove to be havoc and that is why MOE&F has made it mandatory for preparation of Management Plans of all PA's.
5	Brief description	:	Detailed survey and inventories of natural resources existing in the PA's will be made. The past system of management will be reviewed and future strategy will be formulated on the basis of past experience and analysis of data.
6	Time frame	:	Management Plans will be prepared for every ten years and reviewed after every five years.
7	Other Departments involved.	:	Not applicable
8	Resources available	:	Technical/trained personnel available.
9	Additional resources required, if any (including funds).	:	Computer, scanner, camera and related office stationery trained computer data entry operator and Analysis.
10	Expected benefits	:	Scientific management of PA's leading to improvement in the biodiversity.
11	Any other comments	:	Management Plans are supposed to be "Bible" for the management of PA's. Their preparation is of utmost importance.

Project Proposal-11

1	Name of Project	:	**Census operation of wild animals in the State.**
2	Strategy addressed	:	- In-situ conservation of wild diversity by identification of key species and their grouping viz. rare, threatened. - To develop methodology for census of key species. - To determine the interrelationship between species and environment.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	- To prepare data bank of wildlife Biodiversity in the State. - To facilitate culling decision.
5	Brief description	:	- The census data will be collected by conducting field exercises in the State. The data will be compiled, analysed and evaluated to determine the change in population from time to time.
6	Time frame	:	The census operation will be carried out as per the requirements and need of management.
7	Other Departments Involved.	:	Not applicable.
8	Resources available	:	Trained personnel
9	Additional resources required, if any nets (Including funds)	:	- Manpower. - Computer, stationery, campus, pencils, ropes, etc. - Rs. 30 lacs.
10	Expected benefits	:	- To facilitate sustainable use of natural resource. - To facilitate scientific management. - To facilitate culling decision.
11	Any other comments	:	The census is one of the most important Management practices for better Management of PA's.

Project Proposal-12

1	Name of Project	:	**Establishment of GIS/MIS labs.**
2	Strategy addressed	:	In-situ conservation of wild diversity through GIS technology.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	Putting Wildlife Biodiversity data on GIS will be helpful in management decision. Also GIS/MIS facility will facilitate in identification and detection of crimes viz encroachment and illegal operation.
5	Brief description	:	The geographical data as well as statistical data will be fed and will be given the shape of layers. The officer/official will be trained to use relevant software and generation of reports.
6	Time frame	:	Within two years.
7	Other Departments Involved	:	Not applicable.
8	Resources available	:	Nil.
9	Additional resources required, if any (including funds):	:	- Computers, Telephone, Software etc. - Trained manpower, computer programmer. - Funds : Rs. 50 lacs.
10	Expected benefits	:	Management decision based on integrated approach can be taken. Which will help in improving the status of wildlife diversity in the State.
11	Any other comments	:	--

Project Proposal-13

1	Name of Project	:	**Establishment of Breeding centers for rare and threatened species.**
2	Strategy addressed	:	Ex-situ conservation of wild diversity
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	Preservation and proliferation of rare and threatened species.
5	Brief description	:	- The rare and threatened species will be captured from wild and will be bred at suitable breeding centers. A germplasm bank will be established. The bred species will be reintroduced in suitable habitat. The project will help in: - Identification of rare and threatened species of birds and mammals. - Study their nutritional requirements and habitat characteristics. - Selection of suitable sites for breeding center - Selection of suitable sites for reintroduction and release of such species.
6	Time frame	:	Within five years.
7	Other Departments Involved	:	Not applicable.
8	Resources available	:	Zoos/Deer parks.
9	Additional resources required, if any (including funds):	:	- Building and infrastructure such as PENS, vehicle, traps. - Trained manpower. - Funds : Rs. One crore.
10	Expected benefits	:	The risk of extinction of rare and threatened species from the wild will be diminished.
11	Any other comments	:	--

Project Proposal-14

1	Name of Project	:	**Establishment of Rescue and Quarantine centers.**
2	Strategy addressed	:	Ex-situ conservation of wild diversity.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To provide timely health care to wild animals injured in accidents and suitable shelter to those who strayed out of forest area. In addition animals seized under Wildlife (Protection) Act, 1972 will be put in the rescue centers. The animals in transit will be placed in quarantine center.
5	Brief description	:	- The sites will be selected near suitable forest areas and rescue/quarantine centers with full fledged veterinary facilities and staff will be established for the purpose. The project will help to: - Study the population dynamics of dominant/social animals. - Compilation and analysis of past trend of rescue operation - Examination and analysis of past records of incidence of straying of wild animals.
6	Time frame	:	The project will be carried out on long term basis.
7	Other Departments Involved	:	Not applicable.
8	Resources available	:	Forest land.
9	Additional resources required, if any (including funds)	:	- Veterinary staff including veterinary doctors. - Veterinary hospitals, mobile rescue van, laboratories cages and enclosures, feed and fodder, etc. - Rs. One crore.
10	Expected benefits	:	- Reduce man-animal conflict. - Benefits to society. - Wildlife protection and conservation
11	Any other comments	:	- The Project will help to save the lives of precious living creatures of nature. Will also be helpful in containing spread of disease.

Project Proposal-15

1	Name of Project	:	**Establishment of Anti poaching Cell.**
2	Strategy addressed	:	- Controlling illegal hunting & paching by: - Establishment of network of informers. - Providing modern communication facilities to the staff. - Providing arms and vehicles to the staff. - Writing articles in press and giving interviews in electronic media. - Provision of rewards and incentives.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To enforce the provisions of Wildlife (Protection) Act, 1972.
5	Brief description	:	The activities of poachers will be detected through intelligence gathering within and outside the State Swift and decisive action will be taken and staff/informers will be rewarded.
6	Time frame	:	It will be a continuing process.
7	Other Departments involved	:	Department of Police, Custom, ITBP, BSF, Intelligence and CBI etc.
8	Resources available	:	Staff/Communication network available.
9	Additional resources required, if any (including funds).	:	Car, Gypsy, Van, telephone, computers will be required. Rs.50 lacs required.
10	Expected benefits	:	It will be a moral boosting step for staff engaged in wildlife conservation and will have a demoralizing effect on offenders.
11	Any other comment	:	To break the nexus between poachers, smugglers, the establishment of anti poaching mobile cell will be very essential.

Project Proposal-16

1	Name of Project	:	**Modernization of communication network.**
2	Strategy addressed	:	Controlling illegal hunting & poaching by: - Identifying the staff not having the access to the communication network. - Installation of communication network system in the places where needed. - Upgradation of existing communication network. - Linking with all the Government office involved in biodiversity conservation through computer networking.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To detect any offence or causative factors for habitat deterioration immediately.
5	Brief description	:	Existing communication network will be upgraded and new facilities will be added where needed the office of wildlife department will be linked with all Government offices through computer networking for sharing the information..
6	Time frame	:	Within two years.
7	Other Departments Involved	:	Not Applicable.
8	Resources available	:	Some wireless Fixed Station and Mobile Stations are available.
9	Additional resources required, if any (including funds).	:	- Additional fixed and mobile stations will be needed. - Wireless operators will be required. - Computers for head office as well as field office will be required. - Funds Rs. 50 lacs.
10	Expected benefits	:	Access to information will be swift. The decision making ability will improve.
11	Any other comments	:	It is necessary to upgrade and improve the existing communication network to tackle the offences and improve the habitat in the State.

Project Proposal-17

1	Name of Project	:	**Man-animals conflict - formulation of methodology for compensation.**
2	Strategy addressed	:	Curbing increasing man-animal conflicts by: - Identifying the causes of man-animals conflict. - Assessment of damages caused to farmers by wild animals. - Assessment of people expectations.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To resolve man-animal conflict.
5	Brief description	:	The carrying capacity of land w.r.t wild animals will be find out, the culling mechanism will be formulated. The damages to crops will be assessed and formula for compensation will be worked out. The affected people will also be interacted with. The loss will be compensated.
6	Time frame	:	The methodology will be devised within one year. However paying the compensation will be continuous process based on the occurrence of damages by wild animals.
7	Other Departments involved	:	Deptt. of Agriculture/Horticulture/Revenue.
8	Resources available	:	Nil
9	Additional resources required, if any (including funds).	:	- Computer accessories. - Funds : Rs. 50 lacs for paying compensation.
10	Expected benefits	:	The project will reduce the apathy of locals towards wildlife and will also ensures the participation of people in biodiversity conservation.
11	Any other comments	:	--

Project Proposal-18

1	Name of Project	:	**Establishment of Wildlife Extension Cell**
2	Strategy addressed	:	Information dissemination on wild diversity by: - Identification of target groups. - To identify the need of department for proper extension regime.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To improve & promote communication channel between Department and people.
5	Brief description	:	Wildlife extension offices with all necessary infrastructure facilities will be opened at district headquarters. The publicity materials such as pamphlet, posters, field guide, brouchers, stickers will be designed and published for distribution to public. Fixed signboards will be used for awareness activities, staff will trained in communication skills.
6	Time frame	:	Within two years.
7	Other Departments Involved	:	Not applicable.
8	Resources available	:	Publicity boards/Audio-visual equipments..
9	Additional resources required, if any (including funds)	:	- Publication of publicity materials. - Publicity mobile van - Signages. - Equipments viz. video camera, CD Projector. - Funds: Rs. 50 lacs.
10	Expected benefits	:	The Wildlife Extension Cell will educate the public about the sustainable use of bio resources and thus will prevent further degradation of our resources.
11	Any other comments	:	Biodiversity conservation can not be successfully done without Wildlife Extension Cell.

Project Proposal-19

1	Name of Project	:	**Establishment of Interpretation Centers in and around Protected Areas.**
2	Strategy addressed	:	Information dissemination on wild diversity.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To disseminate knowledge on environmental conservation and to promote eco-tourism.
5	Brief description	:	A facility with all necessary infrastructure viz. library, auditorium, symposium, gallery etc will be created. A souvenir center will be added as an additional facility to public for orientation.
6	Time frame	:	2-5 years, it will be taken up every year depending upon response & need of the people.
7	Other Departments Involved.	:	Not applicable.
8	Resources available	:	Interpretation center/libraries/Audio-visuals centers in few PA's.
9	Additional resources required, if any (Including funds).	:	- Construction of building. - Interpretive materials such as maps, pictures, exhibit, models etc. - Computer, CDs & accessories. - Telephone. - Funds: Rs. Two crore. for 2-5 years
10	Expected benefits	:	It will motivate local people to participate in conservation movement.
11	Any other comments	:	The improvement in the Status of habitat is unthinkable without public awareness and interpretation center will serve as booster for the purpose.

Project Proposal-20

1	Name of Project	:	**Designing web page and developing linkages globally through internet.**
2	Strategy addressed	:	Information dissemination on wild biodiversity by: - Collection, collation, storage and analysis of data related to wildlife in Punjab. - Coordination with wildlife institutions to obtain more relevant information. - Putting the information on web.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	To have global access to information related to wildlife biodiversity and sharing the State's information internationally.
5	Brief description	:	Web Page for Wildlife Wing of Punjab Forest & Wildlife Deptt. will be developed and all the information related to biodiversity in the State will be put on the web. The provisions to have suggesting from people all over the worked will be made. The web page will be linked to important web sites dealing with biodiversity. Suitable software will be developed for the project.
6	Time frame	:	Within one year.
7	Other Departments Involved	:	Not applicable.
8	Resources available	:	Nil.
9	Additional resources required, if any (including funds)	:	- High power computer, high resolution camera, software, scanner, printer. - Computer programmer and web designer, training facility. - Funds: Rs. 10 lacs.
10	Expected benefits	:	Sharing of information will lead to better management of biological resource in the State. Also, the transparent working will improve the administration of department.
11	Any other comments	:	The project will be a signpost of Government before national and international community.

Project Proposal-21

1	Name of Project	:	**Establishment of Eco-tourism cell.**
2	Strategy addressed	:	Information dissemination on wild biodiversity by conducting survey, Identifying the needs and expectations of people, Identifying the area for ecotourism, Proper publicity, incentives, Feed back mechanism.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department in consultation with Department of Tourism.
4	Purpose	:	- To spread awareness about the importance of biodiversity conservation in the State. - Linking it with employment opportunities.
5	Brief description	:	- The tourist facilities such as tourism complex, conservation education and awareness center, theater, souvenir shop, canteen and visitors accommodation facilities will be set up at suitable ecosite. The calendar of activities will be prepared and information will be disseminated to visitors through showing films and distribution of literatures. - Programmes be revised on feedback.
6	Time frame	:	Within two years.
7	Other Departments Involved	:	Deptt. of Tourism/NGOs.
8	Resources available	:	Interpretation centers at few PA's.
9	Additional resources required, if any (including funds):	:	- Tourist/Log huts. - Infrastructural equipments such as video. - Camera, telescope, VCR, TV, Projector etc. - Van - Funds : Rs. 2 crores.
10	Expected benefits	:	The visiting people will be motivated to participate in Biodiversity conservation.
11	Any other comments	:	Ecotourism will provide employment opportunity to the locals and therefore it has high potential of success.

Project Proposal-22

1	Name of Project	:	**Nature awareness camps.**
2	Strategy addressed	:	Information dissemination on wild diversity by: - Selection of target groups for dissemination of information. - Building of interpretive messages for awareness. - Selection of areas for conducting camps and demarcation of zones for exposures to targets.
3	Implementing Agency	:	Wildlife Wing of Punjab Forest and Wildlife Preservation Department.
4	Purpose	:	- To promote positive environmental ethics and provide informed and rich wilderness experiences. - Spreading the awareness about the importance of biodiversity conservation.
5	Brief description	:	- A calendar of activities will be developed such as film shows, essay/quiz competition. - Distribution of handbills, pocket booklets on wildlife. - Conducting walks on natural trails.
6	Time frame	:	It will be conducted every year..
7	Other Departments Involved.	:	Not applicable.
8	Resources available	:	Nature trails in few PA's.
9	Additional resources required, if any (including funds)	:	- Resource personnel - Nature guides/staff. - Conservation education mobile vans, equipments. - Books, journals and other literatures on wildlife. - Funds: Rs. 20 lacs.
10	Expected benefits	:	It will foster a sense of responsibility among people towards environment protection and promote conservation of biodiversity.
11	Any other comments	:	The project will be helpful in changing the mindset of people towards environment.

Project Proposal-23

1.	Name of Project	:	**Documentation of success stories in Agricultural field**
2.	Strategy addressed	:	Promotion of traditional farming systems.
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	To bring for progress made by progressive farmers so that other farmers may emulate them.
5.	Brief description	:	Data of progressive farmers in different agricultural fields will be collected, analyzed and assessed for selection of stories and the stories will be printed in the form of a book
6.	Time frame	:	2 years
7.	Other Departments involved	:	Line Departments
8.	Resources available	:	Staff is available
9.	Additional resources required, if any (including funds)	:	Rs. 10 lacs for survey, collection of data analysis, assessment and finally publishing the book
10.	Expected benefits	:	The fence sitter farmer will get initiative to venture for new technologies and ultimately the economic lot of the state will improve.

Project Proposal-24

1.	Name of Project	:	**Establishment of Soil Testing Labs at Block Level**
2.	Strategy addressed	:	To provide soil testing facility at the door-step of the farmer and promoting traditional/ organic farming.
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	For judicious and balanced use of Fertilizers
5.	Brief description	:	Attached as annexure
6.	Time frame	:	3 years
7.	Other Departments involved	:	No
8.	Resources available	:	Existing Extension Staff
9.	Additional resources required, if any (including funds)	:	Rs. 160.00 lacs
10.	Expected benefits	:	Reducing the cost of cultivation and increase in productivity and production of crops.

Annexure

Strengthening of Soil Testing in Punjab

Brief Description

The continuous wheat-rice rotation adopted by the farmers of Punjab State is depleting the soil of Macro and Micro nutrients. This crop rotation removes 248 kg of N,50 kg of P and 330 kg of K 20 from one hectare of land. Their replenishment does not take place by Natural means and farmers resort to artificial application of chemical fertilizers. If imbalanced fertilizers are applied on the production cum productivity of crops are affected both ways if quantity will produce harmful effects which will lead not only to decline in yields bad but also gives shape to financial health of the farmers. For the judicious use of chemical fertilizers, soil testing plays an important role which will further improve the quality of the crops.

At present, there are 66 Soil Testing labs functioning in Punjab out of which 8 are mobile and 11 labs. have been provided with the facility of micro nutrient testing. These labs are located at District, Sub-Division and Block levels. The farmers of remaining 70 blocks have to approach far off labs for the analysis of their soil samples. As the recommendations are to be made available for implementation before the sowing of the crops, the existing soil testing labs are unable to analyse the entire soil samples prior to the sowing of crops due to load of work. The establishment of soil testing labs at block level will prove a boon in agriculture by providing timely analysis reports to the farmer in advance to the sowing of crops.

To ease the situation in soil testing in Punjab, 70 more soil testing labs are needed to be established in the remaining 70 blocks to cover the state. This will be implemented in 3 phases i.e. 2002-03, 2003-04 and 2004-05 by establishing 25 soil testing labs in each year for the Ist two years and 20 soil testing labs in the third phase. It will involve an expenditure of Rs. 30 lacs for one lab as detailed below:

1.	Purchase of land and construction of soil testing lab.	: Rs. 20.00 lacs
2	Purchase of machinery & equipment	: Rs. 7.00 lacs
3.	Material & supply (Recurring expenses every year for chemicals & glass wares)	: Rs. 3.00 lacs
	Total	: Rs. 30.00 lacs

At present, there are 11 soil testing labs which are provided with the facility of micro-nutrients testing. To cover the entire state 6(six) more soil testing labs needs to be established. During the implementation of this scheme two soil testing labs will be adopted every year which will involve Rs. 10.00 lacs for each lab in addition to the amount given above for the purchase of machinery & equipment, thus raising the total expenditure to Rs. 40.00 lacs.

No staff will be provided in these newly established soil testing labs and the work will be done by allocating the additional duties to the existing trained staff.

The details of expenditure to be incurred for 3 years is as under:

1st Year (2002-03)	**Rs. In lacs**
23 Soil Testing Labs @30.00 lacs/lab. 2 Soil Testing Labs with Micro Nutrient Testing facilities @ Rs.40.00 lacs/lab.	690.00 80.00 ---------- **770.00**
2nd Year (2003-04)	
23 Soil Testing Labs @30.00 lacs/lab. 2 Soil Testing Labs with Micro Nutrient Testing facilities @ Rs.40.00 lacs/lab.	690.00 80.00 ---------- **770.00**
3rd year (2004-05)	
18 Soil Testing Labs @30.00 lacs/lab. 2 Soil Testing Labs with Micro Nutrient Testing facilities @ Rs.40.00 lacs/lab.	540.00 80.00 ---------- **620.00**
Grand Total	**2160.00**

Project Proposal-25

1.	Name of Project	:	**1. Setting up of New Bio-control Labs at Sangrur and Kapurthala** **2. Completion & Strengthening of existing Bio-control lab at Mansa**
2.	Strategy addressed	:	Promotion of bio-pesticides and bio-fertilizers and integrated pest management system.
3.	Implementing Agency	:	The Director of Agriculture, Punjab, Chandigarh through C.A.O. Sangrur, Kapurthala and Mansa
4.	Purpose	:	To promote IPM approach which is a broad ecological approach for managing pest problems.
5.	Brief description	:	1.Construction of Bio-control labs: Rs. 150.00 lacs Purchase of equipments : Rs. 50.00 lacs Strengthening of existing 2.Bio-control lab, Mansa : Rs. 50.00 lacs Total : Rs.250.00 lacs (Details of accommodation & equipment attached at Annexure I & II)
6.	Time frame	:	About 2 years
7.	Other Departments involved	:	P.W.D. (B&R) Punjab for construction of buildings or any other approved construction agency
8.	Resources available	:	Nil
9.	Additional resources required, if any (including funds)	:	Rs. 250.00 lacs
10.	Expected benefits	:	Prevents water and air pollution and health hazards. Judicious use of pesticides will lower the cost of cultivation

Annexure-I

Details of accommodation for the State Bio-control Laboratory

Sr.No.	Room be utilized for	No.	Size (m)	Area(sq.m)
1.	*Corcvnm* mass breeding room	10	7x5	350
2.	*Corcynm* egg laying room	1	7x5	35
3.	*Heliothis* mass-breeding room	1	7x5	35
4.	*Sendoptera* mass-breeding room	1	7x5	35
5.	Egg Parasites mass-breeding room	2	7x5	70
6.	NPV mass-breeding room	2	7x5	70
7.	*Trichogvamma* mass multiplication room	2	7x5	70
8.	*Chrysopa* predator mass-breeding room	2	7x5	70
9.	Field collected post material rearing room	1	7x5	35
10.	Deputy Director room	1	5x4	20
11.	Staff room	1	7x5	35
12.	Office room	1	7x5	35
13.	Store room	1	7x5	35
14.	Gara	1	5x4	20
15.	W.C. (Men)	1	5x4	20
16.	W.C. (Women)	1	5x4	20
17.	Generator room	1	7x5	35
		30		**990** (Carpet area)

Plinth area – 600 sq.m

The building could be double storeyed or single storeyed depending on available land on a plinth area of 600 sq m. A gallery of 2m width and 36m. long is required since the rooms will be constructed to have natural light which require a provision of central gallery and water channel around building to avoid entry of ants. The entrance gate of the building should have automatic double doors with ante room space like glasshouse, windows are to be provided with airtight glass pans and stainless steel 100 mesh shutters.

Annexure-II

Equipments and Vehicles required for the setting up of State Biocontrol Laboratory

Sr.No	Equipment	No.	Cost (in Rs./Unit)	Total amount (in Rs.)
1.	Air/Desert cooler	20	6,000	1,20,000.00
2.	Heat Converter	40	1,500	60,000.00
3.	Air conditioner with 4 KVA stabilizer	2	40,000	80,000.00
4.	Refrigerator 300 lt capacity with 1KVA stabilizer	2	17,000	34,000.00
5.	Hot air oven	2	16,000	32,000.00
6.	BUD incubators with temp. humidity and photoperiod provision with 1 KVA stabilizer	2	40,000	80,000.00
7.	Centrifuge	2	8,000	16,000.00
8.	Laminar Flow station	1	18,000	18,000.00
9.	Fomenter	1	2,00,000	2,00,000.00
10.	Autoclave vertical	1	20,000	20,000.00
11.	*Coreyro* cages	3,000	200	6,00,000.00
12.	Steel racks (7x3x18) with 6 compartment	200	1,000	2,00,000.00
13.	*Chryao* cages	20	1,000	20,000.00
14.	Laboratory tables	5	6,000	30,000.00
15.	Laboratory stool	20	250	5,000.00
16.	Hydrometer	10	400	4,000.00
17.	Thermometer	10	400	4,000.00
18.	Mixure-cum-grinder	2	2,000	4,000.00
19.	*Corcyre* egg laying cages	50	100	5,000.00
20.	UV chamber with UV tube light	2	1,500	3,000.00
21.	Exhaust fan	10	1,000	10,000.00
22.	Vacuum cleaner	2	4,000	8,000.00
23.	Water distillation unit	1	2,000	2,000.00
24.	Microscope (Research) with accessories	1	30,000	30,000.00
25.	Stereo Binocular microscope	1	20,000	20,000.00
26.	Top loading electronic balance	1	35,000	35,000.00
27.	Glassware (Petri dishes, Jars, Flask, etc.)	-	--	60,000.00
28.	Miscellaneous items	--	---	50,000.00
29.	Diesel Jeep	1	2,50,000	2,50,000.00
				20,00,000.00

Project Proposal-26

1.	Name of Project	:	**Establishment of 14 New Pesticides Testing Laboratories in 14 districts of the Punjab State.**
2.	Strategy addressed	:	Improvement of soil health and promotion of bio-pesticides
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	For testing the pesticides samples to ensure the supply of good quality pesticides to the farmers within the specified period.
5.	Brief description	:	There are 17 districts in Punjab State. Out of these SPTLs, exist in three districts which are inadequate because approximately 7200 M.T. (Technical grade) of Pesticides is consumed in the state yearly. So, to increase the efficiency of supply of good quality pesticides to the farmers, more SPTLs are required for testing the pesticides samples. Therefore, it is proposed for the setting up of one Pesticides Testing Laboratory in all the remaining fourteen districts of the state. In the 1st year of the project, land would be purchased and construction for the said laboratories would be undertaken. In the next phase, i.e. 2-5 years, furniture, etc. would be purchased and testing of pesticides samples would be undertaken. The lab will also study efficacy of bio-pesticides.
6.	Time frame	:	10 years: a) First year: Cost of Land & Building b) 2-5 years: Cost of machinery & equipment and material & supply c) 5-10 years: Cost of chemicals, solvents, etc.
7.	Other Departments involved	:	----
8.	Resources available	:	----
9.	Additional resources required, if any (including funds)	:	As no funds are available for the establishment of new SPTLs with the State Govt., so project for the setting up of 14 new SPTLs is submitted . This will involve approx. Rs. 2162.00 lacs in a phased manner (details at annexure a & b).

10.	Expected benefits	:	Pesticides play a vital role in increasing the productivity of various crops. Due to various factors, the incidence of attack of different insects pests is increasing which directly reduce the crop production. By providing better facilities for testing of pesticides in the SPTLs the supply of good quality pesticides to the farmers would be ensured which will indirectly enhance the crop production by way of minimizing the crop losses.
11.	Any other comment	:	The project be restricted to bio-pesticides only instead of chemical pesticides.

Annexure-a

Established of 14 New Pesticides Testing Laboratories in Punjab

Sr.No.	**Item**	**Estimated cost for one lab.**	**Unit**	**Total cost (Rs. In lacs)**
1.	Cost of Land (1/2 Acre)	25.00	14	350.00
2.	Building cost (600 sq ft @Rs.500 sq ft)	30.00	14	420.00
	Total	**55.00**		**770.00**

Annexure-b

Cost of Purchase of Machinery & Equipment & Supply for the establishment of 14 (Fourteen) New Pesticides Testing Laboratories in Punjab

Sr.No.	Item	Rate	Unit	Total cost (Rs. In lacs)
I. 1.	Gas Liquid Chromatograph (complete unit)	10.00	14	140.00
2.	H.P.L.C. Unit	15.00	14	210.00
3.	Fourier Transformed Infrared (FTIR) Spectro Photometer	22.00	14	308.00
4.	U.V. Visible Spectro-Photometer	5.00	14	70.00
5.	Visible Spectro Photometer	2.00	14	28.00
6.	Analytical Electronic Digital weighing balances (2 Nos.)	4.00	14	56.00
7.	Uninterrupted power supply (UPS) Units (3 Nos.)	9.00	14	126.00
	Total			**938.00**
II.	**Routine Laboratory Equipments**			
1.	Hot air ovens (2 Nos.)	0.50	14	7.00
2.	Refrigerators (2 Nos.)	0.20	14	2.80
3.	Air conditioners (5 Nos.)	1.50	14	21.00
4.	Other laboratory equipments & electric appliances	1.00	14	14.00
5.	Glass ware (Borosil)	2.00	14	28.00
6.	Laboratory Chemicals & solvents	3.00	14	42.00
7.	Power Generating set	2.00	14	28.00
	Total			**142.80**
III.	Furniture	1.00	14	14.00
IV.	Miscellaneous	5.00	14	70.00
V.	Two Laboratory Attendants on contract basis per year	1.20	14	16.80
	Total of item no. 1 to V			**1181.60**

Project Proposal-27

1.	Name of Project	:	**Strengthening of existing three State Pesticides Testing Laboratories in Punjab**
2.	Strategy addressed	:	Judicious use of pesticides and promotion of bio-pesticides
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	For testing the pesticides/weedicides samples in a stipulated period.
5.	Brief description	:	At present, there is a single set of Insecticides Testing Equipments/Machinery in all the three SPTLs which is quite old and often goes out of order. Due to recent amendment in the Insecticides Act, the Testing period in the laboratory has been reduced from 60 days to 30 days. When any equipment goes out of order, it takes lot of days for repairing. Thus, the time available at the disposal of labs for testing the samples is reduced and if the samples are not tested in the specific period, legal complications can arise. In order to get the samples tested in a specific period and to avoid legal complications, it is imperative to have a double set of testing equipments/machinery, so the project is submitted.
6.	Time frame	:	10 years a. First year: Cost of mach./equipment b. 2-5 years: Cost of chemicals, solvents, etc. c. 5-10 years: Cost of chemicals, solvents & replacement of equipments.
7.	Other Departments involved	:	Nil
8.	Resources available	:	Infrastructure & specialists for testing the pesticides samples are available with the Deptt. of Agriculture.
9.	Additional resources required, if any (including funds)	:	As no funds are available for strengthening of these SPTLs for this purpose Rs. 416.00 lacs are required as per enclosed details in Annexure.
10.	Expected benefits	:	Pesticides play a vital role in increasing the productivity of various crops. Due to various

factors, the incidence of attack of different insects pests is increasing which directly reducing the crop production. By providing better facilities for testing of pesticides in the SPTLs the supply of good quality pesticides to the farmers would be ensured which indirectly enhance the crop production by way of minimizing the crop losses.

Annexure

Cost of Purchase of Machinery & Equipment & Supply for strengthening of existing three Pesticides Testing Laboratories in Punjab

Sr.No.	Item	Requirement for 3 SPLTs		
		Unit	Rate	Total cost (Rs. In lacs)
1.	Gas Liquid Chromatograph (complete unit)	3	10.00	30.00
2.	H.P.L.C. Unit	3	15.00	45.00
3.	Fourier Transformed Infrared (FTIR) Spectro Photometer	3	22.00	66.00
4.	U.V. Visible Spectro-Photometer	3	5.00	15.00
5.	Visible Spectro Photometer	3	2.00	6.00
6.	Uninterrupted power supply (UPS) Units (3 Nos.)	3	3.00	9.00
7.	Chemicals & solvents etc.	3	3.00	9.00
			Total	**180.00**

Project Proposal-28

1.	Name of Project	:	**Establishment of Agricultural Information Cyber Extension Centers at Block Level.**
2.	Strategy addressed	:	To provide latest technology to the farmers by accessing the experts within the country and abroad through internet. Also to provide marketing intelligence information to the farmers.
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	To help the farmers to address their field problems and to help them plan their crop production/marketing strategy.
5.	Brief description	:	These AICEC will be provided connectivity through networking with research institutes and general internet. These will also act as Tariff free help lines for the farmers.
6.	Time frame	:	2 years for connection and equipping the centers
7.	Other Departments involved	:	i) Research Institutes ii) Line departments line Horticulture, Soil Conservation, Animal Husbandry, Dairying and Fisheries may share the services.
8.	Resources available	:	Staff is available
9.	Additional resources required, if any (including funds)	:	For each center Rs. 6.00 lacs for buildings and equipments and Rs. One lac for operational charges & contingencies (138x7 = Rs. 9.66 crores)
10.	Expected benefits	:	Tremendous benefits will accrue to the State through enhanced and better production in agricultural field and will bring in, economic upliftment.

Project Proposal-29

1.	Name of Project	:	**Rashtriya Krishi Bhumi Yojna**
2.	Strategy addressed	:	Establishing social security system for farmers.
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	To ensure adequate returns from the crops of the farmers.
5.	Brief description	:	To conduct the requisite number of C.C. experts to arrive at the threshold yield for providing compensation to the farmer. Statistical Section of the Department has to be strengthened.
6.	Time frame	:	Pilot project for 3 years
7.	Other Departments involved	:	Revenue Department of Punjab
8.	Resources available	:	Nil
9.	Additional resources required, if any (including funds)	:	Rs. 116.00 lacs
10.	Expected benefits	:	To compensate that farmer in the event of crop failure, especially traditional crops.

Project Proposal-30

1.	Name of Project	:	**Arranging literacy campaigns for farmers on farmers rights, breeder rights, plant variety protection, sui generis system etc.**
2.	Strategy addressed	:	IPR and trade related issues
3.	Implementing Agency	:	Department of Agriculture, Punjab (jointly with PAU & PSCST)
4.	Purpose	:	To make the farmers aware about their rights and the rights of other players vis-à-vis GATT.
5.	Brief description	:	Seminars will be arranged for the general farmers and specific interest groups of farmers
6.	Time frame	:	2 years
7.	Other Departments involved	:	Research Institutes, Punseed, etc.
8.	Resources available	:	Staff is available
9.	Additional resources required, if any (including funds)	:	Rs. One lac for each block for each (138x1x2 = Rs. 2.76 crores)
10.	Expected benefits	:	The farmers will be aware of their rights.

Project Proposal-31

1.	Name of Project	:	**Establishment and Maintenance of Seed Bank**
2.	Strategy addressed	:	Addressing IPR and trade related issues
3.	Implementing Agency	:	PUNSEED
4.	Purpose	:	To make available seeds of improved varieties to farmers.
5.	Brief description	:	Seeds of various varieties of wheat, paddy, grain, pulses, oil seeds and cotton will be stored and made available to farmers as per requirement.
6.	Time frame	:	5 years
7.	Other Departments involved	:	Department of Agriculture, Punjab
8.	Resources available	:	----
9.	Additional resources required, if any (including funds)	:	Attached as Annexure
10.	Expected benefits	:	Seeds of various crop varieties will conserved and made available to farmers as per requirement.
11.	Any other comment	:	The present emphasis is on hybrid varieties only. However, traditional native varieties may also be stored in the seed bank.

Annexure

Additional Resources Required:

For the Year 2001-02 to 2005-06 Crop/ Variety	**2001-02**	**2002-03**	**2003-04**	**2004-05**	**2005-06**
Wheat	--	2000.00	2500.00	2500.00	2500.00
PBW-343					
PBW-396	80.00 (F/S)	100.00	100.00	150.00	150.00
PBW-373	50.00 (F/S)	400.00	400.00	350.00	350.00
Total	130.00	2500.00	2500.00	3000.00	3000.00
Gram					
L-769	20.00	50.00	50.00	100.00	100.00
Paddy					
R-114, PR-116	200.00	250.00	250.00	300.00	300.00
Oil Seeds					
Pulses	50.00	50.00	50.00	50.00	50.00
Cotton	100	100	200.00	300.00	300.00
	200	200.00	300.00	400.00	400.00
Funds Requirement Rs. (Approx.)	10,00,000.00	35,00,000.00	35,00,000.00	40,00,000.00	40,00,000.00

Project Proposal-32

1.	Name of Project	:	**Improvement of Soil Health in Punjab**
2.	Strategy addressed	:	Improvement of soil health: to encourage Greening Manuring Compost Manuring and Vermi-compost
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	To add organic matter and improve physical condition of soils
5.	Brief description	:	Attached as annexure
6.	Time frame	:	2002-03
7.	Other Departments involved	:	---
8.	Resources available	:	Existing Extension staff
9.	Additional resources required, if any (including funds)	:	Rs. 183.70 lacs
10.	Expected benefits	:	Quality of the land will be improved

Annexure

Improvement of Soil Health for 2002-03

Brief Description

In the wake of green revolution, recently our agriculture is heavily dependent on chemical fertilizers and pesticides. The application of chemical fertilizers organic manures lead to decrease in soil fertility and increasing pollutants. The soil organic matter should be maintained and needs to be improved for sustainable agriculture. The soil organic matter helps in the improvement of physical health of the soil by increasing moisture holding capacity, regulating soil temperature and by improving soil texture and structure. The availability of almost all the major nutrients is related to the presence of organic matter contents of the soil.

Keeping in view the above facts, the use of Green Manure Farm Yard Manure, Town compost and Vermi-compost need to be encouraged to improve the soil health. It is proposed to cover the following aspects for improvement of soil health during the next year 2002-03.

1. Green Manuring
2. Promotion and popularization of vermi-culture
3. Promotion of Farm Yard Manure

1. Green Manuring: It will play very important role in future on agriculture. To improve the organic matter of the soil, the area should be covered under green manuring in phased manner. The farmers are not adopting green manuring at required rate due to one reason or the others. To popularize green manuring, seed of green manure crops will be provided to the farmers on 75% subsidy maximum limit up to Rs. 1000/- per hectare and an area of 15950 hectares will be covered under green manure. Only these farmers will be covered under the scheme, who have not been given benefit for this purpose under Reclamation of Alkali Soils Scheme. The total cost of this component will be Rs. 159.50 lacs.

2. Promotion and popularization of vermi-culture: The vermi-culture is a new technology to prepare compost from residues, animal dung and feed wastes, etc. The vermi-culture technology is beneficial over conventional compost making process. It decomposes raw material in short time and vermi-compost is rich in plant nutrients. For promotion and popularization of vermi-culture technology, its trials, demonstration and trainings are to be arranged at beneficiaries fields. It is proposed to adopt two villages of each district under this component and trials-cum-demonstration will be arranged at farmers fields. Trainings are to be imparted to beneficiaries on the spot/demonstration site for preparing vermi-compost and its use for crop cultivation. Total cost of this component will be Rs. 12.10 lacs @Rs. 35,583/- per village trail-cum-demonstration and training in 34 villages of 17 districts.

3. Promotion of Farm Yard Manure: In Agriculture, use of Farm Yard Manure has proved a back bone for maintenance of soil health. Farmers in general are not much aware about the benefits of use of Farm Yard Manure. It is need of the time to create awareness among the farmers rewarding improved methods of compost making and its use. It is proposed to adopt two villages in each district under this component. Demonstrations will be laid down at beneficiaries fields for proper preparation and use of Farm Yard Manure.

Time to time contact programmes training will be imparted to the farmers at demonstration sites. Total cost of this component will be Rs. 12.10 lacs @Rs. 35,583/- per village demonstration-cum-training in other 34 villages.
The total cost of the scheme will be Rs. 183.70 lacs. It is also worth mentioning that sowing of Jantar Seed for Green manuring is done in the month of April.

Statement of cost in respect of Scheme for improvement Soil Health for the year 2002-03

Sr.No.	Item	Area	2002-03	Rs. In lacs
1.	Green Manuring (Subsidy on seeds @ Rs. 75/- maximum limit Rs. 1000/- per ha)	Ha	15950	159.50
2.	Promotion & popularization of vermiculture	Two villages in every district of Rs.------ per station-cum-demonstration training	34	12.10
3.	Promotion of New Technology of F.Y.M. preparation methods and demonstration.	-do-	34	12.10
4.	Promotional efforts and other expenditure	-----	---	----
	Total			**183.70**

Project Proposal-33

1.	Name of Project	:	**To promote use of straw reapers and rotator for harvesting the straw or mixing in soil left after cutting of wheat crop by harvester combines.**
2.	Strategy addressed	:	Rejuvenation of land by mixing the crop residue in soil or use the straw for any other useful purpose
3.	Implementing Agency	:	Department of Agriculture, Punjab
4.	Purpose	:	To distribute straw reapers and rotators to the farmers on subsidy.
5.	Brief description	:	To distribute 1000 straw reapers costing about Rs. 80,000/- each on 50% subsidy subject to maximum subsidy of 30,000/-. Also to distribute 1000 rotators costing about Rs. 70,000/- each at 50% subsidy subject to maximum of Rs. 30,000/-.
6.	Time frame	:	To distribute within one year from the availability of funds.
7.	Other Departments involved	:	----
8.	Resources available	:	The difference between the cost of machine excluding subsidy will be borne by the farmers
9.	Additional resources required, if any (including funds)	:	For 1000 straw reapers: 1000x30,000 = Rs.3,00,000/- (Rs. 3.00 crores) For 1000x30,000= Rs.3,00,000/- (Rs. 3.00 crores)
10.	Expected benefits	:	It will improve the soil condition and reduce the population created by burning of straw.

Project Proposal-34

1.	Name of Project	:	**Study of Impact of exotic species on Native species in the natural waters of the State.**
2.	Strategy addressed	:	Indigenous species of fishes need to be promoted. Phasing out of all exotic species which compete with the native varieties.
3.	Implementing Agency	:	Fisheries Department, Punjab
4.	Purpose	:	To asses the production level of the exotic species in comparison with the native species and the dominance of various species of fish fauna in natural water of the state.
5.	Brief description	:	This project includes the study of total fish fauna available in the natural waters. It will look into the ecological impact on the aquatic ecosystem and impact on native species by the introduction of exotic species. It will also indicate the species of fish which are near threatened, vulnerable and endangered.
6.	Time frame	:	2 years
7.	Other Departments involved	:	Panjab University, Chandigarh
8.	Resources available	:	Technical and field staff of the department will help the research workers for collection of fish samples. Man power infrastructure for collecting samples and transportation facilities will be provided by the department.
9.	Additional resources required, if any (including funds)	:	Department needs additional funds i.e. Rs. 10 lacs from Ministry of Environment & Forests, Govt. of India for conducting the research.
10.	Expected benefits	:	The study will give information of fish fauna available in natural waters of the state. Number of exotic species which are endangering the native fish fauna and the measures require to protect threatened, vulnerable and endangered species of fish. It will help to minimize ecological impact of exotic species on the aquatic ecosystem and on native species.

11.	Any other comment	:	The increase of pollution level by the discharge of effluents by the industries established along the river bank, sewerage discharged towns like Ludhiana is causing great loss on the Aquatic life and destroying the fish habitat. A detailed study is required for Nangal which causes large scale mortality of fish. The matter has already been taken up with the Government and on the advice of Science & Technology different universities in the state have been approached for submitting the project proposal for the same for onward transmission to Ministry of Environment & Forests, Govt. of India through Punjab State Council for Science & Technology.

Project Proposal-35

1.	Name of Project	:	**Strengthening Biological Diversity in Govt. Garden, Bara Dari, Patiala, Camarabagh, Kapurthala Aam Khas Bagh, Sirhind (Fetehgarh Sahib)**
2.	Strategy addressed	:	Conservation of horticultural biodiversity and existing flora & fauna
3.	Implementing Agency	:	Department of Horticulture, Punjab
4.	Purpose	:	Conservation of horticultural biodiversity propagation and multiplication of plants of rare species.
5.	Brief description	:	The wealth of existing endangered species will be maintained, preserved and will be used as mother plants for further multiplication.
6.	Time frame	:	Within 10-20 years
7.	Other Departments involved	:	Nil
8.	Resources available	:	Nil
9.	Additional resources required, if any (including funds)	:	Rs. 30.00 lacs (Rs. 10.00 lacs for each of three gardens)
10.	Expected benefits	:	Enhanced biological diversity of horticultural crops.

Project Proposal-36

1.	Name of Project	:	**Conducting Survey of Industry conserving bioresources**
2.	Strategy addressed	:	Assessment of Bioresource utilization in industrial sector
3.	Implementing Agency	:	Industries Department, Punjab
4.	Purpose	:	• District-wise survey of industry using bio-resources. • Analysing of data so collected. • Future planning and citing or expansion of such industry. • To conduct survey for availability of bioresources used by industry. • Creation of Data Bank on the availability of bio resources and its future monitoring. • Short term and long term planning for use of bio resources. • To provide continuous expert services for up-dating of know-how in the field of bio resources management.
5.	Brief description	:	There are about 21 lakh SSI Units running in the State and about 650 units in the Large & Medium Sector which are consuming raw-materials which is directly or in-directly effecting the Bio-diversity. There are many Small Scale and Large & Medium Industries, which are directly affecting the Biodiversity of the State. These industries include manufacture of paper-pulp, leather, textile, food processing, sugar mills, rice shellers, flour mills and tanneries etc. There is a great need to conduct a survey of such industries with regard to consumption of raw-materials and effect on biodiversity. At the same time, a survey is required to be conducted with regard to availability of bio-resources so that a future plan can be made for effective monitoring and use of such resources.
6.	Time frame	:	One year
7.	Other Departments involved	:	---
8.	Resources available	:	As per budget

9.	Additional resources required, if any (including funds)	:	Attached
10.	Expected benefits	:	The project will help to generate information on: - Industries using bioresources and extent of usage. - Industries affecting biodiversity.

Technical/ Non-Technical Staff Required

			Salary per month
i)	Bio-Technologist	One	10,000
ii)	B.SC Analysits	Two	8,000 each
iii)	Data Operators	Two	6,000 each
iv)	Enumerators	Forty-two	5,000 each-
v)	Helpers	Two	4,000 each
vi)	Driver	One	5,000 each
vii)	Peon	Two	3,000 each

Budget Estimate

a)	Salary	31,84,000
b)	Computer & Type-writer	1,20,000
c)	Staff car	5,00,000
d)	Stationery & other expenses	2,00,000

Project Proposal-37

1.	Name of Project	:	**Technical Assistance to support the successful execution of Punjab Cleaner Production Center in Punjab**
2.	Strategy addressed	:	Promotion of Environment and Biodiversity conservation
3.	Implementing Agency	:	Industries Department, Punjab
4.	Purpose	:	To promote resource efficient low waste technologies.
5.	Brief description	:	The project shall facilitate the small & medium enterprise: (SMEs) to increase the production efficiency while at the same time eliminate or at least minimize waste and emissions at their source rather than treat those wastes after these have been generated. This is because the additional financial burden brought about by the cost of pollution and end of pipe treatment has disabled industry from voluntary adoption of pollution control approach. The project shall identify & develop linkages with UNIDO, National Cleaner Production Canters at New Delhi and abroad for capacity building and development of clusters in the state by persuading them to adopt cleaner production techniques. **Part A: Content** **i) Description of the Subsection:** Punjab State is known for small scale industry. There are about 2,00,000 SSI and medium scale units working at various industrial towns such as Amritsar, Jalandhar,Patiala, Ludhiana, Goraya, Phagwara, Mandi,Gobindgfarh, Dera Bassi, Moga, etc. There is consistent growth of clusters of these places such as textiles, Rubber goods, leather goods, Hand tools, Bicycle, Auto parts, Sewing, M/C & parts, machine tools, Foundry, Hosiery wasten & Re rolling, etc. of the SME Sector employs simple and old technology which results into waste development and pollutes our environment. The Punjab Cleaner Production Center has enormous potential to help industry to adopt cleaner production Techniques & Realising

the potential of CP programme the State Govt. has already set up Punjab Cleaner Production Centre in the Office of Directorate of Industries PB. PCPC with the active cooperation of National Cleaner Production Centre New Delhi, has started its activities. Six units representing various clusters have been selected and given training in field of C.P. Techniques. The officer of the Deptt. who shall be directly involved with implementing process have also undergone two days training. The further follow up process shall follow.

ii) Country and Host Govt. Strategy:

The State Govt. realized the importance of environment preservation much earlier and brought out an act called Water (Prevention & Control of Pollution) Act, 1974 and set up pollution Control Board at Patiala. But the board restricted its activities to regulate pollution. Deptt. of Science & Technology has also been set up to help industry in setting up pollution Control devices.

In the year 1996, the State Govt. brought out new industrial policy vide which the State Government also encourages and supports efforts in technology upgradation, modernization and installation of pollution control devices. Further it is also committed to speed up the clearance procedure and establish mechanism to assist industry in export promotion and market development.

The details of the project are available with Industries Department, Govt. of Punjab.

6.	Time frame	:	2 Years
7.	Other Departments involved	:	UNIDO
8.	Resources available	:	As per budget
9.	Additional resources required, if any (including funds)	:	UNIDO Us$: 1,48,910 Govt. of Punjab in cash : 43,000 Govt. of Punjab in kind : 90,000 Contribution of Industry : 20,000
10.	Expected benefits	:	The project will help to generate information on: - Industries using bioresources and extent of usage. - Industries affecting biodiversity.

Project Proposal-38

1.	Name of Project:	:	**Promotion of non-formal Biodiversity Education**
2.	Strategy addressed	:	Promotion of non-formal Biodiversity Education through practical approach.
3.	Implementing Agency	:	Education Department
4.	Purpose	:	To make the students understand about the importance of plants & their protection
5.	Brief description:	:	Separate proposals attached
6.	Time frame:	:	2002-2003
7.	Other Department involved:	:	Department of Forestry and Wildlife, PSCST
8.	Resources available:	:	1. Space 2. Water facility
9.	Additional resources required, if any (including funds):	:	Green Surroundings (38a) : Rs. 1,25,000/- Gifts of Nature (38b) : Rs. 1,71,000/- Funds for developing/procuring activity books (38c): Rs.66,00,000/- Non-formal EE (38d) : Rs. 1,00,000/- Total: Rs. 69,96,000/-
10	Expected benefits:	:	Better understanding of biodiversity issues
11	Any other comment:	:	Students will be interested to know more about the plants and biodiversity of the area.

Project Proposal-38a

Name of Project:	:	**Green surroundings**
Strategy addressed	:	Promotion of non-formal Biodiversity Education through practical approach.
Implementing Agency	:	Education Department
Purpose	:	To make the students understand about the importance of plants & their protection
Brief description:	:	20 schools which are not adopted by Eco-club scheme will be selected, those schools will be taken which possess unmaintained ground & water facility. Funds will be provided for leveling, digging and for seeds and plants. Surrounding area of school will be maintained.
Time frame:	:	2002-2003
Other Department involved:	:	Department of Forestry and Wildlife.
Resources available:	:	Space Water facility
Additional resources required, if any (including funds):	:	One lakh for 20 schools @ Rs. 5000.00 per school + Rs. 25000 as TA/DA for monitoring staff.
Expected benefits:	:	Environment of school and its surroundings will be clean and green.
Any other comment:	:	Students will be interested to know more about the plants and biodiversity of the area.

Project Proposal-38b

1.	Name of Project	:	**Gifts of Nature**
2.	Strategy addressed	:	Promotion of nonformal Biodiversity Education through practical approach.
3.	Implementing Agency	:	Education Department
4.	Purpose	:	To create awareness among the school students about the importance of biodiversity & its conservation.
5.	Brief description	:	In summer vacations, students will be asked to collect different plants, feathers, nests, seeds, etc. or small projects will be given to students. Innovative collections/projects will be displayed and evaluated at tehsil, district & state level. As an incentive prizes in the shape of biodiversity books will be given to the winners.
6.	Time frame	:	2002-2003
7.	Other Departments involved	:	Punjab School Education Board (meeting to stress the inclusion of such project work in school curriculum of at least 5 marks in annual exam)
8.	Resources available	:	Students can do this work in holidays easily.
9.	Additional resources required, if any (including funds)	:	One lakh and seventy one thousand (Rs. 1,71,000) details attached.
10.	Expected benefits	:	Students will be in direct contact with nature and they will realize its importance and conservation.

Details of funds

At District level

Prizes	1st-500.00	
	2nd 300.00	
	3rd 200.00	
Total	**1000.00**	
Prizes will be in the shape of books related to biodiversity.		
For 17 districts total amount for prizes		17000.00
Organisational charges @ Rs. 2000 per district		34000.00
	Total	**51000.00**

At State level

Prizes	1st- 5000.00	
	2nd 3000.00	
	3rd 2000.00	
Total	**10000.00**	
Organizational charges	**10000.00**	

G.Total 10000 +10000 + 51000 = 71000

At state level from the prize money Rs. 2000, 1000, 600, will be utilized for awards to winning students and their guide teachers, remaining money will be utilized for books related to biodiversity. These books will be given to the libraries of winning schools. For giving further incentive an excursion related to biodiversity (wetland, hilly area, sea side) will be sponsored. An amount of Rs. 50000, 30000, 20000 is suggested to be given to winning schools for excursion i.e total amount of this project is One Lakh & Seventy One Thousand. (Rs. 1,71,000/-)

Project Proposal-38c

Title: Funds For Developing & Procuring Activity Books

Funds for developing special activity books for High School & Senior Secondary Schools	1,00,000/-
Funds for printing of acitivity books for libraries of all Senior Secondary Schools and High Schools. Approximate No. of Books 6000.	4,00,000/-
Total funds for developing & Printing of activity books	5,00,000/-
Funds for procuring general biodiversity books for libraries of 1300 Senior Secondary Schools and 1750 High Schools @ Rs. 2000/- per School	61,00,000/-
Grand Total	61,00,000 + 5,00,000 = 66,00,000/- (Sixty Six Lakh only)

Project Proposal-38d

Title : Funds For Non-Formal Environmental Educational Activity

Funds for an awareness rally on biodiversity in 5 districts @ Rs. 15000/- per District each year.	75,000/-
Funds for development & printing of 5000 Brochures on biodiversity each year.	15,000/-
Organizational Expenses including stationery, postage, etc. each year	10,000/-
Grand Total	1,00,000/- (Rs. One Lakh only)

One officer will be designated in State Institute of Science Education (SISE) for awareness to students & community regarding biodiversity.

Project Proposal-39

1.	Name of Project	:	**Biodiversity of Dermaptera (Earwigs) and Dictyoptera (Cockroaches and Mantides) of Punjab with particular reference to Shivalik region.**
2.	Strategy addressed	:	Promotion of R&D
3.	Implementing Agency	:	Dr Tarlok Singh, Retd. Professor Department of Zoology, Punjabi University. Patiala.
4.	Purpose	:	To work out the complete list of species of the above -mentioned two orders of Insecta and their relationships vis a vis other groups and environments.
5.	Brief description	:	These insects predominantly occur in tropical and semitropical regions. Dermapterans are leaf associated and omnivorous insects & predators and are of economic use.
6.	Time frame	:	Two Years
7.	Other Departments involved	:	Botany Deptt. of the Punjabi University, Patiala for identification of the Plants associated with the insects.
8.	Resources available	:	Basic lab facilities are available in the Deptt. of Zoology, Punjabi University, Patiala.
9.	Additional resources required, if any (including funds)	:	Traveling grants + Contingency (for local expenditure & literature collections). Rs. 20,000/- per year And Rs. 60,000/- per year as fellowship. Total Grant: Rs. 1,60,000/- (For 2 Years)
10.	Expected benefits	:	As no work is done in Punjab on these insects So, the work will fill up the gap and help in understandings the relationships among the insect groups.
11.	Any other comment	:	Under the Strategy and Action Plan of Biodiversity Conservation, it is essential to know about each and every group of animals but more essential is where no information there.

Project Proposal-40

1.	Name of Project	:	**Systematics of the Aquatic and Terrestrial Arthropod Fauna of Wetlands of Punjab**
2.	Strategy addressed	:	Promotion of R&D
3.	Implementing Agency	:	Department of Zoology, Punjabi University, Patiala 147 002
4.	Purpose	:	Survey & collection, identification and taxonomic keys, inventories and distribution maps, diagnosis and description of various taxa, conservation and management aspect, food chain studies.
5.	Brief description	:	The state of Punjab has the distinction of having three wetlands viz. Harike, Ropar and Kanjli as per Ramsar treaty. These are unique ecosystems hitherto not fully explored from the proposed point of view. The systematic study on the diverse Arthropods will help us in understanding specific and general long term roles of wetlands in ecological stability and sustainability.
6.	Time frame	:	5-10 Years
7.	Other Departments involved	:	Punjab State Council for Science & Technology, Chandigarh
8.	Resources available	:	University facilities
9.	Additional resources required, if any (including funds)	:	Manpower (JRF's 10 Rs. 6,00,000/- Lab Attendants 5 Rs. 1,80,000/-, Equipment Rs. 35,00,000/-, Contingency 10,00,000/, travel Rs. 5,00,000/-, Unforseen Rs. 5,00,000/-) Total: 62,80,000/-
10.	Expected benefits	:	Ecological, conservational and taxonomic approaches will help in establishing capacity building in these programmes.

Project Proposal-41

Name of Project	**Conservation of Agricultural biodiversity in Punjab**
Name of the Co-ordinator	The Additional Director of Research PAU Ludhiana
Name of Head of Departments	Part 1 : Dr. GS Sidhu Part 2: Dr. JS Hundal Part 3: Dr. JS Kanwar Part 4: Dr. SS Gill
Planned project duration	Five years initially
Funds requested	Rs. 1,52,43,360
A. Recurring costs	: Rs. 1,18,57,600
B. Non-recurring costs	: Rs. 20,00,000
C. Institutional charges	: Rs. 13,85,760

Introduction and Scope:

The different floristic and vegetation types of India support rich diversity in plant wealth because of diversity in climatic and geographical conditions coupled with ecological habitat. The vascular flora of India has large number of endemic species and these include potentially economic plants for timber, food, fodder, fuel, medicine, industry, etc. These invaluable resources are now threatened because of over exploitation of natural habitats to meet the demand of the growing population. The demand for the biological products is on the rise both for internal consumption and external demands. As a result, these have been exploited, butchered and ruthlessly exploited for a variety of reasons including developmental activities, industrial establishments, spreading habitations, etc. Approximately 98 per cent of the global vascular flora has become extinct during the past 400 million years. With the present rate of destruction, which is faster than ever before, a large number of species will be lost every year. According to an estimate of Threatened Plants Committee of International Union of Conservation of Nature and Natural Resources (IUCN) about 10 percent of world's flowering plants are reported to be dangerously under threat. It is, therefore, necessary that in the wake of such transformation, the rich heritage of mankind represented by diverse plant components are preserved for posterity. All our efforts by involving different agencies and public are thus warranted by inculcating the idea "World as Sanctuary". All human beings owe moral, ethical and religious responsibility in conserving the vast diversity created by the mother nature. Our action in the next few years will determine whether we take a road towards a chaotic future characterized by over exploitation and abuse of our biodiversity or take the opposite road toward maintaining great biodiversity and using biological resources sustainable. Let us all contribute our might in this essential and great task and in the process heal and enrich the planet.

At present, one quarter of the earth's biological diversity is in danger of extinction in the next 30 years. Studies have revealed that the cause of loss of biodiversity are varied; social, economic and political. This excessive consumption of a large part of world's resources by a small but rich minority of the world's population has caused an ominous imbalance. The destructive impact of the certain things the world's poor and hungry people do in a desperate bid to survival and the excessive population growth are also considered responsible for the over-exploitation of natural habitats. Furthermore, soil management, chemical fertilization, use of chemicals for pest, weed and disease control, as well as abuse of irrigation with anomalous water, have affected soil microbial composition in many areas. As a consequence, conspicuous segments of plants, animal or microbial genetic diversity were lost for ever. Another threat is the extreme genetic homogeneity brought about my monoculture in man made forests, moreover, such material are vulnerable to diseases and insect pests. Therefore, any upsurge of any mutant strains of the pathogen or pest shall provoke a wide spread switch of plantation reaction from resistance to susceptibility causing dramatic production losses. High production levels on new species/strains/clones can only be maintained over time if sufficient provision of genetic variability are made.

Biological diversity cannot be addressed as a single entity. it is just too many different kinds of things. Choices will, therefore have to be made on which aspects of diversity will receive highest priority in particular areas at particular time. Our flora is virtually a living gold which is crying for immediate care, protection and judicious utilization. We can no longer afford the rich green diversity to disappear. This project will discuss the forest diversity (floristic) as it has many values i.e. internal value, contributions to current and future resources, and contributions to overall environmental quality. If conserved and utilized properly, it may act as "Sanguine Booti" for the unhealthy economy of the country.

The project on conservation of biodiversity in Punjab will be undertaken as a coordinated project across the departments already involved in related activities. Presently, there is work going on collection and evaluation of germ-plasm in different crops including cereals, pulse crops, oil seeds, vegetable crops etc. Among trees, fruit crops, ornamental and forest trees are being taken care of. The activities are being carried out both at head quarters as well as at different research stations suited to the plant type. as the nature of work is very comprehensively diversified, as many as four different departments are presently involved in activities related to biodiversity conservation.

The project as proposed will undertake biodiversity conservation work systematically under the following heads:

1. Conservation of biodiversity in Agricultural Crops.
2. Conservation of biodiversity in Vegetable Crops.
3. Conservation of biodiversity in Fruit Trees.
4. Conservation of biodiversity in Forest Trees

The main activity will be to survey, collection, introduction, characterization, evaluation, and conservation of the germplasm for present use and for posterity.

Part 1 : Conservation of Biodiversity in Agricultural Crops

Objectives:

The project will have following broad objectives.

1. Augmentation of the existing germplasm collections of land races, wild relatives and progenitor species of major crop plants of Punjab.
2. Development and documentation of maintenance and utilization protocols for wild germplasm of various crop species.
3. Characterization of the assembled germplasm collections with respect to standard descriptors and easily scorable economic traits.
4. Assessment and strengthening of the "natural germplasm storage facility of P.A.U." at Keylong, H.P. for conservation of different plant species.
5. Current status of germplasm (land races/wild and weedy relatives) availability and utilization at PAU.

Methodology:

- In consultation with the breeders of different crops the relevant land races and wild germplasm will be requested from various sources within and outside the country at the outset of the project. The already available collections at PAU. Will also be requested from the concerned scientist.
- A small, centralized short term storage facility with controlled temperature and humidity and stand by power arrangement will be established in the department. (It is the basic infrastructure requirement for conducting this research).
- Cultural and environmental conditions required for growth and wild germplasm of various crops would be established. Several features such as dormancy and chilling/vernalization requirements are known is some cases. The project would linked up on already available information in this regard and devise small experiments to target specific problematic cases. The experiments would require the use of vernalization and growth chamber facilities.
- Storage requirements of various germplasm would be worked out in terms of short term artificial storage at Ludhina and medium term storage at PAU germplasm conservation facility at Keylong(H.P.). These experiments would be initiated in the first year of the project so that viability parameters can assessed in successive years of storage. A suitability of the natural conservation facility for different crops. Initial work with wheat and its wild relatives have shown this systems to be promising. Minimal running costs make it an attractive option worth detailed exploration.
- The project envisages to produce a manual of cultural practices environmental requirements for growth and reproduction of different groups of germplasms. The storage requirements of these plants materials will also be documented in the manual.
- The assembled collection will be subjected to characterization and evaluation with the help of crop experts acting as Co-PIs in the project. Beside generating the passport data and cataloguing with respect to standard descriptors, preliminary evaluations for economic attributes would be undertaken. Resistance to diseases and pests would serve as a major economic criteria.

- The evaluation and process would lay a major emphasis on wild progenitors species of crop plants and other same genome species. These represent a ready source of novel alleles with minimal linkage drag. These species have been demonstrated to confer improvement even for productivity and quality. The transfers do not require cytogenetic manipulations and are generally not accompanied by sterility. As a step towards utilization of wild germplasm crosses of cultivated species with progenitor wild species would be conducted and the crossed seed passed on to the crop breeders for raising F1 and backcross generations.
- The characterized germplasm would be multiplied and one set submitted to NBPGR, New Delhi for long term storage as well as dissemination to other research institutes.

Part 2: Conservation of Biodiversity in Vegetable Crops

Tomato, carrot, okra and ash gourd are important vegetable crops of the state. A large number of diseases and insect-pest attack these crops thereby limiting their cultivation in Punjab state. To tackle these problems improvement of these crops can be undertaken by use of new germplasm. For this programme exploration, collection, evaluation, characterization, maintenance and utilization of the germplasm is essential. For a effective breeding programme, there is an urgent need to collect available germplasm of these crops from appropriate places and systematically screen it for various traits.

Objectives:

1. Exploration and collection of large number of germplasm from appropriate centers.
2. Evaluation and characterization of the germplasm as per the descriptors list of NBPGR .
3. Maintenance of germplasm

Part 3: Conservation of Biodiversity in Fruit Trees

The Punjab has rich biodiversity of minor fruits like galgal, pomegranate, jamun, jamoa, karonda, bael, etc. These fruits are vary important from medicinal point of view, because these are rich sources of vitamins, minerals, carbohydrates, etc. More importantly these fruits are ecologically and economically viable for the state. The need of the hour in the state. The need of the hour in the state is diversification of the present wheat-rice systems of rotation, which has created many problems for the growers as well as for the state policy makers. Substantial area can be diverted towards these fruit crops from the traditional cropping systems. The Johl committee in 1986 also suggested to divert at least 6 per cent of the cropped area towards fruit growing. Hence, the scheme is proposed to survey the area, particularly the Kandi and Shivalik foothills for collection, propagation, planting maintenance and evaluation of ideal genotypes of the fruit crops like phalsa, fig, jamun, jamoa, loquat, dela, jack fruit, lasora, karonda, amla, bael, mahuwa, capegooseberry, water nut, wild persimmon, pomegranate, galgal, plum, prickley pear, dheu, imli, pilu, etc.

Objectives:

Survey, collection, propagation, planting, maintenance, evaluation and recommendations of ideal genotypes for commercial cultivation.

Details of work for achieving above state objectives: The extensive survey of the state will be conducted to collect the different genotypes and these will be evaluated under the suitable agro-climatic conditions for their plantation.

Part 4: Conservation of Biodiversity in Forest Trees

The present project will be under taken with the following objectives:

1. Survey and quantification of germplasm.
2. Classification/exploration of different plant species for the commercial use and their Ex-situ conservation.
3. Establishment of botanical garden/arboretum of commercially exploitable species.
4. Standardization of commercial propagation techniques.
5. Educate the people for judicious use of natural resources and their conservation.

Total budget for the Project Proposal
"Conservation of Biodiversity in Punjab"

A. Item	**Ist year**	**IInd year**	**IIIrd year**	**IVth year**	**Vth year**	**Total**
TA	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	10,00,000
Consumable cost*	6,00,000	6,00,000	6,00,000	6,00,000	6,00,000	30,00,000
Wages	6,00,000	6,00,000	6,00,000	6,00,000	6,00,000	30,00,000
B. Salaries						
Research Fellows (2) @ Rs. 10,500 PM +HRA	9,71,520	9,71,520	9,71,520	9,71,520	9,71,520	48,57,600
C. Non recurring	20,00,000	---	--	---	---	20,00,000
Total	43,71,520	23,71,520	23,71,520	23,71,520	23,71,520	1,38,57,600
Institutional charges (10%)	4,37,152	2,37,152	2,37,152	2,37,152	2,37,152	13,85,760
Grand total	48,08,672	26,08,672	26,08,672	26,08,672	26,08,672	1,52,43,360

* Includes taxi charges for survey purpose.

Budget for the Project Proposal "Conservation of Biodiversity in Punjab"

Part 1: Plant Breeding

A. Item	**Ist year**	**IInd year**	**IIIrd year**	**IVth year**	**Vth year**	**Total**
TA	50,000	50,000	50,000	50,000	50,000	1,50,000
Consumable cost*	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
Wages	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
B. Salaries						
Research Fellows (2) @ Rs. 10,500 PM +HRA	2,42,880	2,42,880	2,42,880	2,42,880	2,42,880	8,69,400
C. Non recurring	5,00,000	--	--	--	--	5,00,000
	10,92,880	5,92,880	5,92,880	5,92,880	5,92,880	34,64,400

* Includes taxi charges for survey purpose

Part 2: Vegetable crops

A. Item	**Ist year**	**IInd year**	**IIIrd year**	**IVth year**	**Vth year**	**Total**
TA	50,000	50,000	50,000	50,000	50,000	1,50,000
Consumable cost*	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
Wages	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
B. Salaries						
Research Fellows (2) @ Rs. 10,500 PM +HRA	2,42,880	2,42,880	2,42,880	2,42,880	2,42,880	8,69,400
C. Non recurring	5,00,000	--	--	--	--	5,00,000
	10,92,880	5,92,880	5,92,880	5,92,880	5,92,880	34,64,400

* Includes taxi charges for survey purpose

Part 3: Horticulture

A. Item	**Ist year**	**IInd year**	**IIIrd year**	**IVth year**	**Vth year**	**Total**
TA	50,000	50,000	50,000	50,000	50,000	1,50,000
Consumable cost*	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
Wages	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
B. Salaries						
Research Fellows (2) @ Rs. 10,500 PM +HRA	2,42,880	2,42,880	2,42,880	2,42,880	2,42,880	8,69,400

C. Non recurring	5,00,000	--	--	--	--	5,00,000
	10,92,880	5,92,880	5,92,880	5,92,880	5,92,880	34,64,400

* Includes taxi charges for survey purpose.

Part 4: Forestry & NR

A. Item	**Ist year**	**IInd year**	**IIIrd year**	**IVth year**	**Vth year**	**Total**
TA	50,000	50,000	50,000	50,000	50,000	1,50,000
Consumable cost*	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
Wages	1,50,000	1,50,000	1,50,000	1,50,000	1,50,000	4,50,000
B. Salaries						
Research Fellows (2) @ Rs. 10,500 PM +HRA	2,42,880	2,42,880	2,42,880	2,42,880	2,42,880	8,69,400
C. Non recurring	5,00,000	--	--	--	--	5,00,000
	10,92,880	5,92,880	5,92,880	5,92,880	5,92,880	34,64,400

* Includes taxi charges for survey purpose.

Project Proposal-42

1.	Name of Project	:	**Establishment of community seed bank and cultivar regulatory systems to create IPR benefits to local farmers**
2.	Strategy addressed	:	Conservation of Agricultural Biodiversity
3.	Implementing Agency	:	Department of Plant Breeding, Punjab Agricultural University, Ludhiana-141004
4	Time frame	:	Five years initially
5.	Other Departments involved	:	PSCST Department of Agriculture, Punjab
6.	Resources available	:	University Resources
7.	Additional resources required, if any (including funds)	:	Rs. 93,98,000 Rs. 68,98,000 Rs. 25,00,000

Project Details:

Background:

Plant Breeding initially started as a private enterprise of the primitive farmer but subsequently became organised and mostly government funded sector. The development and release of maize hybrids in USA during 1930's attracted the interest of private sector. Implicit in the private sector's interest was the protection of innovation and adequate financial returns. Different forms of protection of new plant varieties were developed for over 100 years in many countries. The direction and impetus in these activities was provided by establishment of an intergovernmental organization (Union International Pour La Protection Dos Obsention Vegetables or (UPOV), with headquarter at Geneva. It was established under International Convention for protection of New Varieties of Plants which was signed in Peris in 1961. The convention was later revised in Geneva in 1972, 1978 and 1991. Recognizing the needs of globalization of economy and necessity of meeting obligations under agreement on Trade Related Intellectual Property Rights (TRIPS), Indian parliament recently passed the Plant Variety Protection and Farmer's Rights Act, 2001. The law not only grants Plant Breeder's Rights on new varieties of seeds but also recognized the farmer's rights. As per chapter VI, clause 39 of the Act, a farmer who has bred or developed a new variety shall be entitled for registration and other protection in like manner as a breeder of a variety under this act. In addition, a farmer who is engaged in the conservation of genetic resources of land races or wild relatives of economic plants and their improvement through selection and preservation shall be entitled in the prescribed manner for recognition and reward from the gene fund.

In light of provisions of the farmer's rights enshrined in the bill it is proposed to develop a separate cell in the university for establishment of community seed bank and cultivar regulatory system with following broad objectives:

1. To provide advisory service to farmers desirous of getting their germplasm protected.
2. To generate necessary data for registration of varieties bred/selected by the farmers.
3. DNA fingerprinting of elite land races and farmers collections.
4. Registration of farmer's varieties as source of germplasm
5. Protection of farmers against innocent infringement.
6. Establishment of community seed banks for protecting farmers from monopolistic tendencies among breeders of the protected varieties and to provide them succour at the time of natural/manmade calamities.

Project Methodology:

1. Establishment of IPR advisory cell

An adequately manned cell will be created in the University to undertake following IPR related activities:

i) Establishment of national/international data base of protected varieties in key crops.
ii) Helping farmers in evaluating the suitability of their germplasm for protection.
iii) Initial testing of farmer's germplasm/landraces to identify their key characteristics/DUS testing.
iv) Channeling and providing technical base to the applications for registrations received form the farmers.
v) DNA fingerprinting of elite germplasm and landraces for their ultimate protection.

2. Dissemination of IPR related knowledge among farmers

Creation of broad awareness among the farmers about various IPR issues will be the most important activity of the project. This will help in not only aiding farmers to get benefits of IPR's but also save them from innocent infringements. This activity will involve use of audio visual media/organization of state level and district level training camps.

3. Human resource development of key University staff in the area of plant variety protection

In the absence of trained technical manpower, it will not be possible for the University scientist to help farmers to derive IPR related benefits. Key scientists engaged in plant variety production will first be trained in advanced countries. These key scientists will extend their expertise to rest of the involved faculty and subsequently to the farmers.

4. Establishment of community seed banks

Community seed banks will be established to provide short term storage facility to the farmers at a small cost (no profit no loss basis). This will help in

obviating shortage of seeds due to their deliberate short supply or at the time of natural calamities. Such community banks can initially be established in KUK's or farm advisory service of the University.

BUDGET

Item of expenditure	First year	Second year	Third year	Forth year	Fifth year	Total
A. Recurring Contingencies						
1. TA	20,000	20,000	20,000	20,000	20,000	1,00,000
2. Training of research staff	3,00,000	3,00,000	3,00,000	--	---	9,00,000
3. Training of farmers	2,00,000	2,00,000	2,00,000	2,00,000	2,00,000	10,00,000
4. Operational costs	4,00,000	4,00,000	4,00,000	4,00,000	4,00,000	20,00,000
B. Salaries Research Fellow (4) (@ Rs. 10,500 PM+ HRA)	5,79,600	5,79,600	5,79,600	5,79,600	5,79,600	28,98,000
C. Non recurring	12,50,000	12,50,000	--	--	--	25,00,000
Total	27,49,600	27,49,600	14,99,600	14,99,600	14,99,600	93,98,000

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