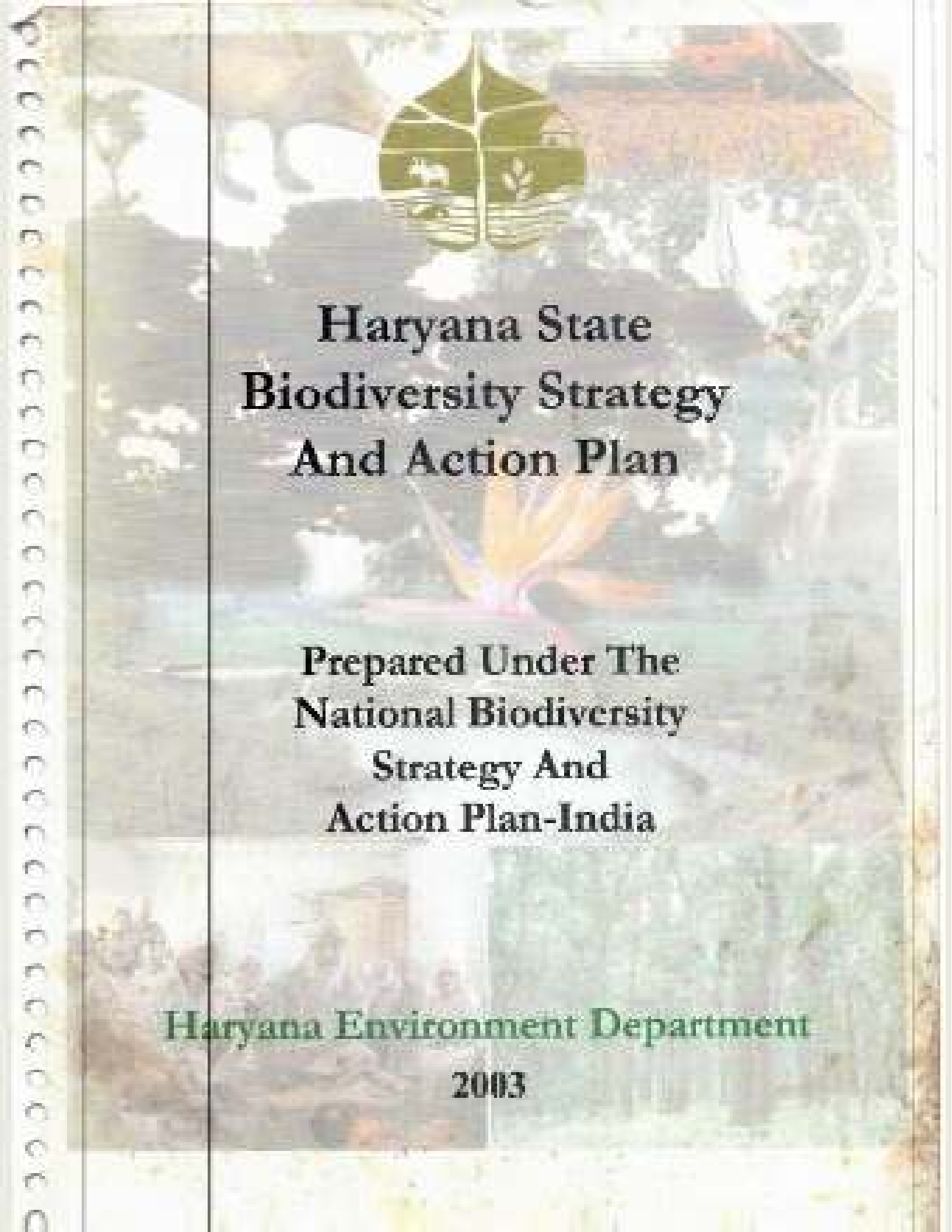


Haryana State Biodiversity Strategy And Action Plan

Prepared Under The National Biodiversity Strategy And Action Plan-India

Haryana Environment Department

2003

HARYANA STATE BIODIVERSITY STRATEGY AND ACTION PLAN

PREPARED UNDER THE
NATIONAL BIODIVERSITY STRATEGY AND
ACTION PLAN - INDIA

HARYANA ENVIRONMENT DEPARTMENT

2003

NBSAP EXECUTING AGENCY: Ministry of Environment and Forests, Government of India
NBSAP FUNDING AGENCY: United Nations Development Programme (UNDP)/Global Environment Facility
NBSAP TECHNICAL IMPLEMENTING AGENCY: Technical and Policy Core Group (TPCG) coordinated by Kalpavriksh
NBSAP ADMINISTRATIVE AGENCY: Human Consortium India Ltd.
HARYANA STATE BSAP NODAL AGENCY: Haryana Environment Department
NODAL AGENCY PERSONNEL: Mr. D.S.Dhesi, IAS, Secretary,Environment
Mr. Sarbjit Singh, IAS, Director, Environment
STEERING COMMITTEE/WORKING GROUP/LOCAL ADVISORY GROUP MEMBERS: (names of all members)

1. Commissioner and Secretary to Government, Haryana Environment Department.	Chairman
2. Director, Environment Department, Haryana.	Member-Secretary.
3. Director, Agriculture Department Haryana.	Member.
4. Director, Horticulture Department, Haryana.	Member.
5. Director, Fisheries Department, Haryana.	Member.
6. Principal Chief Conservator of Forests, Haryana.	Member.
7. Engineer-in-Chief, Irrigation Department, Haryana.	Member.
8. Director, Animal Husbandry Department, Haryana.	Member.
9. Chairman, Haryana State Pollution Control Board.	Member
10. Director, Land Use Board, Haryana.	Member.
11. Engineer-in-Chief, PWD (Public Health) Department, Haryana.	Member.
12. Dean, Haryana Agriculture University, Hisar.	Member.
13. Chairman, Department of Environmental Sciences, Guru Jambheshwar University, Hisar.	Member.
14. Chief Wildlife Warden, Haryana.	Member.
15. Director, National Dairy Research Institute, Karnal.	Member.
16. Director, National Bureau of Animal Genetic Resources, Karnal.	Member.
17. Director, National Institute of Soil Salinity, Karnal.	Member.
18. R.D. Jakati, IFS, Chief Conservator of Forests, Haryana.	Member (Chairman Drafting Committee).
19. Shri Rajiv Kakkad, Lecturer, M.L.N.College, Yamuna Nagar.	Member.

TPCG MEMBER ASSOCIATED: Mr. Madhu Sarin, H.No.48, Sector 4, Chandigarh.

PEER REVIEWERS:

1. Forests and Plant life ——— Sh. Gurnam Singh, IFS, H.No.484-85, Sector-6, Panchkula.
2. Wildlife and animal life——— Sh. R.C. Tripathi, IFS, H.No.873, Sector 9, Panchkula.
3. Agriculture and medicinal plants— Dr. J.L. Dalal C/O Dr. R.S Dalal, Tech. Adv. to VC, CCS, HAU, Hisar.
4. Horticulture ——— Dr. R.K. Wadhwa, H.No.3191, Sector-37D, Chandigarh.
5. Fish and Aquatic fauna ——— Dr. Mrs. Usha Misra, Principal Scientist, Central Inland Capture, Fisheries Research Institute, Karnal.
6. Animal Husbandry ——— Dr. D.S Balaine, C/O Dr. Dharm Pal, Dy. Director, ICDP, Karnal.

CITATION:

Haryana Environment Department (2002), Haryana State Biodiversity Strategy and Action Plan, Prepared under National Biodiversity Strategy and Action Plan, executed by Ministry of Environment and Forests (Government of India), Technical implementation by Technical and Policy Core Group (TPCG), Coordinated by Kalpavriksh and; Administrative coordination by Biotech Consortium India Ltd., Funded by Global Environment Facility through United Nations Development Programme, 212 pp.

State Biodiversity Strategy and Action Plan

Contents

****

Foreword

The utilisation of various forms of plants and animal life has been an essential and integral part of human civilisation. There have also been conscious efforts to conserve biodiversity in practice since ages through various social, religious and agricultural traditions, and forests and wildlife management practices in our country. But the deliberate efforts to conserve the entire gamut of biological resource got impetus after the Convention on Biodiversity in 1992. This has mainly been because of the realisation of the economic importance associated.

Biodiversity conservation is a serious job. At the theoretical level it tends to be purely scientific while at the practical level it is obviously economic. Although, the old regimental management practices may be irrelevant, especially in the democratic polity of the country, yet at the same time making the resource totally free for all may not be a prudent policy. A balance, therefore, needs to be struck but within the frame work of the sustainability of the resource as a bottom line.

We may not know, fully, all that is with us but lack of knowledge should not be the reason for not taking adequate measures to prevent further degradation and loss.

I believe all these considerations have been kept in view while working out the strategies and action plans for the conservation of the entire range of biodiversity in the state.

O S Dhesi IAS
Commissioner and Secretary
Environment Department
Government of Haryana -cum-
Chairman, State Steering Committee
BSAP, Haryana

Chandigarh
MAY 2003

Acknowledgement

The genesis of National Bio-Diversity Strategy and Action Plan lies in the fact that we can not afford to sacrifice our tomorrow for the sake of today. The 1972 United Nations Conference on Human Environment at Stockholm, the convention on Biological Diversity signed by 188 Governments at the 1992 United Nations Conference on Environment and Development- The Earth Summit, coming into being of Global Environmental Facility, UNEP, UNDP demonstrate global concern for conserving environment and Bio-Diversity. The inter-dependence of different species hardly needs to be over emphasized. Over the years, a need for Sustainable Development has been felt everywhere.

Taking a big leap forward, apart from fulfilling the commitments made at the International level, Government of India in the Ministry of Environment and Forest decided for undertaking the largest ever environmental planning exercise in the shape of formulating a National Bio-diversity Strategy and Action Plan for the country. Like all other states, Haryana has prepared its own Bio-diversity strategy and Action Plan which will form the part of the National document. In this exercise, a large number of experts, departments, organizations, grass root level people have been involved. Obviously, in the process of accomplishing a job of such a magnitude, it is difficult to individually thank all those who made their contributions. However, I would like to express my gratitude to those who directly took part in this attempt on the preparation of State Bio-Diversity Strategy and Action Plan-Haryana.

The process was set in motion with the constitution of the State Steering committee in August, 2000. Regular meetings, discussions and monitoring at the level of Chairman of the State Steering Committee- Sh. D.S. Dhesi, IAS, Commissioner & Secretary to Govt. Haryana, Environment Department, were a source of constant inspiration, guidance and encouragement for the team. The detailed discussions with Sh. J.P.L. Srivastava, IFS, Chief Conservator of Forests, Haryana culminating into a survey on Bio-Diversity in 98 villages of Gurgaon, Mahendergarh and Rewari Districts occupies a significant part of the document. The co-operation extended by Sh. Rajiv Sharma, IAS, Deputy Commissioner, Yamuna Nagar, Sh. A.K. Singh, IAS, Deputy Commissioner, Gurgaon and their teams made the workshops conducted in their districts successful. The resource Dr. B.N. Mathur, Director, NBRI Karnal and Dr. S.K. Prasad, Director, National Bureau of

Animal Genetic Resources, Karnal is a valuable input. The papers received from Dr. M.S. Kahar, Registrar and Dr. B.S. Dahiya, Director, Research, Haryana Agriculture University, Hisar threw ample light on conservation of bio-diversity in agriculture. The Heads of Departments of participating Departments, Sh. Rajiv Arora, IAS, Director, Agriculture; Dr. K.S. Dangi, Director Animal Husbandry; Dr. V.P. Ahlawat, Director Horticulture; Sh. B.S. Saharan, Director, Fisheries; Sh. Banarsi Dass, IFS, PCCF made contributions relating to their departments. M.D. Sinha and Dr. Verma of Haryana Land Use Board provided timely assistance. An interactive session with Sh. N.S. Tiwana, Executive Director and Dr. Neelima Jerath of Punjab State Council for Science and Technology proved useful in the initial stages. Participation of Sh. V.D. Sharma, Co-ordinator Aravali Range Eco Regional working Group, Jaipur was of great value. Ms. Madhu Sarin made rich contributions on gender issues. The Regional Officers, Haryana State Pollution Control Board, Dr. S.S. Kadian and Mr. Bhagwan Singh took special pains during the organisations of workshops.

I will be failing in my duty if I do not thank the Senior Officers and eminent experts and scholars of Ministry of Environment and Forests, Government of India; UNDP; GEF; Technical and Policy Core Group and Bio-tech consortium India Limited, who sent guidelines from time to time and organized the mid-term national workshop from where many thrust areas came to our notice through the presentations and discussions. Mr. R.D. Jakati, IFS, Chief Wildlife Warden, Haryana assisted by Sh. D. Hembram, IFS Subject Matter Specialist, in addition to contributing his departmental share to this document also made every effort in his capacity as Chairman of the Drafting Committee to pool in all the resource material and compiled them to give its present shape in a time- bound manner. Last but not least, I appreciate the work done by the officers of my office Mr. A.K. Mehta, Mrs. Usha Sharma and Mr. V.K. Garg and the personal/office staff who were found always ready during the undertaking of this exercise. In the end, I wish to thank all those whose names I have not been able to mention.

Sarban Singh, IAS
Director, Environment, Haryana,
And member secretary/coordinator for
State steering committee
UNDP, Haryana

Chandigarh
MAY 2003

The term conservation is the essential and key ingredient of the concept of sustainable development. Conservation means protection and utilisation. For defining the term conservation another parameter which needs to be considered is the "time frame". In the context of natural resource conservation the "time frame" is "in perpetuity". This perpetual utilisation of the natural resource brings in the limits on the harvests. The utilisation, therefore, has to be in such manner so as to retain the natural resource intact for all future times to come.
We may think of a set of strategies for the conservation of certain resource under consideration for a definite foreseeable future but at the policy and vision level it must be clear that the resource has to be protected for all times to come.

These considerations have been kept in mind while working out the strategy and action plan in this report.

Although found throughout the natural biological resource is confined broadly to Forests and Wildlife, Agriculture, Horticulture, Animal Husbandry, Fishery and aquatic resources, sectors of the economy. The management of these sectors of economy lies with respective departments in the State. At present all of these sectors do not necessarily make conscious efforts for the conservation of the diversity as such but by virtue of knowledge and the skill of the concerned sectors appropriate inputs required for this strategy and action plan from the concerned departments and other institutions has been obtained and incorporated in this report. Definite sections have been allotted to each of these sectors and the interlinkages affecting the other sectors have been reflected in both. This approach of writing strategy and action plan separately for each sector is presumed to be of practical and implementable value.

Efforts have been made to make this document as complete as possible within the time constraints. The report incorporates the names of all the contributors, however, there might be others who might have contributed indirectly or directly but whose name may not be appearing in the list. We are grateful to all these people for sharing their experiences and contributions.

Jakati R D
Hanbaran D

Panchkula
MAY 2003

Summary

1. Haryana is amongst the smaller states of the Indian Union. The state has 1.3% of the total area of the country supporting 2% of its population. About 75% of the state population lives in rural areas and about the same percentage of the population depends directly upon agriculture. 77% of the land under agriculture is irrigated. Presently canal water irrigates 54% of the area and the ground water the remaining 46%. The state contributes about 6% to the total food production of the country. The per capita income of the state as recorded in 1996-97 at 1980-81 prices was Rs. 4029 and the state stood at 4 th position in the list of states and Union Territories in this regard. As per 2001 census (provisional), there were 861 females per 1000 males as against 865 in 1991. The literacy rate is 68.59% (excluding the children between 0-6 years).

2. **Natural resources**

About 83% of the land is put to agricultural use. The land under forests is barely 3.8%. Of the total forest area, about 30% is along the rail, road and canals in strips which are mainly man made plantations. The natural forests are mainly confined the Shivaliks on the northern border along Himachal Pradesh and Uttaranchal. The natural vegetation on the Aravalli Hills in the south is in degraded state.

2.1. Although the extent of wild resource is very limited yet the state is quite rich in ecological diversity. The state has Shivaliks and outer Himalayas, a substantial part under the Gangetic plains, the north eastern tail ending in Delhi of the Aravalli Hill system and a considerable area under the arid desertic conditions on the border of the Thar deserts. Each of these regions support flora and fauna of its own kind.

2.2. The central Gangetic plains are flat and accumulate water in depressions especially during the monsoon which harbour aquatic flora and fauna, and a plethora of migratory birds in the winter.

2.3. There is only one river, Yamuna, which is perennial and flows along the border with Uttar Pradesh. The other smaller rivers are seasonal.

3. The State BSAP

3.1. This strategy and action plan deals with the state of Haryana within the overall frame work of the National Biodiversity Strategy and Action Plan and attempts to deal with the issues of conservation and sustainable utilisation of the biodiversity in a holistic manner.

3.2.1. The strategy and action plans for the conservation of biodiversity were obtained from the departments dealing with the corresponding natural resource. In the process, the state departments of Agriculture, Forests, Animal Husbandry, Wildlife, Horticulture, Fisheries were involved. Inputs were also obtained from the National Dairy Research Institute, Karnal, CCS Haryana Agriculture University, Hisar, Department of Zoology, and Botany, Punjab University and Institute of Microbial Technology.

3.2.2. To get the views of people, two workshops were organised at Yamunanagar and Gurgaon. To get the perceptions of all the categories of rural population survey was conducted in 98 villages in Gurgaon, Mahendergarh and Rewari. Two public hearings were also organised. One was organised in the Chhikni village in the Shivalik foothills of Yamuna Nagar district and another was organised at village Bodla in the fertile ganagetic plains of Kurukshetra district.

3.2.3. The contributions obtained from the volunteers have also been incorporated in the report.

3.3. This report contains the strategy and action plans for the sectors separately. It is felt that this scheme of writing separate chapters for different sectors will be helpful and easy especially from the comprehension and implementation point of view.

4.0 Reasons for loss of biodiversity

4.1 One of the most important reasons for the loss of biodiversity which manifests in different forms is the increasing human population. The waste lands which met the fuel and fodder requirement of the local community gradually were diverted for various developmental activities which resulted into the increased pressure on the natural resources. The increased human population is responsible for the encroachment of forest lands or utilization of forestry resources and hunting of wild animals beyond the sustainable limits. In the last 50 years the lands where domestic animal could graze

decreased by 45%. The decrease in the available wastelands resulted into consequent pressure on the natural resources.

The Sukhomajri experiment has clearly indicated that the biological resource conservation in a developing country like ours is possible only with the joint efforts of the government and the local community especially those who depend most on these resources. Adequate care, therefore, has been taken to involve the local community in the conservation efforts suggested in the plan.

4.2. With increased population, the land holding decreased considerably. The formation of new state, Haryana, saw the taking up of large scale developmental. This coincided with the beginning of green revolution. These factors resulted into the conversion of wastelands for agriculture purpose, and the decrease of the fallow lands resulting into increasing pressure on wild natural resources. With the need for the increasing the agricultural productivity newer hybrid varieties were developed. The agricultural crop varieties which had evolved over centuries of human efforts were replaced by newer varieties. These new varieties produced more and so they removed more nutrients from the soil. The enhanced use of pesticides and fungicides disrupted the plant insect/pathogen association. The improved agriculture prosperity resulted into the loss of agricultural crop varieties and the destruction of floral and faunal composition of the agricultural field ecosystem.

4.3. The development resulted into the levelling of large number of wet lands affecting the aquatic fauna of the state. The increased pesticides also resulted into the decreased avian population, the most important of which, observed recently, is the mortality of peacock in the state.

4.4. To produce more wood to meet the local fuel wood requirements large scale afforestation of the community waste lands was done. Mono-culture was raised with high density of trees which did not allow the growth of other plants. Thus, even the afforestation activities have been responsible to some extent for the reduction of biodiversity in the areas out side forests. These plantations however indirectly reduced the pressure on the natural forests elsewhere and thus helped the protection of biodiversity of the natural forest areas.

5.0 Strategies

The following paragraphs summarise the strategies and action plans of the various sectors:

5.1. Forests

5.1.1. Creation of preservation plots in various vegetation types and ecosystems represented in the state is recommended.

5.1.2 Standardisation of nursery techniques of 100 lesser known species is proposed to be taken up. To reduce the pressure on the natural forests promotion of agro-forestry on farmers fields, promotion of silvi-pasture practice on community lands with very low tree density, and taking up of income generating activities for the population depending on the forests resources have been proposed.

5.1.3. For the conservation of the species and improvement of the habitat, soil and moisture conservation works and fire protection measures have been provided for.

5.1.4. To know and monitor the status of various species, it is necessary to have base line survey. This would also help in calculating the sustainable productivity potential of the various species (NTFPs). The preparation of biodiversity registers with the involvement of the local community especially the women has been included in the report.

5.1.5 The state is one of the pioneers in the field of Joint Forest Management (JFM) in the country, having evolved and successfully implemented the JFM rules. To further strengthen the people's participation in the management of natural resources throughout the state, provisions to this effect have been incorporated in the report.

5.2 Wildlife

5.2.1. For the conservation of the wild biodiversity and other vertebrate and invertebrate faunal diversity of the state, eight pronged strategies both short term and long term, has been stressed. Improvement of the habitat in the forested ecosystem by plantation of fruit species and making water available in the protected areas, provisions of water to the threatened wet lands and to protect the wild life out side the forest areas amendments to the Panchayat act to keep 25-30% of community lands under tree cover (very low density tree crop) have been suggested.

5.2.2. For creating the awareness amongst the people at large, nature education and conservation programmes, and to wean the communities involved in wildlife offences away, the provision of income generating activities have been suggested.

5.2.3. To help and monitor the status of various species at a later date, base line surveys including the preparation of biodiversity registers of all life forms and local traditions and knowledge have been incorporated in the report.

5.2.4. To conserve the biodiversity of the north western Himalayan region and also of the state, strengthening of the protection mechanism has been provided for in the report.

5.3. Agriculture

5.3.1. For the conservation of the varieties of various agricultural crops, improvement of soil and restoration of the earlier plant animal association through the use of farmyard manure and bio pesticides has been suggested. Although it is difficult to conserve all that we have lost yet it is hoped that this strategy will make a beginning to that effect.

5.3.2. Cryo preservation of various strains and genetic material has been suggested as an ex-situ conservation method.

5.3.3 During the process of development, the agricultural crop diversity as also of varietal diversity has greatly shrunk. This is proposed to be restored through extension and integrated crop management practices.

5.3.4. There are large number of medicinal plant species which are used for ailments. The CCS HAU, Hisar has proposed to take up a detailed survey of medicinal plants in the state, the study of their bio-chemical composition and also the pharmacology of various ingredients. The University has already formulated a project to that effect. The project also envisages holding of workshop to elicit the local knowledge of the people about various plant and animal species. The preparation of the biodiversity registers with the involvement of the local community has been suggested.

5.4 Horticulture

Surveying and documentation of existing horticultural diversity by various means and various ex-situ and in-situ conservation methods have been suggested over a period of 20 years. The preparation of the register of local biodiversity is incorporated.

5.5 Fish and aquatic fauna

5.5.1. There are 77 species of fish of 41 genera found in the state. The list of endangered species of the fish has been mentioned. Rapid Industrialisation, pollution of water resource have direct bearing on aquatic ecosystem. Siltation of ponds and levelling of the depressions have led to depletion in the fish diversity.

5.5.2. The base line survey of the existing fish and aquatic fauna in the state already exists. However, a monitoring mechanism which is needed, has been incorporated in the report. The preparation register of biodiversity and local knowledge is also suggested.

5.5.3. For in situ conservation of the aquatic flora and fauna, some stretches of Yamuna river and some other canal systems is proposed to be declared as "Fish Sanctuary".

5.5.4. To reduce the pollution in the aquatic systems especially in the Yamuna river, setting up of the sewage treatment plants in major towns has been recommended. It has also been proposed to create bigger ponds in the Yamuna river bed for the conservation of the aquatic fauna.

5.6 Animal husbandry

5.6.1. The state is gifted with the presence of some of the very good cattle and buffalo breeds of the world. Murrah buffalo is world known. The Hariana breed of cattle is being cross bred with the high yielding European breeds. The Karan Fries and Karan Swiss breeds developed at NDRI, Karnal by cross breeding of Holstine Friskin and Brown Swiss have received wide acceptance amongst the farmers in the state.

5.6.2. The in situ and ex situ conservation measures have been proposed. Formation of breeder association and progressive farmers club is encouraged to be formed to adopt multi-pronged strategy including provisions for keeping biodiversity intact. Preparation of biodiversity registers and local knowledge and traditions has also been provided for.

5.6.3. Genetic mapping of the wilder relatives of the domesticated animals has been suggested over a period of next 15 years.

5.7 Financial requirements

The tentative requirements of the funds for the implementation of various action plans over 5-20 years' period as worked out for various sectors is given below:

*(Rs. in lakhs)

Sectors	5 year	5-10 year	10+ year
1. Forests and plant life	1921	1076.5	13779
2. Wildlife and animal life	50	1710	1233
3. Agriculture and medicinal plants	350	1500	23000
4. Horticulture	Up to 10 year	1040	
5. Fish and aquatic fauna	400	3200	1800
6. Animal husbandry	4800	3000	4000

* These financial requirements are based on very rough estimates and are likely to vary greatly.

Introduction

1.1. Brief background to the SAP

The National Biodiversity Strategy and Action Plan (NBSAP), a project of Union Ministry of Environment & Forests (MoEF) aims to produce a series of planning documents dealing with the conservation of India's biodiversity, sustainable use of its biological resources, and equity including in decisions regarding access to such resources and the benefits accruing from them. The project is funded by the Global Environment Facility through United Nations Development Programme (UNDP). A unique aspect of the project is that its technical execution is by a Technical and Policy Core Group(TPCG) being coordinated by an NGO Kalpavriksh, and its administrative coordination is by Biotech Consortium India Ltd.

The NBSAP process has included extremely widespread consultation across the country and across all sectors of society, involving tens of thousands of people. It aims to produce not one national action plan, but 18 local (substate) plans, 33 state and union territory plans, 10 ecoregional (interstate) plans, and 13 thematic plans. All these will coalesce into a national plan, but will also remain independent for implementation purposes. In addition, over 30 thematic papers have been commissioned on a variety of topics related to biodiversity.

Within this overall process, one of the state action plans is on Haryana, which has been drafted by various departments and agencies who are members of steering committee (the list of contributors is appended as annexure) consisting of persons experienced in the field.

1.2. Scope of the SAP

The SAP covers the State of Haryana, which is situated between 27° 39' to 30° 56' N latitude and 74° 27' to 77° 36' E longitude, covering an area about 44,212 Sq. km. It occupies 1.35% of the total area of the country. The state has natural geographical boundaries of the Shiwalik hills in the north, the river Yamuna to the east and the river Ghaggar in the West. The southwest boundary is provided by a range of Aravalli hills which runs through southern Delhi and Gurgaon district upto Alwar in Rajasthan. The state is bounded by Uttar Pradesh on the east, Punjab on the

west, Himachal Pradesh on the north and Rajasthan in the south. Administratively, the state has been divided into 19 districts. Various important aspects of the state have been provided in detail in Chapter 2 which deals of the profile with area.

1.3. Objectives of the SAP

The main objectives of the SAP, in terms of National Policy and Macro-level Action and Strategy on Bio-diversity, are to:

i) achieve conservation and sustainable use of biological diversity through consolidating ongoing efforts and initiating new steps wherever necessary.

ii) ensure participation of community, people, NGOs, industries and other stakeholders including women in the conservation and sustainable use of biodiversity.

iii) realize the consumptive and non-consumptive values of biodiversity through necessary investment in R&D & Biotechnology development.

iv) ensure benefit to the local community and people as conservers of biodiversity, creators and holders of indigenous knowledge systems, innovations and practices.

v) ensure consideration of biodiversity concerns in other sectoral policies and programmes.

1.4. Contents of the SAP

This SAP has been divided into a number of chapters. It generally follows the format suggested in the Ministry's publication entitled 'National Biodiversity Strategy and Action Plan-Guidelines and Concept Papers'. After the chapters dealing with introduction and profile of the State, further discussion has been organized sector wise. This has been done to facilitate a clear-cut demarcation of responsibilities and accountability in implementing the SAP. While it is necessary to recognize and clarify the linkages amongst the various sectors or agencies, which has been reflected in the action plans of the executing organization, the proposed sector wise action plan provides us the advantage of delineating the role of various organizations at the implementation stage. The Agriculture sector includes the SAP for domesticated crops, vegetables, and medicinal plants. The Fishery sector incorporates the SAP for

fish, frog, reptile and other aquatic fauna both domesticated and wild. The Forestry sector SAP includes all kinds of plant life including fungi, lichens, gymnosperms etc. The SAP of Wildlife sector incorporates all the faunal components including reptiles, amphibians, molluscs, pisces and mammals etc. The other sectors for which separate SAPs have been prepared are Horticulture and Animal Husbandry.

A SAP, which deals with a rich biodiversity at the level of genes, species and eco-systems, requires considerable amount of information. All of such information may not be readily available. An effort, therefore, has been made in this SAP to compile the information that became available as a result of concerted efforts. At the same time information is being collected on the gaps identified in this report. A lot of useful information has also been provided in the Annexes.

1.5 Methodology adopted for the compilation of the Strategy and Action Plan

For the compilation of this biodiversity action plan, the following method was adopted:

1. The nodal agency for the compilation of this action plan is Environment Department of Haryana. A meeting under the Chairmanship of Commissioner and Secretary to Government of Haryana, Environment Department was held initially. In this meeting the departmental heads of Agriculture, Animal Husbandry, Fishery, Horticulture, Forests, Wildlife and representative of Hisar Agriculture University were invited and they were requested to submit their strategy and action plan for the conservation of the biodiversity of their respective areas of working.

The final chapters sent by the respective departments were reviewed as per the guidelines of NBSAP (TPCG) by experts who were not involved earlier in making the state BSAP. The comments of these experts were sent to the concerned departments for their views. These have been incorporated in the final plan of the state.

2. The State of Haryana can broadly be divided into the northern and southern region. The first workshop of local Sarpanches, Non-Governmental Organizations (NGOs), Government officials of the concerned departments, individuals and women on biodiversity conservation in the State was held for the northern region in February, 2001 at Yamunanagar. For the southern

region a similar workshop of Government officials, NGOs, individuals, village representatives was organised in the month of June, 2001.

Two public hearings were organised. One was organised at the village Chicken in the foothills of Shivalik hills of Yamuna Nagar district. The second public hearing was organised at village Bodla in the fertile Gangetic plains of Kurukshetra district.

3. In order to get the views of all the socio-economic classes of the rural community on the conservation of the biodiversity, a survey was conducted in 88 villages of Gurgaon, Rewari, Mahendergarh districts of Haryana. The questionnaire prepared for the survey is appended as Annexure .

4. The detailed write up on the biodiversity in the field of Agriculture, Animal Husbandry and Horticulture and the strategy and action plan to conserve the same was obtained from Hisar Agriculture University. The concerns as given their write up on these three fields has been incorporated in this report.

5. For the conservation of domesticated animals, the strategy and action plans were obtained from National Bureau of Animal Genetic Resources and National Dairy Institute, both at Karnal.

6. In order to cover the whole spectrum of biodiversity of the State, inputs were requested from the Botany Department, Zoology Department of Punjab University, And also from Institute of Microbial technology Chandigarh. These inputs have been incorporated at the appropriate place.

7. Inputs from individuals who had volunteered to help in the formulation of the SAP have been incorporated in the report.

Profile of the state

1.1 Area and location

The state of Haryana has an area of 44212 sq. km. which forms 1.3 percent of total area of the country. The state's landscape and soil fertility are remarkably diverse. Situated in the north of Indian Union it is bounded by Uttar Pradesh and Uttaranchal in the east, Punjab on the west and part of Himachal Pradesh on the north and it extends to Rajasthan in the south. It is located between 27° to 31° north latitude and 74° to 77° east longitude.

The national capital Delhi is surrounded on three sides by Haryana. Nearly half of National Capital Region representing about 40 percent of its population falls within the state.

1.2 Administrative set up

The state of Haryana came into being on 1st November 1966 as the 17th state of the Indian Union, as a result of reorganization of erstwhile state of Punjab into Haryana and Punjab. For administrative purposes, the state is divided into 4 Divisions namely Ambala, Hisar, Rohtak and Gurgaon. The state is further subdivided into 19 districts 45 sub-division, 65 tehsils, 31 sub-tehsils, 111 development block, 94 towns and 6759 inhabited villages. There are 90 state legislature assembly seats and 10 parliamentary seats in the state. At the time of formation of Haryana state, there were seven districts viz, Ambala, Karnal, Rohtak Gurgaon, Mahendragarh, Hisar and Jind. During the subsequent reorganization of the state 12 new districts were notified from the time to time by changing the boundaries of the districts. The districts of the state are shown in Figure below:

1.3 Climate and rainfall

The climate of the state is subtropical, semi-arid to sub-humid, continental and monsoonic type. The average rainfall of the state is 360 mm which varies from less

from 350 mm in south-western parts to over 1000 mm in the hilly tracts of Shivalik hills. The state has 3 main climatic regions. Average annual rainfall and air temperature are given below:

Table 1.3 Rainfall and temperature of Haryana.

Region	Mean Rainfall (mm)	Avg. Temperature (°c)
Hot Arid Region	300-500	27
Hot Semi Arid Region	500-750	26
Hot Sub Humid Region	750-1050	24

1.4 Physiography

Haryana located between the Shivalik hills on the northeast and Thar Desert on the south-west borders mainly the inland drainage basin. A topographical depression exists in the center with its axis passing through Delhi –Rohtak-Hisar and Sirsa on the regional scale. The state also forms a divide between Indus and Ganges basins. Haryana state has a flat topography with altitude varying from 130 to 480m above the mean sea level except some hills of the Shivalik in the north and those of Delhi system in the south.

The state is bounded on the east by the river Yamuna. Ghaggar, Tangri, Markanda and Chautang are the other important rivers. Its northern part generally slopes from the north-east to south-west, but the southern section is undulating due to the hills of Aravalli system and sand dunes. The non-perennial streams flowing in the south are Krishnawati and Kotla Dhipur.

Yamuna is the only perennial river. It forms the boundary between Haryana and Uttarpradesh for over 320 km. The Ghaggar river rises on the slopes in the Shivaliks in Sirmur and enters Haryana near Pinjore. It alternately passes through Punjab and Haryana before entering Rajasthan and ultimately disappears in Hanumangarh area of Rajasthan.

1.5 Geology

The geological formation ranges from precambrian to recent times and can be divided into 3 geological systems, viz.,

i) Aravalli System

ii) Shivalik System

iii) Indo-Gangetic Alluvial Plains.

1.5.1 Aravalli system is the oldest formation present in south western parts of the state covering Bhiwani, Mahendragarh, Rewari and Gurgaon districts. They are composed of quartzite sandstone, mica schists, phyllites and crystalline limestone.

1.5.2 The Shivalik system is located in northern part of Ambala and Panchkula districts and is composed of sedimentary rocks. The dominant rocks are sandstone, shale, clays and boulders.

1.5.3 Indo-Gangetic Alluvial plains are formed by deposition of alluvial sediments between Shivaliks and Aravallis and forms a part of great Indo-Gangetic plains. They consist of sand, silts, clays and occasional gravel beds. Wind blown sand deposits are found in the form of sandy plains and sand dunes over alluvial deposits in parts of Bhiwani, Hisar, Sirsa and Fatehabad districts.

1.6 Soils

The soils of Haryana have been divided into 10 distinct units namely soils of Shivalik hills, soils of piedmont plains, soils of Aravalli hills, soils of old alluvial plains, soils of old alluvial plains with sand dunes, soils of active flood plains, soils of undulating plain, soils of aeolian plain.

1.7 Water resources

1.7.1 Water scenario

Haryana state is in a disadvantageous position with regard to rainfall, surface water quantum and groundwater quality. On an average, the state receives 545 mm

rainfall annually, as compared to the environmental requirement of 1550 mm and the country's average rainfall of 1250 mm. The total potential utilizable surface and groundwater resources are estimated at 25.1×10^9 m^3/year. The total surface water potential is 14.8×10^9 m^3/year and includes the state's share of 4.2×10^9 m^3/year of Ravi and Beas water, yet to be developed. Total potential groundwater resources are estimated at 10.3×10^9 m^3/year including marginal quality groundwater. In addition to canal water and groundwater, effective rainfall for meeting consumptive use demand of crops is estimated at about 10×10^9 m^3/year.

For the projected cropping pattern and a gross cropped area of about 5.2 million ha in the year 2000, the gross irrigation water requirement (excluding effective rainfall) has been estimated at 46×10^9 m^3/ year. The potential availability is, therefore, only 80 percent of the irrigation water requirement. However, present use of the potential water availability is even less than 50 percent of the requirements. In addition to agricultural water requirements, the demand for other uses, such as municipalities, industries, forestry and livestock is expected to be about 2×10^9 m^3/year, which makes the effective demand of water of the order of about 48×10^9 m^3/year.

1.7.2 Surface water potential

Haryana state falls under two major river basins, the Ganges and Indus basin. The Yamuna river, a perennial river and tributary of the Ganges, flows along the eastern boundary of Haryana. The flow of Yamuna river varies from 6.4×10^9 m^3/year with an average of 10.3×10^9 m^3/year. The Ghaggar river on the western boundary of the state forms part of Indus basin. The Tangri, Markanda and Sarsuti, the minor streams flowing into Haryana state join the Ghaggar river on its left bank after passing through Kurukshetra district.

1.7.3 Groundwater

Ground water cell of Dept. of Agriculture, Haryana has carried out extensive studies on the quality and quantity of groundwater in Haryana. For this purpose, it has installed 2021 observation wells with spread throughout the state. Out of these 171 are piezometric tubes and another 104 as key observation wells. In addition Haryana State Minor Irrigation Tubewell Corporation(HSMITC), Central Ground Water Board

(CGWB) and Agriculture Dept. have drilled 639 exploratory bores to assess the quality and quantity of water at various locations of Haryana. Based upon the observations made from the observation wells, groundwater contours for pre-monsoon and post-monsoon have been prepared. It shows that maximum area falls between 5 to 20 metres depth of water table. Almost 13 percent area in pre-monsoon period and 28 percent area in post-monsoon is under critical water table level of 0 to 5 metres. Almost 9 percent of the geographical area has deep water table varying from 20 metres and above. This area falls mostly in the districts of Ambala, Mahendergarh and Rewari.

Historical water table fluctuations for pre-monsoon period for the period from 1974 to 1998 indicate the water table has fallen drastically in the districts of Kurukshetra, Mahendragarh, Gurgaon, Panipat and Panchkula. During the same period, water table has risen substantially in districts of Hisar, Jind, Bhiwani, Fatehabad and Rohtak. Historical water table fluctuations in the post monsoon period for the years from 1974 to 1998 indicate that the water table has risen in districts of Hisar, Sirsa, Jind, Bhiwani, Rohtak and Fatehabad. On the other hand, water table has fallen substantially in the districts of Mahendragarh, Gurgaon, Kurukshetra and Panipat. Thus, the position remains almost unchanged during the pre and post monsoon period as far as rise or fall in water table is concerned.

The percentage of fresh water is more in the shallow depth zone as compared to deeper depth zone. Water salinity becomes more predominant with the increase in depth of water zone. In fact, the area under saline water is substantially higher in the deep depth water zone. Position is more acute in case of districts Rohtak, Hisar, Bhiwani, Sirsa, Jind, Gurgaon and Sonepat.

Groundwater exploitation is highest in the districts of Karnal, Panipat, Kurukshetra, Rewari, Jhajjar and Yamunanagar. The least exploited districts are Bhiwani, Hisar, Panchkula and Sirsa. Groundwater balance is the difference between the net recharge and the net draft from aquifer. It has a set bearing on the long-term sustainability of water availability in the area. A look at the table shows that ground water has been over exploited in the districts of Mahendragarh, Kurukshetra, Karnal, Panipat and Rewari. Optimum exploitation is observed in the districts of Bhiwani, Gurgaon, Kaithal and Yamunanagar whereas it is underutilized in case of districts of

Hisar, Jind, Panchkula, Rohtak, Jhajjar, Sonepat and Sirsa. While over-exploitation need to be avoided, under-utilization of ground water potential shows the need for more efforts in this direction.

District Wise Position of Ground Water Exploitation (1997)

S. No.	Districts	Name & Category of Blocks		
		Over Exploited	Optimum	Under-Exploited
1.	Ambala	Barara Naraingarh	Ambala	-
2.	Bhiwani	Badhra Dadri-I Dadri-II	Loharu	Bawani Khera Bhiwani Tosham,Siwani
3.	Faridabad		Ballabgarh Palwal	Hathin Hodal
4.	Gurgaon	Farukh Nagar Gurgaon Pataudi Taoru, Sohna	Pataudi	F.P.Jhirka Nagina Nuh
5.	Hisar (Including Faridabad)	Barka Tohana	Hansi Narnaul	Adampur Agroha Barwala Bas Bhattiankalan Bhuna Fatehabad Hisar-I,Hisar-II Uklana
6.	Jind	Alewa Safidon	-	Jind, Julana, Narwana, Pillukhera Uchana
7.	Karnal	Assandh Gharaunda Indri Karnal Nilokheri Nissing	-	-
8.	Kaithal	Guhla,Pundri	-	Kaithal,Kalayat Rajound
9.	Kurukshetra	Ladwa,Pehowa Shahabad,Thanesa r	-	-
10.	Mahindergarh	Atelli Nangal Kanina Mahindergarh Nangal Chaudhary	-	-

		Narnaul		
11.	Panipat	Madlauda,Panipat Samalkha	Israna	-

1.7.4 Irrigation system

In 1966, irrigation facilities were available for 1.3 million ha out of total cultivable area of 3.6 million ha i.e. 35 percent of the cropped area. The state government, therefore, accorded the highest priority to develop and utilize all surface and groundwater resources. New major and medium irrigation schemes and lift canal irrigation schemes were taken up in addition to modernizing old irrigation systems. The schemes for augmentation of deep tubewells, supplying groundwater to canals as well as direct irrigation to canals as well as direct irrigation tubewells were launched. As a result of the development of canal water and groundwater resources, the net irrigated area has doubled to 2.6 million ha which is about 70 percent of the net sown area. Presently canal water accounts for 54 percent of area and groundwater for the remaining 46 percent. Surface water irrigation in Haryana is received form two canal system, namely, Bhakra Canal Systems and Western Yamuna Canal system. These two main canal systems supply water by gravity to about 88 percent of the surface water irrigated area.

About 12 percent of state area in the south west consists of upland area with sand dunes and Aravalli hills and is not suitable for gravity irrigation. These areas are chronically drought prone and to provide life saving irrigation, lift irrigation schemes have been developed. These are Jui, Siwani, Loharu, Indira Gandhi, Jawahar Lal Nehru and Rewari Irrigation Schemes. The present irrigation system in Haryana is highly insufficient in terms of irrigation water allowances. In the Western Yamuna Canal Command Area, the annual allocation is 4950 m3/ha resulting in an annual irrigation intensity of 80 percent. In the Bhakra Canal System, the allocation is 6070 m3/ha with an irrigation intensity of 62 percent. In the lift irrigation systems, irrigation intensities vary from 4 to 28 percent. Irrigation water is supplied to farmers following the classic rotational schedule, also known as 'Warabandi system'. The farmer's entitlement of water is proportional to his land holding without consideration of soil type, crops grown, climatic factors etc. Irrigation water charges to the farmers are fixed based upon type of crops and area actually irrigated with

surface water. The water charges are very low and based upon the area actually irrigated. This system leads to over-irrigation and wasteful use of water.

1.8 Socio-economic status

The total population of the state as per 2001 census (provisional) is 21.1 million and has 1.3% of the total area of the country supporting 2% of its population. The percentage of the rural population is 75.37%. The density of population works out to be 372/sq km. The literacy rate (exclusive of children in the age group of 0-6 yr.) is 68.59%. The population of the state was around 58.59 lakhs in 1951. The population grew by 34% (1951-61) and 32% (1961-71) in the first two decades respectively but later the rate of growth slowed down and the population increased by 28.75% in 1981 and by 27.0% in 1991. The percentage of the population below poverty line reduced from 25% in 1971 to 12% in 1981.

The per capita income of Haryana as recorded in 1996-1997 at 1980-81 prices is Rs. 4029 and the state holds the 4th position in the Indian Union below Goa, Maharashtra and Punjab. The average All India per capita income stands at Rs. 2761. As per the 2001 census (provisional) there were 861 females per 1000 males as against 865 in 1991.

2.0 Agriculture

Agriculture is the mainstay of Haryana economy and it is the highest contributor to the state treasury. 75% of the population depends directly upon agriculture. In 1981 about 59% of the workers were engaged in agriculture sector as compared to about 63% in the year 1981. Wheat, Rice, Bajra, Gram, Sugarcane, Cotton and Mustard are amongst the principal crops grown. 80% of the total geographical area of Haryana is put to agriculture use, 77% of which is irrigated. The state produced 11.45 M tonnes of food grains in 1998, contributing about 6% to the total food production of the country.

After comparing the area in 1966-67 with that of 1996-97 it is seen that the area under wheat cultivation has increased by 103% and that of rice, by 271%. The area under all the crops under consideration has shown continuous increase. The increase in case of mustard (including rape seed) has been 367% and that of 223% in case of cotton. This increase in the area under mustard and cotton especially, has great significance from the Social Forestry point of view. The stalks of both these crops

are used as fuel in mainly the rural areas of the state especially in south Haryana. So it can be seen that the oilseed production has been responsible for meeting the energy requirements of the farming community to a great extent. These two crops have helped in easing the pressure on the plantations for fuelwood in the rural area.

The study on the 'Energy Consumption Patterns and Technologies in Villages of Haryana' conducted by Energy Research Center, Punjab University, reveals that 92% population in study areas uses agricultural residue while the percentage of population using agricultural residue in plains is 97% and 22% in hills.

The decrease in the landholding has been responsible for the increased intensity of cropping, the decrease in the extent of current fallow lands, and also in the decrease in the width of inter-field bunds. Earlier the width of the inter-field boundaries used to be about 1m which is now less than 0.6m. These wide bunds were a source of fodder in the rural areas which is not the case now. The current fallow lands used to provide temporary grazing facilities to the village cattle. The decrease in the land holding has lead to the decreased availability of fodder in the rural areas.

3.0 Forests

The forests in the context of the state could be divided into two main categories: the natural forests and the man made ones. The natural forests are mainly confined to the Shiwaliks on the northern border and to the highly degraded forests of the Aravalli Hills in the south. The total extent of the forests in the state is 1538 sq. km of which about 7.8% is private forest closed under Section 38 of IFA and under Section 4&5 of Punjab Land Preservation Act 1900. The extent of Reserved Forests (RF) is 16.06% and that of Protected Forests (PF) 74.97%. About 35% of the total PF is in the form of linear strips along rail, road and canal sides.

3.1 Natural Forests

The Shiwalik hill forests of the northern part of the state belong to the Northern Tropical Dry Deciduous type with Sal as the important species. In the higher elevation, in Morni Hills, the chir pine forests belonging to the Sub Tropical type Pine forests cover a small area of 22.7 sq.km. Dry Bamboo Brake forests, an edaphic climax, are found on the H.P. border. In the south and southwestern part, the vegetation belongs to Northern Tropical Thorn forest and cover sizeable area with *Acacia nilotica*, *Prosopis cineraria*, *Acacia senegal* as the important species.

The Aravalli Hills in the south carry the edaphic type-dangelatus pendula forest, most of which is in a highly degraded state. The blanks and the degraded areas have now been planted mainly by *Prosopis juliflora, A.senegal, Holoptelia* species etc. under EEC aided Aravalli Afforestation Project. Most of the natural forests are poorly stocked. In the good forests of Shivalik Hills the growing stock is around 50-60 m^3 / ha.

3.2 Man Made Forests

The degraded forests in the state have been planted mainly by species like *A.catechu, A. nilotica, Eucalyptus hybrid, D.sissoo, A. tortilis* and *Prosopis juliflora*. The strip forests are wholly man made and carry growing stock upto 60-80 m^3. The productivity of the forests depends on many factors but on an average Eucalyptus gives mean annual increment (MAI) of upto 10 m^3/ha/yr , but under good soil and moisture conditions MAI upto 18 m^3/ha/yr are not uncommon. The clonal Eucalyptus is likely to give MAI upto 20 m^3/ha/yr. A.nilotica produces MAI upto 8m^3/ha/yr on strips and about m^3/ha/yr in block forests in the semi-arid tracts of the state. The growth of A. tortilis which is extensively planted in the sandy deserts of the state gives MAI of about 3-4 m^3/ha/yr.

3.3 Agroforestry

Good economic returns from the initial yields of Eucalyptus in the early seventies gave a boost to agroforestry in the state. Eucalyptus was the preferred species among farmers till mid eighties. After its debacle in the late eighties, Poplar gained popularity and became an important species in agroforestry. With the decline in the economic returns from agriculture, due to various reasons, agroforestry is gaining prominence as one of the important options of land-use diversification being thought of in this region.

4.0 Common lands

In Haryana there are 5958 Gram Panchayats. The total number of Sarpanches is 5958 (3964 male and 1994 female). The total number of Panches is 54149 of which 30583 are male, 17928 female and 5648 belonging to Backward Classes. (Haryana Statistical Abstract 1996-97.) Of the total Panchayat land in Haryana 0.9 lakh hectares is cultivable land and about 2.142 lakh ha., the uncultivable land (Social Forestry Project, 1981). A study was conducted by The Indian Institute of Rural Management For Haryana Community Forestry Project on the common lands in

Haryana. It reveals that of the total common land 13% is under forest, 49% is used for non-agriculture purpose, 36% is leased out for agriculture, 5% is cultivable waste, 3% is pasture and grazing land and about 1% is barren and uncultivable waste. The study has also estimated that about 41% of the land is not under the Panchayat possession due to either leasing for agriculture purpose (22%), encroachment (10%) or social inamlat (9%). In Kurukshetra District, however, the extent of Panchyat area not under possession is of the order of 82% and of this area (not under possession) 68% is under encroachment. In Mahendragarh 13% of land not under possession is under encroachment. (Common Land study- TERI for HCFP, Haryana Feb. 2000).

5.0 Cattle Population

The population of different animals has undergone changes for various reasons. Earlier cows were maintained as milch cattle and bullocks were put into use as draught animals. Over the last thirty years, this population has shown a considerable decrease. This is because of two main reasons. First was the introduction and the subsequent popularity of tractors among the farming community in Haryana. This resulted in the removal of the bullocks from the agriculture scene thereby reducing the cow population. Secondly, the cows were slowly replaced by the buffaloes because cows yield relatively less quantity of milk as compared to buffaloes and they also require large areas as grazing lands which had been constantly decreasing in the state. On the other hand there is an increase in the population of sheep and goats which could be attributed to economic factors. Because of reduction in grazing lands and consequent reduction in the fodder availability, the number of nonvillaticks decreased. So some people, especially the landless and poor, started rearing sheep and goats instead of cows. Moreover, the sheep and goats can survive on relatively poorer fodder. Goats were reared mainly for meat and sheep for wool and meat. However, because of the availability of synthetic carpets in the market, the sheep is now reared mainly for meat purposes. There has not been any significant change in the camel population. The marginal reduction in the population is due to the replacement of camels by tractors in the southern districts of the state. The buffalo population in the state has gone up. This is because many people prefer buffaloes over cows for economic reasons. Moreover, buffalo is basically a stall fed animal and doesn't need vast areas of grazing land. The decreased extent of grazing lands, therefore, didn't affect their population growth. Moreover, because of increase

in the irrigational facilities the extent of land under cultivation of irrigated fodder crop has gone up by about 48% i.e. from 213 thousand ha. in 1977-78 to 316 thousand ha. in 1996-97. The number of tractors in the state has increased many folds. It was 4803 in 1966-67 but 1,87,678 in 1998-99. This increase is mainly responsible for the decrease in the population of cows and bullocks.

5.1 Grazing Lands

5.2 Permanent Pasture Lands

The land which was meant for grazing purposes has reduced from its 1966 value of 46 thousand hectares to 25 thousand hectares in 1997-98. The land was put to use for various other developmental activities.

5.3 Barren and uncultivable land

The lands belonging to this category were put to many uses like afforestation, construction of school building, hospitals, roads, housing colonies and other infrastructural facilities during the process of development. The extent of these lands in the year 1966 was about 212 thousand hectares, which in the year 1997-98 came down to 88 thousand hectares. This has reduced the grazing lands in the state. With the introduction of sprinkler irrigation system, many uncultivable lands have been brought under plough, especially in the south and south-west Haryana. This has also contributed to the decrease in the wasteland in Haryana.

5.4 Culturable but barren land

The land area falling under this category has shown a perceptible decrease i.e. from 87,000 ha. in 1966 to 73,000 ha. in 1997-98. One of the major reasons is the ever increasing demand for more cultivable land and the other, an increased availability of irrigation. This has facilitated the conversion of this category of land into agriculture land.

5.5 Current fallow land

The fallow lands in the villages have also reduced. Because of increased facilities of irrigation and decreased land holding in the state there has been a tendency to cultivate all available land. Every farmer in his effort to increase his income tries to cultivate most of the land he owns. This has lead to the reduction in this land category. Though these lands are not meant for grazing they are used as such when they are not under cultivation temporarily.

5.6 Forest lands

The extent of forest land has shown an increase from 91 thousand hectares in 1966 to 113 thousand hectares in 1997-98. This increase is at the cost of other categories of lands mentioned earlier. When new rail, road and canals are constructed, the waste strip along these utilities is declared as protected forest. Secondly, there has been acquisition of land by the Forest Department for various reasons, and also because of the transfer of land under Forest Conservation Act(FCA), 1980-compensatory afforestation purposes. These factors have led to the increase in the extent of forestland in the state.

It can thus be concluded that in the rural areas, all categories of land which could be used for grazing purposes have decreased considerably. The total area of all pasture land put together was reduced to 407 thousand hectares in 1997-98 from 715 thousand hectares in 1966 i.e., to 57% of its extent in 1966. It can thus be seen that there is a reduction of 43% in the land available for grazing in the state.

5.8 Energy Consumption Pattern in Rural Haryana

The consumption of various sources of energy in rural areas depends mainly upon the economic status of the user and the availability of the source of energy. Economically well-off population in villages now uses LPG. For example, in the prosperous villages of Jhansa and Jakhoda of Kurukshetra district, 60% of the villagers now use LPG as the main source of energy. This however, may not be applicable to all rural areas. In the areas in the proximity to the forests like those near the Shiwalik Hills of Yamunanagar, Panchkula and Ambala District or the Aravalli Hills in the south, the rural population still depends mainly on the wood brought from the forests.

The study on Energy Consumption Patterns and Technologies in Villages in Haryana (2000) has arrived at the following conclusions:

i) Wood consumption is maximum in hilly areas because of the relatively easy availability of wood from the forests.

ii) Consumption of cow dung and agriculture- crop residue is maximum in sandy areas. This is because of the easy availability of cotton and mustard stalks and relatively higher population of cattle in this region.

iii) The consumption of wood decreased with the increase in the household income. The middle income groups of rural population use cow dung and agriculture waste as the main source of energy and the population in the higher income groups of the village use more kerosene and LPG.

(Source: Study on Energy Consumption Pattern and Technologies in villages of Haryana. Energy Research Centre: Punjab University, Chandigarh 2000).

7.0 Socio-economic development and biodiversity

Understanding of natural ecosystems that support diverse flora and fauna is far more complex than imagined and involves intricate interactions between the organisms and the environment at various levels. However, definite evolutionary or economic significance of each and every organism of nature, whether identified or not, is established and accepted. Therefore, all the living organisms on the earth have one or other essential role for the ecosystem viability. The development of any kind without understanding the systems or far away from the natural systems only for economic goal is deleterious to natural resources and the environment. This understanding has strengthened the idea of conservation of biodiversity.

Increased population and economic development during last few decades saw a tremendous change in use of natural resources in the state. In order to meet the food requirement of ever increasing population, there have been intensive and revolutionized agricultural practices over three decades involving use of high yielding varieties, intensive use of chemicals, mechanization etc. Land resources have been subjected to severe exploitation by way of fragmentation, shrinkage of common and fallow lands being brought under agriculture and exploitation ground water for growing more food. Cropping pattern and practices have been changing so fast that a crop species or varieties lose their importance over a short period of time and space. Traditional agriculture practices which co-existed harmoniously in the past with natural environment have changed to become exploitative of nature and natural resources. Forest resources are depleting gradually but surely day by day due to increased biotic pressure, both from human and cattle which has led to irreparable destruction of wildlife habitat and damage to the watersheds. Changing life style of new consumer generation have developed distaste for forests, natural resources or professions related to natural resources and hence, indigenous knowledge is being lost with the passage of time. Such socio-economic developments have brought about

quantitative and qualitative changes and spatial distribution of a vast known and unknown flora and fauna of the state. Such developmental activities in many eco-regions have brought about drastic changes in landscape, which support diverse vegetation growth and native manageable living forms. Though quantitative information is not available, landscape modifications are amply indicative as to how the socio-economic changes have affected the flora and fauna of the state over the years.

Forests

8.0 Profile of Area

Introduction

The present section is an action plan for conservation of biodiversity submitted by Forest Department of Government of Haryana. Less than one percent of the area of the state has natural forests in Shiwalik and Aravalli hills. Except these natural and habitat forests not much of forest areas are left in the state and scope for action plan, therefore, is very limited. The existence of very small area under natural forests also highlights the reasons why natural forest area should be preserved because unless that is done whatever solid tract we have in the state would also be lost in foreseeable future. It is a sectoral plan by a line department, focussing perceptions of experienced professionals. For last two decades, at various interphases with the people, some lessons have been learnt in Shiwalik and Aravalli forest area which are also incorporated in the proposals made here under. Wildlife related strategy and action plan has been dealt separately. Habitat preservation is the core issue. For conserving living organisms sizeable areas are to be left out for supporting viable breeding populations. Unlike human beings habitat for wildlife is a space to exist, gather food, shelter, breeding ground to continue species and place for interaction with other species. If any of the above linkages fail, the remained habitat fails to serve natural purpose. While human beings can subsist by ingenuity and can create alternatives for difficult situations plants and animals have much less options in the game of survival. It is in this crucial understanding that altruistic nature of man should find expression to ensure inter - generational equity, hence this effort.

1.1 Geographical profile

Haryana has a geographic area of 44212 sq. km. It lies between latitude 27° 39' to 30° 56' N and longitude 74° 27' to 77° 36' E. The state is divided into two natural zones, the Shiwalik and the Aravalli Hills and the Indo-Gangetic plains. The Yamuna and the Ghaggar rivers are the important fresh watercourses of the state. Former being more important as it is perennial in nature, the later though seasonal in nature is beneficial as a source of recharge of water and also notorious for flood damage in Kaithal and other districts such as Sirsa. The land use pattern of the state is given in Table No 1.6 .

The state experiences sub-tropical monsoonic climate with bulk of rainfall during summer and some sprinkling of rain during winter owing to western disturbances. Winters are mild in comparison to harsh winters elsewhere in temperate countries. Summers are harsh and the temperature touches a maximum of 45° centigrade. The rainfall varies from 213 mm in south – west to 1,400 m in the north – east. The annual mean temperature varies between 22.5° C to 25° C.

The state can broadly be divided into four major vegetation/ phyto-geographical regions which are very briefly described below:

a) the northern most region has Shiwalik hills with northern tropical dry mixed deciduous forest with small patches of sal and chir pine and bamboo.

b) the central plain region which is predominantly prosperous agricultural land has practically nothing left of the earlier savannah with scrub vegetation of Ruta racemigerma and Acacia leucophloea .

c) the south-western sandy region borders the Thar desert and supports thorny vegetation.

d) in the south south-eastern part of the state the north north-eastern fringe of the Aravalli hill system supports highly degraded vegetation of Anogeissus pendula.

1.2 Socio – economic profile

Haryana state is an agrarian state with its majority of people engaged in raising agricultural crops. Traditionally keeping milch cattle is one of the important

subsidiary operations of peasants. Assured irrigation exists in 61 % of the area of the state, 50 % by canals and 11% by tube wells. There are 3, 75, 513 tube wells all over the state. River Yamuna through Western Yamuna Canal Irrigates central and eastern side of the state. Ghaggar being a monsoonic torrent is used to recharge ground water. Western districts use water from Bhakra System.

The rural populaces adjoining the Shiwaliks hill forest depend on the forest for their livelihood. In most forest the villagers have rights of fuel fodder collection against their service of protection of the forest from fire. The Aravali hills are by and large under the control of the village panchayats and there are very few government forests. Although the hills are denuded the poor people depend on these degraded hills for their fuel and fodder requirements. In the other regions the dependence of the rural community on the forests is minimal. Only the very-poor people depend partly on the forest vegetation, their most requirements being met by the agriculture waste.

1.2.1 Demography and life stock

The population of the state is 21.1 million (2001 census provisional). There is no Scheduled Tribe population in the state. Population density of the state is 477 persons per sq.km. Haryana is by and large a vegetarian, on account of which wild animal conservation should have been better than what it is today. But, for a flourishing agriculture land was diverted in the past in such an extent, loss of habitat is nearly complete. The state has a dubious distinction of having just 1.38 percent of habitat forests. Elsewhere in the country both non-vegetarian food habits of resident population and habitat destruction have continually damaged existence of variety of animals. The livestock population of Haryana is 9.14 million (1992 livestock census) which is largely stall-fed. Except in Shivalik and Aravalli hills damage to vegetation by goat and sheep is not rampant. Regular cattle migrations to escape drought situations periodically and annual migrations during dry part of the year occurs from Rajasthan and Gujarat.

1.2.2. Ethnic groups

A belt of Jats in central and northern districts of Haryana is evident. Those of early settlers are called "deshwali" and later settlers are called "bagris" meaning there

by new migrants from "bagar" (Barmer and Jaisalmere districts of Rajasthan). In to this more or less homogeneous group at the time of partition fresh repatriates from Pakistan were added. Land lost by them was reallotted in similar or comparable agro-climatic zones. Eventually large proportion of repatriates have since migrated to urban centres in search of better economic prospects. Gurgaon, Rewari and Mahendergarh have large concentration of Ahirs also, Jhajjar, Faridabad and Bhiwani have sizeable number of Ahirs in clusters. Above areas are locally called "ahirwal". Near southern side of Ahirwal adjacent to Rajasthan border there is a belt of Meos, a mughal time Mohammedan converts mostly belonging to mughal and meena tribes. Both varieties of Brahmans from Bengal (Gaur Desh Bengal, hence Gaur Brahman) and Saraswat Brahman (from extinct river saraswati on the banks of which lived fair skinned Brahmans) continue to live in the state. Some villages are single caste villages of Brahmans indicates caste wise pioneering occupancy of fertile plains. Gurjars mostly settled in hilly terrains carry out animal rearing. Some belong to Hindu fold and others to Islam fold, as they share common sub caste titles common origin is often concluded.

1.2.3 Major occupations

Agriculture and animal husbandry are the major occupations of resident population. In the hilly areas one of the minor occupations is mining building material. Youth from all ethnic groups tend to get themselves employed in defence services. Educational opportunities have since improved and technical and professional courses are being preferred.

1.3 Political profile

All villages have a panchayat and at the district level panchayats are organised in to Zila Parishads. Decentralization of power is proposed for effective grass roots democracy. Leader of the majority party is sworn in as the Chief Minister who acts as the chief political executive and chooses council of ministers. Every district has a civil administration headed by Deputy Commissioner helped by Additional Deputy Commissioner who specially looks after current economic development. Forest, Fisheries, Agriculture and Animal Husbandry are technical line departments. Line

departments are controlled by technical officers of respective lines and for coordination they are also controlled to a limited extent by Deputy Commissioner at the district level.

1.4 Ecological profile

1.4.1. Forest Resources

Haryana, an intensively cultivated state, is deficient in natural forests. The recorded forest area of the state is 167,300 ha which is 3.78% of the geographic area of the state. As per legal classification, Reserved Forest constitutes 14.76%, Protected Forest 65.99% and Unclassed Forest 19.25%. Forests are mainly distributed in the north - eastern and south - eastern districts of state. There are three forest types, the Tropical Dry Deciduous in the eastern part, Tropical Moist Deciduous in the Shivalik region and Tropical Thorn Forests in the western part of the state.

1.4.1.1 Protected Areas

One National Park and nine Wildlife Sanctuaries in Haryana cover an area of 23,975 ha. which constitutes 0.63% of the geographic area. Bulk of the above-cited area is at Abubshahar Wildlife Sanctuary as a large tract of above named sanctuary is privately owned agricultural land.

where no much of regulatory activity is being done, effective net work is very small. Proposed work in BSAP can usefully contribute towards this requirement.

1.4.1.2 Forests in Villages

There are 6,759 villages in the state of which 90 have forest as a land use. In these villages, 7,967 ha is classified as forest. Population inhabiting these villages is 0.13 million. The villages having less than 100 ha. forest

100-500 ha and more than 500 ha forest area in each village constitute 79%, 17% and 4% of the total villages, respectively. Table 1.1 provides details of villages by forest area and population.

1.4.1.3 Joint Forest Management

In Haryana, Joint Forest Management was started as early as 1972 though the Government notification in this regard was issued in 1990. The world famous Sukhomajri model of village development through the use and management of available natural resource was developed by Late Padmashri P.R.Misra.The concept of 'social fencing' evolved in Sukhomajri. There are, at present, 350 village level committees, 108 Resource Management Societies, (HRMSs), Village Forest Protection Committees,(VFPCs) managing 60,714 ha of forestland.

JFM is to be practiced in forests for their development and meeting the requirements of the local people. The net income is to be apportioned between the Government and the HRMS in 70% and 30%. The HRMS shall contribute 30% of its share towards plough back fund for further improvement of management area and another 10% towards *Kalyan Kosh* (Welfare Fund).The working of the JFMcommittees will be oriented towards biodiversity conservation through awareness generation camps--nature education camps held by Forest Department.

Table 1.1 Forests as land use in villages

Forest area	No. of villages	Total forest area (ha)	Populat ion
Less than 100 ha	71	1388	114,413
100-500 ha	15	3859	12,773
More than 500 ha	4	2721	492
Total	90	3967	127,678

1.4.1.4 Forest Plantations

The plantation activities in the state started extensively in early 1980s. Large-scale plantations were carried out under Aravalli Project since 1992. Plantations have been raised mostly on panchayat lands,

along the roads, canals, railway lines, water courses, on the available institutional land and on the farm lands.

Table 1.2 Forest plantations by all agencies

Period	Area in '000 ha
Upto 1980	72.87
1980-85	182.41
1985-90	159.35
1990-91	31.31
1991-92	46.12
1992-97	192.37
1997-98	19.61
1998-99	19.70
Total	742.74

Source: NAEB, MoEF: 1999

Existence of large-scale plantation outside forest (55 million trees) was also estimated by FSI through the inventory as reported in SFR-1997.

1.4.1.5 Forest Cover

The forest cover of the state, based on satellite data of November-December, 1996, is 964 sq.km. which constitutes 2.18% of the geographic

area. Dense forest accounts for 449 sq.km. and open forest 515 sq.km. An overall increase of 360 sq. km in forest cover has been observed in the present assessment compared to the previous assessment. The difference between the data periods of the two assessments is about 3 years.

The change matrix, given in Table1.3 reveals that there has been an overall increase of 79 sq.km of dense forest. This is the result of improvement of 18 sq.km of open forest, 17 sq.km of scrub and 61 sq.km of non forest to dense forest, which is partly offset by degradation of 3 sq. km to open forest and 14 sq.km of dense forest to non forest.

The increase of 281 sq.km of open forest is on account of conversion of 3 sq.km of dense forest, 93 sq.km of scrub and 280 sq.km of non-forest to open forest. The improvement is also associated with conversion of 18 sq.km of open forest to dense forest and 17 sq.km of non forest to open forest.

There are 19 districts in the state but boundaries of only 12 districts, excluding newly created ones, are incorporated in the SOI maps. The extent of dense and open forests and scrub, alongwith the change compared to 1997 assessment, has been provided in Table 1.4.

The table reveals that Gurgaon district has registered an increase of 212 sq.km, mostly in open forest category. In the previous assessment, the imageries used were mainly of October-November, 1994. Because of non-availability of suitable imageries of the above period for a part of Aravalli hills, imageries of October 1992 were used. Therefore, in the current assessment, for some part where extensive plantations were carried out, the changes reflected are for four years. Forest cover increase in Gurgaon, Mahendergarh, Faridabad and Rewari is mainly due to plantations raised under the Aravalli Project, which was started in early 1990s.

During the field visits the plantations of *Prosopis Juliflora*, *Acacia nilotica*, *Acacia tortilis*, *Albezzia* spp., *Euphorbia* spp., *Dalbergia sissoo*, *Acacia catechu* etc. raised during 1991-94, were observed. In Ambala also, plantations of *Eucalyptus* spp., *Acacia nilotica*, *Dalbergia sissoo*, *Bombax ceiba*, *Syzygium cumini*, etc raised between 1991-93 are now accounted for.

Table 1.3 Forest cover change

1997 Assessment (Data Oct.92 & Oct.-Nov.94)	1999 Assessment (Data Nov.-95) (Sq.km)				
	Dense forest	Open forest	Scrub	Non-forest	Total 1997
Dense	353	3	0	14	370
Open forest	18	199	0	17	234
Scrub	17	53	88	1	157
Non-forest	61	260	105	43,025	43,451
Total 1999	449	515	193	43,057	44,212
Net change	+79	+281	+36	-394	

Table 1.4 District-wise forest cover

1999 Assessment

(Sq.km)

District	Geographic area	Dense forest	Open forest	Total	Change compar ed to 1997	Scrub
Ambala	3,832	293	175	468	+63	64
Bhiwani	5,099	26	15	31	+19	5
Faridabad	2,150	23	33	56	+39	34
Gurgaon	2,716	83	199	282	+283	71
Hisar	6,315	11	3	14	+1	15
Jind	3,306	4	1	5	+1	0
Karnal	3,721	5	1	6	-4	1
Kurukshet	1,740	28	14	42	-3	0
Mahender garh	1,899	24	47	71	+12	0
Rohtak	1,841	1	20	21	+4	0
Sirsa	4,276	1	0	1	0	1
Sonipat	2,2077	0	7	7	-7	0
Total	44,212	449	515	964	1368	191

In Haryana 1082 species of angiosperms plants have been described as per Botanical Survey of India. The plants have been mostly described in the

flora of Chakrata by Sh. Kanji Lal, I.N. and also by Sh. Parker, R.N. As per the introductory pages of Maheshwari who has written flora of Delhi which includes adjacent districts of Haryana, there is diversity in plant species owing to convergence of three streams of vegetation, one type represents the Shiwalik hill vegetation, second the Indo Gangetic plain vegetation and a third from the Aravalli & deseric zone. Because of above convergence there is unusually large floral diversity not usually imagined to be existing in a small geographic area of 44, 212 sq. Km.

Owing to agricultural pressure most of the land is sown, about 83% constitutes the sown area. Rest of the area has canals, roads and rails that are scrupulously kept clean of vegetation. Only about 1% of the total land support natural plants and in that land also for economic reasons more of monoculture has spread leading to decimation of species. There are however some good area of natural vegetation left in some areas such as Morni, Panchkula, Pinjore, Kalesar, Jhir forest, Nimbi Duloth, Sohlabuddin which are to be further preserved and extended along scientific lines in consultation and involvement of people.

1.4.1.6 **Natural Forest and wildlife Ecosystems**

(a) Transitional Shiwalik Sal Forests of Kalesar, Yamuna Nagar District.

(b) Transitional Shiwalik Chir Forests of Morni, Panchkula District.

(c) *Anogeissus pendula* forests of Jhir area in Pimpro- Jhirka of Gurgaon District.

- (d) *Terminalia chebula* forests of Mandhna and Hathin- Udhoo- Panchkula District.
- (e) *Dendrocalamus strictus* or bans forests of Thadagarh- Pinjore- Panchkula District.
- (f) *Salvadora oleoides* forest of Nimbi Duloth with *Capparis aphylla* and *Acacia senegal* in Mahendergarh District.
- (g) *Commiphora wightii*- Gugal (endangered) forests of Madhogarh- Mahendergarh.

(h) *Sterculia urens* and *Acacia senegal* forests in Khol of Rewari District.

(i) Phoenix forest of Faridabad;

(j) *Prosopis cineraria, Tamarix articulata* forests of Sohlabudin, Mahendergarh district.

(k) Hill forests of *Anogeissus latifolia, Lannea coromandelica, Acacia catechu* in Panchkula and Yamuna Nagar districts.

1.4.1.7 Grass Land ecosystems

Not many grass land ecosystems are preserved in the State. Some of them that can be taken up for preservation are as under:

(a) *Cenchrus ciliaris/Cenchrus setigerus* grass lands of [illegible] and [illegible] Forests in Mahendergarh District.

(b) *Saccharum munja* grass lands in Sohlabuddin in Mahendergarh District.

(c) *Saccharum spontaneum* grass lands along the streambed of Sahibi in *[illegible]* Forest of Rewari District.

(d) Neem/*Saccharum munja* grass lands of *[illegible]* in Bhiwani District.

(e) Dholu grass lands of Mandhan (*Chrysopogon fulvus*)

(f) *Eulaliopsis binata* or Bhabbar grass lands of Morni & Yamuna Nagar.

(g) *Dendrocalamus strictus and Vetiveria zizanioides* grass lands of Saraswati plantations of Kurukshetra.

(h) *Diplachne fusca* Karnal grass lands of kallar areas.

1.4.1.8 Wetland Ecosystems

(a) Wetland ecosystem of Sultanpur in Gurgaon District.

(b) Wetland ecosystem of Bhindawas in Rohtak District.

(c) Wetland ecosystem of Chhilchhila in Kaithal District.

(d) Wet land ecosystem of Dam Dama in Gurgaon District.

1.4.1.9 **Desert Ecosystem**

Semi arid ecosystems that are similar to desert ecosystems have been covered elsewhere in Bhiwani, Rewari and Mahendergarh forest ecosystems hence have not been repeated here.

1.4.1.10 **Mountain Ecosystem**

Mountain ecosystem has already been covered under hill ecosystem and hence are repeated here.

1.4.1.11 **Coastal & Marine Ecosystems**

Coastal and marine ecosystems are not present in the state.

1.4.1.12 **Riverine ecosystem**

(a) Yamuna river - bank terrace riverine ecosystem.

(b) Ghaggar river - bank terrace riverine ecosystem.

Above ecosystems are present along Yamuna and Ghaggar rivers of Haryana State and it is proposed to conserve them.

1.4.1.13 **Other land-water uses: Unique habitats of the state**

1. Johar – Bani habitat

Apart from the above natural eco- systems, in villages of Haryana there are what are called village ponds or " Johars". All these johars have catchments that are kept under natural vegetation of the area and that patch is

called "bani". "Johar and bani" ecosystem is peculiar to Haryana. Usually it is associated with an open well that has fallen into disuse after piped water supply was given. This ecosystem requires to be rejuvenated into a village park by conserving diversity. It is proposed to develop these systems in representative areas at a cost of Rs. 100.00 lakh for a period of five years.

2. Bawri - habitat

In Shiwalik hills there are community maintained wells called as "bawri s". These community water holes were built around a spring called "sayal". The bawri had many levels. The top level, is generally covered overhead, to prevent unwanted material polluting water. It was kept separate for collection of drinking water. Excess water used to flow out and get collected at a lower level for consumption by domesticated animals. The over-flow from "Khal"- water point for animals, was used for washing clothes or taking bath by humans and the molem-water after coursing through some distance was again channelled into a natural drain. This ekbeautifully designed water supply system owing to disuse, after piped water supply came, requires to be rejuvenated in the hills. It is proposed to develop these systems in representative areas at a cost of Rs. 100.00 lakh for a period of five years.

3. Johar - Temple

In addition to being a water spot the village well used to be associated with "Kua Pujan" custom. Also, the village temple or mandir invariably used to be built near the well where village festivals get organised. Being rallying points of village community they used to serve a meaningful social purpose as a daily forum of interaction. Owing to disuse many of the social links are snapping they are required to be renovated as they give glimpses of extant low cost- low energy technologies that can be re invented in case of emergencies. It is proposed to develop these systems in representative areas at a cost of Rs. 100.00 lakh for a period of five years.

4. Jaal Forests of Mahendergarh & Bhiwani

Salvadora oleoides is a species that grows in semi-arid areas of the state. It occupies a unique place in the landscape of the state and gives it a

Savannah like appearance during summer. It is the habitat where lions lived in the past and feasted on plentiful supply of black bucks. Of course, lions have been eliminated from the state and are presently confined to remote areas of Kathiawar of Gujarat. Some time past such land, though privately owned, was not much valuable. Since the advent of deep tubewells and sprinkler irrigation such marginal areas have become valuable as they produce lucrative crops every year. Position of farmers is also pitiable and cannot be expected to preserve this habitat on their own initiative. Such areas are a habitat for lizards and reptiles of many species and if eliminated they are not likely to find a second home. It is proposed to preserve 200 ha. of such land, 100 ha. each in Mahendergarh and Bhiwani districts at cost of Rs. 160.00 lakh, which also includes possible cost of acquisition and fencing. It is proposed to convert them into nature parks.

5. Phoenix Forest of Faridabad District

An area about 25 ha. in extent is a patch of gregarious phoenix forests in the district of Faridabad. The area on the right bank of river Yamuna is the only patch of gregarious phoenix present in the State. The wild date fruits are a treat to many birds and rodents and attracts many food seekers. Also many migratory birds roost during night on these trees. Preservation of this unique heritage is a requirement of present time. Also the phoenix nursery and growth habits are required to be studied. It is to be preserved as nature park at a cost of Rs. 10.00 lakh.

6. *Capparis decidua* forests

Some of the old destroyed habitations of the area constitute suitable habitat for natural gregarious growth of *Capparis decidua*. These forests are a source of tender fruits called "dela" or "karir" in local parlance extensively used in pickle making in the countryside. The locations are getting gradually absorbed into cultivation or construction. Such areas eg. Beri Bhandore in Mahendergarh are proposed to be preserved in districts of Mahendergarh,

Jhajjar and Bhiwani to an extent of 100 ha at a cost of Rs. 200.00 lacs. It is to be developed as nature park for research and education.

7. Other species of ecological importance

There are patches of forests in various parts of the state having immense ecological value but have received inadequate attentions. Plant species in such forests are gradually disappearing due to change in land use pattern. Some of the species, for example, are Ilema nanosperma in the Aravalli hills and also in Karnal, Kaithal and Kurukshetra districts; Saccharum munja near Farukh Nagar and Firozpur Jhirka in Gurgaon districts and on some sand dunes in desert areas; Vetiveria zizanioides and Desmostachya bipinnata in various places of Kurukshetra and Karnal districts; *Ziziphus nummularia*, Flacourtia ramontchii, *Diospyros* spp. etc in various places of the state. It is proposed to protect and preserve these species by various conservation techniques in corresponding areas already mentioned elsewhere in the report.

In all the above vegetation types, where the land belongs to the community the conservation work would essentially be done by the community the Forest Department will only act as the facilitator providing the technical knowledge where and if required.

1.4.1.14 Rare and endangered plant species of the state

S. Kumar (2001) has listed rare and threatened species of the state which are economically important and need special attention for conservation. These plant species are given below: **Table 1.5**

Name of the species	Status	Name of the species	Status
1. Boswellia serrata	I	14. Justicia quinquangularis	I
2. Caesalia axillaris	I	15. Lepidagathis hamiltoniana	I
3. Centaurium centaurioides	I	16. Manilkara hexandra	I
4. Cochleria	I	17. Mimosa hamata	I

cochlearioides			
5. Cordia dichotoma	I	18. M. himalayana	I
6. Crotalaria mysorensis	R	19. Pentanema vestitum	R
7. Cythocline purpurea	I	20. Pogostemon benghalensis	V
8. Erigeron asteroides	R	21. Pueraria tuberosa	R
9. Erythrina suberosa	R	22. Pulicaria angustifolia	I
10. Exacum pedunculatum	R	23. Terminalia arjuna	I
11. Hemigraphis latebrosa	R	24. Trema politoria	R
12. Hoppea dichotoma	I	25. Wattakaka volubilis	V
13. Iseilema prostratum	I		

I= Indeterminate V= Vulnerable R= Rare

2.6. Brief history.

At the time of carving of Haryana state, natural forests between 3 – 4 % of total land area came to state's share. Rest of the area happened to be agricultural, owned by private peasants. As on today the apportionment of land amongst various users is as under:

Table 3.6 Land use in Haryana

Land use	Area in '000 ha.	Percentage
Total geographical area	4424	
Reporting area for land utilization	4399	100.00
Forests	143	3.2
Not available for cultivation	481	10.93
Permanent pasture and other grazing lands	24	0.55
Land under misc. Tree crops and groves	4	0.10
Cultivable wasteland	23	0.52
Fallow land other than current fallows	a	0
Current fallows	137	3.11
Net area sown	3615	82.18

a: less than 500 ha. Source: Land use statistics At a Glance.

3.0. **Current range and status of his diversity**

3.1 **State of natural ecosystems and plant / animal species**

Details have already been given under Ecological profile item (iv) of Profile of area. In most of the eco-systems the state of affairs are less than optimal for continued existence. Pressure owing to population and cattle is so unreasoning that many systems profiled above are threatened with irreversible damage.

4.0. **Statement of Problems Relating to Bio-diversity**

4.1. **Proximate causes of the loss of bio-diversity**

Name of Region — Cause of loss of bio-diversity

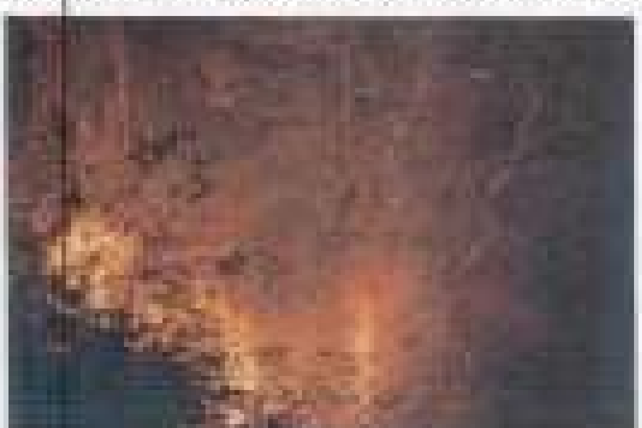
1. Shiwalik hills -
   i. Precarious agricultural practices.
   ii. Encroachment of forest land.
   iii. Poaching of trees and wild animals.
   iv. Forest fires, deliberate and accidental.
   v. Habitat destruction and conversion.
   vi. Precarious animal husbandry practices such as scrub cattle rearing.
   vii. Indiscriminate collection of NTFP to the detriment of regeneration of species.

	viii. Most important is excess of human population
2. Aravalli hills	i. Precarious agricultural practices. ii. Encroachment of community land. iii. Poaching of trees and wild animals. iv. Habitat destruction and colonization by builders. v. Precarious animal husbandry practices such as scrub cattle rearing. vi. Indiscriminate collection of NTFP to the detriment of regeneration of species. Eg., Browsing of Dhau. vii. Most important is excess of human population Viii. Quarrying high silica sand called as Badarpur bajri and building stones. Also large quantity of slates, quartzites and schists are removed from Aravalli hills. ix. Firewood collection for domestic use and sale.
3. Indo-Gangetic plains	i. Agriculture- overuse of irrigation water for paddy- paddy wheat rotation. ii. Excessive chemical fertilizer use. iii. Excessive use of plant protection chemicals namely, insecticides and fungicides. iv. Use of dung cakes for domestic energy. v. Loss of biodiversity on agricultural fields owing to mechanized agricultural practices, leading to destruction of valuable tree species such as Prosopis

cinerarie, Azadirachta indica, Salvadora oleoides,
Ficus religiosa, Ficus benghalensis, Ficus infectoria,
Crataeva religiosa etc., as rootstock interfered with agricultural operations;
vi. Faulty natural drainage further deteriorated by lines of communications, waterways network.
vii. Habitat loss owing to conversion;
viii. Introduction of exotic species like Eucalyptus,
Populus species and monoculture.

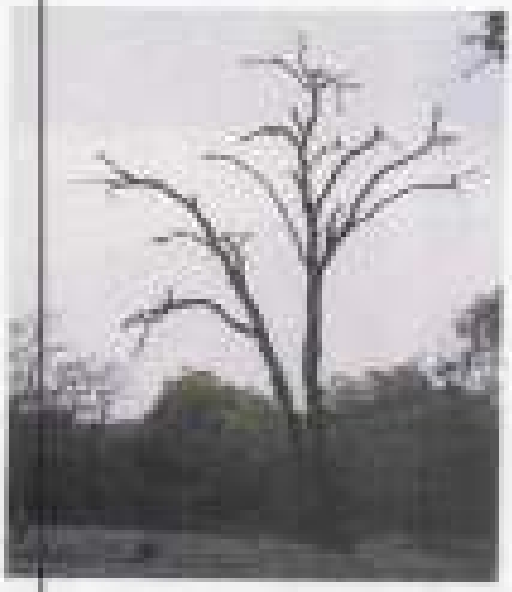
4.2 Root causes of loss of biodiversity

The habitat forests or forests that have natural vegetation have been reduced to 1.38% of total land area of the state. Much of the land was diverted to agricultural use during last three and a half decades of the existence of the state. No doubt Haryana is one of grain baskets of the country but the progress in agriculture has been done at cost of natural ecosystems. To support agriculture irrigation system was laid out. For speedy transportation of agricultural produce roads were built. All of these are assaults on natural ecosystems. Net work of roads is impeding drainage also extravagant use of water for agriculture has adversely affected about 20% of total agricultural land, damage is continuing. Unsustainable model of agricultural development is the root cause of loss of biodiversity.



One of the most important ecological precipitating factors that has very long range impact on soil health is use of cow dung cakes as domestic fuel. Having

exhausted firewood and even while agroforestry produces firewood, that is committed to commercial purposes. Not less than nine months cow dung production is used as domestic fuel. This robs soil of very valuable nutrients such as nitrogen, sulfur and phosphorus that get released to atmosphere and also cause pollution. Absence of organic carbon in the form of humus adversely affects soil fertility and agricultural soils are rapidly loosing their structure and productivity. Soils that used to produce known weight of grain using 1 unit of chemical fertilizer after about 30 years of use under intensive agriculture require 1.3 units of fertilizer for producing same weight of grains. Soil alkalinization, salinization, water logging, residual effect of plant protection chemicals on life



support systems are continually deteriorating overall productivity. Damage done by over drawal of resources and indiscriminate use of chemicals and water is seriously damaging basic resource. The hurt is more evident in vulnerable pockets than others cannot be denied but creeping effect of damage is slowly making itself felt all over the state.

5.0. Major actors and their current roles relevant to biodiversity

5.1. Governmental: Forest Department

i. Rehabilitation of degraded forests.

ii. Rehabilitation of waste- lands of Aravalli hills.

iii. Rehabilitation of waste- lands of Shivalik hills (Kandi project).

iv. Establishment of protected area net - work in the form of sanctuaries and national park.

V. Implementation of vanmahotsava project at Morni.

Are some of the important schemes and projects that are being implemented in Haryana state that have an impact on biodiversity conservation.

5.2. **Citizens Group and NGOs**

There are few NGO groups especially in the southern part of the state. Village Forest Committees (VFC), Hill Resource Management Societies (HRMS), Village Resource Management Committees (VRMCs) are involved in promoting the JFM.

5.3. **Local Communities Rural and urban**

Hill Resource Management Committees (HRMS) in Shivalik hills and village Forest Protection Committees (VFPC) in Aravalli are doing social fencing activity. Together they number about 350 institutions. The break up is 45 in Panchkula, 12 in Yamuna Nagar rest in Gurgaon, Faridabad, Rewari, Mahendergarh and Bhiwani.

5.4. **Donors**

Specific donors for biodiversity conservation are yet to be identified.

5.5. **Industry and Corporate Sector**

There are no important agencies showing interest in the bio-diversity conservation in the state. However, their requirements of the biological resources does affect biodiversity conservation in the state. Opening up of the economy and change of technology also affect the conservation. The cheap availability of pulp in the international market has stopped the local purchase of bhabbar and other grasses by the paper mills. This industry is now promoting planting of high yielding eucalyptus and poplars clones on large scale in agro-forestry sector. Similarly the availability of the asbestos and cement sheets in the rural areas associated with the increased purchasing power of the rural population the use of Saccharum kunzii grass in thatching of the roof tops has reduced considerably. This has resulted into standing of the thatch grass unharvested.

The mining and quarrying for stones, slates and minerals in the Aravalli hills destroys even the existing degraded vegetation. The plantation of the species other than those of naturally occurring species, as compensation, changes the species composition once the oil and results into the loss of biodiversity.

Introduction of high yielding varieties and cultivars lead to dumping of the indigenous varieties as uneconomical and became extinct through disuse. In fact most of the 'developmental activities' in the sectors dealing with the biological resources otherwise, unless associated with conscious efforts to conserve the biodiversity, lead to the depletion of the species and genetic diversity of the indigenous vegetation.

6.0. Ongoing Biodiversity - related initiatives. (Including official assessment)

6.1. Governmental

In sanctuaries and National Park, i.e., protected area net work, during last three years there is complete ban on commercial exploitation of forest area. Wasteland afforestation scheme of Aravalis did carry out 39400 ha. of plantation and wasteland afforestation of Karal is doing water-harvesting works that is benefiting villagers. Biodiversity conservation is incidental to above main frame activities. A separate precisely targeted biodiversity project is yet to come up.

6.2. NGOs

In JFM in the Shiwaliks, 57 HRMSs are actively involved in management of forests. Similarly, VFCs and VRMCs are managing natural resources in the Aravalli areas and in the Community Forestry project villages respectively.

6.3. Communities and peoples movements

As has been stated elsewhere in the document HRMSs and VFPC have been established in Shiwalik Hills and Aravalli Hills respectively. They are doing much needed community participation work in preserving forest areas kept under their management.

7.0 Gap Analysis

7.1 Gaps in Information

Botanical Survey of India is continuing survey of higher plants and have listed 1002 species so far. But, the other plant groups like pteridophytes, bryophytes, algae, fungi, animal species of all varieties are required to be surveyed.

Owing to agricultural pressure most of the land is sown, about 85% constitutes the sown area. Rest of the area has canals, roads and rails that are scrupulously kept clean of vegetation. Only about 1% of the total land supports

natural plants and in that land also for economic reasons most of monoculture has spread leading to decimation of species. There are however some good areas of natural vegetation left in some areas such as Morni, Panchkula, Pinjore, Kalesar, Jhir forest, Nimbi Daloth, Sohnabuddin which are to be further preserved and extended along scientific lines in consultation and involvement of people.

7.2. Gaps in vision

Agricultural offtakes acquired over a period of last 50 years, helped by assured market owing to sustained demand has almost blurred the vision of policy makers and planners. The visible symptoms of secondary salinization and water logging and loss of soil structure are superficially analysed and ad hoc efforts are made to redress them. Of recent reduction of demand is forcing farmers to rethink. Further accentuation of this problem is expected during the next decade, during which policy makers are likely to listen to sane advice.

7.3 Gaps in policy and legal structure

State level land use policy is not there for major land using departments such as Agriculture, Horticulture, Forest, Fisheries and Animal Husbandry. Land being sheet anchor of agrarian societal placement in rural Haryana, constitutional guarantee is there for right to property. Being a populist democracy, none of the political parties intend to regiment land use purely on merits of scientific land use system.

7.4 Gaps in institutional and human capacity

An integrated land use policy of the state, supported by an integrated apex organization to oversee implementation is the urgent need. It has to evolve with personnel drawn from various line departments who can bind together as a team.

8.0 Major strategies to fill these gaps, and to enhance/strengthen ongoing measures.

- Since the forests are the repositories of the majority of biodiversity the Forest Department may be the nodal agency of the State level board to be established under the new Biodiversity Act. The composition of the Board may be multi-

sectoral and gender balanced with the representation of all the stake holders. The objectives of the Board may be, besides those included in the Act, to review the sectoral policies to ensure their compatibility with biodiversity conservation and recommend to the State suitable measures to that effect.

- Demonstrate that in the long run sustained land use is desired social objective compared to high input high out put exploitive use of land.
- Integrated management of land is more beneficial as per land capability classification.
- Biodiversity conservation is very important from integrated planning of rural health services using Ayurveda system of medicines. Unless herbal medicinal plant varieties are conserved physical basis for practice of Ayurveda suffers irreparable loss. Owing to excess load on allopathic system it is showing signs of collapse to resuscitate the system off loading is necessary.
- Sustained development of agriculture and other natural resource utilization aspects is to be ensured.
- To reduce the demands on natural forestry system, promotion of agro-forestry on private lands and plantation of fuel-wood species and grasses on community lands under social forestry need to be revitalized.

  Availability of fuel-wood, now generally required by landless and small farmers, will help release of cow-dung necessary for organic farming and improving soil.
- To reduce dependence of the local communities on the forests, income-generating activities need to be promoted.
- Survey and current status of various NTFP items be carried out and the utilization of these items be linked to the production potential.
- Joint Forest Management system needs to be further strengthened by creating a cell in the Forest Department to oversee it's working. Forest protection mechanism against fire encroachment, illicit felling, needs to be revamped.
- Standardization of Nursery techniques of lesser-known species which are endangered requires to be done.

9.0 Required actions to fill gaps, and enhance/strengthen on going measures

9.1 Action 1: Conservation and sustainable use of (where relevant) natural ecosystems, and wild plant and animal diversity

Category: High priority

Details:

- Creation of preservation plots of suitable size in all the normal natural eco-systems and habitats under the control of Forest Department during the project period of four or five years or multiples of four or five years each.
- Management of such areas with community participation. Where the ownership of the area rests with the community the major responsibility would lie with the community, the Forest Department only providing the technical guidance where and if required.The package of incentives to the community for taking up the biodiversity initatives will be worked out with mutual agreement.
- New kind and nature of activities, to be established after suitable trial & error, hence require higher doses of expenditure per hectare.
- An area 6005 Ha or it's multiple to be taken up for bio-diversity action plan related works depending on the availability of funds.
- Execution of works through existing staff and so, no recruitment of any personnel.

Responsibility: Forest Department, Haryana, Panchayats, Department of Rural Development.

Time frame: 20 year

Resources required: The total cost at present rates is Rs. 1498.75 or say 1500 lakhs. Nursery work Rs 421 lakh and training Rs. 13. 75 Lakh is proposed. In addition to this Rs. 390.00 lakh are proposed to be spent on unique area conservation during first five years and in multiples there after. This adds to Rs. 2324.75 lakh in the first five years and depending on availability of funds in multiples of five years each, upto 20 years with appropriate appreciation to account for cost escalation. Escalation of

appropriate percentage linked to whole sale prices of commodities prices may be made commencing from the end of base year of 2001-2002.

Table : 1.7 Proposed area under biodiversity conservation and estimated expenditure

Sr.No	Name of Natural Ecosystem	Area proposed to be treated (Ha.)	Cost per Ha (Rs.)	Total expenditure (Rs. in lakhs)	Remarks
1	**Forest Ecosystem** Transitional Sal forests of Kalesar Valley in Yamuna Nagar district Hill ecosystem	1000	25000	250	*Shorea robusta* is a important timber species of tropical deciduous forests & has many associated plant and animal species preservation is ecologically desirable by fire conservation and regeneration. Eco tourism spot. Wildlife sanctuary.
2.	Chir pine forests of Morni hills-Panchkula district. **Mountain ecosystem**	1000	3000	3.0	*Pinus roxburghii* is the source of resin and turpentine and is a valuable timber. Grows as a primary colonizer in hill slopes with moisture It adds to beauty of landscape in northern aspects. Eco tourism spot.
3.	*Anogeissus pendula* forests of Jhir area in Firozpore-Jhirka of Gurgaon District. **Semi-arid ecosystem**	250	25000	62.5	*Anogeissus pendula* is also known as Axle wood is very good quality firewood known for its high calorific content. One of the best patches of natural forest accessible by Delhi is present in this area. Eco tourism spot.

4.	*Terminalia chebula* forests of Mandhna, Udhon and Sahlyon of Morni, Panchkula. **Hill ecosystem**	200	25000	50	Fruit is used in Ayurveda as a decongestant and laxative and reputed to be cure for three doshas of 'Vata', 'Pitta' and Kaph. Only about 1000 trees grow in Haryana and they require propagation and preservation.
5.	Bans forests of Thadugarh-Panchkula District.	250	25000	62.5	Called as poor man's timber the bans plant naturally grows on the hillsides of Thadugarh and is very valuable.
6.	Jaal forests of Nizzhi-Dulath-Mahendergarh District. **Desert ecosystem**	200	20000	100.0	*Salvadora oleoides*-Jal *Capparis aphylla*-Teent *Acacia senegal*-Gum senegal Have a grass land ecosystem with occasional growth of trees, habitat of birds and small mammals for 10 year.
7.	Guggal forests of Madhogarh-Mahendergarh District and Sohna Gurgaon District. **Semi-arid ecosystem**	50	30000	15.00	Guggal is used in medicine and preparation of incense. It is endangered plant, nursery activity and regeneration to assist plantation would be done.
8.	*Sterculia urens* and *Acacia senegal* in Khol of Rewari District. **Panchayat land**	50	20000	10.00	There is only one forest area in the state of Haryana where this species grows and requires to be preserved.
9.	Phoenix forest of Faridabad plains ecosystem	50	10000	200.00	Gregariously growing old phoenix trees of great beauty and bird food

	Panchayat land				value. A special ecosystem of genetic diversity; 10 year.
10.	Jand and Senegal forests of Sohlabuddin Mohendergarh District **Desert ecosystem**	500	20000	100.00	Jand is an important desert tree and can be grown under agriculture situations also and it improves fertility of soil. Acacia senegal is a tree of desert hills and yields gum.
11.	Chal, Jhingan, Khair forests of Shiwalik hills	1000	25000	250.00	Chal is an important winter fodder in Shiwalik hills. Jhingan is packing case timber. Khair yields Katha and timber.
12.	**Grass Land Ecosystems** Anjan grasslands of Dulodi forest Mohendergarh District.	50	25000	12.50	Cenchrus ciliaris is a nutritious palatable natural grass.
13.	Munj grass lands of Sahabuddin Mohendergarh Forest with Neem trees.	50	20000	10.00	Preservation of valuable raw material for cottage industry for mats making, rope making.
14.	Kans grass lands of streambeds of Sahibi.	50	20000	10.00	Preservation of thatching material.
15.	Dhoka grass lands of Manethana & Rajpur Rani.	100	20000	20.00	Preservation of locally used grass variety and also landscape.
16.	Bhabbar grass lands of Morni & Yamuna Nagar.	1000	25000	250.00	Used in rope making and also manufacture of good quality paper.
17.	**Wetland Ecosystems** Sultanpur Wetland	140	25000	10.00	A national park has been established and Wildlife Preservation Department.

	ecosystem.				is doing the job.
18.	Bhindawas Wetland ecosystem.	160	25000	40.00	-do-
19.	Chhilchila	5	25000	1.25	-do-

9.2 Action 2: Training and Employment of Resource Persons for Skill upgradation

Category: High priority.

Details:

- Training for skill upgradation of forestry personnel and staff from the line departments on raising and maintaining less known plant species that are threatened.The local community knowledge will be utilized and the community participation ensured in the process.
- Training of village community for imparting knowledge and upgrading their traditional skills on these species.

Responsibility: Forest Department, Haryana.

Time frame: 5-10 Years

Resources required: Rs. 76.5 lakh

Table 1.8 Proposed community training programme

Sr. No.	Year	Item of activity	Quantity/ number	Expenditure per unit	Total
(i)	(ii)	(iii)	(iv)	(v)	(vi)
1	Ist year	(i) Survey and documentation	100 villages 100 villages	1000/village	100000
		(ii) Awareness generation meetings	500/trainees	10,000/ village	1000000
		(iii) Selection of 5 trainees per village preferably 3 office bearers of HRMS/ VFPC and two women participants office bearers of Panchayat or HRMS/ VFPC	500/trainees	@ Rs.125 per day for two	1,25,000
		(iv) Employment of consultants and other resource persons.	200/Resource person Man days	days=250 1,500 (including training)	3,00000
					15,25 x5 =76.25

9.3 Action 3: Standardization of Nursery Techniques for One Hundred Lesser Known Species

Category: Medium priority.

Details:

- Standardization of nursery techniques for 100 lesser known species out of 1062 angiosperms. The species found in the state and declared 'Rare' and 'Vulnerable' will be as a matter of fact considered first.
- Ethno botanical surveys before commencing standardization of nursery techniques to determine the species that require such an effort. In this process the

involvement of the local community, of men and women, will be ensured to determine the priority of the species.

- Nursery technique standardization for medicinal plants on priority basis.
- Sufficiently large number of plants not less than 10,000 each to be raised for successive period of three years for confirming artificial regeneration.
- Publicity and extension through pamphlets for all above important species.
- Stream lining processing, post harvest technology and marketing of medicinal plants.

Responsibility: Forest Department, Haryana and CCS HAU, Hisar with the involvement of the Department of Women and Child Development and the Department of Rural Development.

Time frame: 10 year

Resources required: Considering possible errors the projected work is time sequenced as under:

Table 1.9 Standardization of nursery techniques for lesser-known species

S. No.	Year	Species to be tried	Qtm of operation	Cost of operation per plant Rs	Total cost (Rs. lac)	Remarks
1.	1.	100	Survey of plant species to determine their importance.	1000	10000	Cost of Books, periodicals, field visits, photographs.
2.	2.	25	Collection of seed, plant material and raising of seedlings Nursery 10,000.	3/seedling	7,50,000	Nursery work
3.	3.	25 25 20	-do- Planting of 500000 seedlings	-do- 12/seedling	15,00,000 6000000	Nursery work Plantation
4.	4.	25 25 25 25	Nursery Planting		22,50,000 9,00,0000	Nursery Plantation

5.	5.	25 25 25 25	Nursery Planting		22,50,000 9,00,0000	
6.	6.	25 25 25 25	Nursery Planting		22,50,000 9,00,0000	
		100 qty.	Preparatory Nursery Planting Total		100000 9000000 33000000 42100000	

9.4 Action 4: Promotion of agro-forestry

Category: Medium to high priority.

Details:

- Promotion of agroforestry through supply of improved clones or planting stocks to farmers for their economic improvement.

Responsibility: Forest department, Haryana.

Time frame: 10 year.

Resources required: It is proposed to supply 50 lakh plants @ Rs. 2/- each to farmers, and for plantation in other rural areas every year for next 10 years continuously. Total estimated cost would be Rs. 100 lakh annually and Rs. 1000 lakhs over 10 year.

9.5 Action 5: Promotion of silvi-pasture on community lands

Category: Medium priority

Details:

- Planting of tree species for fuel wood purposes along with fodder grasses on 200 ha in every district on an average with 500 plants per ha and grass in between.

Responsibility: Forest Department, Haryana with the involvement of the Departments of Social Welfare and Women and Child Development.

Time frame: 20 years.

Resources required: With average cost per ha at Rs. 6000/- the total cost over next 20 years would be Rs. 4500 lakhs.

9.6 Action 6: Income generating activities

Category: Medium priority.

- Implementation of income generating activities to reduce the dependence of rural community on forest in 300 villages around the Aravalli hills and 400 villages elsewhere including the Shiwaliks.

Responsibility: Forest Department, Haryana. (The experience gained by the other agencies in such work elsewhere shall be utilized).

Time frame: 5 year.

Resources required: With an approximate grant of Rs. 2 lakh per village for next five years the project would costs Rs. 1400.00 lakh.

9.7 Action 7: Survey of non-timber Forest produce including the preparation of the Biodiversity Register.

Category: Medium priority.

Details:

- Preparation of biodiversity registers. This will include documentation of the indigenous /traditional knowledge of the local domestic and wild biodiversity and the related tradition and their social and economic implications, if any. Women of the area will be associated in the preparation of the registers.
- Survey of NEP and studying their production potential in the Shiwaliks and the Aravalli Hills of 100 lesser-known species.

Responsibility: Forest Department, Haryana, Punjab University and other Universities of the State

Time frame: 5 year

Resources required: Rs. 100.00 lakh.

9.8 Action 8: Promotion of JFM

Category: High priority

Details:

- JFM promotion and strengthening of forest protection mechanism.

Responsibility: Forest Department, Haryana

Time frame: 20 year

Resources required: Rs. 500 lakh over 20 years, @ Rs. 25 lakh per year.

9.9 Action 9: Protection of forests from fire

Category: Medium priority

Details: Fire conservation measures in the five prone natural forests in the Shivalik hills.

- Extension work to elicit people's partition in forest-fire prevention works.

Responsibility: Forest Department, Haryana

Time frame: 20 years.

Resources required: Rs. 1000 lakh.

9.10 Action 10: Soil and moisture conservation

Category: Medium priority.

Details:

- Soil and moisture conservation activities in Shivalik hill region and other areas in order to improve soil moisture regime and to reduce soil erosion.

Responsibility: Forest Department, Haryana

Time frame: 10 year

Resources required: Rs. 1000 lakh.

9.11 Action 11: Research

Category: Medium priority.

Details:

- Studies on suitable plant species, clones, or varieties for different agro-climatic zones or in agro-forestry systems; on various aspects of silviculture; also on tree growth parameters.

Responsibility: Forest Department, Haryana

Time frame: 20 year.

Resources required: Rs. 20 lakh every year for a period of 20 years.

9.22 Action: Operational changes in the working of forest.

Category: High priority

Details:

- In case of plantations mixture of various species should be planted instead of monoculture.
- No felling of trees other than those planted on large scale.
- In afforestation phenotypic and genotypic variation will be considered to preserve the genetic diversity and also to take care of air pollution.
- While undertaking plantations jungle clearance will be kept to the minimum.
- Incorporation of these recommendations in the working plans of the Department.

Responsibility: Forest Department, Haryana

Time frame: 5 year

Resources required: Nil

9.23. Actions: To achieve equitable decision-making

Category : High priority

Details:

1. It is a state level initiative mostly restricted to forest areas, time scaled between 5 to 20 years depending on availability of resources.
2. The Forest Department through involvement of people would do implementation. Hill Resource Management Societies, Village Forest Protection Committees are community institutions that are to be involved.
3. Conservation activities are concrete and implementable.
   Ecosystem in hills particularly Shivalik hills, followed by Aravalis and plains is the order of priority.
4. In some habitats instead of preservation artificial regeneration can be taken up.
5. People's empowerment and equity, ensuring wide spread participation

and gender related biodiversity conservation initiatives are already part of Joint Forest Management that is successfully being practiced in Haryana. However, as is evident from the out come of public hearings at Chicken and Bodla more needs to be done and JFM needs to be further strengthened in the state.A special unit/ cell to oversee the work of JFM in the state needs to be established.

In the villages and Panchayats the decisions even when taken by the community the voice of the real users of the biological resource ie, the poor people, especially the women is rarely heard To know the views of the real users their views be obtained in a separate group meeting and be represented in the village Panchayat meeting by the group leader of the under privileged.

Responsibility: Forest Department, Haryana/ Govt. of Haryana.

Time frame: 5 year

Resources required: Nil

Action 14: Strengthening the land use policy measures

Category: High priority.

Details:

- A Land use Board exists in the state which needs to be further strengthened by adopting experts from different land using agencies.
- Making the Board more effective and making its recommendations mandatory under appropriate statute.
- Making biodiversity conservation a mandate of the Board through appropriate land use policy measures.

Responsibility: Government of Haryana

Time frame: 5 year

Resources required: Nil

11. Follow up

Follow up would be done similar to other projects that are being implemented in Haryana.

12. References and bibliography

1. Jain, S.P et al., (2000). Flora of Haryana, Central Institute of Medicinal and Aromatic Plants (CIMAP), Lucknow.

2. Kumar, S (2001) Flora of Haryana, Published by Bishan Singh and Mahendrapal Singh, Dehra Dun.

3. Anon. (1981). Social Forestry Project, Govt of Haryana.

4. Anon. (1985). Afforestation of Wastelands of Aravalis, Govt. of Haryana.

5. Anon. (1980). Afforestation of Waste lands of Shivalik Hills, Govt of Haryana.

6. CSIR, (1993). *Terminalia chebula*. In: Wealth of India Raw Materials. Vol.x. CSIR, New Delhi. pp.157-185.

7. Thakur, S., Handa, A.K. and Singh, N.B. (1998). Seed germination studies in *Terminalia chebula*. Van Vigyan, 34 (3) : 134-135.

8. Todaria, N. P. and Negi, A.K. of (1995). Effect of elevation & temperature on seed germination of some Himalayan tree species. Plant Physiol. & Biochem., 22 (2) : 178-182.

9. Troup, R.S., 1950. The Silviculture of Indian Trees. Publisher, Oxford University Press. Pp. 512.

10. Turner, J.C.E., 1967. Ind. Forester, Vol. (33): pp 362.

11. Anon., (1980) Pamphlet of WIMCO on Poplar cultivation.

12. Anon., (1996) Discussions, Workshop on joint forest management held at Vigyan 13, Bhawan, New Delhi.

13. Anon: (1999) Annual Research Note by DFO-Production Yamuna Nagar.

14. Anon, 1999. Credit Plan For Yamuna Nagar District, Haryana State.

15. Anon: (2000) NABARD report of Workshop on forestry and wasteland development held on 15.12. 2000 at Chandigarh, page 2.

16. Anon: (2000) Statistics at glance Govt. of Haryana, 2000. Per capita gross domestic price at 1980-81 prices.

17. Anon., (2000) Discussions with office bearers of Yamuna Nagar Plywood Manufacturers Association on the eve of one day workshop held at Chandigarh.

18. Chaturvedi, A.N. and B.S. Rawat., (1994) Poplar Tree Improvement programme, Indian Forester 120 (2): 97-103.

19. Chaturvedi, A. N. (1981) Poplar Farming in U.P., U.P. Forest Bulletin No. 45.

20. Hans, S.S., (1990) Sustainable High Production, Soil & Environmental Protection with high Income- A personal experiences in Agroforestry.

21. Venkatesh, C.S. (1983). Notes on Poplars, Indian For. 109 (9): 694-695.

22. Chaturvedi, A.N., (1981) Survey of Poplar plantations-Uttar Pradesh. U.P. For:Leaflet No. 23, Lucknow.

23. Chaturvedi, A.N. (1983) Poplars for farm forestry in Uttar Pradesh. Indian For. 109 (9): 661-664.

24. Bucklaus, (1983) Introductory address Proc. Workshop on Poplars, Jan. 23-24 Haldwani, F.R.I., Dehra Dun.

25. Kaul, O.N., (1980) Impact of forest land uses on environment in India. IUFRO/MAB Conference on Research on Multiple-use Serv., General Tech. Report W.O-25.

26. Kaul, O.N. and K.K.Sharma, (1983) Biomass Production Systems of Poplars and Willows in India. Indian For. 109 (9): 645-654.

27. Ashok Dhillon et al., (2001) An economic analysis of Poplar cultivation. Indian For. 127 (1): 86-90.

Annexure 1

In a Work Shop that was organised by Forest Department at Firozpur Zirka, Gurgaon following plants were reported to be of special use:

1. Azadirachta indica, Neem or Margosa tree, Insecticide, Febrifuge. Cures skin ailments.
2. Ficus benghalensis, Bargad. Cures skin ailments. Helps foetal retention in women prone to abortion.
3. Ficus religiosa, peepal, Fruits are used as laxative. Dried bud powder as general purpose tonic.
4. Ocimum basilicum, Tulsi, Sacred basil, Febrifuge. Cures skin ailments.
5. Acacia nilotica, Kiker or Babul, Gum used as food additive to tone up muscles after child birth.
6. Moringa oleifera, Suhanjana, Leaves and flower buds reputed to be source of Iron, mildly aphrodisiacal in function. Used as vegetable and pickling of fruits.
7. Aloe barbadensis, Ghrit Kumari. Hemicellulose of leaf used in activating pelvic circulation. Supposed to be rejuvenating women and enhancing their beauty.
8. Ailanthus excelsa, Ulta Neem. Leaves and bark used in skin ailments and also against flatulence.
9. Vinca rosea, Sadabahar, contains an bitter alkaloid used in dressing wounds.
10. Tribulus terrestris, Gokhuru, Tincture is used as diuretic.
11. Capparis decidua, Kair, tender fruits used in pickling reputed to be laxative and digestive.
12. Zizyphus jujuba, Ber ber, stomach disorders.
13. Commiphora wightii, Guggal, one of the very usual ingredients of many Ayurvedic preparations restorative in function.
14. Barleria prionitis, kala baras, tincture used as lung expectorant.
15. Cordia rothii, for ulcers of mouth.
16. Ricinus communis, errand, dependable safe laxative, reduces rheumatic pains.

Wildlife

1.0 Profile of the Area

1.1 Geographical profile

The general description of the size of the state, location, latitude and longitude has been detailed in the earlier general chapter. From the wildlife diversity point of view the state can be divided into the following geographical regions, the description of which is given in brief.

1.1.1 Shivalik and outer Himalayan Region

The northern part of the state in Panchkula, Ambala and Yamunanagar districts fall in this category. The general topography of the region is undulating to steep hilly slopes with loose geological formation.

The Shivalik hill system at places merges with the Himalayan Hills. This region is very rich in flora and fauna of the general Shivalik system. The main vegetation type in this region is of Sal (*Shorea robusta*) forests in the Kalesar valley, Darpur, Chiken, Nagli khol, Meharaniwala and is of scrub in Sunder Bahadurpur forests. Sal in this region is found on gently sloping and valley parts. The steep hilly and undulating areas have mixed miscellaneous forests of *Anogeissus latifolia* and *Lannea coromandelica* species. In the flattish undulating terrain the main animal found is Cheetal, in parts Black buck, Red jungle fowl and Wild boar. In the hilly and steep miscellaneous forests, the combination of Sambhar, Kakkar, Wild boar, Leopard with Red jungle fowl, Kaleej pheasants is found. The area is rich in wildlife and the habitat in the last 20 years has not depleted any significantly. If at all, it has improved may be because of the Joint Forest

Management adopted in the state. Wild dogs were found in Kalesar forests, which were exterminated under Govt. orders on public demand.

1.1.2 The Indo-Gangetic Plains

Vast area of the state falls in this category. The land is highly productive. The terrain is flattish and is predominantly under agricultural use. The original forest vegetation comprise Dhak, Shisham, *Acacia leucophloea*, *Acacia nilotica* with thorny shrub vegetation of *Capparis horrida* . Most of this area has been brought under cultivation. Lower parts of Ambala with the entire districts of Yamunanagar, Kurukshetra, Karnal, Panipat, Sonepat, Faridabad and northern part of Jhajjar and Rohtak districts fall in this category. This area was once rich in wild animals, which are now confined only to very small pockets of forest vegetation left. Notable wild animal of this region is Black buck in Karnal, Panipat, Sonepat districts, even up to Rohtak district. Hog deer is found only in Sultanpur Wildlife Sanctuary in the state. Nilgai is present throughout the state especially in and around Aravali Forests. The excessive use of pesticides in this agriculturally prosperous belt has adversely affected the wild animal population, especially the bird population.

1.1.3 The Thar Desert Region

Parts of Jhajjar district and the districts of Rewari, Mahendergarh, Hisar, Sirsa, Bhiwani fall in this category. The terrain basically is undulating and the soil is sandy. The vegetation comprises *Acacia nilotica*, *Prosopis cineraria*, *Acacia leucophloea* with shrubs of *Capparis aphylla*, *Calotropis procera*, *Zizyphus Nummularia* and *Salvadora oleoides*. The typical animal association of this region is of Chinkara and Monitor lizard. This area once supported a sizable lion population. The record of hunting of lions in Hisar are available.

1.1.4 The Aravalli Hill System

The northwestern tail of Aravalli hills is in Delhi. A sizable part of this hilly system (estimated to around 60,000 hectare) falls in Haryana. The rocky hills of Aravallis which once supported a good forests of *Anogeissus pendula* have been highly degraded. Some stock of this vegetation is available even now. Some protection has been afforded to this vegetation during the project period of Aravalli

Afforestation Project. These hills which now support some Hyena, Jackal and Fox population had once supported Tiger population. The Panthers as well as tigers occasionally visit the area from the adjoining hills in Rajasthan.

1.2 Socio-economic Profile

1.2.1 In the Shivalik region, there are pockets predominantly inhabited by the Muslim community and Gujjars. Since the area does not support good agriculture, dependence of the local community on the forest and wildlife resources is probably the maximum in the state. The Gujjars rear cattle and practice grazing of animals in the forest. Some people indulge in illicit felling of Khair and other trees. The practice of construction of dams for harvesting of water and use of water for irrigation of agricultural lands in the gently rolling hills and adjoining plains areas is transforming the local economy . In pockets in this region also live the people belonging to 'Deh', 'Bangale', 'Shikligar', 'Bawaria' community who indulge in wild animal offences. These communities traditionally lived by hunting of wild animals, big and small.

Wild boar occurring in the forest causes damage to agriculture crop in this area. The people of this region have been representing and agitating to allow hunting of wild boar to prevent the damage to agricultural crops. However, if any such permission is issued to local people other animals will also be vulnerable to killing. Hence no such decision to allow hunting of wild boar has been taken in the state.

1.2.2 **The Indo-Gangetic plain** areas belong predominantly to Hindu and Sikh communities. The main occupation of these people is agriculture. Damage to agricultural crops by Nilgai, which is found throughout the state, is viewed seriously and these people have been largely responsible for putting pressure on the Govt. for taking the decision for allowing hunting of Nilgai.

1.2.3 **The Thar Desert Region:** These areas are dominated by Hindu community who have largely been against killing of animals. Notable amongst these are the Bishnois who are known to protect trees and animals. Because of the protection afforded by these people Black bucks, Chinkaras and other animals are still seen moving openly in the agricultural fields in these areas. Although these people complain about the loss to agricultural crop by Nilgai they have never come forward for killing of the animal any

significantly. The 'Saperas', 'Bawarias' and people belonging to such smaller communities indulge in capturing of 'Goh' (Monitor lizard) and hunting of Sanchu (Spiny tailed lizard) and also of Partridges which are supplied to Delhi.

1.2.4 **In the Aravalli hills** especially in Gurgaon district, the predominant community is of Meos who are generally Muslims. These people indulge in hunting of Nilgai and capturing of migratory birds and other small animals. Agriculture being not-a-very prosperous occupation in this region, the dependence of the local community on natural resources is substantial.

1.3 Political Profile

As in any other state of the country, the state has a regular mechanism of governance by elected members, Judiciary and Executive departments.

Because agriculture has been the main stay of economy, agriculture and allied sectors have relatively larger say in the governance of the state. Agriculture, irrigation, electricity, road network, health and education are important sectors of the state economy. Being poor in the natural resources, forests and wildlife have much less say in the governance of the state. However, because of the presence of Bishnoi community whose population is relatively more especially in the south, southwestern part of the state conservation of trees and animals is generally not ignored in the state. The general local population in the state being vegetarian the status of protection of the animals in the state is much better compared to that in many other states.

1.4 Ecological Profile

The various ecosystems and the type of floral and faunal association occurring in the state are enumerated below: (an attempt has been made to make this list as exhaustive as possible but possibility of finding some other smaller associations can not be ruled out).

1.4.1 Forest Eco-system

1.4.1 a) The Shivalik Sal forests of Kalesar Wildlife Sanctuary is characterized by Panther-Chinkal-Wild boar- Sambhar – Barking deer- Red Jungle Fowl-Peafowl - Blue jay – Hoopoe – Treepie – Woodpeckers.

1.3.1 b) Chir Forests of Morni areas characterized by Panther-Wild boar-Barking deer-Red Jungle Fowl-Peafowl-Blue jay-Hornbill-Treepie-Woodpeckers.

1.4.1 c) Northern tropical mixed deciduous forests of Panchkula and Yamunanagar districts are characterized by Leopard-Sambhar-Barking deer- Ghorral-Wild boar- Nilgai- Jackal- Hare- Fox- Reptiles.

1.4.1 d) *Anogeissus pendula* forests of Aravalli hills in Gurgaon district are characterized by Panther (rare)- Hyena-Nilgai- Common langur-Hare-Jackal.

1.4.1 e) The Bamboo forests of Tindrgarh forests in Panchkula district are characterized by Leopard-Sambhar- Barking deer- Wild boar- Porcupine-Red Jungle Fowl- Kalej Pheasant.

In addition, Langur, Monkey, Porcupine, Partridges, Quails etc are common in these places.

1.4.1 f) Salvadora forests of Nimli-Dukoth of Mahendergarh district with *Capparis aphylla* and *Acacia senegal* are characterized by Chinkara-Desert cat- Fox- Spiny tailed lizard.

1.4.1 g) Conocarpus forests of Mashengarh in Mahendergarh district are characterized by Chinkara- Nilgai- Fox- Jackal- Hare- Monitor lizard- Spiny tailed lizard, Sandgrouses- Partridges, Quails.

1.4.2 h) *Shorea* and *Acacia* scrub forests of Khol of Rewari district are characterized by Chinkara- Nilgai- Fox- Hare- Spiny tailed lizard - Partridges- Quails-Green pigeons- Peafowl.

1.4.2 i) *Phoenix* forests of Faridabad district characterized by Hyena-Nilgai- Jackal- Hare- Partridges- Quails.

1.4.2 j) *Prosopis cineraria* and *Tamarix articulata* forests of Mahendergarh district are characterized by Chinkara-Hyena-Nilgai- Hare- Jackal- Fox – Partridges- Quails- Peafowl.

1.4.2 k) *Acacia leucophloea*- *Gymnosporia* - *Ziziphus* –Blood scrub forests in the foothills of Aravalis are characterized by Nilgai- Chinkara-Hare.

1.4.3 Grass Land Eco-systems

Kans and Munj grass lands in the stream bed of Tangri in Panchkula-Ambala districts and in the stream bed of Sahibi river in Rewari district are characterized by Black buck-Partridges-Hare and Reptiles.

1.4.3 Wetlands Ecosystems

1.4.3 a) Wetland ecosystem of Sultanpur in Gurgaon district is the home of bird migration in Haryana. Pelicans, Flamingos, Comb ducks, Shovellers, Ibises, Geese and a large number of other water birds visit this Park in winter. Some crane breeds here.

1.4.3 b) Wetland ecosystem of Bhindawas in Jhajjar district is characterized by large number of migratory birds .

1.4.4 Desert Ecosystem

These are semi arid ecosystems like those in Bhiwani, Rewari and Mahendergarh districts. These are characterised by the presence of Chinkara-Desert fox-Hyena.

1.4.5 Mountain Ecosystem

This has been covered under forested hill ecosystems.

1.4.6 Riverian Ecosystem

This is present along the Yamuna and Ghaggar rivers and is characterised by Otters (now rare), Tortoise- Black buck.

1.5 Brief history of changes in land use

The state of Haryana was formed after the trifurcation of the erstwhile Punjab state. The south and south eastern part of the erstwhile Punjab came into existence as Haryana state on 1st November, 1966. This part of the erstwhile Punjab was relatively under-developed. And therefore, the efforts of the early administration of the state was to develop the state in all the sectors of the economy. These developments have brought about a lot of change in the land use and water resource consumption and have changed the face of the earlier landscape. These changes have had negative impact on the biodiversity of the state.

1.5.1 For the development of agriculture sector, large scale conversion of waste lands was undertaken. The reduction in the waste lands have meant reduction of biodiversity, both floral and associated faunal diversity, in the state. For improving the agricultural

production especially under the green revolution, a wide network of canal was laid out in various parts of the state. The construction of this canal network and the embankments have changed the natural flow of water resulting into changes in the floral and faunal diversity. Because of the seepage through these canals especially in the sandy areas, the area under water logged conditions in a narrow belt along these canals has increased over years. The construction of Hathni Kund Barrage and channeling of river water causing reduced flow through the river bed of Yamuna have meant the consequent changes in the floral and aquatic life along the Yamuna river in the state.

1.5.2 The availability of better technology for irrigation in the form of sprinkler irrigation have resulted into the conversion of substantial extent of area in the south and south western sandy part of the state into agricultural fields. This conversion of waste lands in the desert conditions have adversely affected the flora and fauna of the desert part of the state. Further, because of the available irrigation large areas in the foothills of Aravallis, which are basically undulating sandy deposits have been bulldozed either for converting these areas into agricultural fields or for human habitation (especially near Gurgaon). This loss of undulating sandy dunes in the foothills of Aravalli hills has especially resulted into the loss of habitat of the endangered Chinkaras in the state.

1.5.3 The colonisation of Aravalli hills has been greatly responsible for the loss of biodiversity in the region. Faridabad and Gurgaon have come under the expanding population pressure of the metropolis of Delhi resulting into colonisation and habitat destruction of the fringe of Aravallis in the state.

1.5.4 In the Shivalik hills the increasing pressure of population from Chandigarh and adjoining areas have resulted into the ingress of human population into the adjoining forest areas. Whereas the people have been sensitised towards forest protection through the mechanism of Joint Forest Management especially through the construction of water harvesting dams in the foothills, they are relatively less sensitive towards the protection of wild animals. Forests may have survived in the vicinity of this population but the increasing human pressure is reducing the wild animal population. Otters which were common in Ghaggar near Panchkula about 20 years ago, are very rare to be found anywhere in the state (There are unconfirmed reports of the presence of Otters in the

Jamni Head Works near Ambala). With the increasing population of Chandigarh and the increasing demand for facility of forest recreation the adjoining forests are under great pressure and time is not too far when the natural population in the forests near Panchkula would be greatly depleted.

1.5.5. For increasing the area under cultivation the small depressions which used to accumulate water during monsoons and which used to attract a host of migratory birds during winter have been leveled. Because of the large scale developmental activities in the catchment area of Sultanpur National Park the run-off to the lake from the catchment has practically becomes zero resulting into the drying of the lake. (Some efforts have been made to rejuvenate the lake system by putting 60 cm. diameter pipe line from Kalowas to Sultanpur lake and recharging the lake for attracting winter migratory birds).

The Jhajjar sub- branch which used to feed the Khaparwas water body (a wildlife sanctuary) has been abandoned making the water body a dry depression. The area under the water bodies in the state has reduced considerably and conservation of these wetlands in the future appears gloomy.

1.5.6. The village common lands, Shamlat and Panchayat lands in the vicinity of the villages also used to harbor a host of wildlife. The Jungle (the tree vegetation of *Salvadora* species) which used to harbor reptiles have disappeared under the developmental activities. Large areas of these common lands have been brought under cultivation for giving 'Pattas' to the poor to generate income to the panchayat lands.

A substantial part of these common lands has also been brought under plantation by the Forest Department.

1.5.7 Quarrying and mining for silica sand, Badarpur sand and stones from the Aravallis especially between Gurgaon and Faridabad area and the associated increase in the human and machine population in the area have for all practical purposes destroyed the ecosystem and impaired the floral and faunal diversity beyond repair.

2.0 Current range and status of Biodiversity

For the conservation of wildlife in the state, there is one National Park and nine wildlife sanctuaries, which are listed in the 'ongoing initiatives of the state'. The status of the plant and animal species in the various ecosystems described in the earlier chapter is given below:

2.1 Forest Eco-system

2.1.1 The Shivalik Sal forests of Kalesar Wildlife Sanctuary

The Sal forests of Kalesar are well protected and are a good habitat for wild animals. Apparently there are no signs of any degradation. However, there are reports of little damage to Sal trees by Sal borer (Hoplocerambyx spinycornis). The Forest Research Institute of India, Dehradun was requested to study the extent of damage or attack of this borer to the Sal crop. The preliminary report submitted by FRI, Dehradun says that the damage is low of intensity . They have suggested taking up of manual trapping of the insect for the conservation of the Sal forests. The list of plant species of the area and also of the animal species found has been given in the Working Plan of the area. A detailed report on the evaluation of the availability of food during the pinch

period was studied by Sh. R.C. Trigotra, a forest officer of the state. The report is available in this office. The detailed survey of the animals found in the sanctuary has not been carried out.

2.1.2 Chir Forests of Morni areas

The resin tapping of Chir crop was stopped by the Forest Department in 1983. The health of these forests has improved because of this. However, with the gradual increase of human population the wild animal population is showing the sign of depletion. The Chakore, which used to be found in Bhondi areas of Morni is very rare to be sighted.

2.1.3 Northern tropical mixed deciduous forests of Panchkula and Yamunanagar districts

Although there has not been any significant depletion of these forests, the areas in the vicinity of human habitation have degraded under human pressure.

2.1.4 Anogeissus pendula forests of Aravalli hills

The Dhok forest of Aravalli have suffered the maximum in the last three decades. The EEC Aided Aravalli Afforestation Project carried out extensive plantation in these hills. The main species planted are *Prosopis juliflora, Acacia Senegal, Acacia leucophloea* etc. Although the vegetation has improved the original crop composition stands destroyed. The animal population is reported to have increased and the small animals like Hare, Jackal and Hyena are reported from the area.

2.1.5 *Sterculia* and *Acacia senegal* forests of Khol of Rewari district

Mining of slates is done this area. This has increased the human and machine presence and have a degrading effect on the animal habitat.

2.1.6 *Prosopis cineraria* and *Tamarix articulata*

The increased human population and the availability of irrigation through sprinkler sets, the wastelands have been converted into agriculture lands.

2.2.7 *Acacia Jacquemontii-Gymnosporia-Benthamia*

The colonization of Aravalis and the foothills have resulted into the destruction of habitat of the animals.

2.3 Grass Land Eco-systems

The Kans and Munj grass lands have not degraded significantly but the animal population of Hare, Partridges and Reptiles etc. in these areas has reduced

2.3 Wetlands Ecosystems

The destruction of wetland ecosystem in the state has been elaborated earlier. Although a check list of birds found in Sultanpur and Bhindawas is available, there is no seasonal classification. The monitoring of the birds population is not done.

2.4 Desert Ecosystem

There is little information on the status of vegetation or animals in the desert ecosystem and the Riverian ecosystems of the state.

2.5 Census of animal population

The census of Tiger, Leopard and ungulates carried out in 1997, gave the following figures:

Name of area	Chital	Sambhar	Barking deer	Wild boar	Ghoral
Kalesar	65	222	175	263	802
Kalsia	26	108	79	121	103
Morni	-	247	302	1606	1022
Raipur Rani	30	-	-	-	-
Bir Shikargah	35	46	38	234	49

Khol Hot Rohtak	-	125	75	434	206

Aravalli Hills Nuhgal - 5210
Chinkara - 422

3.0 Statement of problems relating to Biodiversity

Causes of the loss of the biodiversity:

Some of problems related to the loss of biodiversity in the state have been discussed in para 1.5 under brief history of changes and land use. These reasons alongwith others have been enumerated below:

3.1 Habitat destruction

3.1.1 Conversion of waste lands for agriculture use.

3.1.2 Colonization of large extent of areas in Aravalli under pressure of Delhi population.

3.1.3 Ingress of human habitation into the forested hills in Shivalik areas.

3.1.4 Conversion of village common lands for other developmental purposes, agriculture and afforestation.

3.1.5 Quarrying and mining of the hills for minerals like silica -sand and for stones.

3.1.6 Construction of roads, canals, drains, bunds etc fragmenting original habitat.

3.2 Use of Pesticides

Green revolution was achieved through the cultivation of hybrid varieties of wheat which require irrigation and fertilizers. To control the insect pests on these hybrid varieties, increasing amount of pesticides are used by the farmers. The increased utilization of pesticides also kills large number of insects which are consumed by small animals and birds.

The bio accumulation of these pesticides and the related toxic effects have resulted into the decreased population of small animals and birds. Recently, large scale mortality of peafowls was seen in the rural areas of the state. Investigations by Haryana Agriculture University, Hisar revealed that the mortality of peafowls was because of the consumption of seed treated with Chlorpyriphos. Whereas the recommended quantity for the treatment of seed is 1.5 ml. of the pesticide per kg. seed in actual practice the quantity of pesticide used by the farmers was more than four to five times the required dose. The sudden disappearance of vultures, however, is attributed to the suspected viral disease.

3.3 **Hunting of the animals by man**

Around 1888 lions were hunted by the then rulers in Hisar. Record to this effect is available.

The last remaining tiger in Haryana was shot in the forests between Barwala and Mandhana in Panchkula district. There is no resident tiger population in the state now. The Kalesar forests had resident wild dog population. During the period 1968 to 1970, a campaign under the title "shooting of wild dogs in Kalesar reserved forests", and "annihilation of wild dogs" was taken up and as per the record available in the Govt. office, the last wild dog was shot in February, 1970.

In 1963, the Secretary Forests, Himachal Pradesh declared award of cash incentives to encourage public in killing of wild animals. Each panther fetched Rs. 50/-, Hyena Rs. 15/-, Black bear Rs. 15/-, Jackal & Wild cats Rs. 5/- each, Monkey Rs. 3/-, Langur Rs. 5/-, Fox , Fakons, Baj & Shikras Rs. 3/- each.

There has been a total ban on the hunting of all wild animals throughout the country, which has come into effect after 1991 amendment to Wildlife (Protection) Act. Despite this ban and fairly good implementation on the ground, instances of poaching do take place.

There are some communities, especially, Deh, Bengali, Shikalgar and Sevaria etc. who indulge in small game offence on a regular basis. These people catch Hare, Monitor lizards, Partridges, Quails and such other small animals. Earlier these people

need to go for hunting and bring their catch openly. After the stricter implementation these people now bring their catch not on cycles but change the mode of transportation or the nearest transport head.

The local communities also indulge in the hunting of wild animals for various reasons. The survey of some villages in Gurgaon, Rewari and Mahendergarh districts reveal that the wild animals are used for their various medicinal value. As revealed by the survey the following animals are used for the purpose mentioned.

3.3.1 Porcupine : The flesh of the animal is used to control Foot and Mouth disease of the cattle.

3.3.2 Blue Rock Pigeon: The blood is used in the treatment of Paralysis and also in the treatment of Asthma.

3.3.3 Green Pigeon: The flesh of this bird is used to control Polio.

3.3.4 Peacock/Peafowl: The legs and the toes are used to treat the bone injuries . The eggs of this bird are used in the treatment of the diseases of cattle.

3.3.5 Black Partridges: The flesh is used to treat Tuberculosis .

3.3.6 Fox: The fat removed from the brain of the animal is used as medicine.

3.3.7 Frog: The whole animal used in the treatment of certain infection in human beings.

3.3.8 Owl: The flesh and feathers are used in the treatment of diseases of children. The flesh is also used to treat the Foot and Mouth disease of cattle.

3.3.9 Jackal: The flesh is used in the treatment of Foot and Mouth disease of cattle and also in the treatment of mouth ulcers.

3.3.10 Hare: The blood is used in the treatment of diseases of children, as an antipyretic, in the treatment of eczema . The blood is also to cure pneumonia in children.

3.3.11 Tortoise: The flesh is used to treat Tuberculosis.

3.3.12 Snakes: The bones are worn in the form of a necklace and is supposed to cure jaundice. The skin is used in the preparation of eye liner . The black snake poison is used by the 'Sapera' community in the preparation of eye liner.

3.3.13 Monitor lizard : The fat is used in the treatment of arthritis.

4.0 Major actors and their current roles relevant to Biodiversity

4.1 Governmental

The Forest Department has been entrusted with the responsibility of conservation of wildlife in the state. The Forest Department is the custodian of the forests, areas notified or declared as forests under various sections of the relevant Act. The conservation of forests and its management is oriented towards the protection of wild animals through habitat management in the protected areas -areas which are declared as wildlife sanctuaries and National Parks. The wildlife wing implements the provisions of the Wildlife (Protection) Act, 1972 both in the Protected Areas and outside the forest areas.

To advise the Govt. on the conservation of wildlife in the state an Advisory Board has been constituted in the state.

Inter-departmental Co-ordination Committee has been constituted in the state to enforce the provisions of Wildlife (Protection) Act and specifically to prevent the trade in wildlife and wildlife products. Similarly Inter-Departmental District Co-ordination Committees have been constituted to strengthen the protection mechanism at the district level.

4.2 Institutions

Wildlife Institute of India has been helping the state in technical matters. In the early nineties, this institute conducted an exhaustive study on Nilgai and its control mechanism to prevent crop damage. They have also been helping the department by training of the field staff in various fields.

4.3 Citizens Groups and NGOs

Non governmental organizations or citizen groups, which are doing some related job, are mentioned below:

4.3.1 WWF Chandigarh chapter

The World Wide Fund for Nature- India has a chapter located at Chandigarh. This organization is working in the area for the cause of biodiversity conservation. Creating public awareness, especially in the school children, is one of their main activities.

4.3.2. All India Jeev Raksha Bishnoi Sabha

This organization has been active in the state especially in the south and south-western part of the state where there is a significant population of Bishnoi community. Although they are not doing anything significantly towards the development of wildlife habitat but have extended protection to all animals against killing. They have also been assisting the local population and have taken steps to prevent hunting of wild animals. Through their efforts they also influence Govt. policy to some extent.

4.3.3. Bombay Natural History Society

This internationally known voluntary agency has come forward recently for the conservation efforts of the dwindling vulture population. They have also been voicing their concern on the decision of the State Govt. of allowing hunting of Neelgai to prevent agricultural crop damage.

4.3.4 The Environment Society of India has been active in increasing the awareness of conservation of nature. However, their activities are confined basically to Chandigarh and adjoining parts in Haryana.

4.3.5 There are few individuals who are active in wildlife conservation efforts. The check-list of birds of Haryana has been compiled by Mr. S C Sharma (resident of Sonepat) and Mr. Bill Harvey.

4.4 Local communities rural and urban

4.4.1 Although the issues of forests, wildlife and environment are acknowledged by the educated urban communities, there is very little contribution from them in conservation of forests and wildlife in the state. The wildlife wing has been making continuous efforts to create awareness among rural communities particularly school and college students about the importance of wildlife conservation. Community involvement is also sought for the protection of wildlife wherever required. However, it will be a time taking process to sensitize the rural communities so as to secure their spontaneous actions and co-operations in conservation efforts. The contribution of the Bishnoi community in the protection of plants and animals needs special mention. The protection of plants and animals is one of the twenty nine principles of living. Ban for their strong belief in the

protection of the wild animals, their population in the country side especially in the south and south-west of the state would have been vastly depleted.

There are few other individuals in the state who are making efforts in the conservation of wild animals, especially birds.

4.8.2 Rural Communities

a) There are some communities who have been indulging in wildlife offences. They are Deh, Banjara, Bengali, Shikligar , Bawaria and are found throughout the state.

b) The bird trappers of Ambala: They indulge in the trade of birds in Ambala district.

Besides these, there are no major actors in the conservation efforts in the State.

5.0 Ongoing initiatives

5.1 Governmental efforts

5.1.1 In-situ conservation efforts

Besides protecting wild animals found anywhere in the state under Wildlife (Protection) Act, the State Government has declared one National Park and nine wildlife sanctuaries in the state for the development and conservation of wildlife. Brief description about the National Park and wildlife sanctuaries is given below:-

LIST OF NATIONAL PARK AND WILDLIFE SANCTUARIES

Sr.No.	National Park/ Wildlife Sanctuary	Tehsil/ District	Wild animals which are found.	Area (in acres)
(A)	**National Park**			
1.	Sultanpur National Park.	Gurgaon	Water birds.	359.51
(B)	**Wildlife Sanctuary**			
1.	Bhindawas Wildlife Sanctuary.	Jhajjar	Water birds, Black buck, Blue bull, Black & brown Partridges.	1016.94
2.	Nahar Wildlife Sanctuary.	Kosli (Rewari)	Black buck, Blue bull, Black & brown Partridges.	522.25
3.	Chhilchhila Wildlife Sanctuary.	Kaithal	Water birds.	71.45
4.	Bir Shikargah Wildlife Sanctuary.	Kalka (Panchkula)	Chital, Wild boar, and Red Jungle Fowls.	1896.00
5.	Abubakarpur Wildlife Sanctuary.	Dabwali (Sirsa)	Blue bull, Partridges and Black buck.	28492.00
6.	Saraswati Plantation Wildlife Sanctuary.	Ochla-Cheeka Kaithal/Kurukshetra	Black buck, Hog deer and Wild boar.	11003.00
7.	Khaparwas Wildlife Sanctuary.	Jhajjar	Water birds.	204.36
8.	Bir Bara Bun Jind Wildlife Sanctuary.	Jind	Blue bull, Monkeys, Hare, Black & brown Partridges.	1058.00
9.	Kalesar Wildlife Sanctuary.	Chhachhrauli (Yamunanagar)	Leopard, Bear, Chital, Sambhar, Wild goat, Barking deer, Wild boar & Red jungle fowl.	25001.65

For the development of these protected areas for promoting the wildlife therein various developmental works are taken up which are briefly described below:-

5.1.1 a) **Sultanpur National Park**

Because of the urbanisation and related developmental activities in the catchment of this protected area the run-off to the lake has greatly been impeded. To augment the supply of water, tubewells were dug in the early and mid nineties. However, when these tubewells started throwing saline (brackish) water, they were disconnected. For three years the lake remained totally dry. In 1999-2000, a pipe line connecting Gurgaon water supply channel to the lake was laid at a cost of around 50.00 lacs. However, the water supply through Gurgaon water supply scheme may become a problem in coming years because of the increasing population of Gurgaon. A museum and a Salim Ali Centre are constructed to give the visitors information on the bird life.

5.1.1 b) **Bhindawas Wildlife Sanctuary**

This water body wildlife sanctuary depends essentially on the water flow from the escape canal during the power failure period. With the improvement in the power situation in the state water supply to the lake by way of failure of power will be stopped and therefore, water to the lake needs to be supplied.

Water hyacinth has become a problem in this lake since last 5-6 years. The Govt. has taken up a project of biological control of weed through the release of two American weevils and a mite. This project is being taken up in collaboration with PDBC under ICAR Bangalore.

5.1.1 c) **Kalesar Wildlife Sanctuary**

At present there are no major developmental works being undertaken in Kalesar. However, improved protection, deployment of more wildlife guards and plantation of fruit trees besides need to be undertaken.

Sal has been affected with the borer at low intensity in some compartments. The operation of trapping of beetle need to be taken up continuously to prevent mortality of Sal in the area.

5.1.1 d) Bir Shikargah Wildlife Sanctuary

In this wildlife sanctuary, provision of some more water bodies especially to cater to the requirements during peak summer need to be taken up. The existing plantation of Eucalyptus and Kikar need to be phased out and planted with fruit trees. This, however, can be taken up only after seeking permission from the Hon'ble Supreme Court.

5.1.1 e) Saroswati Plantation wildlife sanctuary

This sanctuary basically has Eucalyptus, Kikar and Mesquite plantation. The only important wildlife in this sanctuary is Hog deer. To develop and propagate the animal in the sanctuary pockets of marshy areas having Kikar, Mesquite plantation need to be protected and depressions should not be allowed to be filled up for any purpose. If the depressions get silted up over years they would need desilting. There is a proposal of the Forest Department to desnotify this sanctuary in lieu of the notification of equivalent area in the Shiwaliks. However, it is recommended to convert this area as a 'Conservation Reserve' with a view to afford adequate protection to Hog deer found only in this area.

5.1.1 f) Bir Bara Ban Jind Wildlife Sanctuary

Since the area is relatively small and has only Eucalyptus and some other species plantations, there is hardly any scope for the development of this area as a better wildlife area. No developmental works are being taken up in this sanctuary.

5.1.1 g) Nahar Wildlife Sanctuary

This is a reserved forests in Rewari District. Unfortunately, to fill up the grassy blank, the territorial wing has planted *Prosopis juliflora* .The area, which once supported a local population of Black bucks, is almost devoid of this population now. The management by way of removal of this *Prosopis juliflora* and sowing of Anjan grass need to be taken up. Trees of *Prosopis cineraria* and Jal be planted in the area.

5.1.1 h) Abubshehar wildlife sanctuary

The area has relatively larger population of Bishnoi community and therefore, wildlife has the protection of the local people. Since the wildlife sanctuary comprises private area, human habitations and such other rural areas the strict implementation of Wildlife (Protection) Act is not possible. Such areas are better managed as community reserves and be notified as such as and when the Wildlife Protection Act ,after amendments, allows such conversion.

5.1.1 i) Chhilchhila wildlife sanctuary

This is a small depression on a community land with less potential for the development. In view of the people's objections on the continuation of the area as wildlife sanctuary there is little scope for the future development. The status of this sanctuary also needs to be changed to 'community reserve' as and when the Act allows such conversion.

5.1.1 j) Khaparwas wildlife sanctuary

This is a small depression surrounded by embankment. This water body used to get its supply of water from Jhajjar-sub-branch canal, which has been abandoned and therefore this water body has dried up. The future of this area as a wet land (water body) as a sanctuary is uncertain.

5.1.1 k) There is a proposal of the state to notify the natural forests area lying between Berwala and Mandhana on Panchkula-Morni road as wildlife sanctuary in lieu of de-notification of Saraswati Reserved Forest Plantation Wildlife Sanctuary and Bir Bara Ban Reserved Forest Plantation Wildlife Sanctuary. These two plantation wildlife sanctuaries are not good habitats whereas the proposed area is quite rich in wildlife. The proposed

blomi areas be developed to protect the biodiversity of typical Shivalik hill forest biodiversity.

5.1.2 Ex-situ conservation units

5.1.2 a) At the Pheasant Breeding Centre, Morni, Red jungle fowl has been successfully bred and released in the forest. Even Kalej pheasant was bred and released. The efforts to breed Cheer pheasant and Chakore have not succeeded for various reasons.

5.1.2 b) At Bhoor Siroha, breeding of crocodiles was started earlier. Now there are a large number of crocodiles in the lake which are facing the problem of over population.

5.1.3 c) Chinkara Breeding Centre at Kairu is a 58 acres fenced area in village Kairu in Bhiwani District. The animals here are in their near natural environment, and for all practical purposes this can be called as in-situ conservation effort.

5.1.2 d) There are two zoos in the state, one at Rohtak and the another at Pipli. Both these zoos are small and as per Central Zoo Authority guidelines fall in the category of mini zoos. Although they serve the local population, their role as conservation centres is only limited.

5.1.2 e) There are two deer parks one at Hisar and one at Mohan.

5.1.3 Wireless Communication

All the protected areas are connected with wireless communication with the district headquarters. The frequency of wireless communication in Haryana is the same as that of Uttar Pradesh, Himachal Pradesh and Punjab and therefore communication between the states for local exchange of information has improved.

5.1.4 Provision of Arms

Three Inspectors posted at Panchkula, Morni and Yamunanagar have been provided with revolvers and a total of six 12 bore, 10/80 guns have been provided to wildlife guards for the protection in the Shivalik areas.

5.1.5 Vehicles

Fifteen Inspectors in the state have been provided with motorcycles. There is one jeep, which is used for protection and publicity works in the state. The position of vehicles is highly inadequate. The apprehension of poachers and their further proceedings become difficult in the absence of Govt. vehicles.

5.1.6 a) Education, training camps are organized for the farmers, school children and teachers. However, this activity is constrained for the want of adequate resources and trained manpower.

b) Rural extension

To educate the rural community about the provisions of Wildlife (Protection) Act and to generate appropriate awareness meetings at the village/panchayat levels are held regularly.

5.1.7 **Eco-clubs**

The Department of Environment, Govt. of Haryana has initiated a programme of constituting Eco clubs in the state. At present about 100 Eco-clubs are functioning with differing enthusiasm in every district. The school children are given necessary environmental education through these Eco clubs.

5.2 NGOs and other people movements

As explained earlier there are few NGOs or voluntary agencies working in the state. The WWF (Chandigarh chapter) and Environment Society of India are working for creating general awareness about nature conservation. Bombay Natural History Society has recently started some activities in the state.

6.0 Gap Analysis

6.1 Gaps in information

6.1.1 Although the wildlife wing has been protecting and developing wildlife and wildlife areas there is hardly any scientifically collected information on the wildlife resources of the state. The information on the animals found, the status of their habitat and adequacy of the developmental works is far from satisfactory. A check list of birds as prepared by Mr. SC Sharma and Mr. Bill Harvey is available but their local/seasonal availability and their status is not known.

6.1.2 As explained earlier a 200 km. long road and rail transport from the north, northwestern Himalayan region connecting the metropolis of Delhi passes through Haryana and, therefore, because of strategic location effective control by way of interception can be undertaken within the state. However, the nature and content of illegal trade in wildlife through Haryana has not been studied.

6.1.3 At the vision and policy level the appreciation of the importance of biodiversity conservation is not satisfactory. For the stricter implementation of the Wildlife (Protection) Act, the local infrastructure is also inadequate.

6.1.4 There is no sanctuary in the southern region for the protection of the biodiversity of the Aravalli Hill system and of the sandy desert region. Some protected areas in the regions, therefore, need to be established.

6.2 Gaps in institution and human capacity

6.2.1 Traditionally, the staff of the erstwhile Wildlife Department had been responsible only for areas outside forest boundaries and therefore the need for training of the wildlife staff from forestry and habitat management point of view has been inadequate. And, therefore, the implementation of section 33 of the Wildlife (Protection) Act even if desired and required is not possible with the staff of wildlife wing alone.

6.2.2 The departmental infrastructure has not kept pace with the improved sophistication in the methods adopted in the trade of wildlife and wildlife products. The work of intelligence gathering, apprehension of offenders and poachers, prosecution and interrogation is very weak.

6.2.3 Because of the existence of the wildlife department as a separate department in the state earlier, the state forest officials had been alienated from the working of the wildlife department. Moreover, in the training of forest officials, generally, the training inputs on wildlife conservation are relatively less.

6.2.4 Wildlife Institute of India although provides technical training inputs to the state it is felt that the National level institute needs to be further strengthened to cater to the specific requirements of the state.

6.2.5 With the growing importance of biotechnology, genetic engineering, genetic manipulation there is a need to educate the state bureaucracy and the forest administration including the wildlife staff on the importance of resources under their possession.

6.2.6 The wildlife extension service is weak and needs further strengthening.

7.0 Strategies for the conservation of the wildlife in Haryana

For the conservation of wildlife and biodiversity of the state, eight-pronged strategy, as suggested, both short term and long term need to be adopted. Although at the moment some work on these strategies is being implemented a concentrated effort on further strengthening various activities and undertaking newer activities is required.

7.1 Forested Ecosystem

Protected areas representing the Aravalli Hill system and the sandy desert system need to be strengthened.

The forested ecosystems need to be further developed so that they can support a greater population of wild animals by improving the habitat. Plantation of fruit species and provision of water especially during the pinch period need to be undertaken.

To reduce the pressure on the protected areas, Eco-development works for raising the fuelwood and fodder and other income generating activities in areas outside the PA have to be taken up. At the state level promotion of agro-forestry, and production of fuel fodder on community lands i.e. social forestry needs to be revived on a larger scale.

7.2 Wet land

With the development in all other sectors the wetlands in the state are fast disappearing. Provision of water to the wetlands and their protection should be done and sustained efforts needed for maintaining them in future. The catchment area of Sultanpur national park needs to be notified under the provisions of appropriate Act to prevent any further construction creating obstruction to the free flow of run-off to the lake.

7.3 Community land

For the conservation of wildlife outside protected areas amendments to the Panchayat Act is required to be done so that 25 to 30 % of the community land is kept under tree cover in consultation with the concerned Panchayat. The extent of such land may vary depending upon the total area of community land. Where existing, the communities and the panchayats should be prevented from further appropriating the area for other developmental activities.

7.4 Wildlife Trade

Prevention of trade in wildlife and wildlife products from within the state and passing through state should be prevented for which the protection mechanism needs to be strengthened.

7.5 Generating awareness

For all these efforts to be sustained in future and for creating the awareness for the conservation in the people, nature education and conservation awareness programmes should be continued with full support and adequate fund. funding.

The local community will be associated, as far as possible in the management of the Protected Areas Help of articulate men and women will be taken in this awareness generation.

7.6 Capacity building

To enhance the capability of the department and to sensitize the associated personnel, staff should be trained and sensitized for various skills in the wildlife management.

7.7 Baseline Surveys

Base line survey of wild animals and other organisms should be undertaken and the status of each and every of these should be monitored continuously periodically.

7.8 Small animal offences

A long term plan to wean away the community involved in wildlife offences be drawn up.

8.0 Action Plans

In order to translate all these strategies into various specific actions, the following actions are suggested. The time frame for these actions have been mentioned along with each of these actions:-

8.1 Action 1: Habitat improvement of forested eco-systems

Category: High priority

Details:

- Plantation of fruit species namely Gular, Amla, Ber, Harad, Bahera, Bar, Pipal to be taken up in Kalesar, Bir Shikargah, Saraswati, Jind wildlife sanctuaries.
- Replacement of Khair and Eucalyptus crops in Bir Shikargah is a phased manner by these plantations and the removal of Lantana.
- Provisions of water in Kalesar, Bir Shikargah wildlife sanctuaries to be further improved so that the wild animals do not feel the pinch of water during summer period.
- Development of Morni area (the proposed sanctuary) to afford adequate protection to biodiversity of Shiwalik system.

Responsibility: Wildlife wing of the Forest Department.

Time frame: 5-10 yrs.

Resources required:

- The total area of Kalesar, Bir Shikargah, Jind, Saraswati wildlife sanctuaries works out to about 15600 hectares . At the rate of 20 plants per hectare a total of 3,12,000 plants need to be planted in these four sanctuaries . At Rs. 100/- per unit plant the total expenditure towards habitat improvement works out to 3,12,00,000/- rupees for next 10 years.
- For providing water one water body or one water point for 5 Kms. square area 62 water points at 50,000/- rupees per point the total expenditure would be around Rs. 31.00 lacs for next 10 years.

8.2 Action : Strengthening of Protected Area net work including the establishment of Conservation Reserves and Community Reserves in the State especially in the Aravalli Hills and the Sandy Deserts of the state.

Category: Medium to high priority

Details:

- Establishment of Protected Area in Aravalli Hill system:- The Bhondsi area of Gurgaon District could be notified as a Community Reserve and developed as a center of eco-tourism to create awareness among the people of the region and also to protect biodiversity of Aravalli Hill system.

- Establishment of Protected Areas in the sandy part of the state like in Nimbi Dukali and SohlaBadu in Mahendragarh District.
- Inventorization of old tree growth areas and declaring them as Conservation Reserves or any other category under any other Act including Environment Protection Act.
- Appropriate action would be initiated to further strengthen the community initiative in the conservation like those of the Bishnoi community in Abubshehar area.

Responsibility: Forest and Wildlife Department, Haryana.

Time frame: 0-5 years

Resources required: The notification of the areas as protected area does not require resources but for developing Bhurudsi area as eco-tourism area a separate project needs to be prepared.

8.3 Action 3: Improvement of Wetlands

Category: High priority

Details: Provision of alternate source of water to Sultanpur lake and Bhindawas through a Government level decision as the quantum of water supply is gradually reducing. Simultaneously efforts shall be made to notify the catchment area of the national park under the provisions of appropriate act to prevent construction activity which creates obstacles in the free flow of water to the lake.

Responsibility: Wild life wing of the Forest Department

Time frame: 15-20 year

Resources required:

- To bring water from around 50 Km. distance an estimated cost of 5.00 crores may be required for period between 10-20 years.
- Bhindawas lake is silting up and it may be necessary to desilt the lake. An estimated cost of Rs. 50.00 lacs for desiltation is proposed for next 10-20 years.

8.4 Action 4: Improvement of community lands

Category: Medium to high priority

Details:

- Amendments to Panchayat Act to bring that 25% to 30% of the community land to be kept under natural vegetation or as 'Gauchar' in order to protect the

biodiversity and the animal life in the community waste lands. This will be done in consultation with the concerned Panchayat and the extent of such delineation may vary depending upon the total area of the Panchayat.

- Bar on appropriating the community land for any other developmental activity.

Responsibility: Development and Panchayat Department and the State Government.

Time frame: As early as possible.

Resources required: No expenditure is envisaged.

8.5 Action 5: Regulation of Wildlife Trade and control over poaching.

Category: High priority

Details:

- Building a control mechanism of intelligence gathering, checking of trade, organising raids for the prevention of illegal trade in wildlife and wildlife products, for Haryana being in the strategic location.
- Establishment of wildlife stations, provisions of arms and better means of communication: two stations one at Ambala and one at Gurgaon; two vehicles, four guns and with wireless communication.

Responsibility: Forest and Wildlife Department, Haryana.

Time frame: Within the next five years.

Resources required: The estimated expenditure would be of the order of Rs. 50.00 lacs.

8.6 Action 6: Awareness generation including eco-tourism.

Category: Medium to high priority

Details:

- Arranging sensitization programmes for the benefit of the senior government functionaries of all the technical departments and other bureaucrats.
- Generating awareness among all sections of people in the state through publicity and exhibition.
- Strengthening existing nature education scheme in the state scheme for arranging nature camps.

- Tourism near and around the forest and Protected Areas, like in Morni areas, would be taken up on the lines of eco-tourism policy of Govt. of India and would be for the benefit of the local community
- Purchase of two publicity vehicles one for the north and one for the south for facilities to screen films in addition to holding of nature camps for different categories of people.

Responsibility: Forest and Wildlife Department, Haryana in collaboration with Education , Women and Child Development, Rural Development, and Social Welfare Departments.

Time frame: 10 year

Resources required: A capital expenditure of Rs. 20.00 lacs alongwith recurring expenditure of Rs. 4.00 lacs annually is proposed for next 10 years. Total amount required towards this is Rs. 60.00 lacs.

8.7 Action 7: Capacity Building

Category: Medium priority

Details:

- Training of the staff to enhance the capability of the department and to enhance the skills of staff.
- Training required in the field of eco management, wildlife and wildlife breeding.

Responsibility: Forest and Wildlife Department, Haryana

Time frame: 20 year

Resources required: Annual expenditure of the order of 2.00 lacs per year for next 20 years is estimated. The total amount required is Rs. 40.00 lacs.

8.8 Action 8: Baseline Surveys including preparation of Biodiversity Registers

Category: High priority, long term action plan

Details:

- Preparation of biodiversity registers. This will include documentation of the indigenous /traditional knowledge of the local domestic and wild biodiversity and the related tradition and their social and economic implications, if any. Women of the area will be associated in the preparation of the registers.

- Extensive survey by the universities of their area of influence on the existing status of the fauna district-wise and also on the basis of the habitats like aquatic and terrestrial fauna including micro-organism.
- Each university to survey different areas under its influence as a first step by getting the financial assistance to strengthen the existing infrastructure and man power specific for this enormous task.
- Each university of the state to take up the following projects in first phase of implementation of this project to develop a check list of the fauna of the state of Haryana. The local community will be involved in the inventory of the biodiversity of every area under study.
  - I systematics, Incidence of occurrence, seasonal variation and environmental effects on the aquatic fauna of Haryana state.
  - II Systematics, Incidence of occurrence, seasonal variations and environmental effects on the terrestrial fauna of Haryana state.

This study should include protozoans, coelenterates, annelids, crustaceans, insects, arachnids, molluscs, fishes, amphibians, reptiles, birds and mammals for their systematics upto species level. The incidence of occurrence and reasons for variations along with existing environment, including the socio-economic conditions and traditions as far as relevant, around their habitat should be made an important component of this study as it would identify the causes of the depletion or abundance of a species. This would help in working out the future strategies in conserving it.

Responsibility: Punjab University, IMTECH Chandigarh and other Universities in the state, Forest Department.

Time frame: 5- 10 year

Resources required: Rs. 200 lakh

8.9 Action 9: Research

Category: High priority

Details:

- Study of biology of available fauna both in the vertebrates and invertebrates whose biology is not known and show the signs of depletion or extinction.

- Studies in captivity or in natural environment for their biology or reproductive potential. Cyto-genetic record of the fauna for identifying the species and establishing inter and intra specific relationship between different species.
- Nucleotides sequence study through genomic mapping in order to establish the link between the present stock and ancestral stock that would help in preserving the germplasm of the state.
- Establishment of a separate state agency to monitor and coordinate the research and survey works under the name "Biodiversity monitoring Agency" headed by a Chief Coordinator.

Responsibility: Punjab University and other Universities in the state

Time frame: 5-10 year

Resources required: Rs. 500 lakh. This includes studies to be undertaken by the universities and the Bombay Natural History Society.

8.10 Action 10: Small animal offence prevention

Category: Medium to high priority

Details: Income generation activities matching with the activities of the Department in order to wean away the community involved in wildlife offence.

Responsibility: Forest and Wildlife Department, Haryana.

Time frame: 10 year

Resources required: It is proposed to start the income generation activity for the community at the rate of 5.00 lakh rupees per district i.e. Rs. 95.00 lacs per year for next 10 years. The total cost of the project would be of the order of Rs. 9.5 crores.

8.11 Action 11: Breeding of animals and birds

Category: Medium to high priority

Details:

- Breeding of rare and endangered animals found in the state like Vultures, Cheer Pheasant, Chinkara, Black partridges, Otters, small animals like Pangolin, Red desert fox, Caracal etc.

Responsibility: Forest and Wildlife Department, Haryana.

Time frame: 15-20 year

Resources required: An estimated cost of Rs. 15.00 lakh per year is required to be spent on this activity. The total cost is estimated at Rs. 300 lakh.

9.0 Follow up

9.1 Once the action plan has been approved and the funds are made available through appropriate agency a state level co-ordination committee would be set up to oversee the implementation of the action plan. A committee comprising Commissioner & Secretary, Forests and Wildlife, Principal Chief Conservator of Forests, Chief Wildlife Warden, Territorial Conservators of Forest and representative of Finance Department would be set up for the purpose.

9.2 Monitoring mechanism:

The state level co-ordination committee set up to oversee the implementation of action plan will also monitor the implementation of the state action plan under the overall guidance of State Wildlife Advisory Board.

Agriculture

1.0 Agricultural Profile of the State

Haryana with 4.4 m ha geographical area has 3.61 and 6.14 m ha net and gross cropped area, respectively. The state has 169 per cent cropping intensity, 76.8 per cent irrigated area, 19.4 ha under each tractor, 8.3 ha under each tubewell and use of N+P+K is 136.5 kg /ha. During last 34 years food grains production has gone up from 25.92 lakh tonnes in 1966 to 121 lakh tones during 1999-2000. The cereal to other crops ratio is 1.0: 0.64. Wheat, rice, cotton, mustard, Bajra and gram are main crops in the state. The production of rice, wheat cotton and oilseeds has gone up manifold. During this period, the food grains production has increased 4.6 fold, irrigated area by 39% and crop intensity by 35%.

Presently, Haryana is witnessing a fast change in cropping pattern and farming system. In 1966-67,pearl millet was the major *kharif* crop in the state occupying nearly 48% area in the season followed by sorghum (15%), rice (10%) and cotton (10%). Sugarcane, maize, *kharif* pulses and *kharif* oilseeds occupied 8,5,3 and 1 per cent area respectively. This pattern has now drastically changed. Now, rice occupies 34% of the cultivated area in *kharif*, followed by pearl millet (27%), cotton (24%), sugarcane (6%), sorghum (5%), *kharif* pulses (3%) and maize (1%). Such shift has also been observed in

Rabi cropping pattern. In 1960-67,the cultivated area under various *Rabi* crops was 53%wheat, 48%chickpea, 9% oilseeds, 8%barley and 2% other *Rabi* pulses. But the scenario has now completely changed. The area under wheat has risen to 64% followed by 19% mustard, 14% chickpea and 2% barley. The area under other *Rabi* pulses remained almost static over the years.

Similarly, area under horticulture is about 29000 hectare with production of fruits 21290 metric tones.

1.1 Existing area under different crops

During 1997-98 the area under cereals, pulses, oilseeds, cotton and sugarcane were 61.1, 7.6, 10.0,10.3 and 2.3 per cent, respectively. The area under **cereals** dominated in the districts Karnhal, (86.7%) followed by Karnal (85.75%) Panipat (83.1%) Faridabad (77.4%), Ambala (75.1%) Sonipat (72.9%), Gurgaon (72.3%), Rohtak (71.8) and Kurukshetra (70.8%); **pulses** in the districts Bhiwani (25.8%), Hisar (25.6%) and Rewari (19.4%); **oilseeds** in the districts Rewari (35.6%), Mahindergarh (29.8%), Bhiwani (17.1%), Kurukshetra (15.6%), Gurgaon (14.7%), Jhajjar (14.1%) and Hisar (12.7%); **Cotton** in the districts Sirsa (34.67%), Fatehabad (26.5%), Hisar (26.5%), Jind (13.3%) and **sugarcane** in the district Yamunanagar (20.8%) followed by Rohtak (6.4%), Ambala (6%) and Kurukshetra (5%).

1.2 Existing cropping pattern

There are three major climatic zones of Haryana viz. **Arid 58% area** (Arid I : Hisar, Fatehabad and Sirsa 25.7% and Arid II : Part of Rohtak, Jhajjar, Rewari, Part of Mahindergarh, Bhiwani, Part of Jind 32.3%); **Semi arid 34% area** (Semi arid I : Sonipat, Part of Rohtak, Part of Jind, Part of Mahindergarh, Kurukshetra, Karnhal , Karnal & Panipat 17.8% and Semi arid II : Faridabad, Gurgaon and Jind 16.2%) and **Dry sub-humid 8.8% area** (Ambala, Panchkula and Yamunanagar) .Rice-wheat is most important cropping system occupying about 36% area in semi arid-I, 23% in sub-humid, 9% in semi arid-II,, 4% in arid-I and 3% in arid-II. Another important cropping system is **cotton- wheat** occupying about 26% area in arid-I, 4% in semi arid-II,and 2% in arid-II. **Sugarcane based cropping system** is mainly concentrated in irrigated area adjoining to

sugar mills with 12% in sub-humid, 2% in semi arid-I, 2% in semi arid-II and 1.5% in arid-II and 0.3% in arid-I. **Bajra-gram** is important cropping system with an area of 9% in arid-II, 4% in arid-I and 1.5% semi-arid-II. **Bajra-mustard** occupies major area. 10% in arid-II, 5% in semi-arid II, 2.5% in arid-I. **Bajra-wheat** is mainly followed in arid-II, semi arid-I, arid-I. **Fodder based cropping systems** are generally grown all over state under irrigated conditions. In Dry Land, arid-I and arid-II have major area occupied by single cropping of **bajra, gram, mustard, moong, cowpea, guar, castor etc.**

In state as a whole, maximum area is under **rice-wheat** (22%), followed by **cotton-wheat** (16%), **bajra-mustard** (9%), **bajra-gram** (5%), **fodder-based** cropping system (8%), **bajra-fallow** (2%), **fallow-mustard** (4.5%) and **fallow-gram** (4%) other important cropping systems are **maize-wheat, Jowar-wheat, Jowar-gram** and **Jowar-mustard.**

The cropping pattern in Haryana underwent a major change during late 60s and 70s in the green revolution era. As far as land use is concerned, to give a historical perspective, the area under various crops had witnessed a major change. If the land use during the year 1967-68 is any indication, the area under different crops was as under:

Sr. No.	Name of Crop	Area (in lakh ha)
1.	Paddy	2.17
2.	Maize	1.15
3.	Bajra	8.85
4.	Kharif pulses	0.78
5.	Wheat	8.41
6.	Gram	11.60
7.	Barley	3.02
8.	Rabi pulses	0.38
9.	Sugarcane	1.21
10.	Cotton	2.41
11.	Rabi oilseed	2.46

After the green revolution, the area increased under cotton, paddy and wheat at the expenses of pulses, maize and gram etc. The land use pattern during the year 1998-99 is as under:

Sr. No.	Name of Crop	Area (In lakh ha.)
1.	Paddy	10.86
2.	Maize	0.20
3.	Bajra	6.13
4.	Kharif pulses	0.39
5.	Wheat	21.88
6.	Gram	3.57
7.	Barley	0.36
8.	Rabi pulses	0.15
9.	Sugarcane	1.28
10.	Cotton	5.82
11.	Rabi oilseed	4.98

1.3 Biological profile of agriculture systems in the State can also be discussed in the light of different cropping sequences. The net cultivated area in the State is around 36.50 lakh ha. and the area occupied by different crop sequences is as under :-

1.3.1 Wheat based cropping system

Wheat is grown approximately on an area of 23.00 lakh ha and it is grown in three major crop sequences i.e. rice-wheat, bajra-wheat and cotton-wheat. The area under rice is around 10.50 lakh ha, Bajra 6.00 lakh ha. And cotton 5.5 lakh ha.

1.5.2 Sugarcane based cropping system

The area under sugarcane keeps on fluctuating between 1.30 lakh ha to 1.50 lakh ha and the area under sugarcane during the year 2000-2001 was 1.44 lakh ha.

1.5.3 Mustard based cropping system

Mustard is grown on an average area of 5.00 lakh ha and the crop is preceded by either bajra or kharif pulses or fallow.

1.5.4 Gram based cropping system

Gram is grown over an area of 3.50 lakh ha. However, the area coverage is greatly influenced by the behaviour of rainfall, as the crop is by and large grown under rain fed conditions. Cultivation of gram is preceded by Kharif pulse, guar and fodder crops. Fodder crops like sorghum maize, lobia, guar etc. in Kharif season and berseem, oat etc. in Rabi season occupy around 5.00 lakh ha. The area under fruits and vegetables in the State is around 1.60 lakh ha. In this way, the net cultivated area comes to around 36.50 lakh ha.

The department now is laying emphasis on diversification. As a result of the efforts of the department, the area under Summer/Kharif paddy could be reduced from 85000 ha during summer/kharif, 2000 to 35000 ha during summer/kharif, 2001. Similarly, the target of area under paddy cultivation has been kept as 9.50 lakh ha against the achievement of 10.50 lakh ha during kharif, 2000. The area retrieved from paddy would be diverted to maize, kharif pulses, cotton, sugarcane and green manure crops.

2.0 Current range and status of biodiversity

Agriculture offers unique biodiversity in terms of genetic, species and ecosystem variation of flora and fauna. Flora in agriculture ecosystems includes domesticated crops, lower plants like algae, fungi etc. grasses, herbs and shrubs which are termed sometimes as weeds, trees etc. On the other hand, bacteria, nematodes, fishes, reptiles, frogs, snakes, birds, rats, herbivores etc constitute the faunal components in the domesticated crop biodiversity. A stable agro-ecosystem is developed through intimate interactions of all

the floral and faunal components as well as it's environment. Some of these flora and fauna and/or their mutual interactions are beneficial for crop improvement and have economic importance. Nature and quality of interactions though realized and conceptualized in many cases, evaluation and quantification of these flora and fauna in domesticated crop ecosystems has not been attempted from biodiversity point of view because of increasing tendency of monitoring the production of economically important crops. Therefore, quantitative information of agro-ecosystems in the state could not be produced except for those presently under cultivation.

2.4 Generic, species and varietal variations of crops

The State of Haryana is one of the few advanced and richer states with relation to agriculture. There are cereals, pulses, oilseeds, cash crops, vegetables, sugarcane, tuber crops, etc being under cultivation in the state. Each crop has large number of varieties suitable to various agro-ecological zones and qualitatively responsive to improved agricultural inputs like irrigation, fertilizer etc.

During the village visit to Palwas , Bikha (Mewat), Chiksa (Yamunanagar), and Bodla (Kurukshetra), it was revealed that people would like to cultivate older crop varieties like Chitti Mundi / Lal Mundi (wheat) if the loss by way of reduced crop production is made good through compensation or special marketing facilities.

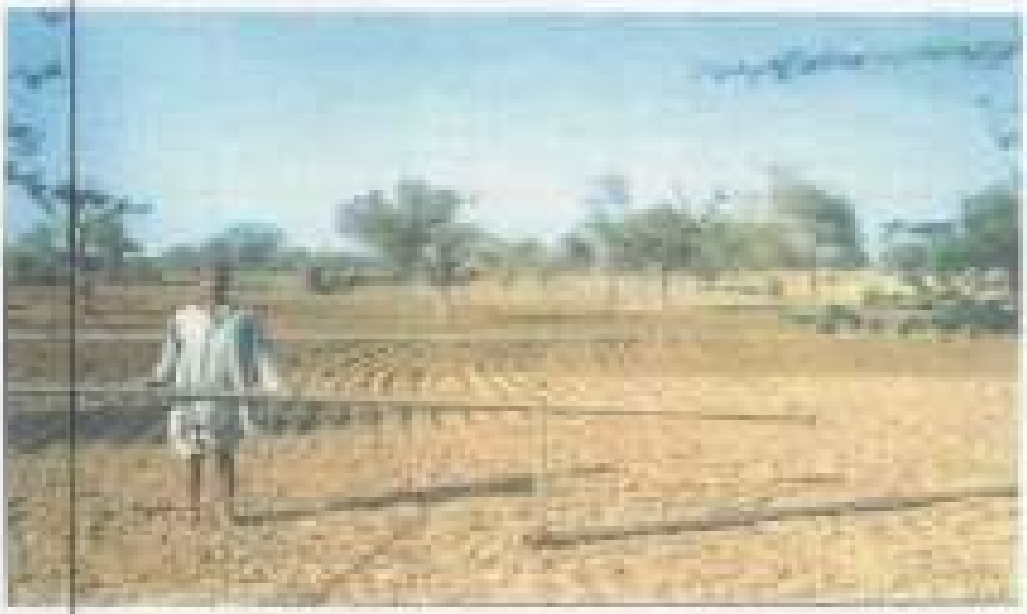
3.0 Statement of problems relating to biodiversity

3.1 Agriculture as a means for economic prosperity

In Haryana, agriculture is viewed as means of economic prosperity. The Government and it's people/the farming community aims at maximizing production by maximum utilization of land holding, the basis of agricultural production systems, through optimum productivity through optimum but not is what desired ecologically and scientifically. Objective of all of them is to derive maximum return from the agriculture by expanding the production base horizontally, by bringing more lands which other wise is the house of flora and fauna and vertically, by using superior variety which again removes from the genetic base. For example, though Haryana is major wheat and paddy producing state in the country, however, only a few varieties of these crops are grown at a time in the state. This leads to conditions of mono-cropping or mono-genic cultivation.

3.2 Shift in cropping pattern

3.2.1. After the evolution of high yielding varieties in paddy, wheat and bajra, the cropping pattern in the state underwent a drastic change. The evolution of these varieties coincided with creation of infra-structural facilities for intensive agriculture in the state during late 60's and early 70's. The area under high yielding varieties which were responsive to irrigation and fertilizer increased dramatically. The increased level of productivity per unit area particularly in case of paddy and wheat attracted the farmers for adoption of paddy-wheat crop sequence in the State. If we look at the historical perspective, the area under Jowar in the state during the year 1967-68 was 2.95 lakh ha which declined to merely 90000 ha during 1993-94. Moreover, another kharif crop occupied 1.19 lakh ha area during the year 1975-76 which also came down to 20000 ha during 200-2001. The area under bajra also declined from 10.05 lakh ha during 1975-76 to 5.46 lakh ha during 2000-2001. The entire area under these kharif crops was shifted to paddy and cotton. The area under paddy increased from 1.29 lakh ha during 1966-67 to 10.92 lakh ha during 2000-2001. Similarly, the area under cotton increased from 1.83 lakh ha during 1966-67 to 6.52 lakh ha during 1996-97.



3.2.2. The above statistics has been mentioned just to drive the point home that the production systems which promoted the proliferation of biodiversity was changed after

the green revolution. Any agricultural production system having ample scope for legume crops is beneficial to the biodiversity because the flora derive benefits out of the nitrogen fixation characteristics of legumes. During the process of shift in cropping pattern, Kharif pulses also received a set back as the area declined from 78000 ha during 1967-68 to 23000 ha during 1999-2000. Coverage of area under pulses/legumes in any production system is very important to proliferation of biodiversity. Serious damage though was not caused to the biodiversity due to shift in cropping pattern, but the biodiversity did get a serious set back in view shrinking base of biodiversity. Number of plants which used to grow in such crops like Jowar, maize and kharif pulses are nowhere to be seen due simple reason that paddy growing system does not allow such plants to thrive because paddy is grown under submergence system where plants capable growing under anaerobic conditions do not thrive.

3.2.3. The area from Rabi crops like gram, barley and Rabi pulses was also diverted towards wheat. Gram and other Rabi pulses as mentioned above were conducive systems for the biodiversity. Thus, paddy and wheat cropping system was established where emphasis was more on clean cultivation and selective herbicides were introduced in a big way for this purpose. The wide-spread use of selective herbicides put a cap on diversity of natural flora. Special kinds of weeds earlier unknown in the region got established and number of insects and diseases also came into being. Though the production system increased agricultural production, yet biodiversity in the process received a set back. Many plant species which used to grow earlier in the region are nowhere to be seen.

3.3 Water logging

3.3.1. The pre-requisite for intensive agriculture was assured irrigation and irrigation network was expanded in a big way both by exploiting surface irrigation water and underground water. The surface irrigation water was provided by and large in south western areas of the state, where the underground water was brackish and unfit for irrigation. It was a priority at that time in order to augment food grain production in the state. Incidentally, the soils were light in texture and the underlying ground water was brackish which resulted in rising of underground water level with continuous canal irrigation. As a consequence large tracts of lands became critically water logged and as

per latest estimate, 513.98 ha area has become water logged and unfit for cultivation. It is further estimated that if the present system of irrigation continues, another 5.09 lakh ha area will become critically water logged in 4-5 years.

3.3.2. The phenomenon of water logging results in drastic reduction of productivity of crops which ever could be grown in these areas. The reduction occurs due to drainage congestion in the root zone. As a result, the plants are unable to uptake nutrients and also suffer from moisture stress. It is not only the field crops which suffer on account of water logging but the biodiversity in general also gets a set back on account of water logging. The flora which grows on well drained and aerated soils fail to survive under water logging conditions and special kinds of species which are limited in number replaces the local flora.

3.4 Pesticide residues in food stuff

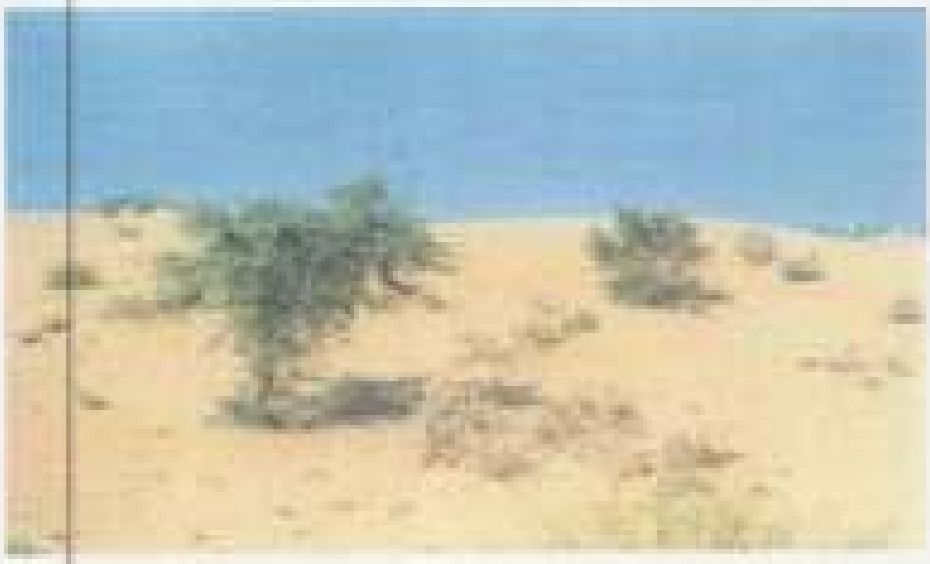
As mentioned above, the widespread use of selective herbicides had a toll on proliferation of flora because the growth varied plant species which were considered weeds were suppressed/controlled by these herbicides. The continuous use of these chemicals resulted in shift in flora, the earlier species giving way to the exotic species earlier unknown in the region. The exotic species later on acquired resistance against the herbicides and even the wheat cultivation was endangered because of the exotic weed,

Phalaris minor (mandoli). New chemicals were invented to control the resistant species which took toll of the biodiversity.

The pesticides residue in food stuff are generally higher than the concentration considered to be safe for human/animal consumption as prescribed by the WHO. The sole reason behind the high residual concentration is indiscriminate use of chemicals. These chemicals have adversely affected the population of beneficial insects and wildlife. Recently, large population of peacock, a National Bird, was reported to have been killed due to indiscriminate use of pesticide. Therefore, emphasis is laid now a days on integrated pest management which essentially means reducing the dependence on chemicals.

3.5 Diversion of lands for agriculture

For expansion of agriculture in the state a large chunk of lands, which were either community or waste lands have been brought under plough. Such lands earlier provided home for large number of flora and fauna.



3.6 Intensive mechanized agriculture

Agriculture in the state during post green revolution period has depended heavily on mechanization and use of agro-chemicals like fertilizers, herbicides, insecticides, fungicides etc for increasing the production. In the process, the balance between domesticated crops and other associated flora and fauna has been disrupted. Mechanized

tilling operations and use of herbicides has wiped out many floral species considered as weeds which otherwise have medicinal and nutritive value. Similarly, there are many beneficial soil micro-organisms like azolla, blue green algae, nitrifying and denitrifying bacteria, Rhizobium etc which are adversely affected by excessive use of chemicals though the nature of interaction is not established. The mono-crop cultivation with wheat or rice with single or few gene resistance has serious consequences of resistance breaking through development of more damaging pathogens by mutations.

3.7 **Lack of policy**

India has no policy/legislation for the protection of biodiversity. Therefore, Indian biodiversity was subjected to bio-piracy, over exploitation and non-protective cultivation over a long period, which led to serious loss in biodiversity.

3.8 **Development**

The biodiversity is at loss mainly due to human induced factors. Traditional way of life is always conservative in approach whereas the non-traditional way of life is destructive to biodiversity. Urbanization, industrialization, intensive agriculture and other such factors have played major role in biodiversity depletion.

3.9 **Economic goal**

During the green revolution era, biological resources were subjected mainly for the evaluation of their productivity value. The high yielding ones were given attention whereas others were left to their fate. This promoted mono-culture/cultivation of few crops/varieties. Consequently, biodiversity base was reduced. Over exploitation of vegetation also led to loss in biodiversity.

3.10 **Pollution and habitat destruction**

Habitat fragmentation and destruction, species over exploitation, introduction of exotic species and release of toxic chemicals into the air, water and soil are other major causes of biodiversity loss. Due to the soil, water and air toxicity/pollution, the sensitive species of flora and fauna have been progressively eliminated/lost. Emissions of gases such as sulphur dioxide, hydrogen fluoride, chlorine, and ammonia and gases particularly containing toxic metals affected the vegetation structure. Air borne pollutants such as

Ozone and peroxy acetyl nitrate and acid depositions are found to be problems of some regions affecting plant, microbes and animal life directly. Change in carbon cycle due to elevated level of CO_2 in the atmosphere and disruption of nitrogen cycle due to human induced nitrogen fixation leading to increase in nitrous oxide emissions and higher level of nitrogen depositions may cause drastic change in species diversity.

3.11 Ozone depletion

Increase in UV-B radiation as a consequence of depletion of stratospheric O_3 will have direct effects on biodiversity and ecosystem.

4.0 Major actors and their current role in relation to the biodiversity

4.1 Government

Department of Agriculture is primarily responsible for production, pricing, marketing, extension and training on agricultural crops in the state. Mandate of the Department is maximize production through new and improved technologies so that people and the government can derive maximum economic benefit from the lands. Therefore, biodiversity of domesticated crop ecosystems had little relevance as maximizing economic goal was the main objective of the department. However, diversification of agriculture is of recent phenomenon arisen out of the globalization.

CCS Haryana Agricultural University, Hisar is engaged on agricultural research in the state. It has made significant contribution in domesticated biodiversity conservation by conserving large number of germplasm of agricultural crops.

4.2 Citizen groups and NGOs

There are no such groups or NGOs working in the state in the field of domesticated crop biodiversity.

4.3 Local communities, urban and rural

Agriculture is privately owned occupation and hence, entire crop production system is controlled and managed by the individuals. Choice of crops, varieties, inputs, management practices etc depends entirely on the individuals under the consideration of soils, climate etc.

5.0 On going biodiversity related initiatives

5.1 Government

5.1.1 Agriculture Department

The Department does not have the mandate to conserve wild plants. Wild plants, rather are considered to be weeds in cropping sequences. For sustainable use of land resources, the degraded lands are reclaimed, soil erosion is arrested and likewise saline/waterlogged areas are also being reclaimed. The actions to conserve and sustainable use of domesticated plants are initiated at the district level in shape of various crop oriented schemes. The microorganisms play an important role for the availability of nutrients to the plants and by fixing atmospheric nitrogen through symbiotic process. The microorganisms are conserved by way of practices suitable for conservation like green manuring, addition of compost farmyard manure and management of crop residues. The actions are planned and executed at the level of Deputy Directors of Agriculture at district headquarters. Recently, agricultural diversification has received paramount importance whereby cropping pattern is being diversified by encouraging cultivation of number of economically important crops in stead of typical wheat-paddy system as practiced now.

5.1.2 Universities

Information regarding most of the crops is available in the CCS Haryana Agriculture University, Hisar. They have detailed information on position of germplasms (Table 1). The university has enhanced the number of lines of different crops by way of collection. The University maintains only working germplasm whereas the remaining germplasm is either maintained by National Research Centres or CGIAR institutes. By this way the available biodiversity was protected at this university. A large number of germplasm lines are being maintained by crop breeders to utilize them in crop improvement programme. The available germplasm of different crops is as under:

1. **Crop plants**

Sr.No.	Crop	No. of Accessions		
		In 1979	*Current position*	
1.	Wheat: *Triticum aestivum* *T. durum*	4100 -	1000 250	Remaining are with DWR
2.	Barley	800	606	
3.	Bajra	200	1015	
4.	Pulses			
	i) Gram	6500	208	Remaining are with ICRISAT and NRC
	ii) Soybean	-	292	
	iii) Moong	150	72	
	iv) Urd	-	227	
	v) Lentil	-	50	
	vi) Peas	-	43	
	vii) Pigeonpea	100	235	
5.	Cotton			
	Gossypium hirsutum	220	1300	
	G. arboreum	105	500	
6.	Forages			
	i) oats	250	305	
	ii) Berseem	110	215	
	iii) Sorghum	410	220	Remaining lines are with NRC
	iv) guar	150	218	
	v) Cowpea	50	100	
7.	Oilseeds			
	Brassica juncea	1000	600	Remaining lines are with NRC
	Toria	150	100	
	B. Napus	-	30	
	B. carinata	-	30	
	Safflower	400	246	
	Sunflower	-	70	
	Sugarcane	-	500	
	Maize	-	100	

	Rice	1000	1200(Basmati and non-basmati)
II. Medicinal and Aromatic Plants			
	Isabgol	+	76
	Ocimum basilicum	-	20
	Periwinkle	-	8
	Ashwagandha	-	8
	Guarpatta	-	4
	Aganigan sp.	-	15
	Solanum sp	-	5
	Shatavri	-	4
	Mentha spp.	-	8
	Lemongrasses	+	16
	Palmarosa	+	16
	Citronella	+	4
	Vetiveriaes	+	12
	Senna	-	2
	Dhatura	+	4
	Gudmar	+	3
	Mushli	-	2
III. Under-utilized Plants			
	Dhaincha	+	80
	Crotolaria	+	15
	Rice bean	+	80
	Fababean	+	70
	Grain Amranth	+	30
	Guzyale	+	10
IV. Vegetable Crops			
	Ajowain	-	18
	Okra	-	250
	Chillies	-	40
	Methi	-	250
	Fenugreek	+	40
	Coriander	-	85
	Tumeric	-	18
	Cumin	-	6
	Bunga	-	6
	Carrot	-	90
	Peas	+	150
	Radish	-	6
	Bitter gourd	-	76

	Bottle gourd	-	35
	Tomato	-	250
	Garlic	-	25
	Onion	-	25
	Summer Squash	-	30
	Brinjal	-	50
	Thistle	-	8

6.0 Gap analysis

6.1 Gap in information

Quantitative information pertaining to all forms of life i.e. flora and fauna associated with the domesticated crop ecosystems in various agro ecological zones of the state is not available. Kinds of plants such as herbs, shrubs, grasses, trees, lower plants like fungi, algae and fauna like microorganisms, frogs, fishes, reptiles, rodents, birds and herbivores etc. and their association with cropping environment is pre-requisite for effective biodiversity conservation planning.

6.2 Gap in policy and legal framework

As such there is no guideline for conservation of domesticated crop biodiversity.

6.3 Gap in *In situ* conservation

Agriculture in the state mainly aims at maximizing production and economic returns and intensive agriculture is being practiced for achieving the goal. This high input based agriculture practices has neglected associated flora and fauna in cropped ecosystems. No effort has been made for conserving such diversity. Rather, present crop management practices has adversely affected these flora and fauna, some of which are under the threat of extinction.

6.4 Gap in public awareness

The farming communities are not much concerned about the biodiversity conservation primarily because of lack of awareness amongst them. Scientifically sound, eco-friendly crop management practices need to be followed by them to further the cause of biodiversity conservation.

7.0 Major strategies

7.1 The value of traditional, conventional, ethnic way of resource utilization can be considered as potential method for biodiversity conservation. This involves society/community to protect the bio-diversity without any financial burden on state. Such communities should get due incentives. Domestication, protection and rearing/cultivation of animals/plants have been done mainly by communities and their role would continue in biodiversity protection in future as well.

In order to apply ethnic knowledge to conserve/restore the partially depleted biological diversity, it is essential to know what are the ethno-biological species that flourish in the target area for rehabilitation and how far the ethnic groups depend on them by way of product extraction. The socio-economic status, the external influences on the ethnic groups, the ecosystem, the floral and faunal diversity and the carrying capacity of the area are also to be understood before the conservation or rehabilitation programme can be implemented. Tribal, traditionally nomadic and hunter-gatherer in life-style utilized biological resources in their access for almost all their needs in life. In the process, the plant and animal diversity was protected.

How man and his associated living organisms co-existed in the past without much species depletion and habitat deterioration has to be studied and accordingly, the involvement of communities, NGOs and public sector has to be identified.

Traditionally, the womenfolk have played an important role in the selection, exchange and storage of seed of different varieties. This needs to be studied and understood specifically in the context of the different agro-climatic zones of the state.

7.2 The process of loss may be reverted by ex-situ and in-situ conservation, but the magnitude and success in many cases may be far less than the rate of loss. Somatic embryo-genesis, clonal variation, cryo-preservation, induced mating, genetic transformation, tissue culture etc. are some of the advance techniques which can be utilized for biodiversity protection.

7.3 The convention on biological Diversity (CBD) provides for sovereign rights of individual countries on their genetic resources. Therefore, efforts are being made to regulate access to plant genetic resources (PGRs) and also for acknowledgement of national sovereignty. For this purpose, FAO's International Undertaking on Plant Genetic Resources (IUPGR) is also being revised. These issues have been widely debated and were also discussed at the 4th ITC held in June, 1996 at Leipzig. At this conference USA and EU strongly opposed the view held by the developing countries that the sovereign rights of the countries of origin of PGRs held in ex situ collections be recognized. These developed countries were successful in achieving approval for a call to "strengthen cooperation to sustain ex situ collections, recognizing that states have sovereign rights over their own PGRs" (own PGRs here mean PGRs stored on their territory irrespective of the territory of origin). The expression "Sovereign rights of the countries of origin of PGRs" proposed by developing countries was replaced by the alternative expression proposed by USA and EU "sovereign rights over their own PGRs". In this way, they rejected the recognition of sovereign rights of the countries of origin of PGRs available in gene banks in the developed countries.

Under the provisions of 'biodiversity Treaty', different countries will have sovereign rights on their existing natural resources, but not on those of their own genetic resources, which got locked up in gene banks outside their borders before the treaty came into force (29.12.1993). Major part (90%) of the plant genetic resources (PGRs) related to crop plants are actually locked up at the level of IARCs-NARS and apprehensions were expressed that the countries of origin of germplasm may sometimes have no access to their own PGRs earlier deposited in these IARCs, NARS gene banks. Fortunately, a CGIAR/FAO agreement signed in October 1994, and other steps taken by FAO and

(PGR), will ensure that those PGRs at IARCs-NARS system are further enriched and are available to those who need them. Establishment of the FAO commission on genetic Resources for Food and Agriculture (CGRFA) is an important development in this direction. Drafts of 'Material Transfer Agreements (MTRs)' and multilateral System for PGRs' have also been prepared as steps towards equitable distribution of benefits arising from these PGRs. A clearing house has also been established for dissemination of a variety of information on PGRs through an international network.

In view of the above, the companies located in the Northern countries are dealing directly with agencies where PGRs are located rather than dealing with countries of origin of these PGRs. Pharmaceutical industry is also gaining access to and purchasing tropical PGRs from botanical gardens located in temperate countries. A recent study by International Association of Botanical Gardens (IABG) indicates that one sample each of at least 30% of world's vascular plants are available in botanical gardens, three-fourth of these gardens located in the developed countries in the North. The pharmaceutical industry is exploring the possibilities of procuring rights for chemically analyzing the collections at these gardens for developing new drugs. Such a screening will be on payment, but who will determine the manner and means of payment or compensation?
It has however, been provided for in the Convention on Biodiversity conservation (CBD) to protect indigenous / traditional knowledge and share equitably the benefits with the holders of knowledge (in the context of international transfer of such knowledge / technology)

Keeping in view of these developments, we have to bring bio-diversity legislation and then fight for our right at international level.

7.4 In the agricultural sector, genetic diversity of cultivated plants (including their wild relatives) is being lost due to a variety of human activities. In specific crops, it is being narrowed down due to the development of high yielding varieties leading to the use of mono cultures for intensive agriculture. These aspects of biodiversity loss are being widely debated, and efforts are being made not only for in situ and ex situ conservation, but also to encourage on farm community conservation' of biodiversity both at national and international levels. Gene banks have been established under "National Agricultural

Research Centres (NARCs)' under CGIAR system. Crop networks have also been developed by IPGRI to integrate germplasm collections, curators and researchers into groups focused on such individual crops that are currently not receiving the desired attention from IARCs.

The number of each of the accessions of national gene banks and IARCs is swelling due to unrestricted collection of germplasm, without definite efforts towards its possible sustainable and equitable use. Consequently, there will be difficulties in handling maintenance and use of this conserved biodiversity due to its size. This has necessitated the study of the nature and structure of genetic diversity in collections available in different gene banks so that core collections for individual crops may be selected for major attention. Therefore, for a study of genetic diversity, a variety of methods (both non-morphological, evolutionary and molecular data (using phenetic as well as cladistic analysis) have been successfully used in a number of crops.

7.5 Involvement of local community and NGOs

Conservation of plant biodiversity is the need of the time. For centuries, plants have been used in religious rites, rituals, and festivals and as offerings to gods and ancestors in our country. In these rites not only important food crops but weeds and wild varieties were also used leading to their protection indirectly. The recurrent need of these plant materials in rites and religious ceremonies demanded their preservation. Thus, these ceremonies acted as gene banks of today. All the individuals of society felt the need and did their duty of keeping and preserving plants without any material gains out of it. In our strategy, the involvement of religious heads and communities over societies would play a foremost important role in biodiversity protection and involve very little financial burden on the state. Action Plan can be chalked out for involving them at village/block/district/state level. A provision of incentives can help a long way in biodiversity protection. Participation of NGOs in association with public sector for biodiversity protection can also be a very useful strategy.

The Panchayati Raj Institutions, Women groups (like Self Help Groups) and the Women and Child Development Departments could be associated in cataloguing the information

of agro-biodiversity available in the state and for further supporting and stressing the need for biodiversity conservation in the rural areas of the state.

7.6 In order to focus the attention of all the agencies to the need for agro-biodiversity conservation and continue making efforts in that direction the agriculture sector in general and the Department of Agriculture in particular will set up a mechanism which will include experts in the field and public men of eminence.

8.0. Action plan for crop biodiversity conservation

8.1 Action 1: Surveying and inventorization of flora and fauna for strengthening database including preparation of Biodiversity Registers

Category: Short term priority

- **Details:**
- Preparation of biodiversity registers. This will include documentation of the indigenous traditional knowledge of the local biodiversity and the related traditions and their social and economic implications, if any. Women of the area will be associated in the preparation of the registers.
  - Systematic survey
  - Collection and cataloguing of endemic flora and fauna
  - Inventorization and documentation

Responsibility: CCS Haryana Agricultural University, Hisar, through PRIs, Women self help groups and the Departments of Social Welfare and Women and Child Developments

Time frame: 3-5 year

Resources required: About Rs. 30.00 lakh.

8.2 Action 2: Research

Category: medium to high priority

Details:

- Setting up laboratories in universities and research institutes for regeneration/mass multiplication/conservation.
- Studying interaction and association of various components, usefulness of flora and fauna and other ecological aspects.
- Biodiversity conservation for medicinal and aromatic plants
- Conservation and sustainable utilization of biodiversity in all five zones of the state.
- Management of biodiversity for diversification of important crops in Haryana.
- Biodiversity of soil micro-organisms in Haryana soils and their conservation.
- Crop improvement in relation to salt affected soils in the state.
- Testing of flora in different zones for their resistance against concepts of eco-climatic conditions.
- Promotion of eco-friendly initiatives of farmers through appropriate incentives.

Responsibility: CCS Haryana Agricultural University, Hisar and CSSRI Karnal

Time frame: Five to ten year

Resources required: Rs 1000 lakh.

8.3 Action 3: Policy and legislation

Category: High priority

Details:

Formulation of policy framework to ensure ecologically sound crop management practices so that maximum diversification in agriculture is ensured without impairing food security and consistence income to the farming community.

Set up a unit within the Department of Agriculture to keep alive the subject of the need for agro-biodiversity conservation in the state.

Responsibility: State of Haryana , Department of Agriculture and CCS HAU, Hisar.

Time frame: This is a time taking process but should be ensured as early as possible.

Resources required: To be assessed by the Government.

8.4 Action 4: Organic farming

Category: Medium to high priority

Details:

- Eco-friendly crop management systems without use of chemicals
- Incentives to the farming community as opportunity cost for adopting traditional cropping in lieu of the modern one involving high level of agricultural inputs.
- Research on changing organic farming practices.

Responsibility: Department of Agriculture, Govt. of Haryana, CCS HAU.

Time frame: Ten year.

Resources required: An estimated of amount of 1000.00 lakh.

8.5 Action 5: Integrated management practices

Category: Medium to high priority

Details:

- Integrated crop management practices involving selection of suitable crop varieties with maximum variation in a region.
- Scientific agronomic practices, pest and disease management practices.

- Incentives to the farming community to adopt recommended integrated management practices and to revitalize the traditional knowledge of integrated management practices.

Responsibility: Department of Agriculture, Govt. of Haryana, CCS HAU.

Time frame: Ten year

Resources required: Above 2500.00 lakh.

8.6 Action 6: Conservation of wild flora

The State Forest Department has already strategies and actions plan for wild biodiversity conservation.

Category: Medium to high priority

Details:

- Removal of encroachments on Panchayat lands
- Regulating the grazing of cattle, goats and sheep to help conservation efforts.
- Banning allotment of Panchayat lands to non governmental and private organizations except for purposes of education and health
- Promoting cultivation of medicinal and aromatic plants in private lands.

Responsibility: CCS HAU, Hort. Forest Department and village panchayats.

8.7 Action 7: Agricultural diversification

Category: High priority over a period of 10-15 year.

Details:

- Promotion of diversification in agriculture through provision of incentives to small farmers.
- Infrastructure for post-harvest utilization of agricultural produce, storage, transportation facilities etc

- Strong marketing system for post-harvest agricultural goods including sound forward price policy.
- Market research and data processing for promotion of diversification in agriculture.
- Crop genetic diversity, crop species diversity over space, crop species diversity over time, agro-ecosystems biodiversity through crop livestock interactions.
- Natural biodiversity within agro-ecosystems as paradigm of agro-biodiversity protection.

Responsibility: Department of Agriculture and CCS Haryana Agriculture University.

Time frame: 10-15 year

Resources required: About Rs. 20000.00 lakh over a period of 15 year.

8.8 Action 8: Ex-situ conservation

Category: Low priority.

Details: Establishment of botanical gardens, gene banks for various agro-ecological zones.

Responsibility: CCS Haryana Agricultural University, Hisar.

Time frame: Five year.

Resource required: Rs. 100.00 lakh.

8.9 Action 9: Extension

Category: Medium to high priority particularly from community participation point of view.

Details: Strengthening agriculture extension and information service for creating awareness among the farming community, specifically oriented towards biodiversity conservation.

Responsibility: Department of Agriculture, Govt. of Haryana through the Panchayati Raj Institutions, Women Self Help Groups, Department of Women and Child Development and the knowledgeable community groups.

Time frame: 10 year.

Resources required: The cost is around 500.00 lakh.

Horticulture

1. Introduction

1.1. Haryana, predominantly an agrarian state has diverse climatic condition and produces a wide range of tropical and sub-tropical horticultural crops. The state is ideally suited for exploiting the potential of horticultural production because it is in close proximity to the metropolitan city of Delhi which is one of the biggest markets of the country. A majority of the horticulture crops specially fruit crops being perennial in nature having long gestation period require well planned and systematic planning for their development.

1.2. Horticulture is a service area attracting farmers, entrepreneurs, small investors, traders and specialists. There has been significant increase in the horticulture crops in terms of area and production during the last few years. Farmers are taking up horticulture crops as a separate viable economic activity.

1.3. With a view to give a boost to the growth of horticulture in the state, Haryana Government had constituted a separate Department of Horticulture in 1990-91. Since then, the Department has made significant contribution in the development and diversification of horticulture crops in the state.

2. Profile of area

2.1. Geographical profile

The geographical area of the state is 44212 sq. km., out of which 37.94 lakh ha area is cultivable. Horticultural crops are high value crops providing the much needed protective food to human beings, besides having great potential for export in fresh form or in the form of value added products. Fruits trees and other perennial and seasonal horticultural crops lead to the build up of tree cover on the earth which contributes for better maintenance of ecological system / balance and helps in checking/arresting various form of soil erosion. The horticulture crops of late have become comparatively more remunerative than cereals or other agricultural cash crops. With the growing awareness amongst the masses about the nutritive value of various fruits and vegetables, which has led to their increased consumption and demand, the farmers are taking up this venture as a profitable proposition. Total area under fruit crops in the state is 31715 ha. According to 1995-96 reference report the average size of operational holding was 2.13 ha, which

varied from 1.44 ha in Faridabad to 3.13 ha in Sirsa district. Agriculture is the main occupation and about 70 per cent of the state population derives its livelihood from it. The important fruit crops grown in the state are mango, citrus fruits, guava, ber etc.

2.2. Socio-economic profile

Population of the state according to 2001 census(provisional) is 21.1 million with an average density of 372 persons per square kilometer. About 75 percent of the state population lives in the rural areas. The literacy rate is about 68.59 (excluding the children below 6 years age). As per the 1991 census the total number of workers was 8.72 million which accounted for 29 per cent of the total state population. There were 1.83 million cultivators and 0.89 million agricultural laborers, which accounted for 44.67 and 16.11 per cent of the total working population, respectively.

2.3. Ecological profile

2.3.1. Haryana is broadly divided into two zones i.e. western zone and eastern zone. The geographical location of Haryana is in the north-west of Indian subcontinent, which is over 1600 km away from the Bay of Bengal, and is between the western Himalayas in the north and deserts in the south that mainly determines its climatic conditions. Excessive and untimely rains, scanty rains, heat waves, cold waves, high winds in summer, dust and hail storms are important weather abnormalities that adversely affect the crop production in Haryana. The climate of Haryana is strongly influenced by the northwestern cold and southwestern monsoon winds.

2.3.2. Normal annual rainfall is about 300 mm in southwestern region and it increases towards north and eastern regions up to 600 mm to 1100 mm. Rains are mainly received as tail of the summer monsoon.

2.3.3. The wide variations in the soils of Haryana have been grouped into 5 categories viz. i) Reddish chestnut soils, ii) Tropical arid brown soils, iii) Arid brown soils, iv) Sierozem soils and v) Desert soils.

2.4. Brief history

2.4.1 At present the area under various horticultural crops in the state is about 3.5% of cultivable area and there is a vast scope for the increase of area under these crops.

The following table shows the growth of area under the horticultural crops and their production at the time of creation of the state and the status after the constitution of the Horticulture Department.

	At the time of the creation of the state In 1966,		After the constitution of Horticulture Department	
	Area(ha)	Production(tones)	Area(ha)	Production(tones)
Fruits	7865	37527	12640	99800
Vegetables	11305	135360	35260	802240
Mushroom	nil	nil	252150(trays)	850

2.4.2 This many fold increase in the area and the production is because of the following interventions made by the Department of Horticulture in the state:

- The farmers are motivated and acquainted with the latest technologies for growing the horticultural crops by arranging Gyan Goshties, Field Days, Seminars, Exhibitions and Trainings.
- Arrangement of quality planting material, certified and hybrid vegetable seeds and good quality spawn and pasteurized compost for mushroom cultivation are made available in time.
- Demonstrations on various horticultural crops are conducted which help in increasing the area under these crops.
- Where irrigation water is a major constraint, drip irrigation system is popularized to bring more area under horticultural crops.
- Cluster approach is followed for all horticultural crops.

3. **Current range and status of biodiversity**

Information pertaining to the range and status of diverse horticultural crops in the state is not available. Nevertheless, people of the state prefer to grow many predominant fruit, vegetable and flower crops from economical and aesthetic points of view as described below:

3.1. **Fruits crops**

3.1.1. The fruit crops of tropical and subtropical traits mainly belong to Arecaceae, Anacardiaceae, Guttiferae, Tiliaceae, Vitaceae, Myrtaceae,

Euphorbiaceae, Moraceae, Rutaceae and Ebenaceae families. In the semi-arid to arid tracts of northern India including Haryana (in the south south-west part of the State), *Capparis*, *Grewia*, *Zizyphus*, *Rhus*, *Carissa*, *Flacourtia* and *Salvadora* species are found whereas in the northern parts *citrus*, *Mangifera*, *Syzygium* and *Ficus* species are prominent. The species like *Aegle marmelos*, *Emblica officinalis*, *Feronia limonia*, *Syzygium cumini* and *Tamarindus indica* are found throughout the country.

3.1.2. Above said fruits not only ensure nutritional balance but also provide stable income to the poor living in and around the forests, degraded wastelands and scarcity areas. Quite often, they serve as famine insurance to the people during scarcity years by way of edible fruits, firewood, fencing material, leaf fodder, etc. Many of these fruits are nutritionally very rich and are of great medicinal value. The National Institute of Nutrition, Hyderabad has also suggested to augment the diet of people with diversity of such fruits. Thus these fruits hold promise for sustainable agriculture, particularly for a small farmer by augmenting their income with the least risk, and have a growing demand in the local as well as export market and for processing besides providing opportunity for diversification in the wake of the global changes in weather conditions.

3.1.3. Very little has been done to explore and exploit the genetic resource of these fruits crops. Hence it is all the more essential, in the face of a severe genetic erosion and disappearance of several species as a result of activities related to urbanization, to protect the existing resource by all means. The genetic diversity of the related wild species is especially important in a search for sources of resistance to physiological races of patho-types of fungi, bacteria, viruses and nematodes besides winter hardiness, resistance to drought, water-logging and salinity, etc.

3.1.4. Current range of fruits available in the state is given in table 3.1.4

Table 3.1.4 Fruit crops of Haryana

Indigenous species	Introduced species	Exotic species
Ber (*Ziziphus mauritiana*	Bael (*Aegle marmelos*)	Date palm (*Phoenix dactylifera*
Bornli (*Z. mauritiana* var. *rotundifolia*)	Phalsa (*Grewia subinaequalis*)	Mango (*Mangifera indica*)
Jharber (*Z. nummularia*)	Karonda (*Carissa carandas*)	Guava (*Psidium guajava*)
Ker (*Capparis decidua*)	Jamun (*Syzygium cumini*)	Kinnow mandarin (*Citrus nobilis X C. deliciosa*)
Pilu or Bara Jal (*Salvadora oleoides*)	Mulberry (*Morus alba*)	Lime (*C. aurantifolia*)
Chhota jal or mustard tree (*Salvadora persica*)	Pomegranate (*Punica granatum*)	Lemon (*C. limon*)
Hins or Ghoran (*C. zeylanica*)	Karna Khatta (*Citrus karna*)	Strawberry (*Fragaria ananassa*)
Gondi (*Cordia gharaf*)	Mitha or Sweet lime (*C. limettioides*)	Jack fruit

		(*Artocarpus heterophyllus*)
Lasora or Gonda (*Cordia myxa*)	Gab (*Diospyros embryopteris*)	Papaya (*Carica papaya*)
Khejri (*Prosopis cineraria*)	Mahua or butter tree (*Madhuca indica*)	Sapota (*Manilkara achras*)
Gangeran (*Grewia tenax*)	Indian lotus (*Nelumbo nucifera*)	Grapes (*Vitis vinifera*)
Gular (*Ficus glomerata*)	White lotus (*Nymphaea nouchali*)	Peach (*Prunus persica*)
Wild datepalm or Jungli khajur (*Phoenix sylvestris*	Jaman or wild jamun (*Syzygium fruticosum*)	Plum (*P. salicina*)
	Wild cape gooseberry (*Physalis minima*)	Almond (*P. dulcis*)
	Maulsari (*Mimusops elengi*)	Banana (*Musa spp.*)
	Rough lemon or Jatti-khatti (*Citrus jambhiri*)	Litchi (*Litchi chinensis*)
	Wood apple (*Feronia limonia*)	*Loquat (Eriobotrya japonica)*
	Monkey Jack (*Artocarpus lakoocha*)	Natal Plum (*C. grandiflora*)
	Drumstick or Suhajana (*Moringa oleifera*)	Sweet Orange (*C. sinensis*)
	Tamarind (*Tamarindus indica*)	

3.1.5. As far as fruit climatic zone are concerned, the state has been divided into two distinct zones, namely the western and the eastern zone. In the western zone, citrus,

guajes, phalsa, guava, ber, aonla, date palm, jamun, mulberry, pomegranate and beel are the major crops in irrigated areas, while ber, bael, aonla, karonda, mulberry and pomegranate in the dry areas. In eastern zone, citrus, guava, grapes, papaya, peach, plum, phalsa, jamun, mulberry and aonla are the major crops. Zone wise recommended fruit crops to be cultivated is given in Table.3.1.5

Table 3.1.5 Recommended fruits to be cultivated in Haryana.

	Zone	Fruits Recommended
A	**Eastern zone**	
	i) Eastern Hilly Region (Sub-humid with high rainfall) Kalka, Nanangarh, Chhachhrauli, Jagadhri, Karnal, Panipat, Ladwa and Indri.	Peach, Plum, Pear, Mango Loquat, Sapota, Papaya, Aonla Jamun, and Guava.
	ii) Alluvial Plain (Semi- and with medium rainfall) Ambabad, Palwal, Ballabgarh, Gurgaon, Nuh, Pataudi, Sonipat, Karnal, Panipat, Kurukshetra, Kaithal, Guhla, Pehowa, parts of Rohtak and Jind districts.	Citrus, Guava, Grapes, Date palm, Peach, Plum, Phalsa, Jamun , Mulberry.
B	**Western zone**	
	i) Alluvial Plain (Semi-arid with medium to low rainfall) Parts of Hisar, Rohtak, Bhiwani and whole of Mahendergarh district.	Citrus, Grapes, Guava, Ber Aonla, Date palm, Jamun, Mulberry, Bael.
	ii) Sand dunes (Arid ecosystem fed with low rainfall). In the western and south-western parts of the State and adjoining Rajasthan, Sirsa, Bhiwani, Rewari.	

3.1.6. Area under fruits during 1966-67 was 7865 ha with a total production of 27,527 tones. The area and production under fruits has increased considerably from 12,640 ha and 99,800 tones during 1990-91 to 25629 hectares and 313000 tones by the end of 1999-2000 respectively. The projections of total area and production for 2000-01 are 30629 hectares and 3,30,000 tones. Area (in ha) and production (in metric tones) of fruit crops in Haryana are given below (Table.3.1.6):

Table 3.1.6 Area and production of fruit crops in Haryana.

S. No.	Name of Fruit	Area		Production	
		1997-98	1999-2000	1997-98	1999-2000
1.	Citrus	4590	5381	42900	57509
2.	Mango	6000	6849	21890	38546
3.	Guava	4062	5194	39430	43109
4.	Grapes	1197	1213	17400	8400
5.	Ber	3568	4173	29700	41753
6.	Others	4446	5857	27430	33354
	Total	23863	28627	178008	198271

3.1.7. Special emphasis has been given to the production and supply of good quality nursery fruit plants at reasonable rates. The production of fruit plants at Government and registered nurseries during 1998-1 was 1,50,000 which has risen to 750000 by the end of 1999-2000. There are 34 Govt. Garden and Nurseries for nursery and vegetable seeds production. In addition these units are serving as progeny orchards-cum-demonstration center to the farmers. It is planned to produce 7,00,000 fruit plants during 2000-01.

3.2. Vegetables

3.2.1. Haryana is an important state from vegetable production point of view, because of its close proximity to the metropolitan city of Delhi. At the time of formation of Haryana state in 1966, the total area under vegetable was 11,200 hectares with a production of 1,35,300 tones. The area and production of vegetables have increased from 55,760 ha and 8,02,240 tones during 1990-1 to 135000 ha and 9094500 tones by the end of 1999-2000. The programme of area coverage and production for the vegetable during 2000-01 is 1,30,000 ha and 18,50,000 tones.

Area (in ha) and production (in metric tones) of vegetables crops in Haryana are given in following table 3.2.1)

Table 3.2.1 Area and production of vegetable crops in Haryana

S. No.	Name of Fruit	Area		Production	
		1997-98	1999-2000	1997-98	1999-2000
1.	Potato	6560	5301	42900	37509
2.	Onion	8250	12500	14270	180000
3.	Cabbage	3500	6000	65800	125000
4.	C. Flower	8000	12000	109900	220500
5.	Tomato	7500	9000	142430	199500
6.	Okra	6800	8500	64400	87600
7.	Peas	7600	8500	52300	70050
8.	Reddish/Turnip	6300	8500	52300	70050
9.	Carrot	5000	7000	103000	137000
10.	Chillies	5500	6800	45400	60200
11.	Brinjal	4300	5500	72800	99600
12.	Chillies	5500	6500	58600	90200
13.	Leafy Vegetables	4500	6500	34900	71300
14.	Others	9500	13500	109300	220500
	Total	**102000**	**135000**	**1350800**	**2094500**

3.3 Mushroom

The mushroom cultivation was non-existent at the time of bifurcation of the State in 1966-67. The high value and nutritionally rich food picked up during 1989-90. Mushroom cultivation is high income and employment generating activity. Steps have been taken to set up modern pasteurized compost and spawn production, mushroom testing and disease identification centers, one at Murthal and other at Ch. Charan Singh Haryana Agricultural University, Hisar. This will further augment the efforts to better quality mushroom production with increased yield. The production of mushroom during 1990-91 was 850 tones. It has now increased to 3200 tones by the end of 1999-2000.

Table 3.3 Production (in tones) of Mushrooms

	No. of Trays		Production	
	1997-98	1999-2000	1997-98	1999-2000
Mushroom	336800	830000	3680	5200

3.4. Floriculture

3.4.1. Commercial flower cultivation was non-existent at the time of re-organization. Keeping in view the increased demand of flowers and cut flowers for domestic and export market, the department has taken steps to popularize commercial floriculture amongst the farmers. Before 1989-90 there was no planned programme of commercial flower production. There was hardly an area of 50 ha under commercial flowers, but, by the sustained efforts of the extension staff of the department it has now increased to 2550 ha during 1999-2000. The area under flowers during 2000-01 is expected to increase further to 3000 ha.

Table 3.4 Area (in ha) and production of flowers in Haryana during 1999-2000.

Sr. No.	Name of flower	Area	Production
1.	Gladiolus	225	360 lacs spikes
2.	Carnation	10	30 lacs cut flowers
3.	Roses	120	96 lacs cut flowers
4.	Tuberose	135	190 lacs spikes
5.	Chrysanthemum	75	Tones
6.	Marigold	1740	420000 tones
7.	Other flowers	185	15 lacs

3.5 Introduction of New Technologies

Water is a major constraint in the state and it is extremely necessary to conserve, preserve and utilize the irrigation to the best economic advantage by adopting new technologies such as drip and micro irrigation system. The department

has popularized this technology amongst the farmers in the state and so far 2828 hectares area has been covered under drip and micro irrigation system by the end of 1999-2000. This helps in increasing efficiency of irrigation water by 3 to 4 times. During 1999-2000 an area of 241.5 ha was brought under these techniques.

4.0 Statement of problems relating to horticultural biodiversity

4.1. Before 1970's, the government policies were confined to increase cereal food production owing to food deficit in the country and international pressure on prices and external policy of the country. Therefore, limited efforts were made to conserve this valuable fruit flora.

4.2. Even now, priority is given to increased food production for ensuring food [grain] security to ever growing human population. Fruits that provide balance nutrition are still a fancy and aristocracy of the rich and upper economic classes of the society. Therefore, conservation of horticultural biodiversity still remains to be an academic concern.

4.3. Due to increasing population pressure, urbanization and industrialization deforestation has taken place resulting in the loss of valuable land area and the flora.

4.4. Indigenous non-traditional fruit crops, viz. ber, jamun, mulberry and khejarda, that can withstand stress environment and require lower levels of inputs for optimum production on marginal and stressed lands have been neglected so far. These under-exploited fruit species being tolerant to both biotic and abiotic stresses, can be successfully grown to have sustained food supply, employment and income for the people inhabitating the waste lands which are degraded, disaster prone and considered unfit for traditional agriculture. These species are known to provide life support to the people in the arid zone of the state since they supply staple foods during seasonal shortfalls or hunger periods and before the crops are ready for harvest or during famine situations. Their inclusion in the farming system not only has potential to ensure regular farm income for sustainable agriculture but such diversification can also help to conserve these lands and their biodiversity. Some of these fruit species grow wild in different regions of the state and their edible fruits are rich in nutrition and have medicinal values and have potential for commercial exploitation. At present, these are used locally for preparation of food products such as pickles.

5.0 Major actors and their current roles relevant to biodiversity:

5.1. Government:

Horticulture Department is primarily entrusted to increase production of horticultural crops for providing maximum benefits to the common people both in terms of economic and nutritive benefits. Forest department plays great role in conserving wild flora of the state. Similarly, institutes like CCS HAU, Hisar is carrying out horticultural crop improvement programme.

5.2. NGOs

At present, there are no specific recognised NGOs to look after or to protect the habitats of horticultural importance. No care has been diverted towards rehabilitation of fish species having economic importance.

5.3. People and community

The people are driving force for crop improvement as well as for the expansion of horticulture.

6.0 Ongoing biodiversity related initiatives

6.1. As far as biodiversity conservation of horticultural crops is concerned, some work is already going on some indigenous fruit crop of Haryana, growing in the arid region of the state under the Indian Council of Agricultural Research (ICAR) funded projects leading to their conservation and preservation. Notable amongst the various crop varieties being maintained are the 85 variaties of ber which need special mention. Further strengthening of the biodiversity of fruit flora of Haryana is required. Emphasis needs to be laid on the collection of the endangered fruit plant species from different parts of the state.

7.0 Gap analysis

7.1. India has witnessed spectacular changes in agriculture in the past four decades and thereby has attained self-sufficiency in food production. Modern agriculture though provided a quantum jump in food production witnessing the well known green revolution, yet it simultaneously, also led to considerable decrease in wasteland area. Excessive use of fertilizer, pesticides and weedicides into modern agriculture has led to the accumulation of the chemicals in the soil and water to toxic levels and has rendered these lands unfit for traditional agriculture. The indigenous non-traditional fruit crops, viz. ber, jamun, mulberry and karonda, that can withstand the stress

environment and require lower levels of inputs, can ensure optimum production on such marginal lands.

7.2 These fruits species also provide leaf fodder, firewood, serve as windbreaks and fences, raw material for many useful medicinal preparations. Owing to their multifarious uses, these can be used in different agro-forestry management system to meet basic needs of the local population. Presently due to alarming population growth, urbanization and deforestation, their availability from natural sources has declined considerably. The demand for their products has increased in India as well as in international market necessitating due importance to their cultivation as well as preservation of the diversity of these crops.

7.3 Haryana state is endowed with a wide range of diversity in fruit plants including wild relative of crop plants. So far, no systematic explorations have been made to conserve and document the fruit biodiversity available in Haryana with. A lot of biodiversity exists in both dry area (south-west Haryana) and wet areas (Morni hills) of Haryana, which is yet to be explored and exploited. A number of fruits species are under threat in wake of fast urbanization, industrialization and deforestation. Keeping in view, the increasing pressure on the natural habitats of fruit biodiversity, it is the need of the hour to conserve and preserve the precious biodiversity in the form of native species and land races of fruit crops. A large number of fruits have already lost their identity without any documentation and some of them are at the verge of extinction.

7.4 Presently, there is a big gap in information, status, policy and legal structure and institutional and human capacity. No concrete information is available with regard to biodiversity centers in Haryana on fruit plants. Moreover, no institutional efforts have been made so far to protect these valuable plant wealth, in spite of good economic importance. They also hold importance in crop improvement as a source of resistance against diseases, pest and drought. All the concerned industries and institutes have been totally dependent on the natural availability of the raw materials of fruit plants from forests or natural habitats so far.

8.0 Major strategies to fill the gaps, and enhance / strengthen ongoing measures

8.1. Many species of fruit crops are growing in various parts of the state since centuries. The Morni area and foot hills of Pinjore, Raipur Rani, Naraingarh are rich heritage of horticultural crops. Fruits of desi mango, aonla, behera, anar need to be preserved. Similarly, in the district of Gurgaon, Hodal area is also famous for guava, ber etc. In Gurgaon itself, some areas are quite suitable for ber and the farmers are getting remunerative prices. In Narnaul area there are some ber varieties which give high yield. Therefore, other parts of the state also need to be surveyed for getting requisite information on extinct varieties, which need to be preserved. The marked plants may be propagated further through various methods in Government gardens, nurseries and tissue culture laboratories.

8.2. Environment is getting polluted due to urbanization and industrialization. Department is encouraging plantation of mango, guava, ber, aonla, pomegranate and farmers are being assisted in planting material and inputs. The rejuvenations of old orchards to preserve old plantation is also being taken up. The process will be continued further.

8.3. The Department is also planning for conservation of rare endangered plants like Jal (Salvadora species), Ker (Capparis decidua) by assisting tissue culture laboratory which are developing protocol for the multiplication. With the increase in area under orchard, the population of birds and animals like parrot, peacock and black buck are bound to increase which are beneficial for biological control of pests and also helpful for ecological balance.

8.4 To keep biodiversity in horticulture, legislation shall have to be promulgated so that endangered species are not uprooted. It will help in further propagating the plant material of such species for further multiplication. Deshi ber, aonla can be planted on undulating land in Morni area etc. Pharmaceutical companies are also in dire need of herbal and medicinal plants for manufacturing their products. By their uprooting, without any control, certain species are becoming extinct. To keep a check and further multiply these, some methods have to be evolved. Department is encouraging plantation of tulsi, mulhati, ginger, turmeric, [illegible], aonla etc by demonstrating and providing subsidy on plant material of ginger and turmeric. The

such plants also need propagation by tissue culture so that they remain true to type and give high yield. It also helps in preservation of biodiversity.

8.5 Government garden and nurseries as well as registered private nurseries need to be strengthened. Respective District Horticulture Officers will survey the area falling in their jurisdiction and extension staff deployed with them. They will identify the genotype plants and mark them for preservation.

8.6 Major strategies to fill gaps require well planned and cohesive approaches in different directions, such as, collection, evaluation for economic parts; multiplication of important medicinal and aromatic plants; cataloguing and documentation conservation of germplasm of different fruit plants; and standardization of in vitro multiplication of important fruit species.

9.0 Biodiversity conservation action plan

Above mentioned conservation measures can be translated into different action plans as under:

- Surveying and documenting existing horticulture biodiversity
- Selection and identification of plant species of horticulture importance
- Multiplication by various means
- Distribution for large scale cultivation

9.1. Action 1: Surveying and documentation including preparation of Biodiversity Register

Category: Medium to high priority

Details: Preparation of biodiversity registers. This will include documentation of the indigenous traditional knowledge of the local people of the biodiversity and the related tradition and their social and economic implications, if any. Women of the area will be associated in the preparation of the registers.

- Surveying of various areas in different parts of the state to find out where such plants exist naturally.
- Strengthening of extension staff for surveying such plants giving higher yields.
- Sensitizing farmers and farmers about the importance of conservation.
- Documentation of such plants and their utilization. The help of the local community would be obtained in the inventory of the diversity of the fruit crops.

- Propagation and multiplication of such plants in the Government nurseries through various improved techniques like tissue culture etc.
- Distribution to the farmers for growing on their fields so that it gives higher yield and good remuneration.

Responsibility: CCS HAU, Hisar and Department of Horticulture, Govt. of Haryana with the help of the local community wherever necessary.

Time frame: 5-10 year

Resources required: Rs. 150 lakh

9.2. **Action 2: Policy and legislation**

Category: High priority

Details:

- Policy for conserving the biodiversity in horticultural crops at the Government level.
- Involving the local community especially the poor and the women in the development of local and traditional fruits and their conservation.
- Mechanism to preserve such identified plants, which are useful to the farmers and would give good remuneration.
- Formulation of rules and regulations as to how the staff has to implement the policy.
- Defining the roles of CCS HAU, ICAR and other centers of repute.

Responsibility: The State Government.

Time frame: As early as possible.

Resources required: To be decided by the Government.

9.3. **Action 3: Fruit biodiversity conservation and reinforcing existing infrastructure.**

Category: High priority within 5 year.

Details:

- Conservation of fruit plant diversity. If the fruit plant diversity exists on the community owned lands appropriate mechanism will be evolved to protect the resources with the help of the community.
- Strengthening of existing Government nurseries
- Provisions of leaps for mobility of staff

- Employment of staff like Statistical Assistant, Computer Operator, Drivers, Horticulture Development Officers, supporting staff and provision of contingencies.

Responsibility: Government of Haryana and CCS HAU, Hisar with the involvement of the local community . CCS HAU has prepared project for fruit plants diversity conservation for Rs. 405.00 lakh.

Time frame: 5-10 year

Resources required: 500 lakh.

9.4. **Action 4: Research**

Category: High priority.

Details: Research activities on various aspects of horticultural biodiversity including vegetables.

Responsibility: The Government of Haryana & CCS HAU, Hisar. The University has prepared a project for the conservation of vegetable biodiversity in the state for Rs. 217.00 lakh

Time frame: 5-10 year.

Resource required: Rs 350 lakh

Fishery

1.0 Profile of the area

1.1 Geographical profile

Haryana state has an area of 44,212 sq.km. inhabited by 21.1 million (2001 census) people. In the north, the state is bounded by the Shivalik hills and Yamuna river in the east. The Aravali range forms southwestern boundary which is running south along Delhi through Gurgaon district up to Alwar in Rajasthan and further to the desert of Bikaner. In the west, Ghaggar stream forms half of the boundary and other half is framed by the vertical line down from the Shivalik to Khanar town. The state is situated in the flat plain basin of the Indus and the Ganges above a mean sea level of 927 ft.

1.2 Ecological profile

1.2.1. General

The climate of the state shows pronounced continental characters i.e., very hot in summer and marked cold in winter. The maximum temperature is recorded in the month of May and June when it goes as high as 40°C. A minimum temperature of as low as 2.3°C occurs in the month of January. The average rainfall is 500 mm. The rainfall is unevenly distributed during the year except in monsoon and winter. Annually about 2305 sq. km. area is subjected to flooding in monsoon. Ground water in major part of the state is brackish in nature and sweet water is available in limited areas. The water table is very deep in some region while waterlogged areas are also found at many places along canals and rivers. The fluctuation in the watertable is pronounced. In the canal-irrigated areas the water table is rising at an alarming rate, whereas in other areas the water-table is very low.

1.2.2 Water resources in the state

Haryana, though constitute semi-arid desert in some part, has a variety of water resources including river, wetlands, man made canal systems, reservoirs, tanks, ponds, well etc to meet domestic, agriculture and industrial requirements. Ecological importance of these aquatic bodies is immense because of the fact that they constitute a stable habitats for a diverse nature of flora and fauna. The fresh water resources of the state can be divided into three categories, namely,

i) Flowing water, viz. rivers and streams

ii) Standing water, viz. small reservoirs, ponds and tanks, and

iii) Ground water, viz. dugwell, tubewell etc. (not dealt in this document).

1.2.2.1 Flowing Water

a) There are 14 rivers and rivulets in the state. However, the Yamuna and the Ghaggar are two major rivers in northern part of the state to have developmental and economic potentials. The remaining rivers are seasonal in nature and form tributaries of these two main rivers. The Yamuna, originating from the Himalayas, emerges in the plains near Yamunanagar and flows along the eastern border of the state. The river is semi-perennial with a vast catchment area comprising the Himalayas and the Shiwaliks. It flows along the boundaries of Yamunanagar, Kurukshetra, Karnal, Panipat, Sonepat and Faridabad districts of the state. The river Ghaggar also originates from the Himalayas in Himachal Pradesh and it enters the state near Pinjore of Panchkula district. It flows across the semi-arid areas of the state along the boundaries of Haryana and Punjab States and eventually disappears in the deserts of Rajasthan. Seasonal rivers like Dangri, Markanda and Sarasvati constitute the tributaries of the Ghaggar.

b) Sahibi, Kasauli, Dohan etc. are some of the important streams in southern Haryana.

c) The Bhakra Canal and Western Jamuna Canal (W.J.C) are the two major canal systems which have extensive network of distributaries in the state. The Western Yamuna Canal, commissioned during the Mughal period, has its origin at Tajewala head-works near Yamunanagar. The Bhakra canal that caters to large area in the state was completed around 1955.

1.2.2.2 Standing water

a) Among the major lentic Fisheries resources includes ponds, marshy lands, natural and man made small reservoirs, micro watersheds, areas with saline water and critically water logged areas. The estimated extent of each of these resources is given below:

Ponds:	Perennial	8000 ha
	Seasonal	2000 ha
Marshy lands		2000 ha
Reservoirs		900 ha
Micro watershed		360 nos.
Saline water area		28000 sq.km
Critically water logged areas		25000 ha

[a] In addition, there are about 8000 seasonal and 2000 perennial ponds in the state which have profound socio-economic and cultural role in rural Haryana. There are two types of ownership of these ponds i.e. Panchayat or community and individuals. Ponds owned by the Panchayats constitute more than 80 percent of total pond in the state. The size of the ponds normally varies from 0.4 ha to 2 ha. Ponds of even smaller size and bigger ones of 4 ha and above also exist in the state. The village Panchayats lease out ponds to the fish farmers for fish farming for the period of 1 to 3 years and some times upto 7 to 10 years. At the time of creation of the state only 58 ha water area in the shape of village ponds was under fish cultivation when total fish stocking was 1.50 lac and the fish production was 62 tonnes. Thus, there was 1088 Kg fish production per hectare per year. The pond fish culture was developed manifold with the implementation of composite fish culture practices given by ICAR in early 70's and establishing of Fish Farmers Development Agencies (FFDA) in the state. The FFDA has played a vital role in creating a class of fish farmers in the state and motivated them to adopt fish farming. During 1999-2000, 9029 ha water area was under fish cultivation having a fresh stocking of 1770 lakh quality fish seed. The total production from the culture fisheries in the state during 1999-2000 was 30,000 tonnes and thus the per hectare fish production was 4015 Kg.

There are 3214 fish farmers who are engaged in the fish farming. Number of progressive fish farmers have attained a higher productivity level up to 10,000 Kg per year by adopting preferential harvesting and high stocking density of fish seed.

c) Fish farming has also been taken up in sewage water along Gurgaon canal by number of farmers in Gurgaon district. More than 500 ha water area has been adopted as sewage fed fisheries in the State. Farmers are utilising the raw sewage water of Gurgaon canals in ponds and are getting good fish production.

1.2.2.3 Reservoirs

There is no reservoir in Haryana in terms of definition of "Reservoir". However, many small reservoirs have been constructed in Gurgaon, Faridabad and Mahendragarh districts for flood control. These are Ottu, Surajkund, Badkhal and Dohtana etc. Total water area of these reservoirs is about 400 hectares.

1.2.2.4 Lakes

Bibipur, Najafgarh and peacock lakes provide good fishery resources. Morni Tals in Panchkula district are good source of fish production. Aravalli Hills provide large catchment area forming Chandni and Kotla lakes in Gurgaon district. Tilyar lake near Rohtak, Karna Lake in Karnal and Hali Park Lake in Panipat have been constructed for the tourist attraction. The total water area of lakes in Haryana is estimated at 500 hectare.

1.2.2.5 Wetlands

a) Wetlands have recently gained recognition as productive ecosystems, which play an important role in sustainable socio-economic development. There is now a growing awareness that many wetlands are more valuable in their natural form or in only slightly modified state.

b) In addition, these wetlands generate products such as forest resources, wild life resources, fisheries, agricultural resources etc. Further they support bio-diversity and attribute uniqueness to the culture/heritage by their scenic beauty. In Haryana, wetlands are of fresh water category. The natural wetland sites mainly include riverine (rivers, streams with their flood plains), lacustrine (freshwater lakes, ponds, including their flood plains, while the man-made wetlands include the reservoirs for restoring water for irrigation and or human consumption, village tanks for aquaculture-culture and other purposes.

c) As per study conducted by Haryana State Remote Sensing Application Centre, Hisar, the total number of wetlands with an area of 2.25 ha or above are estimated to be 1829 with an area of 20080 ha approx. Natural wetlands are 1395 in number and constitute and area 13325 hectares which is 56.6 percent of the total wetland area in the state. Man-made wetlands are 434 in number and cover an area of 11734 hectares. In addition, there are 2060 smaller wetlands in the state, which can also be used for fisheries. Details of seasonal changes in water spread during pre-monsoon and post-monsoon in the wetlands are given in table 1.1 and 2.2.

Table 1.1: Pre and post monsoon area of wetlands in Haryana

Category	Number	Area (ha.)		
		Wetland	Pre-monsoon	Post-monsoon
Natural	1395	13325	5759	15321
Man-made	434	11734	9203	11049
Total	1829	25056	14912	26370

The distribution of the above area according to source type is given in table 1.2.

Table 1. 2 : Source wise distribution of wetlands in Haryana.

Category	Number	Area (ha.)		
		Wetland	Pre-monsoon	Post-monsoon
Tank/Pond	940	6840	3687	6836
Manmade Ponds	5	115	65	115
Water-logged (Seasonal)	448	8358	-	8357
Tanks	6	129	130	125
Water-logged	425	11568	8824	15668

(Man-made)				
Ash Ponds	5	359	259	256

The district wise distribution of wetlands is given in table 1.3.

Table 1.3: District wise distribution of wetlands in Haryana.

S.No	District	Number (Post/Pre Monsoon)	Area (Post/Pre Monsoon
1.	Hisar	247/135	6229/953
2.	Rohtak	343/183	2869/953
3.	Jind	163/109	1095/680
4.	Sirsa	113/23	4015/759
5.	Bhiwani	48/43	474/935
6.	Faridabad	176/88	2535/483
7.	Karnal	105/89	2515/483
8.	Sonipat	132/97	947/218
9.	Kurukshetra	56/25	625/179
10.	Yamunanagar	44/22	448/174
11.	Gurgaon	135/91	3284/397
12.	Rewari	22/17	106/83
13.	Panipat	84/66	949/413
14.	Mahendergarh	209/24	2486/133
15.	Ambala	91/23	430/249
16.	Kurnal	209/24	2360/133

c) In addition to above water sources, the HSMITC has estimated that about 250 Sq.km area in the state is critically water-logged having 1m or more depth of water throughout the year and 3300 sq.km area is under water-logging with shallow depth, and another 8000 sq.km is low lying where water gets accumulated in the post monsoonal months. All these areas have potential for converting them into economically viable fish culture units by proper treatment/method.

6) Saline water areas where traditional agriculture is difficult can also be used for fish farming. More than 28000 sq.km area in the state is underlain by saline water. The district Gurgaon, Faridabad, Hisar, Sirsa and Rohtak are most affected areas. With development of suitable technology, culture pond and saline water fishes can be effectively produced in these areas. The district-wise area affected by salinity/water logging is given in table 1.4.

Table 1.4: District wise area affected by salinity water logging in Haryana.

S.No	District	Area (000 ha)
1.	Hisar	45.00
2.	Sirsa	17.00
3.	Rohtak	37.80
4.	Sonipat	90.00
5.	Gurgaon	7.10
6.	Faridabad	15.00
7.	Karnal	8.20
8.	Kurukshetra	15.00
9.	Ambala	18.00
10.	Jind	38.00
11.	Mahendergarh	2.00
12.	Bhiwani	1.40

2.0 Current range and status of biodiversity

Aquatic ecosystems are very diverse in species and complexity of interaction among their physical, chemical and biological components. Haryana being land locked state harbours only freshwater habitats. These may be lotic (running water) and lentic (standing water). The rivers, streams, in the upper reaches, support large number of organisms that are capable of adhering to exposed surfaces. These organisms include

Periphyton, filamentous green and blue algae and various invertebrates like larvae of insects, crabs, fishes, etc. In the downstream, emergent macrophytes, burrowing insects, crayfish, cat fishes and carps etc are found. The lentic ecosystem is considered to have the littoral, limnetic and profundal zones. The littoral zone extends from shoreline to innermost rooted plants and supports rooted species with floating leaves such as water lilies. Animal population includes frogs, snakes, snails and variety of larvae and insects. The limnetic zone is open water down to the depth of light penetration. This zone contains phytoplankton (diatoms) green and blue green algae, zooplanktons from protozoans to microarthropods. This zone also supports swimming organisms like fishes, amphibians and larger insects. The profundal zone occurs below the limnetic zone and supports mostly the decomposers like fungi, bacteria etc.

2.1 Zooplankton

Important zooplankters usually found in freshwater fish ponds belong to the Protozoa or single-celled animals, viz., Arcella, Difflugia and Ciliates, the Rotifera or wheel animalcules (e.g., Brachionus, Filinia, Polyarthra, Pedalia, Keratella and Asplanchna) and the Crustacea dominated by the Cladocerans or water-fleas (e.g., Daphnia, Moina, Ceriodaphnia and Simocephalus) and the Copepods several species of Diaptomus and Cyclops and their young ones, the Nauplius larvae. Ostracods are relatively less common.

The Cladocerans and Copepods, almost universally present, form the most important food items of baby fish. Rotifers are also equally relished. In manured ponds, these often appear in dense swarms, but last only for a few days.

2.2 Weed-dwelling fauna

Several rotifers, flatworms and water mites (hydracarina) which live in leaves of water plants, the common Hydra, the snails, the bristleworms (Oligochaeta) and the common insect larvae are included under this category. Some of these, like the Hydra, are attached to the leaves and derive their subsistence from the deposits on the leaves, the small organisms that come near the leaves and also on the tender leaves of plants. This category of fauna constitutes an important source of food for fish of omnivorous feeding habits.

2.3 Bottom-dwelling fauna

Animals living near or in the bottom mud of the pond are included in this group. The red oligochaetes and the bloodworms or Chironomid (insect) larvae are two important constituents of this bottom fauna. The Chironomid larvae live inside small tubes made of sand and the debris. The mud snails (Limnaea and Viviparus), dragonfly nymphs, and the fresh water snails are also commonly met with in most ponds. Fishes, which frequent the bottom regions largely feed on these organisms.

2.4 Phytoplankton

These are minute, microscopic plants, passively floating in water, often multiplying rapidly and occurring in millions, imparting a turbid green, brown or yellowish brown colour to the water. Such a condition is known as a 'water bloom' and the plants are generally called algae. The majority of planktonic algae in the Indian freshwaters belong to the group green algae (Chlorophyceae) and blue green algae (Cyanophyceae), though a number of diatoms (Bacillariophyceae) and flagellates (Euglenineae) are also commonly found. The algae, which have been often found to cause water blooms in fishery waters are Euglena, Volvox, Chlamydomonas, Actinastrum, Scenedesmus, Pediastrum, Microcystis, Anabaena, Oscillatoria, Euglena, Ceratium and Melosira.

The microscopic plants are eaten as food by most of the higher animal organisms in water. Owing to their resistant cell wall, some of them, at least during certain stages, have been found to be unsuitable as food for baby fish. Experiments at Cuttack have clearly shown that phytoplankton have very limited food value so far as the tender carp fry are concerned.

2.5 Hair weeds or filamentous algae

These are ordinarily submerged in water though when growing in profusion they float up in masses. The common forms encountered in fish ponds are Spirogyra, Chaetophora, Oedogonium and Pithophora. Two common forms, Nitella and Chara, which much resemble higher aquatic plants are, however, considered closely allied to algae. Like the plankton many of the algae are eaten by fish but opinion is divided as to whether they are really being digested and assimilated or not.

2.6 Marginal and emergent weeds

These are rooted higher plants, which abound in the shallow marginal areas of ponds and in swamps-the transitional zone between the terrestrial and the aquatic habitats. The reeds and sedges like Phragmites, Typha, Scirpus and Acorus are commonly found. Species of Marsilia, Herpestes, Commelina, etc., often form a continuous marginal belt of plants, while Ipomea, Jussiaea and others trail on the water surface. A continued immersion in water for days does not affect these plants adversely, and they thrive on the ground just above the water edge as well. In nursery ponds they serve as shelter and as breeding spots for predatory aquatic insects.

2.7 Surface-floating weeds

The obnoxious water hyacinth (Eichornia) is a typical example. Pistia is another weed, which often chokes up the water surface. The duck weeds, Lemna and Azolla, usually form green mats on the water surface. Wolffia is one of the smaller duck weeds, small, green and grain like, floating on the surface. These often form a complete screen on the surface, shutting off sunlight and gases so that food production in the lower layers remains very poor. Overgrowth of these weeds is, therefore, direct impact on nutritional status in the bottom aquatic ecosystems and thus, spatial distribution of organisms. The duck weeds, Lemna and Wolffia, are reported to be used as food for the Chinese carps. Pistia is known to harbour the dangerous Mansonia mosquitoes among its roots.

2.8 Submerged plants

The majority of the submerged plants are rooted at the bottom surface. Typical examples are Hydrilla, Ottelia, Vallisneria, Potamogeton, Najas and Lagarosiphon. These plants are ordinarily confined to the bottom of water and choke the surface only when there is excessive overgrowth during summer when the water level falls steadily and rapidly. Some of the submerged plants like ceratophyllum and the bladderwort Utricularia have no typical root systems and, therefore, merely float in water column. These plants are completely adapted to life in water and the latter (Utricularia) develops a series of characteristics like round bladders, which trap minute aquatic animals to be used as food.

Other plants like the lilies and the lotus (Nymphaea, Nelumbium and Limnanthemum) are firmly rooted in the mud but their leaves often float at the water surface. These true aquatic weeds often grow in such profusion that within a few weeks/

over the whole pond gets filled up resulting nutrient imbalance for the growth of plankton. A few fishes like Gourami are known to make use of these plants as food. In other cases, these weeds prevent easy movement of higher organisms like fishes and, thereby, affect their normal growth. Carps utilize some of these weeds as food source, at least in water condition; however, dependence of fish on these weeds for nutritive value is not clearly understood.

2.9 Some Important aquatic higher fauna

Biologically, the water bodies offer different ecological theatres for the support of an intricate chain of interdependent biotic elements from microbes to higher vertebrates. Very little is known about the population of aquatic mammals in Haryana. Presence of otter around river Tangri and Ghaggar has been reported. Likewise, record of avifauna is also scanty. Avifauna, as a whole derives benefit from water bodies in the form of food, foraging ground, shelter, nest, roosting and also the migration route. Many species are totally dependent on water body while others are partially or casually dependent on.

The Reptiles also play an important role in ecological balance and nature conservation. The Invertebrates like molluscs, crustaceans, annelids, coelenterates also support aquatic fauna. Hitherto there is no record of aquatic faunal species endemic to Haryana state.

2.10 Fishes

Fishes are of immense economic importance to mankind. They are good source of protein, vitamins and minerals. They can be used for variety of purposes like food, sport, ornament, biological control and high medicinal values. Survey conducted by many Research workers of the universities and Central Institutes, reported that there are 77 species of fishes of 41 genera, found in Haryana ecosystems.

A. Local fishes:

1.Gudusia chapra. 2. Notopterus notopterus. 3. Notopterus chitala. 4. Ambyphoryngodon mola. 5. Aplocheilus panax. 6. Barilius bendelisis. 7. Barilius bola. 8. Barilius vagra 9. Barilius barila. 10. Cabdo Cabdo 11. Chela laubuca 12. Cirrhinus reba 13. Cirrhinus mrigala. 14. Danio rerio. 15. Danio devario 16.Esomus danricus 17. Labeo bata 18. Labeo boga 19. Labeo rohita 20. Labeo

calbasu 21. *Labeo gonius* 22. *Labeo pangusia* 23. *Labeo curvatus* 24. *Labeo dyocheilus* 25. *Labeo dero* 26. *Ctenopharyngodon idella* 27. *Hypophthalmichthys molitrix* 28. *Cyprinus carpio* var.29. *Crossocheilus* spp. 30. *Cyprinus carpio* var. *Specularius* linnaeus. 31. *Osteobrama cotio* 32. *Puntius chrysopterus* 33. *Puntius conchonius* 34. *Puntius sarana*. 35. *Puntius sophore* 36. *Puntius ticto* 37. *Puntius stigma* 38. *Tor tor*. 39. *Tor* spp 40. *Schizothoraichthys progastus*. 41. *Lepidocephalichthys guntea* . 42. *Nemacheilus botia* 43. Orchid *bimaculatus* 44. *Ompok Pabda* 45. *Wallago attu* 46. *Mystus bleekeri* 47. *Mystus cavasius* 48. *Mystus tengara* 49. *Mystus vittatus* 50. *Mystus aor*. 51. *Mystus seenghala* 52. *Rita rita* 53. *Bagarius bagarius* 54. *Gagata cenia* 55. *Pseudotropius atherinoides* 56. *Silonia silondia* .57. *Heteropneustes fossilis* 58. *Clarias batrachus* 59. *Notopterus cantile* 60. *Gambusia affinis* 61. *Pseudomugil cornula* 62. *Channa gachua* 63. *Channa marulius* 64. *Channa punctatus* 65. *Channa striatus* 66. *Amphipnous cuchia*. or *Monopterus cuchia* 67.*Ambassis baculus* 68. *Ambassis nama* 69. *Ambassis ranga* 70. *Nandus nandus* 71. *Colisa fasciatus* 72. *Colisa lalia* 73. *Glossogobius giuris* 74. *Macrognathus aculeatus* 75. *Mastacembelus armatus* 76. *Mastacembelus pancalus* .

B. Exotic fishes:

1. *Cyprinus carpio* 2. *Ctenopharyngodon idella* 3. *Hypophthalmichthys molitrix* 4. *Tilapia mossambica* 5. *Aristichthys nobilis* 6. *Clarias gariepinus* 7.*Gambusia holbrooki*

C. Trash fishes

These fishes are also called as "Weed Fishes". In common language they also named as "Minnows". It is a group of fishes, which are small in size and have shorter life span. Their existence is significant in water bodies, which are rich in plankton and indicator of good fishery resources of Cat fishes. They compete for space and food with culturable commercially important fishes such as *Catla catla*, *Labeo rohita*, etc. Twenty nine species are found in this group of fish out of which 21 are available in Haryana. These fishes are mostly sacrificed for marketing.

3.0 Statement of the problems related to biodiversity

3.1 Proximate causes of loss of biodiversity

3.1.1. Scientific information on diverse aquatic flora and fauna, aquatic ecosystem dynamics, interactions at various ecosystem levels such as organism vs organism or organism vs aquatic environment with respect to the state is scanty and not readily available for a conclusive inference. Therefore, there is very little scope to describe various factors or causes of loss of aquatic biodiversity in definitive term. Nevertheless, some of the universal phenomena like population pressure, rapid industrialisation, change in land use pattern, depletion of water resources etc have direct bearing on the aquatic ecosystems and this has particular relevance to domesticated fish ecosystems.

3.1.2. With the rapid industrialisation and urbanisation in the country, our natural ecosystems are being subjected to considerable alterations, the adverse effect of which are being manifested by the fish population they harbour. A need has, therefore, arisen to conserve the vast and diverse genetic resources in the country for their efficient utilisation. During the past few decades the aquatic ecosystem have been subjected to various natural and man-induced stress which have adversely affected the fish populations they contain, such distruction of habitat integrity is likely to ecological and genetical thresholds since fish are prone to more rapid evolution in response to environmental alterations than other vertebrates.

3.1.3. There are informations that fishing in major Indian rivers has been going on indiscriminately. Intensive exploitation has rendered capture fisheries no longer remunerative. There are scientific reports on depletion of natural fish resources. Such type of intensive exploitation in the Yamuna river systems and depletion in the natural stock does have an adverse effect on the aquatic ecosystem in the state as the fish have migratory habit. Besides the fishing pressure, there are other natural and man-induced aversies, which have contributed to decline in fish stocks. These are i) habitat degradation brought about by increased water abstraction, ii) land development and change in land use pattern, iii) pollution from industry, and iv) siltation in the pondages of water resources etc. As a consequence, the capture fishery of prized Mahseer in river

Yamuna has registered a drastic decline and many other fishes as well have become endangered.

3.2 Threatened fish resources in the state

Threatened fish species of the state as defined by the N.B.F.G.R. (National Bureau of Fish Genetic Resources), Lucknow are given below: -

Table 3.2: Threatened fishes* of Haryana.

Ecosystem	Total species	Endangered	Vulnerable	Rare	Indeterminate	Total
Cold water	77	01	04	-	12	17
Warm water	344	05	13	02	28	48
Brackishwater	143	-	02	-	04	06
Marine	1440	-	03	-	08	10
Total	2200	04	21	02	52	79

On the basis of report of N.B.F.G.R. following fishes of Haryana may be categorised as threatened fishes

Endangered 1. Ompok pabda

Vulnerable: - 1. Bagarius bagarius 2. Rita rita 3. Ompok bimaculatus 4. Puntius sarana 5. Labeo dero 6. Tor putitora

Indeterminate:- 1. Notopterus chitala 2. Labeo gonius 3. Mastacembelus armatus 4. Tor tor 5. Mystus tengara 6. Mystus vittatus 7. Silonia silondia 8.Xenentodon cancila

In addition to above fish species, it has been observed that 12 fish species which once upon a time used to available in Haryana waters, have now disappeared/disappearing due to various factors.

With the rapid growth in the aquaculture field, the captive populations have become prone to the deleterious effects of inbreeding. Choice of selection of small number of parents can reduce genetic variability and the selection of brood stock from

closely related individuals. This may lead to generation after generation of inbreeding of closely related individuals.

3.3 Introduction of exotic fishes

Introduction of exotic fishes into India during the 19th and the early 20th century was undertaken. The main motivation for the introduction was for the development of game fishing. There are about 300 exotic fish species in India, majority of which are aquarium fishes. Some of the important exotic fish species (except aquarium fishes) are listed below:-

Table 3.3: Exotic fish species cultivated in Haryana

Species Introduced	Source	Year of Intr	Purpose
Game Fishes			
Salmo trutta fario	England	1901	For planting in hill lakes and reservoirs
Salmo gairdneri	Ceylon, Germany England	1907	-do-
Salvelinus fontinalis	Canada	1911	-do-
Oncorhynchus nerka	Japan	1968	-do-
Salmo salar	U.S.A.	1968	-do-
Food Fishes			
Ctenopharyngodon	Japan	1959	Experimental culture & weed control
Hypophthalmichthys nobilis	Hong Kong	1958	Experimental culture
Cyprinus carpio (Chinese strain)	Bangkok	1957	-do-
Cyprinus carpio (European strain)	Ceylon	1958	-do-

Oreochromis mossambicus & Osphronemus goramy	Java and Mauritius	1916	-do-
Tilapia mossambica	Bangkok	1952	-do-
Tinca tinca	England	1870	-do-
Carassius carassius	England	1870	-do-
Puntius javanicus	Indonesia	1972	-do-
Larvicidal Fishes			
Gambusia affinis	Italy	1928	Mosquito control
Lebistes reticulatus	South America	1908	-do-

2.4 Impact of exotic fish on native carps

When a species is introduced into a new environment, there is resistance from the native species, especially from those, which are ecologically analogous to the invader because every species has evolved in a specific set of ecological conditions and has a specific type of relationship with it's habitat. The resistance may be in the form of competition, predation, parasitism and niche modification etc. The newly introduced species will be able adjust in the new habitat only if it can upset or overcome the resistance in the new environment. The change in the ecological conditions, as a result of such introduction upsets the balance of indigenous fishes and threatens their very existence as reported by many scientists. A brief description of exotic fish species and their impacts are given below:

1. **Common Carp**: There are two strains of common carp introduced into India, viz., European strain and Chinese strain. Three varieties of the European strain viz., scale carp (Cyprinus carpio var. communis), mirror carp (C. carpio var. specularis) and the leather carp (C. carpio var. nudus) were introduced into Nilgiri waters in 1939. The Chinese strain of common carp was introduced in 1957 for propagation in the plains due to its

warm water adaptability, pond breeding, omnivorous feeding habits, good growth rate and hardiness towards various ecological imbalances.

In Govindsagar of Himachal Pradesh, common carp has affected the fishery of *Cirrhinus mrigala* (mrigal) and *C. reba* (reba) due to common feeding habits. An analysis of fish catch from Dal lake (Kashmir), Kurnool lake (Uttar Pradesh), Govindsagar (Himachal Pradesh) and Pong (Punjab) reservoirs has shown that the exotic carp has dominance over the more valuable endemic mahseers and schizothoracids (Sehgal, 1989). Due to prolonged spawning period, availability of aquatic vegetation and higher fecundity rate, the common carp breeds profusely in these lakes. On the other hand, mahseers and schizothoracids need spawning migrators to breed in upper reaches of streams in gravel beds. Due to excessive rate of reproduction of the common carp, these two groups are losing grounds in these lakes.

Catches of adults of mrror carp and common carp during November, 1994 and March, 1995 and fingerlings of common carp during peak summer and winter have recently been reported in river Yamuna (CIFRI, 1994-95). Escapement of cultivated exotic carps from ponds, because of flooding during rainy season, may be possible causative factor for the occurrence of these species in the river system, which may have adverse effects on indigenous fish fauna of the river in the near future and these have to be countered.

2. Silver Carp: The silver carp (*Hypophthalmichthys molitrix*) was introduced into India, largely guided by the notion that it is a surface feeder and stenophagic with feeding range limited to planktonic algae. The silver carp thus was identified to fill the role of a phytoplankton feeder, which the country's ecological outfit lacked. It was assumed that the fish play a complementary role to native species Catla catla (surface feeder) in our mixed carp farming system.

Between 1971-72 and 1978-79, major carps, viz., catla, rohu and mrigal contributed to the bulk of the total production from Govindsagar reservoir. Later, however, with the rise in the population of silver carp, the production of catla was lowered. The feeding and breeding vigour exhibited by silver carp led to its stabilization at the cost of catla. Increase in silver carp population in the Govindsagar reservoir catch has not increased the overall production of the reservoir (Natarajan, 1986). It is just a

case of substitution of two high value indigenous major carp species by an exotic carp that is prone to quality fetching lower economic returns.

3. Grass Carp: The grass carp, *Ctenopharyngodon Idella* was introduced into India primarily for controlling submerged vegetation. However, due to it's fast growth rate, it soon became an integral part of composite fish culture. It has proved itself very effective in the biological control of the submerged weeds like Hydrilla, Vallisneria, Lagrosiphon, Wolffia etc (Shelby et al., 1988). Since grass carp feeds on submerged vegetation, there is so far no evidence of any adverse impact on the fish of the Indian major carps when cultured together.

4. Tilapias: The cichlids, *Tilapia mossambicus* (*Oreochromis mossambicus*) was first introduced in India in Tamil Nadu. Tilapias are delicious to eat, with no intramuscular bones. They are easy to breed, cheap to feed, tolerant to wide range of temperature, salinity and water quality and comparatively free from parasites and diseases. In view of these qualities they were introduced for culture purposes.

But Tilapia has dramatically wiped out most of the naturally occurring fisheries of Tamil Nadu. Introduction of Tilapia has brought down the population of Labeo kontius in Vaigai reservoir and Puntius dubius in Amaravathy reservoir. Tilapia predates on major carp spawn besides competing for food i.e. zooplankton, and is found to reduce carp.

Tilapia has started appearing semi-intensive aquaculture ponds in Haryana and Punjab. This trend needs to be monitored before any deleterious effect of this fish appears on the prized carp culture in the State.

5. Other Temperate Food Fishes

Other important food fishes introduced in India include *Cyprinus carpio*, Tinca tinca, *Oncorhynchus gorbuscha* and *Perca fluviatilis*, which are reported to have no impact on the native fish fauna. *C. carpio* was introduced in Nilgiris and has been occurring in the catches of Ooty lake. The only advantage of this fish over common carp is its fine flesh. *Oncorhynchus gorbuscha* was considered to be the best freshwater fish for culture, on account of its large size, delicate flavour and easy in breeding, but because of its slow growth it is of no commercial value.

6. Larvicidal Fishes

Gambusia affinis was introduced to eradicate mosquitoes. Though it is very effective as a larvivorous fish, it has a propensity to feed on fish eggs and is destructive to native fish species (Weitzmann, 1981). It has dominated a number of species in Ooty lake (Das, 1980). Jhingran (1982) pointed out that for eradication of mosquito larvae, local fishes such as Oxygaster spp., Esomus spp. etc. could be easily used in the place of Gambusia affinis.

3.5 Common carp is being cultivated in Haryana by the farmers along with the native carps and also as monoculture. It is found in the Canal systems and at present no adverse effect on the indigenous fauna has been observed. Grass carp and Silver carp is also being cultured but on limited scale due to paucity of fish seed.

At present, fish farmers of Haryana have adopted I.M.C. culture in their ponds but they are not fully satisfied and have desire to switch over to new species of fish to get higher income in short period. Sometimes all the varieties required for composite fish culture viz. Silver carp, Grass carp and Catla are not available in seed composition in desirable quantities. Farmers feel that I.M.C. seed is being reared repeatedly in the same seed year after year and fear that it shall not be economical in future.

Since, fish seed of African magur, Hig head and Tilapia is freely available in Calcutta market, some of the farmers have brought it and their culture is being done unauthorizedly but on the other hand, farmers plead that these species thrive well in saline waters. These fishes are also being cultured in the adjoining states like Punjab and Uttar Pradesh.

Introduction of exotic fishes from one geographical area to another is a global issue and that, at the same time, there are instances of exotic fishes contributing to enhanced production. However, there is an urgent need to educate fish farmers about the consequences of transfer and introduction of exotic fishes in the state and the efforts for minimizing the risk factors are inescapably required. This may be possible by evolving shortened protocol for introduction of exotics and legislations with the help of scientists and progressive fish farmers. Following steps may be taken up in this direction :-

(c) State level monitoring cell may be constituted jointly by N.B.F.G.R. and Haryana Fisheries Department to review the spread of exotics in the natural water bodies.

(d) No exotic fish should be introduced unless it is scientifically recommended.

(e) The spread of exotic magur and highest culture should be checked through legislation.

(f) The unauthorised entry of fish seed of undesirable species should be immediately stopped by enacting modification in the Punjab Fisheries Act. The unauthorised detected seed should also be seized.

(g) Population reserves of local magur (Clarias batrachus) should be investigated and identified for developing measures to protect them.

In view of the above stresses affecting many fish communities, there is an urgent need for conservation of fish genetic resources. However the basic constraint is lack of knowledge as the adequate genetic studies have not been undertaken in this part of the country by the Central Institutes of I.C.A.R. Though "Research" is a subject of central Govt. Intensive efforts are needed for identification of populations of exploited or endangered species and for monitoring of genetic variability of both capture and culture fish population. It is on this context that "National Bureau of Fish Genetic Resources" and "Central Inland Capture Fisheries Research Institute" may start studies in this part of the country.

4.0 Major actors and their current roles relevant to biodiversity

As far as fish ecosystems are concerned, following key actors are to be involved:

1. Local Community.
2. National Bureau of Fish Genetic Resources Lucknow.
3. Central Inland Capture Fisheries Research Institute Barrackpore, Calcutta.

4. Irrigation Department of Haryana and Punjab.

5. Zoology Department of Kurukshetra University Haryana and Punjab University.

6. Zoological Survey of India.

7. Ministry of Environment & Forest

8. Central Pollution Control Board, New Delhi.

9. Pollution Control Board, Haryana and Punjab.

10. Fisheries Department, Haryana, Punjab, Himachal Pradesh, Uttar Pradesh and Rajasthan.

11. Controlling Authority for excavation of sand resources from river bed.

Above actors can significant role by providing specific strategy inputs as described below:

4.1 Government Action

It is important to recognize that the Indian Fisheries Act came into being in 1897. With the objective of obtaining maximum sustained yield of fish from waters without depleting the resource and wastage of effort. Despite legal prohibition, indiscriminate capture of Brooders and Juveniles and destructive fishing practices have been going on unabated all through the major rivers. Though legislation in this regard exists but the machinery for the enforcement of regulations in most cases is so inadequate that the objectives of formulating these are hardly fulfilled. The Fishery regulations sometimes play a subordinate role since they have been ineffective mostly due to enforcement problems and difficulties in subsequent monitoring of the activities of the user group for want of proper machinery.

It is need of the day that a "Conservation Cell" having sufficient manpower be established in the department for strict application of Riverine Fisheries Rules 1986 for the protection and conservation of Bio-diversity. Amendment in the existing rules may be made from time to time in accordance with the requirements of the present and future scenario.

4.2 Community Action

There is no doubt that indiscriminate fishing goes on inspite of best intentions of the legislations. The "Big Fishes" continue to flout the legislations and escape the law of land.

Any effort to protect and enhance the quality of management of natural resources will largely depend on the support of local people and fisherman community who inhabit the villages all around the water resources and are directly or indirectly dependent or related on the resources. Their support can be solicited by initiating trust building activities and helping them to augment their economic status through eco-friendly small scale income generating activities. Once the people of neighbourhood are convinced that their long term welfare is directly linked to the conservation of biodiversity, their cooperation will be ensured. Senior citizens and retired Fisheries personnels may also be approached for seeking their cooperation and valuable guidance.

4.3 N.G.O. Involvement

Non governmental organizations have not yet taken up any initiatives in the field of fisheries in the state.

5.0 On going biodiversity related initiatives

5.1 Conservation of aquatic ecosystems

5.1.1. Legislation

Conservation programme aims at protection, preservation and augmentation of natural water fish stock in rivers, canals, drains and other public waters. Existing measures are based more on economic approaches rather than ecological approaches of resource conservation. Hence, only commercially important fish species get priority in management and conservation of aquatic ecosystems. In exercise of the powers conferred by section 3 of the Indian Fisheries Act, 1897, Haryana Fisheries Rules 1956 have been framed for the regulation of fishing in the Public Waters of Haryana. The purpose of any fishery regulation from a strictly conservation point of view is to provide for a more bountiful harvest of fish, in either volume or net value. The general theories on which most regulations have been based are:

(i) It is necessary to have a fairly large number of older fish for spawning.

(ii) All smaller fish must be fully protected as the majority will grow into big fish.

(iii) It is very essential to protect fish during spawning season.

The salient features of Haryana Fisheries Rules 1996 are:

1. Fishing without licence is prohibited.
2. Observation of close season i.e. July and August in which fishing is prohibited keeping in view their breeding season.
3. Mesh size regulation i.e. fishing with a net having a smaller mesh than that prescribed under the rules to protect smaller fishes.
4. Killing fish of a size less than the standard prescribed in the rules.
5. Fishing with any gear or method other than that permitted under the rules.
6. License holders employing or engaging non-licensees to help them with their nets while fishing.
7. Fishing in "Sanctuaries" is prohibited.
8. Using at any one time more than two of either or any of the gears permitted under the rules.
9. Offering or exposing for sale or barter any fish in any specified area which may be notified.

The Fisheries Act, Haryana was promulgated in 1914 for preservation and conservation of fishes. The Fishery Department regulates fishing under the Fisheries Rules, 1996 through licensing system prohibiting inferior methods for catching fish.

5.1.3 Regulated fishing

The fishing rights in public waters are leased out annually in open public auction commencing from 1st September to 31st August of the following year. Gill nets, cast nets, longline and even old methods of spearing are used by fishermen for exploitation of fish. Cases of illegal fishing method by erecting fixed obstruction in flowing waters are

also seen in the state and are dealt under the Haryana Fisheries Rules, 1996. Dynamiting and poisoning of fish is often reported in the upper reaches in Himachal Pradesh. Restriction on use of certain fishing gears specifying mesh size is imposed to avoid killing of juveniles. Certain areas of congregation are prohibited for fishing declaring them as sanctuaries. Close season is also observed in public waters during breeding season of fish in July and August.

9.1.4 Analysis of the Fisheries acts and rules

Present Fisheries Act and rules were originally derived from the Indian Fisheries Act. The Indian Fisheries Act seems to be more for protection and conservation of fish rather than its development. Rapid fisheries development have been achieved in the last decade. The potential fisheries resources have been identified. A number of employment oriented schemes have been implemented; income from Fisheries has increased; Fish production reached about 32,000 M.Tonnes. Technical measures or the scientific management of the Fisheries resources for the improvement of Fish Stock and increasing production will have any effect unless radical changes in the existing Indian Fisheries Act is made. Therefore it became necessary to review the present Fisheries Act and rules in light of modern development pattern.

Drawbacks in the existing Act and Rules:

(1) It does not provide protection to the Fish and Fish seed in the private waters.

(2) There is no provision for the protection of such fish which migrate in private lands due to inundation.

(3) No provision for registration of private farmer's.

(4) Fishing is an offence but transportation, carrying or attempt of fishing is not an offence.

(5) Being the offence is non-cognizable, Police do not take interest and extend timely help.

(6) No provision for the security of the staff engaged in checking of illegal fishing.

(7) No control over the transport of fish.

(8) Procedure for the trial have not been described.

(9) Punishment is very meagre.

(10) Power's of Fisheries Officers are very limited and not been described.

(11) No control over marketing and the quality of fish.

(12) No provision of check-post or barrier to check fish during transit.

(13) No extra water facility for culture.

(14) No provision for fish culture in seasonal waters.

(15) No provision of arms or armed guards.

(16) No accessibility right to the place of fish in the private areas.

(17) Natural production of fish has not been declared as the property of the State.

(18) No provision of local sale.

(19) No provision of allotment of waste land for construction of fish ponds.

(20) No investigation power to the Fishery Officers.

(21) Duty of police officer relating to offence under Fisheries Act has not been described.

Neither power nor procedure has been described relating to the arrest, searches, etc.

5.1.5 Water resource management

Management of environment also include water quality control and water quantity control. Regarding water quality control, it is the jurisdiction of the Pollution Control Boards of Haryana and the adjoining states to overcome with the problem of pollution due to discharge of effluents in the rivers and canal systems. The water abstraction within Yamuna is going on since 1872 from Tajewala Headworks. 2/3rd of river water is being diverted to western Jamuna Canal (WJC) having on an average 24863 cusecs and 1/3 rd of river water measuring on an average 7602 cusecs is being

diverted to Eastern Jamuna Canal (E.J.C.). Approximate, 3806 cusecs of water only flows for 6 months, mostly in monsoon and the rest of the time only seepage water flows through it. This scarcity of water has posed problem for fishery especially for Indian Major Carps as they need large water column and free breeding run. It has been observed by many experts that the sewerage discharged in the river without treatment have badly affected the aquatic life and depleted oxygen level resulting into foul odour and turbidity. The river water is not suitable for drinking, outdoor bathing, propagation of aquatic life, irrigation and industrial purposes due to pollution. The authorities of Yamuna Action Plan now in operation may look into this problem besides afforestation of areas along the river bank and improvement of soil erosion. Siltation of rivers is also one of major limiting factor for depletion of fisheries and therefore habitat improvement is a fishery management tool with the sole purpose of providing better environmental conditions for desired fishery. Stream improvement can provide additional shelter, an improved food supply, additional spawning areas and steady flow of cold water.

Siltation of rivers have not only destroyed the natural breeding grounds of fishes and deep shelter pools for fish in the river beds vanished but also hampered the smooth flow of water reducing their retentation capacity. Area of rivers in terms of width and depth have reduced to such an alarming extent that habitat has altogether changed thereby threatening the fish live stock either to extinct or migrate towards down stream. Keeping in view the above stresses, Yamuna Action Plan may also include desiltation of rivers and its tributaries, soil erosion and afforestation of the banks of the rivers.

5.1.6 Research and evaluation

It has been observed by the Fishery scientists that out of 1300 Km stretch of river Yamuna (from its source to confluence with Ganga) 1050 Km stretch has been reported to be holding fish. Fishery evaluation have been done mainly within middle and lower segment i.e. from Delhi to Allahabad by CIFRI. There is an urgent need to study the ecology and potential aspect of upper stretches of river Yamuna i.e. above Delhi. So as to frame a policy for conservation and management. A unit of Central Inland Capture Fisheries Research Institute, Barrackpore of I.C.A.R. is at present studying the Fisheries of river Yamuna and Ghaggar but their outcome is still awaited for imparting the department a package of methodology for the conservation of Bio-diversity.

There is a lack of knowledge on the genetic differentiation within most of the naturally occurring species and the quantitative estimates of the magnitude and the relative importance at various levels of organisation i.e., between and within rivers, between lakes within drainages, between ecological or taxonomic forms. This is a serious shortcoming from the point of view of conservation of resources and the efficient use of existing variation. A quantitative estimate of the absolute and relative importance of various sources of variation contributing to the total gene diversity has to be studied hierarchically i.e. within populations, between populations, within rivers and between rivers etc. by collecting samples from areas representing different drainages, multiple locations, within each drainage.

Resource conservation through revision of existing fishery laws and regulations based on the results of biological studies of commercial fish species already available and strict implementation of the provisions of laws through an efficient enforcement machinery would prove advantageous are imperative. A close co-ordination with wildlife sector in each state could be useful for logical interaction and enforcement.

Many fishery scientists of the country have made the following recommendations towards conservation of resources:

(i) Many broad programme of conservation of fish resources requires a proper taxonomic study, of fish species occurring in each area and a thorough checklist of these species. This would also include in the Red Data Book published by IUCN.

(ii) Collection of principal genetic material of both fin-fish and shell fish of known potential value of major socio-economic significance and dissemination of such information through catalogues, news-letters, etc.

(iii) Assessment of the salient genetic characters of species of known commercial value to serve as a basis for future studies. Baseline information on the diversity and vulnerability of aquatic genetic resources and on procedures for identifying vulnerable species and populations.

(iv) Extensive ecological and systematic (taxonomic) surveys of the location of natural habitats and breeding areas of known types and maintenance

of relevant data. Preservation and cataloguing of the genotypes with maintenance of accurate data.

(v) Compilation of information on the genotype-environment interaction for all major groups.

(vi) Studies on the morphometric and karyotypic features of important varieties.

(vii) Research to be conducted on the cryopreservation of sperms, ova and embryos.

(viii) Biochemical correlates of changing age or size class structure of exploited population might be determined and used as indicators of over-exploitations.

(ix) Introduction of exotic species should consider all the risk factors, genetic, behavioural and ecological before a species is introduced in the new habitat.

(x) Research on culture and breeding should strive to collect founder stock from as wide a distribution as possible within the species range to ensure that efforts at domestication are based on the broadest genetic base possible.

(xi) Revision of the outmoded and fragmentary fishery regulations with provision of suitable enforcement measures.

(xii) Because of the high probability of loss of genetic diversity in any species taken into culture operations, a method should be developed to conserve self-maintaining populations in natural habitats by way of nature reserves (Lakes, rivers, etc) which already contain one or more of populations of fish species. These could be multipurpose areas conserving several other types of habitats and communities in addition to fish through collaboration with wildlife reserves.

Conservation of aquatic resources as generally defined, is management of water bodies toward specified aims with the intention of maintaining their scientific interests or

rehabilitating their physical, chemical or biological qualities. This may be done passively or actively. In the former case it may involve only the protection of an area from the advancing civilization so as to maintain their status-quo while in the latter case efforts are made to sustain catches by offsetting the fishing losses.

Declaring certain areas as protective waters or sanctuaries, observance of closed seasons, imposing restrictions on fishing in the rivers in specified areas near the weir/barrage, reserving certain stretches for rod and line only and enforcement of size limits, bag limits and annual catch limits also come under the purview of passive exercise of conservation. These exercises are meant for providing facilities for propagation and resultant growth of particular fisheries. Maximum damage is done to the brooders while migrating the spawning for breeding. The large size fish with belly full of eggs are highly vulnerable to nets. They move in shoals and are captured en-block by the poachers. Such wastes not warrants rigorous punishments.

The quantitative improvement of stock by transplantation (stocking) of farm reared stocking material is considered as an active conservation step. Fish seed of carps and other varieties may be stocked in river and canal systems.

6.0 Gap analysis

Following major gaps exists in management and conservation of fishes in the state:

- Paucity of information on aquatic bio-diversity.
- Need of real time data on water bodies and availability of water.
- Non-availability of good quality and quantity of water for aquatic life, Fisheries and aquaculture.
- The lack of trained man power to undertake the above study.
- Lack of information on actual endangeredness status of species.
- Non-availability of information on loss of genetic variability.

7.0 Conservation strategies of fish resources

The approach to genetic resources conservation involves two essential and complimentary requirements:

All the strategies and actions proposed would be within the frame work of existing Acts including the Wildlife Protection Act 1972.The permission if any required would be obtained by the agencies responsible for fish diversity conservation in the state.

7.1. *Conservation in situ*: The conservation of genetic resources through their maintenance within natural or man-made ecosystem in which they occur.

7.2. *Conservation ex situ*: Outside their habitats either by perpetuating sample population in genetic resources centres, zoos, culture operations; or in the form of gene pools and genetic storage for fish, germplasm banks, etc.

7.3. The United Nations Environment Programme has recommended the following possible approach towards fish genetic resources:

(i) Consultation with experts particularly with respect to conservation techniques and the formulation of plan of action for fish genetic resources conservation.

(ii) Promoting the establishment of a mechanism for monitoring changes in the genetic diversity of fish populations including the possibility of a registry of fish species introductions and encouraging guidelines for the exchange of exotic species, and a medium for dissemination of information on genetic improvement in fish-producing natural or man-made ecosystems.

(iii) Encouraging the production of a catalogue of genetic material, especially including description of genetic qualities which would serve as a markers and as a basis for conservation efforts.

(iv) Promoting of research directed at creation of knowledge on the genetics of fish which would assist in a more applicable definition of genetic

improvement in fish species and appropriate mechanisms to conserve and enhance genetic diversity.

(V) Promotion of in situ conservation through appropriate management of certain ecosystems with rich genetic diversity, especially those relating to fish species having or known to have the potential for a major socio-economic role.

Based on above observations, it is proposed that N.B.F.G.R. (ICAR) may conduct studies on the following issues:

7.4 In-situ studies

1. Study of Biodiversity in River Yamuna and Western Yamuna Canal.
2. Biodiversity in river Ghaggar.
3. Protection, Conservation and development of threatened, rare and important species.

8.0 Action Plan for conservation of fish in the state

8.1. Action 1: Establishment of Mahseer hatchery

Category: Medium priority

Details:

- Establishment of a sub center of coldwater fisheries institute by the ICAR for Mahseer hatchery in Haryana to cater to the seed requirement of the northern states like Haryana, Punjab and Himachal Pradesh.
- Establishment of a small Mahseer Fish Hatchery at Dehgaon for production of seeds.

Responsibility: ICAR, CCS HAU and the Fishery Department, Govt. of Haryana.

Time frame: Five year

Resources required: Rs. 200 lakh

8.2 Action 2: Establishment of turtle and frog breeding center

Category: High priority.

Details:

- Turtle and frog breeding centre to enrich and supplement fish biodiversity in the state.
- Surveying of presence of edible and cultivable frogs in the state prior to establishing frog breeding center.

Responsibility: Fishery Department, Govt. of Haryana

Time frame: Five year

Resources required: Rs. 200 lakh

8.3 Action 3: Development of areas for declaration of sanctuaries

Category: Medium to high priority.

Details: Promoting angling, conservation and propagation of Mahseer, the Fisheries department has declared following waters in Yamuna nagar district of Haryana as "Fish Sanctuary".

1. Yamuna River: from Kalesar village upto Tajewala Head works.
2. W.Jumn-Patkuli River: from village Balachour to Dadupur Head Works.
3. Som River: from Dadupur Head Works upto 500 meters downward.
4. W.J.C.-(I) Main Line upper: Tajewala Head Works to cross Regulator.

   (ii) R.D. 61000 upto Dadupur Headworks.

   (ii) Main line lower: R.D. 0-5000.

8.4 Action 4: Development of deep pools in river Yamuna and Ghaggar for declaring these as "Fish Sanctuary".

Category: Medium to high priority

Details:

- Morni Tal lakes in Panchkula district and Badkhal lake in Faridabad district to be declared as Protected areas.
- Stocking of all the varieties of fish available in Haryana as "Fish Park" or "Bio Reserve".
- Introduction of indigenous threatened and rare fishes other states for stocking purposes.

Responsibility: Fishery Department, Govt. of Haryana

Time frame: 10-15 year

Resources required: Rs. 1000 lakh.

8.5 Action 5: Involvement of key organisations

Category: Medium to high priority

Details: Involvement of key institutions/persons/individuals for scientific management and conservation of fish biodiversity in the state. The institutes are

1. Local community institutions like Panchayats.
2. National Bureau of Fish Genetic Resources Lucknow.
3. Central Inland Capture Fisheries Research Institute Barrackpore, Calcutta.
4. Irrigation Department of Haryana and Punjab.
5. Zoology Department of Kurukshetra University Haryana and Punjab University.
6. Zoological Survey of India.
7. Ministry of Environment & Forest.

8. Central Pollution Control Board, New Delhi.

9. Pollution Control Board, Haryana and Punjab.

10. Fisheries Department, Haryana, Punjab, Himachal Pradesh, Uttar Pradesh and Rajasthan.

11. Controlling Authority for excavation of sand resources from rivers bed.

12. Central Inland Capture Fisheries Research Centre, Karnal

8.6 Action 6: Strengthening regulatory mechanism

Category: High priority for long term sustained fish management

Results:

- Joint management of river banks with the local communities.
- Optimum, sustained yield of fish from waters without depleting the resource and wastage of effort.
- Control of indiscriminate capture of brooders and juveniles and destructive fishing practices.
- Strengthening the enforcement of regulations against indiscriminate utilization of fish resources.
- Strengthening monitoring and evaluation of user groups and fishery activities in the state..
- Establishment of a "Conservation Cell" having sufficient manpower for strict application of Riverine Fisheries Rules 1996 for the protection and conservation of Bio-diversity.
- Amendment in the existing rules in accordance with the requirements of the present and future scenario.

Responsibility: Fishery Department, Govt. of Haryana

Time frame: 10-15 year

Resources required: Rs. 400 lakh.

8.7 Action 7: Community participation in the preparation of the Biodiversity Register and conservation of aquatic biodiversity.

Category: High priority.

Details:

- Preparation of biodiversity registers— this will include documentation of the indigenous traditional knowledge of the local aquatic biodiversity and the related tradition and their social and economic implications, if any. Women of the area will be associated in the preparation of the registers.
- Community involvement to ensure the "Big Fishes" to flout the legislations and escape the law of land.
- Ensuring support of local people and fisherman community by initiating trust building activities and helping them to augment their economic status through eco-friendly small scale income generating activities.
- The local villagers, especially the poor, may be given priority while auctioning the village ponds for fish farming. Licensing system be introduced to give licenses to families /cooperative societies dependent on fishing as their livelihood.
- Cooperation and guidance of senior citizens and retired Fisheries personnels for better management and conservation.

Responsibility: Fishery Department, Govt. of Haryana and the NGOs in the field and the Department of Development and Panchayat, Govt. of Haryana.

Time frame: Five to ten year.

Resource required: Rs. 200 lakh

8.8 Action 8: Monitoring of Conservation status

Category: High priority

Details: Concurrent monitoring and evaluation of conservation efforts in the state.

Responsibility: Fishery Department, Govt. of Haryana

Time frame: A continuous process

Resources required: Rs. 400 lakh

8.9 Action 9: Policy and legislation

Category: High priority

Details: A suitable provision of legislation at the National level as well as legal provision for the protection and conservation of existing threatened species.

Responsibility: Government of Haryana.

Time frame: As early as possible.

Resource requirement: As decided by the Government.

8.10 Action 10: Infrastructure development

Category: High priority

Details:

- Establishment of gene bank for conserving bio-diversity in cultured species of fish. Establishment of sperm banks to preserve the genetic diversity of species under environmental pressure.
- Cryo-preservation technique for the preservation of live sperms of the fish for an indefinite period in liquid nitrogen.
- Gene Bank at National Fish Seed Farm Jyotisar in consultation with National Bureau of Fish Genetics Lucknow.
- Establishment of Mahseer hatchery with the assistance of National Research Centre for cold water Fisheries (Nainital) and Tata Electrical Company (Lonavel).

Responsibility: Fishery Department, Govt. of Haryana

Time frame: 5-10 year

Resources required: Rs. 1100 lakh

8.11 Action 11: Human resource development and Establishment of Conservation Cell

Category: High priority for long term.

Details:

- Strengthening protection capability and management coordination through establishment of conservation cell for the enforcement of regulations and protection of natural fish farm in addition to development of water resources and fish live stock
- Training of field staff to cater the need for conservation of biodiversity and enforcement of regulation techniques.
- Wild life department to include courses for the training of fishery personnel.
- Krishi Vikas Kendra in different Ecosystem in order to effectively use village ponds, lands and small reservoirs for conservation and development of natural fauna.
- Setting up of sewage treatment plants in major towns to control pollution for fishery development.

Responsibility: State Government and CCS HAU, Hisar

Time frame: 5-10 year

Resources required: Approximately Rs. 1500 lakh.

8.12 Action 12: Conservation of river Yamuna and Ghaggar

Category: High priority

Details:

- De-silation of river wherever it has caused loss of breeding and feeding grounds.
- Prevention of industrial effluents entering the river systems.
- Establishment of sewage treatment plants

******

REFERENCES

1.	A.G.Ponniah 4:365 - 377.	Categorisation of India's threatened fishes - Nature Publication
2.	A.G.Jhingran	Fish Genetic Resources of India, N.B.F.G.R. (ICAR) Publication.
3.	Bakir et al. 1982.	A preliminary survey of the fauna of Haryana - Pb. Pkh. Bull.
4.	K.K.Tondon	Fishery Resources of Punjab and Haryana - Proceeding of the Seminar on the ecology and Fisheries of fresh water Reservoirs. Bamalpore Nov. 27th-29th, 1969 p.p. 423-428.
5.	Usha Misra	Evaluation of fish production and community structure in the context of environmental modification in upper stretches of River Yamuna - Fish Congress, Chandigarh Sept 21 to 23rd, 2000
6.	K.K.Tondon	Occurrence of new species of Schistuthyrichus in the river Ghaggar near Chandimandir - Reprinted from 'Curr.Sci' Nov 20, 1965, 34, Nov. 22, 640-641.
7.	Tondon & Sharma	The fish fauna of the river Ghaggar in the vicinity of Chandimandir - Research Bulletin (N.S.) of Punjab University, Vol 16, part IV, p.p. 333-337 December, 1965.
8.	Tondon & Arora	Morphology of Labeo dero - Research Bulletin (N.S.) of the Punjab University, Vol. 21 Part I-II p.p. 243-245 June, 1970.
9.	Khan H.	The Punjab Fisheries Manual printed by Govt Printing Press Lahore.
10.	Anon.	Punjab Fisheries Act 1914.
11.	Anon.	Haryana Fisheries Rules 1995.
12.	V.Vats	Fish Fauna of Haryana
13.	S.C.Agarwal	Capture Fisheries of Karnal Tehsil in Haryana - Fishing chimes Vol. 2 No. 8 Nov, 1982.
14.	Anon.	Report of Haryana State Remote Sensing Application Centre, Hisar, 1987.

15. K.H.Alikuni	Fish culture in India
16. V.G.Jhingran	Fish and Fisheries of India, 1988.
17. Anon.	Punjab Fisheries Bulletin 1985
18. Anon.	Draft Report on strategy for Bio-diversity Conservation, M.P. Council of Science and Technology, Bhopal
19. Fishing Chimes	Sept-1999 Vol. 19 No. 6.
20. Fishing Chimes	Sept 2000 Vol. 20 No. 6.
21. ABNR.	Annual Report of N.B.F.G.R., 1994-95.
22. Hora, R.S.	Hand Book of Fish Culture in the Indo-Pacific Region
23. D.K.Kaushik	Paper on development of Inland Brackish Water Aquaculture in Haryana (Unprinted).
24. Kakkar V.S.	Leasing Policy of Inland Waters A dessertation of CIFE Bombay 1985-87.

Animal husbandry

1. Introduction

The spectrum of genetic biodiversity of indigenous livestock is vast and varied in nature and forms the backbone of rural economy. The primary unit of animal diversity is breed, strain or geographically defined population. Concerns on depletion of genetic diversity have been expressed primarily from the standpoint of decline in population and extinction of certain breeds and strains. However, loss of genetic variability within breed is equally alarming. Advances in breeding technologies have enhanced the productivity of many breeds, but these developments along with commercialization have narrowed down the choice to few so-called elite breeds. The less productive breed has suffered willful neglect and in the process is getting endangered with a threat of extinction. It appears that a very serious situation has arisen in regard to domesticated species of livestock in India in general and Haryana in particular, which may lead to complete loss of available indigenous breeds and immediate steps for taking concerted programmes for their conservation are required.

2. Profile of the area

Although the wealth of animal biodiversity is spread over the whole country, Indo-Gangetic zone of India has been fortunate to possess many important genetic resources of livestock and poultry. Although the state of Haryana was deprived of some good animal of Sahiwal cattle and Nili buffaloes when it got separated from Punjab in 1966. Still it has considerable biodiversity in terms of animal genetic resources.

2.1. Population dynamics

Population dynamics affects the degree and rate of use of natural resources. Haryana state has a rich biodiversity in terms of variety of livestock and poultry genetic resources available through the state. According to Livestock census 1992, there were 2.1336 millions of cattle, 4.3729 million buffaloes, 0.7954 million goats, 1.8538 million sheep, 0.1383 million camel, .0498 million horses, and 8.5804 million of poultry birds in the state. Comparing this figure at national level, this is small number (2.11%) but these genetic resources have contributed significantly in terms of

production of various economic commodities. This is evident from the fact that during 1998-99 per capita availability of milk was 625 gm/day in Haryana as compared to 217 gm/day at national level. Situation is equally satisfying for the availability of other commodities like egg, meat, mutton, wool, skin draught power etc.

Maximum population of indigenous cattle is located in Hisar, Sirsa and Gurgaon districts whereas crossbred animals are dominant in the districts of Karnal, Sirsa and Kurukshetra. The districts of Hisar, Karnal and Jind have maximum buffaloes in the state. Similarly, most of the sheep and goat is available in Hisar, Bhiwani, Sirsa and Gurgaon area; pigs in Faridabad, Jind, Karnal; camel in Sirsa, Hisar and Bhiwani, and poultry birds in the districts of Ambala and Gurgaon.

2.2. Cattle and buffalo

During last three decades, the state has contributed significantly to white revolution mainly by adopting crossbreeding programme in the districts of Ambala, Karnal, Gurgaon, Panipat etc. Indigenous germplasm of Haryana cattle and Murrah buffalo available in south east of Haryana has also added to the state milk pool. Besides, a few animal belonging to Sahiwal and Tharparkar cattle are available at some organised farms in public sector. Rohtak, Faridabad, Karnal, Hisar and Jind are the major milk producing districts in the state. Since, Haryana has always been a milk rich and dairy oriented state, livestock wealth is mainly dependent upon milk production from Hariana and Sahiwal Zebu cattle, crossbred cattle and Murrah buffaloes.

3. Current Range and status of biodiversity

3.1. Haryana state with its limited livestock wealth has undergone significant changes in animal biodiversity in last 35 years. At the time of its partition from the erstwhile Punjab, the state was known to possess rich resources of Hariana and Sahiwal cattle besides Murrah buffaloes. Other genetic resources of goat, sheep, pig, horses and camel were available in limited pockets and good quality poultry germplasm was concentrated near cities only. However, when the crossbreeding program was launched at national level, progressive farmers especially near cities adopted it in a big way. Major research institutions like NDRI, Karnal and HAU, Hisar acted as catalyst and a large population of crossbred population developed specially in the districts of Ambala, Kurukshetra, Karnal, Panipat, Hisar and Gurgaon. This caused erosion of whatever little good quality of Sahiwal, Red Sindhi and

Tharparkar animals the state had. Many productive animals of Haryana breed were also used in this program.

However, the population dynamics is again changing and the farmers have realized that ultimately it is only Murrah breed of buffalo, which is profitable and can make dairy farming a sustainable business in the state. This is also evident from the statistics which suggest that whereas cattle population in the state has decreased from 2.342 millions in 1982 to about 2 millions (projected) in 2001, the number of buffaloes has increased from 7.3696 millions to about 5 millions (projected) during the same period. Similarly, whereas the number of goats and horses has increased steadily, the data suggest that population of sheep, pig and poultry has increased at a very high rate from 1982 to 2001. Number of camel in Haryana has remained almost constant in the last two decades.

3.2. The origin, distribution, physical and morphometric characteristics, performance traits and breeding farms of some of the important breeds are described below:

3.2.1. Hariana cattle

Hariana is predominantly a dual purpose breed which was primarily reared for bullock production. It has its breeding tract and maximum distribution is in the southwest districts of Rohtak, Hisar, Jind and Hansi. In fact despite the onslaught of crossbreeding programmes, purebred Hariana cattle are still abundant in Jhajjar, Bari and Jahajgarh pockets of Rohtak

district. Diversified selection has led to evolution of two strains i.e., Hansi and Hisar.

These animal are white or light yellow in colour with compact and proportionately built body. They have characteristics long and narrow face with flat head and medium size of horns. Facial recognition is breed on small horn, black muzzle and large eyes. Udder is generally capacious with well-developed teats. These animals have short, thin and tapering tail.

Hariana cattle are usually medium to large size in body conformation. Average birth weight of male and female calf varies between 21-23 and 22-31 kg respectively. However, this sexual variation is more prominent in adult animals when the average body weight of cows and bulls is 325 and 500 kg respectively. On an average, Hariana cows yield about 1000 kg of milk in 305 days with 4.3-4.3 % of fat and 9-9.5% of SNF.

Systematic breeding and genetic improvement of Hariana cattle is being done at Government Livestock Farm, Hisar and Haryana Agriculture University, Hisar although some very good animals are also maintained at a few private farms like Shri Gaushala Society, Panipat. Besides, many Government and private organized farms in the states of Uttar Pradesh, Rajasthan, Maharashtra, Orissa and West Bengal are also keeping a few good Hariana cows.

3.2.2. Sahiwal cattle

Sahiwal is one of the best dairy breeds of zebu cattle. Though its main breeding tract lies in the Sahiwal district of Pakistan, a few Sahiwal cattle are available at organized farm of National Dairy Research Institute, Karnal, Government Livestock Farm, Hisar and Sangeru Hari Singh Animal Breeding Farm at Sirsa.

Sahiwal is a heavy reddish dun or pale red breed with symmetrical body and loose skin. These animals have characteristic short and stumpy horns with large and heavy dewlap, a long and fine tail and a big hump. Sahiwal cows possess pendulous and large udders and well-developed teats.

Sahiwal is a medium sized milch animal with birth weights of male and female calves ranging between 20-25 kg and 18-23 kg respectively. Adult body weights of male and female animals vary between 470-560 and 310-360

kg respectively. On an average, good Sahiwal cows yield about 1800 kg of milk with fat percentage ranging between 4.8 to 5.1.

Government organizations like NDRI, Karnal, GLF, Hisar and a private farm of Sirsa have been maintaining good quality Sahiwal cows and bulls and these farms may be contacted for good quality germplasm.

3.2.3. Crossbred cattle

Haryana state has a large population of crossbred cattle during 1992, there were 0.1363 million crossbred adult females. The presence of prestigious organizations like NDRI, Karnal and HAU, Hisar motivated the farmers of the region to adopt crossbreeding program which was undertaken mainly by crossing exotic germplasm of Holstein Friesian and Brown Swiss with indigenous breeds of Haryana, Sahiwal or non local cows. Two crossbreds, Karan Fries and Karan Swiss, developed at NDRI have received wide acceptance among all categories of farmers. Despite some inherent problems, these two fulfilled immediate requirement of milk production. Under proper management system most of the Holstein crossbred yield 3500 kg of milk and Brown Swiss produced 3000 kg milk in their first lactation. Semen from progeny tested bulls is easily available at NDRI, HAU or State AH Department.

3.2.4. Murrah buffaloes

Murrah is known to be the best buffalo breed of the world, which has derived its name due to characteristic spiral shape curled horns. With the main home tract in the districts of Rohtak, Jind, Hisar, Gurgaon, this milch breed has found important place in Indian livestock industry. Animals of high genetic merit have been exported to many developing countries of south East Asia and semen of progeny tested bulls is always in great demand.

Murrah buffaloes are jet black in color with massive long deep body. Short and highly curved horns, bright eyes and short ears are some of the characteristics features for phenotypic recognition. These animals have long neck, broad hips and long tail. The udders are capacious, pendulous with long and prominent well-developed teats.

This breed belongs to heavy category of buffaloes with male and female calves weighing between 34-40 and 32-38 kg respectively at birth. Adult bulls and cows weigh 450-700 and 350-650 kg respectively. On an average, well-managed Murrah buffaloes yield 1600-1800 kg of milk over in the first lactation, with a high fat percentage of 6.5-8.5.

Pedigreed of the buffaloes are available in organized farms of National Dairy Research Institute, Karnal, Government Livestock Farm, Hisar, Haryana Agricultural University, Hisar and Central Institute for Research on Buffaloes, Hisar. However, genetically superior and high yielding pure Murrah cows are also frequently available with many farmers in the districts of Rohtak, Hisar, Sonipat and Jind.

3.3. Statement of problems related to animal biodiversity

3.3.1. Cattle improvement has been accomplished in a few production traits and breeds mainly living in higher input and less stressful production environments. Indigenous breed of domestic animals are being neglected. These vanishing breeds commonly possess valuable traits such as adaption to harsh conditions, including parasitic and infectious diseases, drought and also scarcity of drinking water, poor quality feed. In 60's there was a major change in the breeding policies and programmes and these breeds being replaced by a few high production breeds by introduction of exotic inheritance which to be successful, require high inputs, skilled management and comparatively benign environment.

3.3.2. The demand of native breeds decreased to some extent due to agriculture reduced requirement of bullocks of draught power with hardly any programme for improvement of their milk production potential. Over the years this has resulted in substantial decrease in the population of native breeds and the existence of some of these is threatened. Indigenous breeds seem to be the better proposition under the low input conditions.

The threat to domestic animal resources is such that nearly one out of three breeds are at risk. The reasons are as follows:

- Conservation of breeds at present may not be of interests to farmers as comparatively low production has received little attention.
- In general neither systematic recordering programmes are in place nor is there basic descriptive information for high percentage of animal genetic resources.

- Indigenous breeds, few of which have been actively used and developed, are being replaced by improved breeds developed for high input-output production systems. This is the biggest factor undermining the diversity.

3.3.3. Though there is no immediate serious threat to existence of animal biodiversity in the state of Haryana, the radical changes within bovine population of the state in last two decades indicate a shift in the priority of farming community from production of work animals to sustainable milk animals. This is expected because any genetic resource that is not economically viable is likely to be neglected by farmers and may ultimately become extinct. Haryana, being a small state and close to capital is being afflicted by two types of problems which, if not taken seriously, may snowball and become a threat to its animal biodiversity.

- Non-judicious practice of crossbreeding has eroded valuable genetic resources of zebu cattle like Hariana and Sahiwal. This has caused problem of the unwanted crossbred male calves, which are being neglected, and becoming civil nuisance.
- It is well known that a large number of pure Murrah buffaloes are being exported to metro cities outside the state. During lean season, these animals become non-remunerative and are sent to slaughter houses . Valuable germplasm is lost due to want of a suitable legislation at state or national level.
- Due to non-availability of semen/bulls of purebred cattle and buffalo breeds, there is an indiscriminate breeding with graded breeds that has resulted into creation of pseudo-diversity.

4. Major actors and their current roles relevant to biodiversity.

4.1. Central Government

The overall responsibility and control of the conservation of domestic livestock breeds is within the purview of the department of animal husbandry, Ministry of Agriculture, Govt.of India. The central government has established various livestock and poultry farms for maintaining different breeds throughout the country.

4.2. ICAR Institutes and State Agricultural Universities

SAU and ICAR institutions are also maintaining different domestic species of livestock and poultry and sharing the responsibility of conservation of endangered breeds

4.3. State Government

Role of the Animal Husbandry Department is very vital in conservation of domestic livestock breeds. There are large number of state owned animal breeding farms where breeding population are maintained in situ. Besides these farms there is a vast network of semen collection, freezing and artificial insemination facilities.

4.4. Non-Government Organizations (NGOS)

NGOs are the conservationists at grass root level and able to utilize added approaches to conservation work beyond those developed by government departments or research organizations.

4.5. Private Farmers

Progressive farmers breeding indigenous breeds are also working for conservation of some breeds.

5. On going biodiversity related initiatives:

5.1. The AH Department has adopted multi-pronged programme to improve the genetic stock of its animal wealth by constituting "Haryana Livestock Development Board" in January 2008. Artificial insemination programme is proposed to be taken up in a big way and for this purpose good quality animals are being identified and the germplasm is being procured and multiplied. The department is strengthening its breeding infrastructure by procuring equipments like liquid nitrogen storage and transportation Jars, Artificial insemination guns, sheaths and straws and by constructing bull houses in large scale. Liquid nitrogen which is essential for storage of frozen semen is being made available in sufficient quantities. Embryo Transfer Technology will be encouraged and expanded and farmers will be educated to adopt modern breeding techniques.

5.2. To encourage breeders to retain their good quality high yielding indigenous animals, a scheme to give incentive to breeder has been started and incentive money ranging from Rs. 1000/- to Rs.8000/- is given to the owners. Animals yielding more than 12 kg. milk have been provided insurance cover in the state for which half of the cost is borne by the Government and half by the breeders.

5.3. Animal biodiversity in domestic animals has been well preserved in the state by the farmers and the animal breeders through their selective breeding methods particularly in its original Murrah Buffalo and breeds of Haryana Sahiwal, Tharparkar

cows and Aseel poultry birds. The state had intensively taken up cross breeding in cows about three decades back but the out sorting generation was prone to a number of diseases and was not able to tolerate extreme weather conditions. Therefore the state has decided to preserve its indigenous breeds of cows particularly Hariana and Sahiwal because these have immunity against most of the existing diseases and thrive well even in dry farming areas of the state. This department fully agrees in conservation of Animal biodiversity by not disturbing the old existing breeds of cattle and buffaloes in the state.

5.4. Haryana has more than 20 lacs breedable buffaloes out of which approximately 10% belong to Murrah Breed. Out of the Murrah Buffaloes about 10-15% top quality Buffaloes are exported out of state to Metro cities every year and ultimately find their way to slaughter houses after their current lactation. For the preservation of this breed following steps are being taken up.

5.5. HLDB/ Animal Husbandry Deptt. provide top quality Murrah bulls to Panchayats at subsidised rates thereby eliminating poor quality bulls . A.I. facilities have also been made available in the state at a very nominal price in which cryo preserved semen of top quality Murrah bulls is used.

5.6. Farmers are given cash incentive at the following rates for keeping the Murrah Buffaloes of top quality yielding milk 12 kg. or more per day.

Milk yield 18 kg. and above - Rs. 6000
Milk yield 15-18 kg. - Rs. 3000
Milk yield 12-15 kg. - Rs. 1000

These Murrah buffaloes are also got insured at subsidised rates and 50% share of premium is paid by Haryana Livestock Development Board.

5.7. To conserve Hariana , Sahiwal , Tharparkar cows selective breeding by natural or A.I. technique with top quality bulls is adopted. Export of cattle is regularised and restricted by imposing an export fee with condition of production of an affidavit that the cow is exported out of the state only for breeding purposes. Cow slaughter Act is also in force in the state. Gaushalas and Govt. Livestock Farm, in the state are rearing, propagating the Hariana / Sahiwal cows by maintaining them at their farms in scheduled tracts.

5.8. Aseel Poultry Birds: The villagers are encouraged to keep these hardy birds with them by back yard poultry farming.

5.9. Policy level measures: i) Creation of HLDB, the breeding services/ conservation of animal biodiversity have been strengthened.

ii) A plan for " Creation of disease free zone " has been submitted to Govt. of India which in principle has agreed to approve in next financial year which in turn will not only conserve & preserve the indigenous germplasm but will also enhance its productivity.

iii) Steps are being taken to upgrade district veterinary hospitals to Polyclinics as Centres of Expert Veterinary Services so as to preserve and improve the indigenous germplasm in a systematic & planned manner using modern scientific techniques.

iv) Breeders association/ Progressive farmers' clubs are encouraged to be formed for conservation of animal biodiversity of the state.

v) A separate cell of veterinary extension services at the directorate level is being planned for various activities including awareness programme.

5.10. Legal Measures: For Conservation and enhancement of animal biodiversity following legal acts exists.

1. Cows Slaughter Act.
2. Livestock Improvement Act.
3. Cattle Tress Pass Act.
4. Prevention of Cruelty to Animals Act.
5. Haryana Murrah Buffalo and other milch animal breed (Preservation and development of Animal Husbandry and Dairy Development Sectors) Act, 2001.

5.11. The central/state government/state agricultural universities have been actively taking some programmes for propagation of selected breeds by maintaining some herds/flocks in animal farms and encouraging their use in the farmer's herds/flocks through distribution of breeding males/natural service/AI from government/university institutions. In cattle, conservation efforts have also been made under key village scheme, ICDPs, gaushalas, pinjrapoles. The government of India has also opened herd books for some important cattle breeds (Haryana, Ongole, Kankrej and Gir) to register animals belonging to these breeds. Some programmes also includes establishment and strengthening of breeding farms for indigenous breeds, setting up of bull centers for natural services with indigenous breeds, milk yield competitions/livestock show, assistance to Gaushalas etc.

5.12 The conservation and improvement of goats, sheep, camels etc. is also being taken care of by systematic breed improvement programme for sheep and goats at the government level as well as by the traditional breeders in the state including camels in the south-western parts of the state.

5.13 The ICAR has established a National Bureau of Animal Genetic resources (NBAGR) at Karnal to take up description, evaluation and conservation of the livestock genetic resources and support strategies for their long term conservation. The Ministry of Environment and Forests has been entrusted with the responsibility of processing and formulating a National Biodiversity Strategy and Action Plan for bio-diversity conservation.

6. Gap Analysis

1. Awareness for indigenous cattle breeds and better health care facilities to good quality animals is lacking among the people. They use unproductive cattle to enhance their productivity through natural service though modern techniques including artificial insemination and Embryo Transfer Technology etc. are currently readily available.

2. Information regarding number and distribution of genetically improved quality cattle and poultry birds is inadequate. In absence of such information, any kind of conservation measures will be ineffective.

3. Large-scale export of good quality animals out side the state has resulted depletion of cattle resources. Such export also causes depletion of animal genetic base from the state.

4. Natural services by poor quality males resulting in production of poor quality animals yielding low quantity of milk should be discouraged through publicity/extension/mass contact programme etc.

5. Proper identification of all animals with complete data of their breeding and herd health management is insufficient.

6. Proper disposal and utilization of dead carcass in the state which lately is becoming a big concern of environment pollution

7. Animal Husbandry is a subject in the State List and framework of policy-strategy-programme concerning Livestock breeding has not been achieved in many of the states.

8. The State /National Livestock census is species oriented and not breed based and there is no indicator for monitoring the population statistics for each breed and forecasting the risk of extinction due to lack of field data on different breeds.

9. Degeneration or endangerment of breeds has never been given suitable consideration in the formulation of livestock development strategies.

10. There is practically no representative body of the breeders, who can demand or undertake breed conservation activities except Gaushalas who often undertake breed improvement and conservation activities for Sahiwal and Haryana breed of cows.

11. Authentic estimates of productivity of breeds in their breeding tracts is not available at regular intervals and wherever available are clubbed with crossbreds population seriously undermining merit of indigenous breeds.

12. No organized effort has been made to improve genetic potential of indigenous breeds like Harbans that is an excellent dual-purpose breed. Genes controlling this quality of Harbans may be exploited in future through emerging biotechniques of genetic engineering and transgenesis.However, care and precautions would be taken of the long term socio-economic impact and moral and ethical issues involved in the introduction of the genetically modified breeds.

13. Some of the rare cattle like Sahiwal, Haryana and Murrah buffaloes are important in Haryana state and hence deserve conservation.

14. With the initiation of molecular work on cattle and buffalo genome mapping, there is every possibility of identification of new genes in future that may be manipulated to suit to our needs. Hence, such genes need to be conserved for posterity.

7. Major strategies to fill gaps and to enhance/strengthen ongoing measures

7.1. Most native breeds of livestock are better adapted to the local agro ecological conditions of the region and are capable of producing on almost zero input, there is an urgent need for adopting strategic conservation that may be done at two levels, namely,

(a) **In situ conservation:** Maintenance of live animal population of a breed in its native environment. This approach has major advantage that the breed can gradually adapt to the changing environmental conditions. But due to cost factor, this strategy may not be viable for unsuccessful breeds.

(b) **Ex situ conservation:** Maintenance of germplasm in the form of semen, ova, embryos, DNA, somatic cell clones or even embryonic stem cells in the form of cryo- preserved material.

7.2. Management and conservation of animal genetic resources need involvement and support of farmers and groups of people with active support of government agencies, legal coverage and institutional financing. The approach should be need based and measures taken must not upset the natural environment. Participation of farmers in the conservation program is very important in order to balance the delicacy of animal biodiversity. However, conservation for the sake of conservation may not be economically sustainable. It has to be integrated with breed improvement programmes in all categories of livestock. Hence, conservation of animal biodiversity, particularly of our domestic animals, should be made as an integral part of the overall national plan of biodiversity conservation. Indian Council for Agricultural Research has established a National Bureau of Animal Genetic Resources at Karnal during 1984, which is the national nodal agency for undertaking programs for identification, characterization, evaluation, cataloguing and conservation of Indian livestock and establishing animal data bank and gene bank. This will serve a very useful purpose for maintaining animal biodiversity in the state as well as the country. The bureau has suggested following action plan for conservation of indigenous breeds of livestock:

(a) Evaluation of genetic resources in the natural habitat.

(b) Establishment of Livestock conservation boards.

(c) Establishment of a National Data Bank.

(d) Establishment of National Gene Bank.

In addition, progeny testing alongwith pedigree selection through ONBS and appropriate culling policy would be of much help to animal resource conservation.

7.3. **The State animal Husbandry Department has following strategies:**

(a) Poor quality bulls providing natural service should be castrated with the help of village Panchayats. Simultaneously top quality semenbulls be made available to

the farmers at their nearest doorsteps and the entire breedable population of the state be covered with Artificial insemination within next 5-7 years.

(h) Better health care facilities at subsidised rates should be given to identified top quality animals if possible round the clock/cycle.

(i) Incentive money may be increased to discourage export of top quality identified animals.

(j) Farmers should be educated through publicity/extension to adopt cross breeding with Frozen Semen /Embryo Transfer Technology. Specially women should be increasingly involved in this programme as they can manage better.

(k) Breeders should be encouraged to form Breeders' Associations / Progressive Farmers' Clubs which will serve as a common platform to exchange ideas of mutual benefit and to help in achieving adoption of newer technology for maximising their genetic stock for preservation of bio-diversity and genetic variation.

(l) Better health care facility at subsidized rates including disease diagnosis and specialist services has to be provided to the farmers at their nearest doorsteps.

(g) Complete carcass utilization centers are to be established at strategic locations in the state to minimize environmental pollution and will also maximize returns to some extents.

7.4. In addition some other strategies are also under consideration which are as follows:

1. Survey of genetic resources including ecosystems should form a basis of their improvement and propagation.
2. The national/state livestock census should be on breed basis, so that the correct picture on pure breeding population can be generated.
3. To establish National Information/Data Repository on all types of animal and poultry genetic resources.
4. Relevant ecological and socio-economic issues should be identified which affect conservation and utilization of domesticated animals.

5. Systematic surveys for all the breeds should be undertaken for preparing the comprehensive inventory of animal genetic resources with proper identification and cataloguing.

6. Setting up an institutional mechanism for coordination among major players i.e. ICAR-SAU-NGO and Gaushala for activities concerning conservation of livestock genetic resources.

7. Emphasis should be given to provide all veterinary aid and other inputs to improve the productivity of animal and other socio economic benefits to the farmers who are maintaining the valuable Germ plasm and their overall bio-diversity

8. Formation/Promotion of breed societies/organizations

9 Establishment of livestock farms of different breeds (In-situ conservation) in the native ecology of the breed

10. All facilities and infrastructure available for ex-situ conservation programme needs to be continued on mission mode basis for genetic security and revival of lost breeds

11. Training and Human resource development programmes should be under taken in a big way to support the livestock breed conservation programmes

12. National Breeding Policies for different breeds, financial arrangement and legal aspects needs to be developed

13. Research and training programme should be strengthened on developing new techniques in biotechnology for the economical generation of biological materials and its conservation for posterity

8. Required actions to fill gaps and to strengthen on going measures

8.1 Action 1: Livestock development authority

Category: Medium priority.

Details: Strengthening of Livestock Development and Conservation Board with all modern facilities including Frozen Semen Technology/Embryo Transfer Technology under a recently approved central scheme entitled as National Project for Cattle & Buffalo Breeding.

Responsibility: Animal Husbandry Department, Govt. of Haryana

Time: 5 Years

8.2. Action 2: Better animal health care facilities

Category: Medium to high priority

Details:

- Provision of better health care facilities including disease diagnosis and specialist services at the nearest farmers' doorstep to make Haryana free from contagious diseases of national importance.
- New schems entitled as "Creation of Disease Free Zone".
- Conservation of the habitat, grazing lands and pastures for the indigenous breeds.

Responsibility: Animal Husbandry Department, Govt. of Haryana, in association with the Panchayat and Development Department of the state.

Time: 15 Years.

8.3. Action 3: Extension

Category: Medium priority

Details:

- A separate cell of veterinary extension services at the Directorate level to undertake various activities.
- Awareness programme for the breeders for feeding their stock with balanced diet, proper use of manure and dung as a source of bio-fertilizers, bio-gas production etc. Women should be involved in the programme as they can manage better.

Responsibility: Animal Husbandry Department, Govt. of Haryana, with the assistance of Women and child Development Department.

Time: 10 Years.

5.4. Action 4: Breeders' Association/Progressive Farmers Club

Category: Medium to high priority

Details:

- Clubs to be formed to adopt multi-pronged strategies including starting inter-species dependence and propagation for keeping bio-diversity intact.
- Rearing poultry/ducks over small ponds in which fish are cultured and reared, bird excreta will serve as feed for fish and in turn, this water which is rich in bio-fertilizer could be used for irrigation for the production of healthy crops of feed and fodder which again in turn, can be used as a rich and balanced diet for livestock of the state.

Responsibility: Animal Husbandry Department, Govt. of Haryana

Time: 5 Years.

5.5. Action 5: Training

Category: Medium to high priority

Details: Teaching and training of farmers, including women, for the production of healthy and productive animals and veterinary care using the latest techniques.

Responsibility: Animal Husbandry Department, Govt. of Haryana

Time: 5-10 Years.

5.6. Action 6: Research and preparation of Biodiversity Register

Category: Medium to high priority.

Details:

- Entire aspects of animal biodiversity conservation and cattle and poultry improvement. The indigenous knowledge of the local pastoral communities of

the Shivalik and Aravalli Hills and other pockets of the state would be used for the purpose. Biodiversity register of the local breeds and the related local knowledge and traditions will be prepared with the involvement of the local community.

- Conservation, evaluation and improvement of domestic species of livestock and poultry including those yielding wool, meat and other products .
- Progeny testing alongwith pedigree selection through Open Nucleus Breeding System (ONBS).

Responsibility: NBAGR, NDRI, Karnal and CCS HAU, Hisar and NBAGR Karnal.

Time: Over next 20 years.

8.7. Financial requirements

In order to implement the action plans by the State Animal Husbandry Department and the research institutes like CCS HAU, NDRI, IVRI, NBAGR etc the estimated financial requirement for conservation and improvement of cattle resource in the state over a period of 5, 10 and 15 year is as follows:

	5 year	5-10 year	10+ year
Financial requirement (Rs in lakh)	4000	6000	10000

OTHER DEVELOPMENT SECTORS AND BIODIVERSITY CONSERVATION:

INTER-SECTORAL INTEGRATION OF BIODIVERSITY

Introduction: The following inter-sectoral linkages have been made to identify the activities of the other sectors affecting biodiversity in the state. The root causes have been identified, strategies that may help ameliorate the damage have been suggested and indicators of progress or points of evaluation of effect of amelioration suggested have also been incorporated.

SECTOR: Planning

How Its Activities May Degrade Biodiversity	• Erosion of local planning and decision making institutions (erosion of values), in turn leading to erosion of biodiversity • Erosion of biodiversity by ill-planned development projects or welfare schemes
Historical/Root Causes for Nature of Activity	• Ignorance of, and inadequate valuation of the benefits of biodiversity • Natural resource limits not respected, lack of ecological framework for planning • Sectoral tunnel-vision approach, and lack of coordination amongst sectors and departments of development • Top-down planning: little involvement of local communities and other citizens • Little integration of biodiversity priorities
Policy/Strategies and Actions That May Help Conserve Biodiversity	• Building full value of biodiversity (economic, ecological, socio-cultural) into planning process • Guidelines to be issued for biodiversity integration into all development and welfare sectors • All sectoral activities to do environmental auditing/impact assessment • All development sectors to have a percentage of funds for biodiversity to be spent on issues related to their sector • Awareness, education amongst planners; periodic refresher courses on biodiversity and related issues • Database on biodiversity to be continuously updated, with planning board or coordinator • Biodiversity advisors in each department and in the planning board • Coordination between sectors/departments through statutory, institutionalised and participatory process • Economics/Statistics/Census department should update and show data on natural resources • Ecologically sensitive areas to be identified and made off limits to destructive developmental activities • Enforcement of laws relevant to biodiversity, through effective people's participation • Genuine community participation, with full information, in decision making • Institutional mechanism for biodiversity/environment at each district level- Environment committee as part of DPC • Periodic evaluation and monitoring of policies, schemes, programmes • Natural resource accounting • [illegible] links, and promotion of, alternative models of development and conservation • Usage of various tools for planning: folk tools to space technology • Recognition of women's decision making powers and gender sensitivity • Legal and policy flexibility to enable the above steps and to facilitate site-specific measures
Indicators of Progress Towards Goal: **ACTION POINTS**	Environmental Impact Assessment as an integral part of all projects undertaken in the state Recognition of conservation of biodiversity as a developmental activity. Recognition of the contribution of biodiversity, including unaccounted for renewals, in national GDP considering the value of environmental benefits and future value of the genetic resources.

SECTOR: Mining

How the Activities May Degrade Biodiversity	• Deforestation leading to erosion • Disasters due to mine dam bursts or other accidents, causing flora-fauna loss • Pollution of air, water, soil, with impacts on resident or downstream species • Habitat loss and fragmentation, Disruption of migratory routes, corridors • Human settlements in mining areas, putting pressure on surrounding natural resources • Displacement/cultural loss, leading to loss of biodiversity-related knowledge • Noise related disturbance
Historical/Root Causes for Nature of Activity	• Market forces/industrial and urban demand including consumer choices • Patterns of housing/urbanisation the model of development. Energy intensive construction • Pressure of the mining lobby national and international • Economic/Logistic case for mining at particular sites that are ecologically fragile • Contradictory development policies, schemes, laws, and departmental priorities • Corruption/greed leading to excessive mining and flouting of laws/norms • Lack of strong EIA related to biodiversity, in decision-making • Inappropriate mining technology • Insensitivity towards biodiversity/environmental issues in decision-making and implementation • No holistic land use plan with fragile lands being off-limits to mining or to certain kinds of mining
Policy/Strategies and Actions That May Help Conserve Biodiversity	• Strict compliance to mining laws/EIAs/Environmental clearance conditions • Cost-internalisation of environmental and biodiversity damage, holistic cost-benefit analysis • Education, awareness among decision makers and consumers of mineral products • Community permission before mining; mandatory public hearings • Stringent compensatory and mitigation measures, planned and implemented with local communities • Influencing local leaders and decision-makers through public movements, education, lobbying • Ecologically sensitive areas to be identified at state and national levels, and declared off-limits to any kind of mining • Legal status to sacred forests/sanctuary areas in mining areas • Alternatives to be provided to community for common lands that are brought under mining • Continuous monitoring, cost-benefit assessment and mitigation measures • Benefit sharing with communities and ecosystems that lose out to mining • Safety-based education by mining company to be mandatory • Prioritisation of local livelihood and ecological security needs over 'national' and 'international' demands for minerals • R&D into alternative construction material and alternatives to minerals that involve destructive mining • R&D into alternative, safer mining technologies • Organising and building capacity of communities to respond • Plantation of local species during restoration, with biodiversity enhancement and local community benefits as key priority • Consumer awareness to reduce demand for minerals not essential for basic needs, e.g. marble and diamonds
Indicators of Progress Towards Goal ACTION POINTS	- Rehabilitation of mined sites with original vegetation in the shortest possible time - Compulsory EIA in all mining projects, evaluation and satisfactory implementation of proposed rehabilitation works.

SECTOR: Tourism

How Its Activities May Degrade Biodiversity	• Ecosystem degradation by tourism infrastructure and ancillary activities • Disturbance caused by tourists, including litter pollution • Diversion of forest staff to cater to tourists, especially VIP tourists • Erosion of local cultures, including loss of indigenous knowledge on biodiversity • Illegal hunting by or under the guise of tourists • Wildlife disturbance, leading to migration and/or changes in animal behaviour
Historical/Root Causes for Nature of Activity	• Changing preferences of tourists, including greater demand for roads, vehicles, and infrastructure • Economic policies and subsidies favouring tourism over other land/water uses that lead to conservation • Lack of awareness/concern in tourists and tourist operators • Concentration on a few areas • Promotion of areas without any ecological safeguards being in place • Pilgrimage changes towards intensive, infrastructure-dominated visitations, excessive numbers at certain sites • Lack of enforcement of environmental safeguards • Lack of monitoring of impacts
Policy/Strategies and Actions That May Help Conserve Biodiversity	• Fixing of carrying capacity of each area for tourism • Tourism policy to incorporate biodiversity considerations as a central prerequisite • Tourism Policy changes, including mandatory EIA for tourism infrastructure and projects, community involvement, no tourism attractions including some ecologically fragile and sacred sites, and ecologically and culturally sensitive siting policy • Impact assessment of ongoing tourism • Comprehensive tourism planning with ecological/cultural sensitivity • Publicising negative impacts with case studies • Interpretation/education/orientation of tourists, pre-tour, during visit, and post-tour • Promoting tourism for agrobiodiversity and for conservation • Changing ecological functions, repositioning them to ecosystems and to local people • Community controlled and managed tourism which is ecologically balanced and locally equitable, with special focus on locally underprivileged groups • Mandatory Code of conduct for tourists/industry • Developing a monitoring protocol for tourism activities • Sensitisation of forest officials to genuine ecotourism potential for conservation, as a support constituency, and for employment, local livelihoods, monitoring, and revenue • Promoting low-impact tourism, including trekking • Integrating biodiversity and local community rights into tourism curricula
Indicators of Progress Towards Goal: ACTION POINTS	Strict implementation of mandatory code of conduct Reduced noise, litter No change in the density and spread of various species of flora and fauna of the area

SECTOR: Urban Development

How Its Activities May Degrade Biodiversity	• Destruction of fringe/forest ecosystems (agricultural land, wetlands, forests, grass land) by the expansion of urban habitation, construction garbage dumping, pollution etc • Conversion of natural/mixed ecosystems to manicured systems • Over exploitation of bio resources due to increased urban consumer demands • Loss of biodiversity related cultures/knowledge of villagers engulfed or displaced by urbanisation
Historical/Root Causes for Nature of Activity	• Unplanned economic growth/urbanisation into ecologically and socially sensitive areas • Faulty implementation of plans, laws, policies • Bias towards urban/industrial sector (creation of jobs, infrastructure, amenities) in national and state planning and budgets • Decline in rural resource employment/facilities base • Consumerist lifestyles–resource use, waste generation • Attitudes towards "wild" ecosystems Vs "manicured" ecosystems
Policy/Strategies and Actions That May Help Conserve Biodiversity	• Education/awareness regarding urban biodiversity, impacts of urban lifestyles • Greater resources to rural areas • Prescribed minimum forest cover for every city/town • Protection of urban wetlands, tanks, forest remnants them as Heritage • Mandatory afforestation for loss of trees
	• Natural heritage protection notification for cities/towns • Town and country planning acts/bodies to incorporate biodiversity conservation concerns • Planned development of new towns into "Ecotowns" • Development of 'mini-forests' and wetlands by NGOs/resident associations • Under 74th Constitutional Amendment (municipal/ward committees), incorporate biodiversity into urban planning in a decentralised manner • Integration of biodiversity/environment into housing colony rules/implementation • EIAs to be mandatory for large/green field housing colonies • Roof top/local water harvesting • Urban gardens and roof top kitchens, with indigenous biodiversity (rare species) • Consumer groups/movements for organic food
Indicators of Progress Towards Goals	Increased number of species phenotypes and genotypes planted in urban conglomeration Reduction in the rate of rural land getting converted into urban habitation
ACTION POINTS	

SECTOR: Commercial Energy, Industry, Infrastructure

How Its Activities May Degrade Biodiversity	• Habitat destruction/alteration, fragmentation, pollution • Global warming leading to potential species loss • Excessive raw material extraction • Social disruption (displacement/loss of livelihoods/loss of knowledge/cultural erosion) • Industrial towns leading to natural resource destruction around industrial complexes • Accidental/deliberate killing of wildlife (including poaching)
Historical/Root Causes for Nature of Activity	• Inadequate knowledge of effects • Non-compliance of environmental laws • Increasing consumerism/consumption, driven by the mass media and other forces • Lifestyle changes including greater demand for ecologically destructive products and services • Global economic forces such as trade, and MNCs • National economic forces, including vested interests in the corporate sector • Government policies/developmental model that is insensitive to biodiversity • Lack of public participation in planning and decision-making • Lack of public concern towards ecological issues
Future Strategies and Actions That May Help Conserve Biodiversity	• Sensitization of decision makers/judiciary: – Training/orientation of [illegible] judges, training institutions [illegible] (National Training Institutes, state administrative institutes, etc.) – Training of the armed forces, police Litigation (public interest) by civil society, and use of other existing legal spaces Filling gaps in laws/policies, making all development-related laws and policies biodiversity sensitive Integration of biodiversity concerns into EIAs, at the stage of the project proposals, including: – EIA to determine feasibility of projects, not only mitigatory measures – EIAs to cover all industries and development projects – No rapid EIAs as substitute for full EIAs – Mandatory public hearings, results to be integrated into decision-making Community empowerment: right to information – Involving and building capacity of Panchayati Raj institutions and other relevant local institutions – Creating and empowering [illegible] Ecologically Sensitive Areas- criteria for identification to include biodiversity Critical habitats for threatened species to be off-limits to such projects Creation/aggregation and continuous updating of database on biodiversity, for decision-making Environment cell within each development sector and department, with [illegible] and independent, statutory mandate R&D and promotion of alternatives to destructive energy and industrial processes/technologies, [illegible] Education, awareness, sensitization towards environmental concerns
	– – – – –

Indicators of Progress Towards Goal: **ACTION POINTS**	- Increased number of environmental cells created within development sectors and departments, meetings held, decisions taken - Environmental quality evaluation including land quality, at various sites - Greater emergence and use of viable alternatives - Greater levels of community participation - EIA guidelines changes towards local capacity integration - Percentage of financial allocation for environment and how it is used - Media coverage, contents and quality - Increase in environmental auditing of such projects

SECTOR: PWD (B&R) Irrigation

How its Activities May Degrade Biodiversity	+ Construction of roads & irrigation channels tends to disturb the natural flow of water. + Inaccessible areas opened to development of other sectors destroying the biodiversity + Excessive use of water of River Yamuna for irrigation has reduced the natural flow of water through the natural river bed. This has adversely affected the aquatic flora & fauna.
Amelioration	+ Construction of necessary numbers of culverts to restore the original natural drainage. + Ensuring some minimum water flow through the natural river bed of Jamuna Especially during the dry months.
Indicators of Progress: **ACTION POINTS**	+ Increased number of culverts. + Increased water flow through Yamuna river during lean-time.

Indicators of Progress Towards Goal ACTION POINTS	- Increased number of environmental acts created while development options and opportunities, meetings held, decisions taken - Environmental quality evaluation including biodiversity at various sites - Greater knowledge and use of viable alternatives - Greater levels of community participation - EIA positive changes towards biodiversity integration - Percentage of financial allocation for environment and how it is used - Maybe average question and quality - Increase in environmental visibility of such projects

SECTOR: PWD (NAM) Irrigation

How the Activities May Degrade Biodiversity	• Construction of roads & irrigation channels/canals has obstructed the natural flow of water. • Inaccessible areas opened to development of other sectors destroying the biodiversity • Excessive use of water of River Yamasa for irrigation has reduced the normal flow of water through the natural river bed. This has adversely affected the aquatic flora & fauna.
Amelioration	• Construction of dedicated reservoirs of culverts to restore the original natural drainage. • Restoring some minimum water flow through the natural river bed of Yamasa especially during the dry months.
Indicators of Progress: ACTION POINTS	• Increased number of culverts. • Increased water flow through Yamasa river during May-June.

LIST OF CONTRIBUTORS

General Contributions:

1. Sh. D.S. Dhesi, Commissioner & Secretary, Environment Deptt., Govt. of Haryana.
2. Sh. Sarbas Singh, Director, Environment Deptt., Haryana.
3. Sh. Hansraj Dass, Principal Chief Conservator of Forests, Haryana.
4. Sh. J.P.L. Srivastava, CCF (Protection), Forest Department, Haryana.
5. Sh. S.K. Dhar, CCF, Community Forestry Project, Forest Department, Haryana.
6. Ms. Madhu Saris, Member Technical Policy Core Group, 48, Sector-4, Chandigarh.
6. Sh. Singh A.K, Dy. Commissioner Gurgaon and staff.
7. Sh. Sharma Rajiv, Dy. Commissioner Yamunanagar and staff.
8. Sh. Monga B.D, CCF (Social Forestry), Forest Department, Haryana.
9. Sh. Varma V.K, Then Director Land Use Board, Haryana.
10. Sh. Sinha M.U, Then Director Land Use Board, Haryana.
11. Sh. Hembram D, SMS, Forestry, Karnal Project, Haryana.
12. Dr. Mrs. Monga Kanchan, CCS HAU, Hisar.
13. Dr. Mrs Anubha Kaushik, Guru Jambheshwar Univ Hisar.
14. Dr. Mehta, Zoological Survey of India., Solan.
15. People of village Chuhan, Yamunanagar.
16. People of village Bodla., Kurukshetra.
17. People of village Palwal and Hathin.
18. People of Yamunanagar District who contributed to workshop in January, 2001.
19. People of Gurgaon District who contributed to workshop in June, 2001.
20. People of 98 villages of Gurgaon, Rewari, Mahendergarh Districts.
21. Officers & staff of Forest, Wildlife and Environment Departments, Haryana.

Agriculture:

1. Dr. Mehla, R.S, Additional Director, Deptt. of Agriculture, Govt. of Haryana.
2. Dr. Verma Yashpal, Dy. Director, Deptt. of Agriculture, Govt. of Haryana.
3. Dr. Dahiya B.S, Director, Research, CCS HAU, Hisar.
4. Dr. Srivastava K.B, CCS HAU, Hisar.
5. Dr. M.L. Saini, Professor & Head Department of Plant Breeding, CCS HAU, Hisar.
6. Dr. V.K. Madan, Deptt. of Plant Breeding, CCS HAU, Hisar.
7. Dr. S.S. Dhanda, Deptt. of Plant Breeding, CCS HAU, Hisar.

	8.	Dr. Tyagi C S, Deptt. of Plant Breeding CCS HAU, Hisar.
	9.	Dr. Verma P K, Deptt. of Plant Breeding CCS HAU, Hisar.
	10.	Dr. Gupta S N, Deptt. of Plant Breeding CCS HAU, Hisar
	11.	Dr. Yadav O P, Deptt. of Plant Breeding CCS HAU, Hisar.
	12.	Dr. Hooda J S, Deptt. of Plant Breeding CCS HAU, Hisar.
	13.	Dr. Kushal Pal Singh, Deptt. of Genetics, CCS HAU, Hisar.
	14.	Dr. Kalra S K, Deptt. of Veterinary Microbiology, CCS HAU, Hisar.
	15.	Sh. N.K. Tyagi, Director, CSSRI, Karnal.
Animal Husbandry:	1.	Dr. Dangi K S, Director, Deptt. of Animal Husbandry, Haryana.
	2.	Dr. Raheja K. L., Head & Professor, Deptt. of Animal Breeding, CCS HAU, Hisar.
	3.	Dr. Chahal, Deptt. of Animal Breeding CCS HAU, Hisar.
	4.	Dr. Prasad S. K, Director, National Bureau of Animal Genetic Resources, Karnal.
	5.	Dr. Mathur B N, Director, NDRI, Karnal.
Fish & Aquatic Resources:	1.	Sh. Saharn B S, Director, Fisheries Department, Haryana.
	2.	Dr. Agarwal S C, Joint Director, Fisheries Deptt., Haryana.
	3.	Dr. Y.S. Kakkar, Dy. Director, Fisheries Deptt., Haryana.
Forest and Plant Diversity:	1.	Sh. Ramesh Singh D R, CCF (Production), Forest Deptt., Haryana.
	2.	Dr. Kohli R. K., Deptt. of Botany, Punjab University, Chandigarh.
Horticulture:	1.	Dr. Ahlawat, V P, Director, Horticulture, Haryana.
	2.	Dr. Dal Singh, Head & Professor, Deptt. of Horticulture, CCS HAU, Hisar.
	3.	Dr. Sharma Suneel, Horticulturist CCS HAU, Hisar.
Microbial Diversity	1	Dr. Amit Ghosh, Director Institute of Microbial Technology, Chandigarh
	2	Dr.Tapan Chakrabarty, Institute of Microbial Technology, Chandigarh
Wildlife and Faunal Diversity:	1.	Sh. Sakrel R D, Chief Wildlife Warden, Haryana.
	2.	Dr. Taneja, Chairman & Head, Zoology Deptt., Punjab University, Chandigarh.
	3.	Sh. Sharma Suresh, Gokul Nagar, Sonepat.

Annexure- I

HSBSAP Workshop at Yamunanagar

The workshop was held on 21.1.2001. The following recommendations were made:-

1. The agricultural crop diversity has reduced and this can now be again cultivated after improving the varieties.
2. There is an urgent need for preserving the indigenous stock of local cows.
3. Organic farming should be popularised. Integrated farming is conducive for biodiversity conservation which should be introduced.
4. There is a need for cataloguing the biodiversity of the area.
5. Eco-friendly farming system be popularised to compensate for reduced profits from such systems and raising of older varieties.
6. Soil fertility should be maintained.
7. Increasing public awareness; education and introduction of environment component and biodiversity conservation in education.
8. The various Acts relating to biodiversity conservation. These should be translated in Hindi and be popularised.
9. Joint Forest Management needs to be further strengthened in the State so that people have enough say in the management of the forests. Local NGOs should be involved in the protection of biodiversity of the areas.
10. Before introduction of exotic species adverse effect on the system be studied.
11. Wildlife (Protection) Act should be further strengthened for faithful implementation.
12. Govt. land may be given to villagers on lease for plantation purposes.
13. Plantations done by Forest Department should not be handed over to the villagers. They can be handed over to Joint Forest Management Committees.
14. Annual verification of trees on common land should be done under the supervision of Forest Department.

15. All possible areas should be brought under plantation. Women have more knowledge & State in biodiversity conservation. This should be recognised and their participation in decision making be ensured.

16. People should be made aware of the proper use of pesticides and protection of wild animals against pesticides. Activities like Sericulture, Mushroom cultivation etc. be encouraged to be taken up by the people.

17. Govt. should constitute committee to encourage farmers to cultivate medicinal plants.

18. Centre should be established to spread the knowledge of cultivation of different medicinal plants.

Annexure- II

BSBSAP Workshop at Gurgaon

28th June, 2001

During the process of development human being has gone away from nature. There was abundance of trees, animals and birds. Agriculture required less inputs and also produced enough to sustain. Rains were not so erratic. Nature produced enough to produce the basic human needs.

With development the ecological balance has been disturbed. Forests have been depleted both in extent and stocking wetlands are drying, animals are getting rarer. The taste of food, fruits & vegetables has also changed. The developments in the fields of Science & Technology is posing bigger environmental problems. The following steps need to be taken to restore the ecological balance.

1. Projects like Aravalli Afforestation, which brought greenary to the hills be taken up again.
2. The species planted under afforestation schemes be selected in consultation with people. Fruit plants be increased.
3. There should not any mining activity in the areas planted in Aravalli Hills.
4. Plantation of trees/shrubs as per suitability be made compulsory in every house-hould.
5. It be made obligatory for industrial units to keep their area green.
6. Aravalli Hills or nearby areas should not be taken for developmental activities.
7. The local breed of cows is fast getting replaced. The modern hatcheries are replacing the original poultry stock. Mirral fish had its home in natural ponds of the region has disappeared. Special schemes or packages be introduced to promote the earlier varieties of food crop and animal life.
8. A comprehensive campaign may be launched to educate people about importance of bio-diversity conservation.
9. The increased population of Blue bull which indicates disturbance in ecological balance requires urgent remedial measures.

Annexure- III

Biodiversity Conservation on Community Lands- The People's Perceptions.

In order to conserve the biodiversity on the land owned by communities, a survey was conducted in 98 villages of Gurgaon, Rewari, Mahendergarh districts to get the views of people belonging to different socio-economic background . The following were the views expressed by the local communities:-

(The order in which the views have been recorded here is not necessarily as per the priority of their views.)

1. The community lands have been a source of income to the Panchayats and a means of livelihood to the poor people. People collect fuelwood and grass for their cattle from these areas. Therefore, anything that is done which would deprive people of these facilities and which would amount to loss of income to the Panchayats need to be compensated.
2. In the efforts to conserve the biodiversity on the community lands village people should be involved in decision making. A village level committee should be constituted and the members of this committee be paid through Govt. funds.
3. If on account of the protection efforts there is increase in the wild animals in the said land and the farmers are put loss because of the crop damage by the increased wild animals, it be compensated by the Govt.
4. People derive wood and fodder from these areas and, therefore, if conservation means protection of these areas then the villagers should be provided with alternative means of fuelwood & fodder resource.
5. For the conservation of the flora and fauna on the community lands there should be effective protection from cattle grazing. The laws should be implemented effectively. And plants which are threatened should get special protection under law. Such species should be planted and protected.
6. In the efforts for the conservation of flora and fauna in the area, the villagers should get employment opportunities.
7. The villagers should be educated and told about the importance of the conservation of biodiversity on their areas.

8. For good work done toward this end incentive money and prizes be given to the people and the panchayat. People indulging in offences should be punished.

9. There should be total ban on mining and quarrying in the area.

10. Govt. should plant fruit and medicinal plant . Farmer experts only preparing trees so that he can fell early and earn money .

11. The women folk felt that fuelwood and grass should be made available if conservation means prevention of their access to the areas.

12. There should be a total ban on the hunting of wild animals.

13. Co-operation of the people and strong steps for the protection are required for the conservation of biodiversity on their lands.

14. People in the villages should continue to get fuel wood for the cremation of the dead in the village.

Annexure IV

SDSAF Haryana: Village meeting at Chikni, Yamunanagar held on 27.12.208

The villagers are more concerned about their economic improvement through employment generation, provision of irrigation water, protection of their crops from wildlife, education to the children etc. Village women were even not ready to discuss about biodiversity other than their problems and their mitigation through various activities.

Action:

- Awareness creation among the village community about diverse life form about their ecological and economic values and community involvement in conservation.
- Eco-development activities to generate employment and to conserve biodiversity.
- Measures to improve socio-economic conditions of women.

1. **Forests:** Villagers depends on adjoining forests since past for daily basic requirements of fuel wood, fodder and small timber.

Action:

- Forest improvement through afforestation and better protection.
- Villagers should be involved in the management.
- Change in policies and acts for easy access to the forests for the bona fide requirements of the villagers.

2. **Wildlife:** Adjoining forests are now under Kalesar wildlife sanctuary. Hence, they are not able to exercise their rights over forests for grass, fodder, fuel wood, small timber etc. Now, population of wildlife has increased. This is particularly so with the wild bore. Earlier, hunting of wild animal existed in the village.

Action:

- Alternate provision for grass, fuel wood etc should be made.
- Community/ Panchayat lands should be brought under the plantation for this purpose.
- Management of such lands should rest on the Panchayat.

- Agro-forestry should be encouraged and proper remuneration for such trees should be ensured.

3. **Indigenous knowledge:** Villagers are gradually loosing indigenous knowledge medicinal plants available in the forests. These plants are also gradually decreasing in the forests. This is because of the fact people have developed faith on allopathic medicines. However, species like Baheda, Harar, Aonla, Bel pathar, Neem, Anand etc are still used as medicine and Pipal, bamboo etc in religious deeds.

Action:

- Priority should be given to these species in the afforestation programme.
- Creation of awareness among the people about the herbal medicine
- Encouraging people to grow medicinal plants
- Creating proper marketing facilities for sale of such plants.

4. **Agriculture:** Villagers have small land holding and practice rain fed agriculture. There is problem of crop damage by the wildlife. They grow local varieties of maize and bajra but hybrids of wheat. Earlier wheat varieties like Kagni, Jhusia Gehu, Mudli etc grown in the village are no longer in cultivation because of low productivity.

Action:

- Provision of drinking and irigation water should be explored through some eco-development projects.
- Villagers should be made aware about rain fed crop management practices using indigenous and local varieties.
- Timely and adequate compensation for crop damage by wildlife.

5. **Animal Husbandry:** Villagers are rearing quite large number of local cattle whose milk yield is quite low. This has adverse affect on forests. As such they have knowledge of improved cattle breeds.

Action:

- Provision of on farm fodder production through assured irrigation water.
- Milk productivity of these breeds should be improved through assured availability of fodder and animal health care facilities.

Annexure V

NBSAP- Haryana: Village meeting at Bodla, Kurukshetra held on 31.12.2001

A meeting was organized to sensitize and elicit opinions of village community particularly women about concept and importance of biodiversity conservation. It was attended by 45 villagers out of which 30 were women. In addition, officials from the Forest Department, and Women and Child Welfare Department attended. The village is situated in fertile gangetic plain. Following suggestions were made by the villagers:

- Agro-forestry should be encouraged to meet the fuel wood need of the people.
- Forest Department should plant mixture of tree species in the community lands.
- Plant species used in medicine like Neem, bar, ghaas bel, aonala, shoont etc should be planted by the Government.
- Species like Tulsi, pipal and bamboo used in religious and that feature in their traditional folk song should also be preserved.
- For this purpose, Government should implement schemes for conservation of medicinal plants.
- Diversification in agricultural can be adopted by the villagers if the government ensures proper crop security and incentives.
- Villagers feel the need of organic farming for maintaining fertility of soils.
- There is a need for training and awareness creation among the villagers about judicious use of agro-chemicals and crop management practices for pest management.
- Villagers are not ready to bring back in cultivation the old and local crop varieties due to low productivity, though nutritional value of these varieties was appreciated by them.
- Ground water is depleting day by day in the region. Suitable soil and water conservation measures should be adopted in the upper region to recharge the ground water.

- Suitable measures should be taken to revive the Sarasvati river once used to flow across region.
- Population of Nilgai and their menace should be controlled as they damage agricultural crop quite often.
- Villagers are more concerned about their economic development through infrastructure development rather than conserving old varieties, encouraging wildlife, or other flora and fauna.
- However, they appreciated role of vegetation for clean environment.
- Women opined that earlier system of living, medicine were better in many aspects. However, these are not suitable now for growing requirement of population.