Aravalli Ecoregion Biodiversity Strategy and Action Plan

Coordinator: V.D. Sharma
Coordinating Agency: Paryavaran Prahari, Jaipur

Introduction

Biodiversity is the source of all living material used as food, shelter, clothing, biomass energy and medicaments used by human being. We benefit from other organisms in many ways, some of which we don't appreciate until a particular species or community disappears. Even seemingly, obscure and insignificant organisms can play irreplaceable role in ecological systems or be the source of genes or drugs that some day may be indispensable.

India's economy is based on agriculture, animal husbandry, forestry, and fisheries, our stakes in biodiversity are therefore very high. The increasing pressure of growing human population in the country is leading to degradation of natural habitats and is causing loss of biodiversity.

In 1992, the U.N. Conference on Environment and Development adopted a Global Convention on Biodiversity (CBD) to conserve biodiversity by all nations. A number of countries including India have ratified the CBD. To implement the provisions of the CBD the Government of India initiated the process of preparation of National Biodiversity Strategy and Action Plan (NBSAP). It is being carried out at 5 different levels, local (sub state), state/union territory, eco-region (inter state), thematic and national.

Aravalli hill ranges, spread over Haryana, Rajasthan, and Gujrat act as a natural barrier between the "Thar" desert and rest of the country. Ecologically this region is one of the 26 endemic centers of biodiversity identified in India (Nayar 1989). Because of long history of human settlement and over exploitation, the biodiversity of the region is threatened.

This document describes the present status of the biodiversity of the region, reasons for its deterioration and offers suggestions for its conservation and improvement.

An Eco Working Group (EWG) consisting of members drawn from different sections of the society was constituted for collection of basic information and preparation of Strategy and Action Plan. A number of meetings were organized at different places. In these meetings besides the members of the EWG, knowledgeable local individuals, scientists working in the biodiversity related subjects, interested NGOs, villagers, members of Village Forest Protection and Management Committees (VFPMCs), Sarpanchs of local Panchayats, and local forest officers were invited to participate.

Information about the present status of biodiversity in the region, problems faced by the people, and possible suggestions for conservation and improvement of the biodiversity was collected in questionnaires specially designed in Hindi for the purpose. Services of NGOs, knowledgeable local individuals, schoolteachers, and employees of forest department were taken for collection of information in the questionnaire. Detailed information was collected from randomly selected 159 villages and towns of the three states.

Dr. Yogesh Shrivastava of Rajasthan University; Dr. S. S. Katewa of Udaipur University and Dr. M. Parvateesum of Ajmer have done compilation of published and unpublished research works in biodiversity related subjects. Services of subject experts were also taken to have the technical details about different sectors of biodiversity. Experts on forestry, wildlife agriculture, animal husbandry, medicinal plants, ethnic groups, geography etc. were consulted. Views were also taken in the form of articles.

Profile of Aravalli Ecoregion

Starting from Delhi Aravallis run across the states of Haryana, Rajasthan, and reach plains of Gujrat near Palanpur. Physically the Aravallis are spread over 700 kms with a width varying from less than 10 km to over 100 km.

The Aravallis form a division between the sands of "Thar" and largely non-aeolian terrains of central high lands to the east. The range is also one of the main Indian watersheds separating the drainage of Bay of Bengal through Chambal from that of Arabian Sea through Mahi, Sabarmati, Luni, and other rivers. Its importance goes beyond this, for it marks the present day frontier between

the western Asiatic desert region and the true peninsula of the sub-continent. The continuity of the Aravallis is broken by 12 gaps between Ajmer to Delhi. The rivers of Aravallis are ephemeral and flow mainly during rainy season. Main rivers are Sabi, Indori, Luni, Kantli, Banganga, Sukri, Mansi, Vakal, Jakham, Banas, Sabarmati, and Arjuni. The region has a number of natural and man-made wetlands. Sambhar lake in Rajasthan is an important natural lake of the region. Flamingos visit this lake every year. It is a Ramsar site.

Aravallis are rich in mineral resources. Important minerals found here include Zinc, Leas, Copper, Silver, Cadmium, Marble, Precious and Semi precious Stones, Lime stone, and Sandstone. Soils in Aravallis fall under four broad categories 1) Aridisols, 2) Alfisols, 3) Vertisols, and 4) Inceptisols.

The Aravalli region has three distinct seasons i.e. summer, monsoon, and winter. Average annual rainfall varies between 500 mm to 700 mms with the exception of Mt. Abu, which has much higher rainfall.

The old, time honored, social classification based largely on traditional occupation and in some cases on the consideration of castes is still followed in the entire Aravalli Ecoregion. The main socio groups in the region are Jats, Rajputs, Brahmins, Banias, Gurjars, Ahirs, Rawats, Meos, Jains, Muslims, Meenas, Rebaris, Bhills, Garasias, Damors, and Kathodis.

The Aravallis cover two districts in Gujrat (23 Tehsils), 18 districts in Rajasthan (127 Tehsils), and 5 districts in Harayana (23 Tehsils).

Aravallis have a variety of ecosystems that include a) natural forest ecosystem with a variety of plants, trees and wildlife. b) agricultural eco systems. These ecosystems have been affected considerably by the biotic factors. The natural forests are now in different stages of degradation. A number of species of plants and trees are declining whereas some new plants have come up. Similarly, some species of wild animals are getting reduced and others are increasing. In agricultural fields, changes have taken place in cropping pattern and water uses. Irrigation facilities are limited. In most of the area generally one crop-Kharif during the monsoon season is raised under rain fed conditions. In areas with irrigation facilities Rabi cultivation is also done. Bajra, Sesame, Jowar, Maize, and a variety of pulses are grown in Kharif season. In Southern Aravallis paddy is also grown in Kharif season. Coarse cereals and small millets are traditionally cultivated on a very small scale in southern Aravallis. The main crops raised in Rabi season are wheat, barley, gram, mustard, and other oilseeds. Vegetables are also cultivated extensively near towns and cities. Increased use of fertilizers, high yielding varieties of crop seeds and use of insecticides and fungicides is being practiced.

History of management of Aravallis differs from state to state. In Haryana, the ownership of land in Aravallis vests in village Panchayats. The areas were well wooded and well managed in past. After independence of the country, the control of Panchayats slackened particularly during the famine years in early fifties. As a result of this, the entire forests got degraded. In nineties with the introduction of the concept of JFM and launching of European Union supported Aravalli project the forests have been rehabilitated to some extent. In Rajasthan before independence, the forests were managed by erstwhile rulers for their personal uses, including hunting of wild animals. In post independence period, because of the liberal concessions given to the people, commercial working of the forests, and excessive over grazing by cattle the condition of the forests deteriorated. From mid eighties, afforestation activities in the degraded and barren hills were undertaken by active involvement of local people, first under World bank assisted Social Forestry Project, and later on under the OECF (Japan) assisted Aravalli Afforestation Project. These afforestation activities coupled with the new concept of JFM have helped in rehabilitation of the degraded forest areas. In Gujrat, prior to independence the Aravalli ranges were part of the private property of erstwhile rulers. Rigid protection was provided only to the forest areas reserved for hunting. In other areas, the people were allowed to cut trees on payment of some royalty. These owners also gave long-term leases to people without any measures for regeneration of the forest areas. Most of the forests got degraded. These areas were brought under the state control after independence yet some of the leases continued till their expiry. In early nineties, the concept of JFM was introduced. This scheme has been well taken and is being implemented with some success.

Part of southern Aravallis, comprising of five districts of Rajasthan and two districts of Gujrat have been notified as scheduled areas by the GOI and provisions of Panchayat (extension to scheduled areas) Act, 1996 have been made applicable to these areas. There are no scheduled areas in Haryana and Delhi.

Current (known) Range and Status of Biodiversity

Aravalli Ranges have a variety of ecosystems and ecological niches. They have been broadly classified as 1) Forest ecosystem, 2) Grassland ecosystem, 3) Agriculture ecosystem, and 4) Aquatic ecosystem.

Forest Ecosystem: As per classification of forest types, by Champion and Seth (1968) the forests of Aravallis have the following categories:

- (5E1) Anogeissus pendula forests.

- (5E/DS1) Anogeissus pendula scrub
- (5B/C2) Northern Dry Mixed Deciduous Forests
- (5A/C1b) Dry Teak Forests
- (5A/C1a) Very Dry Teak Forests
- (5/E2) Boswellia Forests
- (5 E6) Aegle Forests
- (5 E 9) Dry Bamboo Brake
- (8A/C3) Central Indian Sub-tropical Hill Forests
- (5/E5) Butea Forests
- (5/DS3) Euphorbia Scrub
- (6B/C1) Desert thorn Forests
- (6/1 S1) Desert Dune Scrub

A number of ferns, herbs, orchids, climbers, and lichens also grow on the hills particularly in Southern Aravallis.

These areas also support a large variety of wild animals. Tiger, lepard, and their prey animals like chital, samber, Nilgai, and Chausingha are found in Aravallis. Other animals found include Sloth bear, wolf, fox, jackal, hyena, civets, mongoose, monitor lizard, python, crocodile, peafowl, gray partridge, great Indian bustard, lesser florican, and various species of small cats. Indian otter, ratel, and pangolin are also found, but their survival in the region is threatened. A number of sanctuaries and National parks have been notified for protection of wild animals.

Grassland Ecosystem: Some areas in the Aravallis, especially in the Southern and Central parts, have semi savanna vegetation. They are called grass "Birs". These areas in past supported good growth of a number of species of grasses such as: *Cenchrus ciliaris, Sorghum halepense, Apluda mutica, Desmostachya bipinnata, Dactyloctenium scindicum, Aristida species, Cymbopogon martini, Themeda quadrivalvis, Sehima nervosum, and Dicanthium caricosum*. Because of presence of Kankar pan, the natural tree growth in the areas is stunted and sparse.

As a result of past mismanagements, most of the grass "Birs" are now either infested with thick stands of *Prosopis juliflora* or have unpalatable weeds and grasses. They are now subjected to heavy unrestricted grazing. The productive potential of this area is good and their proper management can improve them.

Agricultural Ecosystem: In Aravalli ecoregion, due to evolutionary forces, gene pools were created and perpetuated with modification by natural selection by local cultivators. The Jhakharana variety of Bajra, Kamod, and Sal Sutar varieties of paddy and Malan and Sathi varieties of maize are a few varieties to be quoted. A number of new improved and high yielding varieties of seeds developed for agriculture crops have been introduced in Aravalli ecoregion also. Introduction of these varieties has substantially increased the productivity of crops. To maintain the productivity of the soils the farmers have to put in chemical fertilizers as well as farmyard manure in good quantity. The principal crops of the ecoregion grown in various districts are: Pearl millet, Jowar, Maize, Pigeon pea, Kharif Pulses, Cotton, Ground nut, Sesame Cluster beans, Wheat, Barley, Mustard, Chick pea, Castor, and tuberous crops.

A number of fruit plants and wild fruits having good food and economic value grow in the region. Some of the important fruits of the region are: Mango, Jamun, Amrood, Khajur, Karonda, Sitaphal, Ber, Aonwla, Bel, Banana, Papaya, Phalsa, and Nimbu etc. Some cultivators have started commercial cultivation of fruit plants like Nimbu and Aonwla on small scale. The forest department has also planted a good number of fruit plants in forest plantations in recent years.

Domestic animals make a major contribution in the economy of the people of the region. They not only provide draught power but also valuable manure for agricultural fields and food for the people in the form of milk, milk products, and meat. Dead animals provide skins and hides. People generally maintain large number of animals. The important breeds of cows of the region are: Haryana, Mewati, Gir, Kankrej, Malvi, and Nagori. Murrah, Surti, and Mehsana are amongst the good breeds of buffaloes of the region. Goats, because of their hardiness are reared allover the Aravallis. The important breeds are: Jakharana, Marwari and Sirohi. Sheep rearing is an important occupation of the region. Sheep and wool make substantial contribution to the economy of the people. Some of the good breeds of sheep reared in the region are: Chokla, Marwari, Nali, Sonadi, and Malpura. In Central and Southern Aravallis breeding of camels is done by the Rebaris.

A number of poultry-estates have now come up around big cities. The white leghorn is the popular exotic breed for layers. Local non-descript breed of birds, desi-murghi are reared in small numbers for domestic consumption all over the Aravallis.

Aravallis have a large number of tanks and ponds where a number of good local fishes are found. Under Fisheries development programme, a number of exotic species of fish have been introduced. Some of these introductions have adversely affected the local species. The Aravallis have a number of water bodies spread all over the ecoregion. These wetlands are very rich in biodiversity and support a number of species of plants and fishes of economic importance. They also support a large number of migratory and local species of birds. Sambar Lake is one of the important natural lakes of the region/India. It is spread over 90 sq kms. Water of the lake is highly saline and is used for production of salt on commercial scale. It is a Ramsar site and supports a large population of Flamingoes and other migratory birds.

Aquatic habitats are under severe pressure. The main threats to them are : 1) Siltation, 2) Drainage of pesticides from the agricultural fields, 3) Infiltration by noxious exotic weeds like water hyacinth, 4) Pollutions from industries and towns, 5) Decreased inflow of water into the wetlands, 6) Encroachments on the beds and banks, 7) mining in the catchment areas.

Statement of Problems Related to Biodiversity

Main reasons of degradation of biodiversity in the forest areas include: increased demographic, and biotic pressures, excessive and uncontrolled grazing by cattle adversely effecting the natural regeneration of natural plants, degeneration of traditional social and cultural values for protection of "Orans" and totem trees, politicization of Panchayats, unscientific mining, selective extraction of good trees by Concessionist, introduction of exotics, construction of irrigation dams, expansion of habitations, and increased demands of wood by city dwellers.

The wild biodiversity has suffered because of: Shrinkage and degradation of habitats, trade in skins, bones and other body parts of wild animals. Unrestricted use of pesticides in agricultural fields is causing deaths of natural predators of agricultural pests.

The production of traditional varieties of agricultural crops has suffered adversely because of government policies by providing increased irrigation facilities, promoting the high yielding varieties of seeds along with fertilizers and pesticides at subsidized rates. The production of local varieties of cereals has been affected by change in food habits of people because of a number of reasons.

Important factors responsible for loss of domesticated biodiversity are: mechanization of agriculture, improved transportation facilities making the animal draught power secondary. Introduction of exotic breeds of high milk yielding cows has reduced the importance of good local breeds for milk production. Introduction of exotic species of fishes have affected the population of local fishes in lakes and water bodies.

Ongoing biodiversity initiatives and major actors and their current roles relevant to biodiversity

National Forest Policies enunciated by the Government of India from time to time and Forests Act have played an important role in the management and conservation of the forests all over the country and Aravallis are no exception. 1988 Policy of the government of India lays emphasis on meeting the domestic requirements of fuel-wood, fodder, minor forest produce and construction timber of the people living in the forests. The new policy emphasizes that these items or substitute materials should be made available at reasonable prices. This was a marked shift in the Policy at National level in management objectives of the forests. The shift was from meeting the commercial demands of the forest products and maximizing the state revenue to meet the local needs of the people. Another shift was involvement of local people in protection and management of forests by constituting Forest Protection and Management Committees. On 1st June 1990, the GOI in pursuance of the new forest policy issued detailed guidelines for a massive people's movement for protection, development, and management of degraded forests by involving the village community. Gujrat and Rajasthan states issued their detailed guidelines in the matter in 1991. In Haryana, because of the earlier existing Punjab Common lands Act 1961, the VFPMCs were constituted under that Act.

In Rajasthan and Haryana, the externally aided projects for afforestation of Aravallis were implemented by involving VFPMCs under JFM Programme. VFPMCs are being involved in Gujarat Aravallis Afforestation schemes. Because of the involvement of local communities in all the stages right from micro planning to the completion of plantation, and its subsequent management, encouraging results have been seen. These afforestation projects have substantially increased the supply of forest produce from the treated areas and have led to an economic emancipation of under privileged group especially women who have benefited from the increased supply of fodder, fuel, and other non-timber forest produce.

Local communities in Aravallis have tradition of protecting patches of forests by dedicating them to local deities or ancestral spirits. In districts of Udaipur and Dungarpur, the tribal people perform a ritual of sprinkling of "Kesar" water over a patch of forest to protect its vegetation from felling; pollarding etc. the process is called "Kesar Chhanta". The villagers take a vow of not damaging or cutting the tree growth of the area for a specified period of time. There is another tradition of associating certain species of

trees with people belonging to different casts and gotras (sub cast). People of that particular castes or clan don't damage trees of those species.

A number of NGOs viz. Sewa Mandir Udaipur, Tarun Bharat Sangh Alwar, Foundation for Ecological Security Udaipur, Viksat Ahmedabad, Development Support Centre Ahmedabad, Manav Kalyan Trust Sabarkantha, are involved in the field of biodiversity related activities.

A number of VFPMCs and Local communities spread all over Aravallis are involved in regenerating the forests and their subsequent management. Some of the very active ones are Salukhera, Saadni, Nakor, Nayakhera, Bhaonta-Kolyala, and Hamirpur etc.

The forest department is presently providing protection to wildlife and its habitats. Drinking water is a perpetual problem in Aravallis; as such, creation of new water holes and improving the existing ones is given priority. Although a number of wild species are on fringe of extinction in the region, still no research work is being undertaken to study their ecological status. Increase in the populations of some wild animals like Nilgai is causing problem to farmers in many areas.

The Agricultural department is emphasizing on availability of quality and improved seeds of high yielding verities to increase the agriculture production. It is encouraging research on location specific, crop specific technology, and adoption of dry farming techniques in rain fed areas. However, the department is not in any way providing incentive to the cultivators for growing indigenous varieties of crops and other land races. Intensive agriculture with irrigation with tube wells is causing the lowering of water table in many areas.

In northern Aravallis in Rajasthan, farmers are practicing farm forestry by protecting the natural regeneration of babool trees that come up in their fields and planting saplings of *Ailanthus excelsa*. These trees are harvested when saleable. This provides some additional income to the cultivators and also meets the fuel and small timber needs of nearby towns.

Recently people have taken up apiculture and commercial floriculture mostly in northern Aravallis.

Animal husbandry is an important activity in Aravallis. It plays a vital role in rural economy. Live stock population is high but the milk yield is very low. Animal husbandry department is now emphasizing on selective breeding of indigenous breeds by artificial insemination.

The main emphasis of the fisheries department is on setting up of hatcheries for increasing the production of fish. The emphasis is also on increasing the fish-seed and its production. There is practically no check on the fish-seed brought by the contractors from other parts of the country for local water bodies.

In post independence period, because of construction of a number of small, medium, and large dams all over the Aravallis, irrigation facilities have increased considerably. Increased availability of electric power and diesel in the area has been responsible for sinking of a large number of bore wells. Unrestricted pumping of water for cultivation of high water consuming crops from these bore wells and inadequate recharging of ground water have resulted in lowering of the water table. Increased availability of water has also influenced the cropping pattern of the region. The area under crops needing more water has increased.

Tarun Bharat Sangh, an NGO, seeing the degradation of forests and lowering of the water table in the area motivated the villagers near Alwar to construct "Johads" and simultaneously protect the natural forests of the area. These Johads got filled up during monsoon and provided much needed relief to the villagers. Seeing success in the project a chain reaction started in the area. The villagers have resolved not to carry any axe inside the forests. The forest cover has started reviving again and even the wild animals also staged a come back. The wooded hill slopes and the Johads collectively recharge the ground water of the area.

The percolation of water into the soil not only raised the water table of the area but also created an ecological miracle by making the ephemeral Arvari river into a perennial one.

Gap Analysis

In a country with land-based economy, the decision makers at various levels have not fully appreciated the importance of conservation of biodiversity in poverty alleviation and providing sustainable development. Development of the area is generally associated with providing electricity, roads, irrigation etc. Development of natural resources like conservation of rainwater, forests, and pastures etc. generally get a backseat. This is mainly because of lack of informed vision at all levels.

Though the Aravallis are one of the 26 endemic biodiversity centers in India but still no detailed survey to identify prime biodiver-

sity areas, ecological studies of threatened and endangered animals, the impact of various human activities including the development projects have been conducted. Systematic studies of the affect of fertilizers and pesticides, used extensively in agricultural fields, on the terrestrial and wetland fauna and flora have not been undertaken. Ready availability of local markets for indigenous medicinal plants is probably resulting in their over exploitation. Information about their productivity vis-à-vis exploitation is totally lacking. The impact of exotics on the biodiversity is still to be studied.

Information about the land races of different crops still being grown in this region by small/tribal farmers needs to be systematically assessed. Some of these are said to be very nutritive. Nutritional value of the individual races needs to be documented. Drought is a common phenomenon in the region. The state governments, in order to provide relief to the drought-affected population, undertake employment generating relief works. Populist relief works, mostly involving "*kuchha*" earthworks, such as construction of roads are preferred. These works get washed off during the good rain and are of no utility to the people. They do not in any way contribute in combating the future droughts. Very low priority is given to afforestation works and works for water harvesting. The importance of grasslands in the rural economy primarily based on agricultural and animal husbandry has not been properly visualized by the state. This resulted in their destruction by planting of exotics. The government has not properly dealt with the problems of nomadic communities like Raikas.

The continuous increase in pressure on the forests to meet the demands of timber, fuel and fodder of increasing population has not been followed up with a proportionate increase in productivity with proper management of the produce.

Economic benefits of raising trees along with the agriculture crops, especially in the rain-fed areas have not been fully visualized by most of the farmers. These should be quantified and be made available to the cultivators.

Presently there is no interstate coordination body to discuss and resolve interstate environmental and Biodiversity issues. The states have such bodies to resolve interstate Law and order and Water issues.

A number of VFPMCs have been constituted all over the region. They are managing large forest/plantation areas. Presently they are using their social and moral influence in handling the offenders. They do not have any legal authority under the Forest Act to deal with all such offences.

There is a need to review the wildlife protection Act to provide for creation of Protected areas with involvement of local communities and safeguarding their traditional rights over its benefits.

There is a need to provide for an institutional structure for bringing the stakeholders together on a regular basis.
The natural resources, particularly the bio-resources are generally taken for granted by the villagers. There is general lack of awareness about the importance of biodiversity and the role played by it in the rural economy and capacity to manage them.

Strategies Suggested to Fill the Gaps and Strengthen the Ongoing Measures

In forestry they include: 1) Creating awareness 2) Involving the stakeholders 3) Capacity building 4) Restoration of degraded forests giving high priority to natural regeneration 5) Modernize nursery practices 6) Increasing the productivity of indigenous species 7) Enhancing yield of medicinal plants of high market value 8) Eradication of noxious exotics from potentially productive areas 9) Improvement of grasslands 10) Present status of wild bio-resources of the region to be assessed scientifically and to be digitized as data base 11) Improvement of habitat of the existing protected areas and strengthen the protection machinery 12) Improvement of buffer areas around PAs to meet local needs 13) Giving top priority to forestry, water harvesting and pasture development works while taking up famine relief works. For agricultural biodiversity, the strategy emphasizes the following points:

Ensuring Government support in the form of minimum support price for cultivation of land races relating to different crops, encouraging and educating farmers for production of Vermi-compost and other composts for purpose of organic farming. Providing support to farmers in marketing the produce of organic farming. Providing a certificate of produce of organic farming could do this. Making EIA obligatory for all developmental schemes and programmes especially to assess their potential impact on agricultural and wild biodiversity and the livelihood of the small and marginal farmers. Encourage planting of suitable tree species in agricultural lands as farm forestry. Support to set up cottage based agro-industries. Control of blue bull populations is necessary by taking appropriate measures.

Improvement of productivity of local cattle by breed improvement using pure indigenous breed, and finding out acceptable social ecological solution for the problems being faced by nomadic graziers.

Encourage local people for mass production of local species of fish fry for seeding the water bodies of the region.
Mining in all ecologically sensitive areas to be prohibited. An independent authority to be constituted to assess the impact of mining on biodiversity and take steps to check its ill effects and ensure safe disposal of the overburden and waste from the mining activity.

Environmental impact assessment of all development/construction activates of irrigation and public works department to be carried out before their execution in the field.

Reviews and amendments of all laws and policies relating to conservation of biodiversity be undertaken from the point of view of preservation of biodiversity and local lively-hoods based on biodiversity. Biodiversity to be made a part of curriculum in the schools and colleges. Poverty alleviation programmes to focus on skill up-gradation of extremely poor people. Promote eco-tourism in the forest and wildlife areas of the region.

Suggested Actions to Fill the Gaps and Strengthen Ongoing Measures

Based on the identified gaps and the strategies actions have been suggested to enhance/strengthen ongoing measures. A total of 42 action plans have been suggested. Twenty one of these actions relate to wild diversity (Forestry and Wildlife), six actions are suggested for agricultural biodiversity; Five actions are suggested for domesticated animals and fisheries, nine actions have been suggested for Policy and Legal issues and the most important action suggested is for training for decision makers at all levels.

Operational Implementation of the Action Plans and Follow up

For successful implementation and coordination of these Action Plans at state level, there should be an influential and powerful enough organization/body to see that adequate funds are allocated for approved activities. This body should also be in a position to coordinate and monitor the progress of various sectors. For this purpose, every state should have a State Biodiversity Board.

Aravalli hills have special significance in the overall economy and well being of the people of the states of Haryana, Rajasthan, and Gujrat. The forest and mineral resources of these hills have been continuously exploited by the ever-increasing consumer needs and greed of the urbanites and people living in the nearby plains. Large tracts of these hills have been converted into rocky wastes. The riverbeds have been chocked with coarse sand; recharging of ground water in the region has reduced considerably. After independence of the country, no serious attention was paid for development or preservation of the natural resources of Aravallis by any of these states. The need for eco-restoration of the Aravallis is urgent. The state governments of the region are not in a position to provide enough funds for development of the region. It has become necessary to look for some other sources for funding the development of Aravallis. Keeping in view the ecological importance of the Aravallis, the role it plays in maintaining the hydrology of the area, and its present critical stage of degradation, it would be proper to include this important hill system in the Hill area Development Programme of the Government of India. (Presently only two hill systems of the country viz. the Himalayas and the Western Ghats are included in the Programme)

For proper development, conservation, and judicious utilization of the natural resources of Aravallis a separate regional authority is proposed to be created under the proposed Biodiversity Act. Since this authority will have to deal with a number of states and the Central government it should be headed by an officer of the rank of Chief Secretary/Addl. Chief Secretary of the state supported by officers of various disciplines dealing with the natural resources and officers of the concerned states on deputation for proper coordination.

Central India Ecoregion (Vidarbha and Bastar) Ecoregion Biodiversity Strategy and Action

Coordinator: Dilip Gode
Coordinating Agency: Vidarbha Nature Conservation Society, Nagpur

Chapter I: Introduction and Status of Biodiversity

1.1 Brief Background to the SAP

The Central India Ecoregion under NBSAP process comprises reduced part of eastern Vidarbha (Nagpur, Bhandara, Gondia districts and Protected Areas of Gadchiroli and Chandrapur districts) of Maharashtra and whole Bastar region (Bastar, Dantewada, Kanker district) of Chattisgarh under NBSAP process. This area is unique due to rich biodiversity. The Vidarbha Nature Conservation Society was appointed as the coordinating agency and Mr. Dilip Gode, Secretary, VNCS as the Coordinator for this Ecoregion.

1.2 Brief Description of Methodology Used in Preparation of SAP

NBSAP process was introduced and discussed with all the participants through various programmes A working group of members from government, NGOs, experts and grass root organizations was formed to cover specific areas of biodiversity.

1.3 Profile of the Central India Ecoregion

The CENTRAL INDIA ECOREGION spread over an area of 84386 Km2, comprises (A) Lower Maharashtra (Deccan) plateau (metamorphic), with elevations ranging from 150 to 450 m and (B) Bastar Division of Chattisgarh state representing the dominant plateau character.

Chapter V: Action Plan

Strategy I: Expanding, Improving Knowledge of the Characteristics, Uses, Threatsto, and Values of Biological Diversity.

Action Plan I: Proposed Actions

a. Natural/Wild Biodiversity inventorying and monitoring

1. Compilation of Scientific Inventory and establishment of reference collections.
2. Identification, inventory and assessment of Bio indicators, breeds of cattle and poultry
3. Documentation and mapping of indigenous varieties of agricultural and horticultural crops, flora, fauna and livestock.
4. Compilation of information on traditions/culture, inventories at community level.
5. Identify areas of pollution and biodiversity loss.

b. Ecosystems Mapping and Status Studies.

1. Mapping of forest, agricultural, wildlife, aquatic habitat and grasslands through Satellite
2. Mapping of agricultural ecosystems and habitats of wild relatives of crops.
3. Collection, screening and identification of traditional crop varieties.
4. Identification of agriculturally important mammals, fish, and microbes for conservation.
5. Documentation of genetic variability of native, under utilized species of the food crops, fruits, medicinal, aromatic and other economic plants.
6. Documentation of community knowledge on herbal medicines, flora, fauna, livestock etc.
7. Identification of corridors for the passage of wild animals.

c. Socio-economic Studies.

1. The community conservation sites, traditional conservation practices and sustainable use.
2. Negative forces affecting traditional conservation practices and sustainable use and the traditional practices affecting biological diversity.
3. Crop raiding, wildlife offences, forest fires and grazing, ecological status of PAs and wetlands, effect of pollution on wildlife/birds/biological diversity of PAs, dependence of people on PAs, evaluation of individual beneficiary schemes and

VED, illegal trade in wildlife/products and derivatives, effects of mining, extraction of aquatic flora from wetlands, effects of the trends in fishing and loss of biodiversity and role of social institutions and religious leaders of the communities responsible for Biodiversity Conservation and the forces driving out biodiversity and sustainable practices.

d. Studies on Trends and Process Driving Biodiversity Changes

1. Impact of chemical fertilizers and insecticides, mining, illicit tree felling and poaching, pollution in water, land and air, illicit bamboo felling, requirement of fuel wood, fodder and timber, degradation of forest cover, excavations of soil and sand, effect of water pollution on aquatic fauna and flora, ground fire, loss of local crop varieties, exotic livestock//poultry/fish breeds, loss of forest, depletion in surface and ground water and loss of grazing grounds, rural economy and biodiversity and major industrial projects etc.
2. Impact of mono-culture in plantations and exotic/hybrid species.
3. The state policy on industrial development and livelihoods perspectives.
4. Encroachments on forestland and its status, active forces and interests, smuggling and illicit trade of medicinalplants and its effect on ecology and local economy, grazing by cattle herds.
5. The sate policies and schemes creating adverse impact on biodiversity.

Strategy II: Enhancing and integrating existing and planned *in situ* and *ex situ* Biodiversity conservation efforts

Extent of area under protected Area Networking is small. Bring private and revenue lands, other smaller sites and areas of irrigation; fisheries department should be brought under biodiversity management. Necessity to focus on aquatic habitats, forest areas other than PA, grasslands, area of FDCM and Nistar/JFM. Need to focus on agricultural, livestock and biocultural diversity

Action Plan II: Proposed Actions

a. In situ Conservation

1. Conservation of aquatic bird habitats.
2. Participatory PA/Community Conservation Area Management for flora and fauna.
3. Establishment and Management of interstate corridors for crop diversity and wildlife.
4. Conservation of biodiversity in tanks, tree genetic resource at community sites and fragmented diversity sites.
5. Conservation and management of sacred groves/community worship places, heronaries.
6. Conservation of indigenous crop varieties and their wild relatives, fauna and flora in PA and other areas/irrigations tanks/JFM and community conserved areas, community water tanks and ponds, sacred groves, streams and rivers. with emphasis on threatened species.
7. Conservation of Ghariyal in Indravati River and Otters in river Nei.
8. Conservation of Raily ***wild silk moth***.
9. *Pangasius pangasius* fishes may be transplanted for efficient utilization of molluscan fauna.
10. Conservation of agriculturally important microorganism and microbes.
11. Conservation of indigenous cattle/poultry breeds through selective/line breeding, up-gradation of non-descript animals, young sire selection, bull rearing, Associated Herd Progeny Testing, Open Nucleus Breeding Systems.
12. In JFM areas and Community Conserved Areas, promote conservation of medicinal plants, vital floral species, indigenous breeds of cattle/poultry and local crop varieties.

b. *Ex Situ* Conservation

1. Establish medicinal plant genetic research center in Degraded forest areas, catchments of irrigation tanks and other thrust areas with emphasis on threatened species.
2. Establish genetic resources centers for vital tree species other than medicinal plants
3. Conservation of ficus, Mango and Neem tree species through avenue plantations.
4. Conservation of threatened species of local flora and crop varieties in botanical/herbal gardens, agro-parks, gene banks, zoos and safari parks, waste lands and industrial areas.
5. Use and up-gradation of zoos and orphanage for conservation of threatened wildlife species.
6. Agriculture crop germplasm centers at grass root level.
7. Conservation of indigenous livestock breeds by long-term storage of the germ plasm.
8. Preservation of identified cultivars through herbarium museum, whole plant or parts.
9. Establish Cultivated Plant Genetic Resource Centers in representative agro climatic zones.
10. Establish MOET and ONBS for *in situ* and *ex situ* conservation of cattle breed and start Associated Herd Progeny Testing Program (AHPTP).

c. Regeneration/Restoration of Critical Ecosystem

1. Villagers practicing natural farming and cultivating indigenous crop varieties should be involved in agrdiversity conservation. Use of compost, vermin-compost, green manure, biofertilizers and bio-pesticides for protection of microbes
2. Decide package of practices for dry land cultivation, maximum production of the yield to restore local crop varieties and to minimize adverse impact of fertilizers and pesticides on agricultural crops.
3. Protect and manage lakes and tanks for aquatic floral and faunal diversity.
4. Cultivation of indigenous or local crop strains having high nutritive value should receive encouragement.
5. Improve Protected Areas Network by upgrading adding more area.
6. Manage degraded areas under JFM for restoration and regeneration of local flora and fauna.

d. Reintroduction of Threatened Species/Habitat.

1. Collect threatened/extinct species of sorghum, wheat, oranges, paddy and promote conservation through a gene bank at divisional level.
2. Conservation of extinct species of paddy through farmers.
3. Prepare scientific packages of practices for the cultivation of threatened medicinal, aromatic and herbal plants and local crops on farm.
4. Protect Swamp Deer/Hill Myna/Wild Buffalo and their habitat in Indravati and Kanger National Park, Bhairamgarh and Pamed WLS through community participation.
5. Manage identified non-PA areas in Bastar and Vidarbha for the protection and habitat management of tiger and leopard with community involvement.
6. Execute programme on the line of Joint Forest Management for the forest encroachers, related to their economic development to encounter threats to the flora and fauna.
7. Conservation of fresh water crocodile (Crocodilus palustris) in river Kanger and Kolar.
8. Release at least 10% of harvested cocoon in their natural habitat to maintain its resource base.
9. Indigenous breeds, especially draught cattle, poultry and goats need to be evaluated, conserved and improved.
10. Plantation of threatened floral species through social forestry schemes on fallow lands.
11. Proper monitoring and control over new agricultural pests other than insect like *snails*, *slugs*, *nematodes* etc should be taken up.
12. Protect and manage Riparian zones by restricting all harvesting activities.

e. Tackling Trans-boundary Issues (Inter-state and International)

1. Illicit trade of timber, wildlife and their body parts, smuggling of medicinal plants across the interstate boundary should be stopped.
2. Migration of wild animals and cattle herds should be controlled.
3. Review and amend government programmes affecting biodiversity conservation efforts.

f. Related Programmes to Strengthen Biodiversity Conservation

1. Inoculation of domestic livestock in forest areas and around PAs.
2. Check free fishing in rivers and impose restrictions on use of oversize mesh of fishing nets and formulate rules.
3. Establish fish farm with every reservoir for conservation of local fish fauna.
4. Impose ban on migrated settlers and any other commercial interests to operate in streams, river and tanks.
5. Promote mixed cropping for conservation of insects and set up a bureau for implementation and monitoring of conservation for agriculturally important microorganism, breeds and strain of animals, fish and microbes.
6. Intensify efforts on bio prospecting by involving farmers in *in situ* conservation.
7. Establish separate Agro-diversity Conservation wing in State Agriculture Department.
8. Include traditional food grains in the diet programme of school children.
10. Initiate fodder development programme through community participation.
11. Ensure credit facility, insurance cover and marketing support to promote traditional crops.
12. Develop mini watersheds and dug wells to counteract the devastating effects of large dams.
13. Prepare and maintain Village Agrodiversity Register (VAR) with involving Gram Panchayat.
14. Establish district wise anti poaching squad headed by DFO/DCF.
15. Establish Coordination amongst the State Departments of forest, fisheries and Agriculture of MS, MP CS, Orrisa and AP adjacent to Vidarbha and Bastar region for monitoring forest/wildlife/agriculture habitats and addressing inte state problems.

Strategy III: Promoting sustainable use of biological resources.

Action Plan III: Proposed Actions

a. Documenting Quantum and Kind of Use of Biological Resources.

1. The use of NTFP, medicinal plants, fish fauna, plants and tubers, fruits, fodder and fuel wood, bamboo for industrial purposes, tendu leaves for bidi making, khus grass, lotus bulbs and phool bahari and forest flora as vegetables, illegal trade and use of birds/tortoises/eggs of water birds.
2. The identification of traditional crop varieties, its use.
3. The rearing of draught cattle, milch cows and buffalos, poultry breeds of local varieties.
4. The careful use of water resources and management of pasteur lands.
5. The excavation of minerals, murrum etc from biodiversity rich forest and wetland areas.
6. The cultivation and consumption of farm vegetables and their importance in human nutrition.
7. Impact of traditional practices of use on biodiversity.

b. Determining Sustainable Levels of Use.

1. Use of compost and green manure, FYM through Panchayat institutions.
2. Determining carrying capacity of ecosystems and sustainable level of use of NTFP.
3. Study and determine sustainable levels of use of fodder, fuel wood and timber, medicinal plants, NTFP, fishes, domestic animals, poultry, and water resources by the community.

c. Regulations and Incentives to Achieve These Sustainable Levels.

1. Provide subsidies to the farmers on use of organic manure and bio-pesticides, traditional crop seeds, production of quality seeds of indigenous crop varieties.
2. Provide funds to Gram Panchyat/GramSabhas for conservation of agro diversity.
3. Establish "Community Conserved Area" and involve villagers in management under the provisions of proposed amendment of WLPA.
4. Involve people in collection, storage and marketing of tendu leaves through FPC/Gram Sabha.
5. Provide employment to local people on priority through programmes of Forest Department.
6. Encourage local people to involve in eco-tourism as the partners.
7. Provide 50 % of total royalty received from fishing, mining and use of village water to locales.
8. Give priority to village communities, Gram Sabha, Forest Protection Committees in allotment of PDS (Govt. control shops). Distribute traditional varieties of crops through PDS.
9. Provide 50% of revenue/profit received by government or private entrepreneurs on use of biological components to the local people.
10. Give special rewards to the people involved in protection of flora and wild animals.
11. Give special annual rewards/awards/incentives at the onset of monsoon to such villages, where no or minimum number of Parads has been occurred.
12. Implement action plan for conservation of tasar flora involving tribals and researchers.
13. Identify the role of tribal women in Bastar and involve them in collection and conservation of traditional crop varieties in fragile agro-ecosystems.
14. Form Crop Biodiversity Conservation Group at village cluster level.
15. Identify communities growing land races and give their sites, status of Community Plant Genetic Resource.
16. Establish system of economic devices like access fees, incentives and penalties for use of biological resources.
17. The Agricultural Price Commission (APC) should declare support crop price well before the season.
18. While amending Biological Diversity Bill – 2000, identify the role of Gram Sabha, impose industrial tax on the units of the area and consumer tax for use or sharing of benefits of biodiversity, define "equitable sharing" properly and clearly and (VI) create space to address the applications of 73rd amendment of the constitution.
19. Protect existing forestland and wildlife, involving people, particularly marginal and small landholders who are dependant on forest for fuel, fodder and timber and involving them in eco-development works.

d. Enhancing Livelihoods Based on Such Sustainable Use, Including through Value Added Products and Alternative Sustainable Livelihood Options

1. Improve forest by increasing bamboos and introduce cane in Bastar.
2. Empower JFM Committees/tribals in collection and sale of tendu leaves and making bidi.
3. Encourage use of traditional crops in diet and distribute through PDS.
4. Involve fishermen communities in conservation and management of local fish fauna.
5. Encourage farmers to prepare and collect crop seeds of traditional and upgraded varieties.

6. Harvesting/storage/handling of forest produce, their value additions and marketing by people.
7. Promote community enterprises like regulatory eco tourism, pig, poultry and duck keeping.
8. Participatory Protected Area Management and conservation of eco-fragile zones/threatened species of flora and fauna and eco-development works in buffer area of PAs by paying incentives to community members.
9. Prepare harvesting principles or rules for forest produce and impose punishment for violation.
10. Prohibit NTFP collection in core area of PA or eco-fragile zones, community members may be allowed in other areas with restrictions and principles. Provide rice to people in monsoon period at a subsidized rate.

Strategy IV: Achieving equity in access to knowledge, use and benefits of biodiversity.

Action Plan IV: Proposed Actions.

a. Providing Secured Access Rights to Biological Resources for Communities Traditionally Dependent on Them.

1. Access to information on all projects/programmes in forest/ecologically sensitive areas.
2. Access to information on agro diversity available with government/scientific/research bodies.
3. Information to people on the use and exploitation of natural resources.
4. Involve communities and NGOs in preparing village development plan.
5. Amend Indian Forest Act suitably to empower people to access forest resources and benefit sharing.
6. Access to the information on socio-economic and ethnic knowledge to obtain intellectual property rights to benefit local communities and the state.
7. Assign right of access to the local communities to water and bio mass resources.
8. Prepare Peoples' Biodiversity Register (PBR) at village level.

b. Tackling Inequities in Access to and Benefits from Use of Biodiversity, Within and Between Communities, and Amongst Different Sections of Society including Men and Women

1. Communities should have an access to all agreements, programmes related to the use of bio-resources by industries.
2. Decide sustainable harvesting capacities of natural resources through scientific studies and formulate principals or rules for harvesting NTFP and other natural resources.
3. 50 % members of executive body of Forest Protection Committee/Gram Sabha should be women.
4. Empower fishermen to share benefit of fisheries in lakes and rivers.
5. Make sufficient financial provisions to execute micro working plan prepared by VFPCS.
6. Identify and recognize ownership of the local communities, farmers, public or private breeder and give legal protection to the land races and traditional varieties.
7. Identify and register other agriculturally related and important bio-resources like breeds/strains of animals/fish/microbes.
8. Empower women to share benefits by sale of NTFP and its products through Gramsabha and SHGs and given them right over access to protect their own knowledge base related to the biodiversity.
9. Involve communities in planning and execution of programmes related forest management.
10. Access of community members to information with technological and research institute.
11. Empower local community members to share benefits if natural resources of their areas are being utilized for commercial purpose.
12. Promote Participatory Protected Area Management with the involvement of local community members and use their knowledge and capabilities in conservation of wildlife and its habitat.
13. Formation of schemes for the participation of people in all Protected Areas, biologically significant areas with priority to landless and poor families to provide fruitful employment in different field works of management and community resource development.

c. Special Step for Disprivileged Sections, Including Landless, Tribals, and Others, Including Women Within These and Other Sections.

1. Involve Kuruk tribe of Bastar in management of fishing sites and give disprivileged sections like landless labors, economically weaker people and women a proper share in resources utilization for livelihood.
2. Involve women. Landless labourers and tribals in documentation and study of the projects related to inventorying, monitoring of flora, fauna and agricultural crop diversity, collection of seeds, raising of saplings and management of plantations by paying them incentives.
3. Involve tribal youths in conservation of soil and moisture, protection of wildlife and flora, management of wetlands and conservation of fishes by paying them incentives.
4. Identify and use indigenous knowledge and practice of people.
5. Provide training and orientation to the community members for harvesting, storage and handling of forest produce and

their value additions, marketing of forest produce at fair prices.

6. Make mandatory to the department of Forest, Social forestry and all other line departments to purchase saplings from community members.

Strategy V: Formulating an integral policy and legislative framework for Conservation, sustainable use, and equitable sharing of benefits of Biological diversity.

Action Plan V: Proposed Actions.

a. Analyzing Existing Policies and Laws from Biodiversity Point of View.

1. Discrepancies in Wildlife (Protection) Act, 1972.
2. The wildlife cases pending in the courts.
3. The Buffer Zone and its legal category and need to declare it as a separate eco zones.
4. Ban on commercial collection of medicinal plants, except for bona fide domestic consumption.
5. Involve community members, NGOs/CBOs and concerned stakeholders in preparation of working plans/management plans and its execution.
6. The role of MCCTDC/CSCTDC in addressing problems of tribals, NTFP harvesting and marketing etc. and suspension of their activities from the forest area.
7. Invoke proper acts for the protection and conservation of streams and riverbanks, wetland areas.
8. Revoke cross breeding programme of cows with exotic animal breeds and introduce up gradation of local breed using indigenous breeds.
9. Introduction of exotic poultry breeds and its replacement with indigenous breeds.
10. Actions against encroachments on forestland after 1980 and evictions.
11. Formulation of fishing laws for the state with extension to all aquatic forms and ecosystems.
12. Monitoring mechanism to assess implementation and impact of various legislations related to natural resource management and biodiversity conservation.
13. Empowerment of VFPC/Gramsabha/FDA in managing flora and fauna in Protected and eco-fragile/JFM areas and Village Forests.
14. Catchment Area Development of Irrigation Tanks and Biodiversity Conservation.

b. Changing Current Policies and Laws to Make Them Compatible with Biodiversity Goals.

1. The present laws relating to forests and wildlife should be oriented towards restoration, protection, preservation, development and utilization also.
2. Make provisions related to biodiversity conservation, restoration, protection and incorporate in relevant strategy documents and their compliances.
3. Do not allow encroachment on the forestland and if occurs should be evicted.
4. Inquiries under S/18-S/19 to 25 of Wildlife (Protection Act) 1972 in respect of reserved forest, as these areas are subsequently burdened with encroachments.
5. Vaccination/immunization to domestic cattle in the vicinity of the Forest Areas.
6. Abolish subsidies on chemical fertilizers and pesticides and provide to organic manures and biofertilizers.
7. Emphasize on cultivation of traditional crops.
8. Enforce bamboo-cutting rules for bamboo working.
9. Create an appropriate opportunities to the grass root stakeholders and their trainings in harvesting and storing of NTFP in a sustainable manner.
10. Impose guidelines to Judicial Magistrate First Class for regarding their jurisdiction.
11. The forest and line departments should include biodiversity conservation in their working plan.
12. Priority allocation of funds for all programmes related to the biodiversity conservation and habitat management.
13. Allow people to scrutinize schemes funded by indigenous and foreign funding agencies.
14. Involve community in Biodiversity Conservation and allow harvesting of NTFP.
15. Empower Department of Revenue, Municipal Corporations and Zilla Panchayat to manage urban biodiversity.
16. In Bastar, spend at least 15% amount of the bonus on sale of tendu leaves on regeneration and protection of tendu trees and biodiversity conservation.
17. Review and conclude all lawsuits pending against tribals that pertain to encroachment on government owned lands. No forced evictions without their proper rehabilitation.
18. Forest Protection Committee or Van Dhan Samittee should work independently without government interference.
19. Add prescription for the conservation of wetland ecosystem in management/working plans.
20. Formulate policy for management of sacred groves, heronaries, medicinal plants, threatened species of flora and fauna,

swamps, wild relatives of agricultural crops and areas under JFM/gram sabha/Communities.
21. Empower institutions like Gram Sabhas/VFPC to effectively manage and monitor these sites.
22. Provisions in Pollution Control Act to address impact of microclimate change due to the gaseous pollutants in ambient air adversely affect the sensitive flora and fauna.
23. Make Section 80(A) of Indian Forest Act instrumental to fix responsibility of displacement on district administration and arrange services of Executive Magistrate and Police force to execute displacement in judicious manner.
24. Enhance compounding limits under section 54 of Wildlife (Protection) Act, 1972 from current provision of Rs. 2000/- to Rs. 10,000/-.
25. Appoint Law officer at state level in order to remove possible lacunae in the cases.
26. Vigil and control over offenders, functioning of check posts, appointments of staffers with doubtful integrity.
27. Review method of recording a panchnama, depositions, interrogation techniques, preparing case papers, knowledge of procedural matters and make effective for the success of prosecution of the case.
28. Define and legalize sharing of benefits by community in the sale of timber and NTFP.

c. Enacting New Policies and Laws for Enhancing Conservation, Sustainable Use and Equity.

1. The Maharashtra legislature should declare bamboo mat as NTFP under section 2(4) of Indian Forest Act.
2. Create a separate custody at the Range Forest Office, appoint forest prosecutor and establish forest court.
3. Allow collection of NTFP for non -commercial purpose only, as per the management plan, in the sanctuary.
4. Impose ban on Paradh or mass communal hunt by opening dialogue with community members.
5. Fill existing vacancies in the field staff of Forest Department.
6. Promote "Cluster of village" approach for development work/resource management.
7. State Forest Act should not interfere with the traditions and the restrictive norms of tribals.
8. The legal system should recognize different types of forests being protected by the people.
9. Protect Sacred Groves under the provisions of Panchayat (Extension to Scheduled Areas) Act and Indian Forest Act (as Village Forest under section 28).
10. Manage Bastar region as the heritage site under legal provisions.
11. Formulate biodiversity conservation oriented Industrial Policy and land use planning for Bastar/East Vidarbha.
12. Formation of a policy and regulatory mechanism for participatory protected area and eco-fragile zone management and regulatory mechanism for *in situ* conservation of Agro-diversity.
13. Stop promoting use of chemical fertilizers and pesticides in eco-sensitive zones.
14. Involve suitable institutions and instruments for the protection of organic agriculture and marketing of products.
15. Formation of peoples' perspective on the biodiversity conservation through public debate.
16. Include traditions of tribals on sustainable and restrictive use of natural resources in all polices and programs.
17. Restrict commercial harvesting of the forest produce in specific time to maintain biological cycle.
18. Registration of plant germplasm on properly characterized, documented and researched information.
19. Check erosion of land races and promote conservation of elite races through legislation.
20. Identify community areas growing land races and give those sites status of Community Plant Genetic Resource.
21. Encroachers on forest land should be debarred from contesting elections or voting rights.
22. Make provisions in the law to empower District Collector for biodiversity and bio-cultural mapping of district.
23. JFM Committees and GramSabhas should get receipts from tourism and penalties collected in PA.
24. Prepare policies on cultivation of feed and fodder crops in seasonal rotation.

d. Institutional Mechanism to Integrate Biodiversity into Each Sector of Development, With Adequate Funding Within Such Sectors

1. Appoint special Forest Prosecutor to handle the cases of forest department at the district level.
2. Mandatory appointment of wildlife-trained staff in PAs to ensure better management.
3. Set up "Farm Counseling and Information Center" (FCIC) at taluka and district level.
4. Form Wildlife Management Advisory Committees at VFPC/Gramsabha/Pargana level.
5. Field development works of all departments should include biodiversity conservation.
6. Updated Management Plan must be prepared for the PAs.
7. Integrate efforts of line departments for formulating strategies and joint action plan.
8. The state institutes (e.g.YASHADA in Maharsahtra) to organise capacity building programs for the stakeholders.
9. Involvement of Botanical Survey of India, Zoological Survey of India in support and training.
10. Involve network of NGOs, Department of Forest, Zilla Panchyats, NBPGR, NBAGR and NBAGR, Agricultural Universities to expand their activities to execute programmes.
11. Promote micro level planning under Panchyats Raj programme.

12. Constitute Regional Biodiversity Conservation and Management Authority at Nagpur and Jagdalpur.
13. Formation of Abujmar Biodiversity Conservation and Management Authority.
14. Establish information educational centers in AbujMar with the help of Ramakrishna Mission.
15. The young and educated Hill Maria tribal youths should act as the Change Agents.
16. Seek cooperation of experts, social workers to form long-term programme for Biodiversity conservation.
17. Involve VFPC/FDA/Gramsabha and Gram Panchayat in conservation and management of biodiversity.
18. Form Regional and District level Wetland Area Management Authority.

Strategy VI: Strengthening capacities for integrating and institutionalizing Biodiversity conservation and management.

a. Institutional Capacity Programme for All Sectors of Planning

1. Form Regional and District level Wetland Area Management Authority for managing irrigation tank biodiversity.
2. Involve NGOs and people to suggest appropriate strategies and programs on biodiversity conservation. Constitute joint coordination/monitoring cells or committees, wherever possible.
3. Involve Gramsabha/VFPCs and NGOs in wasteland and watershed development, aforestation, and formation of their network through proper training and their capacity building.
4. Emphasize involvement of women, youths and dalits in all biodiversity related programmes.
5. Establish a commission to estimate feed and fodder requirement for livestock. Involve Zilla/Gram Panchayat in improvement of fodder production at proper intervals in a scientific manner.
6. Arrange training at regular intervals for the PA staff, particularly forest guards, foresters.
7. Promote role of NGOs as biodiversity management institutes and involve them in Agro-biodiversity inventorying, monitoring and conservation.
8. Animal Husbandry department should create its own infra structure for conservation of domestic animals and birds, breeds and arrange trainings for their staff.
9. Enhance capacities of VFPC, PFPCS, Gramsabha and Gram Panchayat to organize programmes of training and capacity building.
10. Establish Regional and district level biodiversity information system.
11. Capacity building programmes for the NGOs, community based organizations, Panchyats to address issues of Intellectual Property Right.
12. Promote suitable, impartial institutional mechanism for proper Environmental Impact Analysis.

b. Human Resources Development, Including Education and Training for Various Sections of Society

1. Training for the extension workers in department of Agriculture and Animal Husbandry.
2. Training on laws for the field and administrative staff of line departments.
3. Capacity building of village leaders like Manzi, Mati Pujari, Gaita and Perma
4. Capacity building of policy makers for proper planning and execution.
5. Involve educational institutes, school and college teachers, Patwari, Vaidus, Kuruk, students and youths through training and capacity building in biodiversity monitoring and inventorying
6. Involve NGOs in arranging awareness camps for students, youths, women and tribals
7. Appoint village level para-vets and give them training for livestock management.
8. Impart knowledge in the schools and colleges situated on the fringes of Protected Areas.
9. Development of Curricula and education material through a committee of experts and NGOs.

Strategy VII: Mobilizing an integrated information, education and communication system for biodiversity conservation.

Action Plan VII: Proposed Actions

a. Biodiversity Conservation Awareness and Information Programme for and by Local Communities, Government Agencies and Political, Professionals, NGOS and Others

1. Educate school and college going students, youths, women and children.
2. Dissemination of information through exhibition, newspaper, magazines, TV and audio-visual aids.
3. Training for government officials to manage biodiversity conservation.
4. Education awareness and training for public representatives.
5. Awareness and education of farmers for making traditional agro-practices popular.
6. Awareness programs for the field staff of state departments, community members through effective extension programme, adopting scientific methods.
7. Strengthen extension education programme of the universities on conservation of biodiversity.

8. Educate and develop capacities of local individuals like fishermen, matipujaris, Vaidus, women, NTFP collectors, caretakers of sacred groves or ponds, farmers, SHG, Manzi Pancyhayat, NGOs, CBOs, VFPCs, Gramsabhas and panchayats.
9. Awareness and information for entrepreneurs on biodiversity conservation and sustainable development.
10. Awareness and information programme for law enforcing authorities.
11. Education to the under privileged sections of society.
12. Arrange cattle shows, exhibitions, rallies etc. to popularize the breed.
13. Education and awareness on herbal plants and their use.

b. Creating/Strengthening Central and Diffused Databases on Biodiversity, Including at Community Level

1. Create Data Base, information base at village cluster level, biodiversity information base at district and regional level.

c. Capacity Building and Incentives to Formal and Informal (Folk) Media for Coverage on Biodiversity.

1. Develop capacity of folk artists and utilize hats, parab mandais and religious for educating people and making them aware.

Follow Up Mechanism

1. Constitute Central India Ecoregional Biodiversity Board (CIEBB) at ecoregional level.
2. Constitute Regional Biodiversity Conservation and Management Authority (RBCMA) at Nagpur and Jagdalpur.
3. Divisional Agriculture and Livestock diversity Conservation and Management (DALCMA) at Nagpur and Jagdalpur at divisional level.
4. Form District Agriculture and Livestock diversity Conservation and Management Authority (DALCMA).
5. The irrigation department should form Wetland Biodiversity Management Authority.
6. Avail guidance and facilities developed by ICAR and NBPGR/NBLGR.
7. Form an independent Abujmar Hill Area Biodiversity Conservation and Management Authority.
8. Form interdepartmental coordination committees, wherever required.

Abbreviations Used in the Plan

1.	APC	Agricultural Price Commission
2.	DALCMA	Divisional Agriculture and Livestock- diversity Conservation and Management
3.	DFO/DCF	Divisional Forest Officer/Deputy Conservator of Forest
4.	FYM	Farm Yard Manure
5.	FPC	Forest Protection Committee
6.	ICAR	Indian Council of Agricultural Research
7.	NBPGR	National Bearau of Plant Genetic Research
8.	NBAGR	ational Beaurau of Agricultural Genetic Research
9.	NBLGR	National Beaurau of Livestock Genetic Research
10.	NGO	National Governmental Organization
11.	ONBS	Open Neucleus
12.	PDS	Public Distribution System
13.	PFPCS	Primary Forest Produce Cooperative Society
14.	RBCMA	Regional Biodiversity Conservation and Management Authority
15.	VFPC	Village Forest Protection Committee
16.	WLPA	Wildlife (Protection) Act

East Coast Ecoregion Biodiversity Strategy and Action Plan

Coordinator: L. Kannan
Coordinating Agency: Centre of Advanced Study in Marine Biology, Annamalai University, Parangipettai

Marine Biodiversity

The total number of named species of organisms is about 1.4 million (Wilson,1988). Of these, about 2,50,000 are vascular plants and bryophytes, 44,000 are vertebrate animals and 7,50,000 are insects. There are reports stating that over 50 million species may exist if we take into account the biodiversity of microorganisms and invertebrates. But, in reality, it is very difficult to estimate the exact number of organisms that actually exist because many individual groups such as fungi, nematodes, mites and bacteria are poorly known. This includes marine biodiversity also especially the deep sea biodiversity (Ray,1988).

Much of the world's wealth of biodiversity is found in highly diverse marine and coastal habitats. The pelagic water column and wealthy benthic marine environment are the dwelling places for millions of species including mammals, reptiles, fish and invertebrates like crustaceans, molluscs and worms. The marine ecosystems such as estuaries, coral reefs, marshes, mangrove forests and seagrass beds are all characterized by high biological productivity and any erosion into the species diversity of these areas would signal a decline in productivity; of course with detrimental consequences for coastal communities. The present population is consuming directly or indirectly 40% of the energy fixed on land as food and the percentage exceeds 50% when the production of the ocean is included (Swaminathan,1991). Exploitation of marine living resources, even of single stocks, is therefore a biodiversity issue.

Current Status of Coastal and Marine Biodiversity of East Coast of India

India is endowed with a long and varied coastline of nearly 7500 km, under 53 coastal districts of 10 maritime states and 6 union territories including the Andaman, Nicobar and Lakshadweep islands. Nearly 50% (420 million according to 1991 census) of the country's population resides in these areas. About 340 communities are primarily occupied in marine and coastal fisheries. Its Exclusive Economic Zone (EEZ) stands over 2 million km2.

Seaweeds: It has been recorded that 806 species of seaweeds exist along the Indian coast, of which, 487 species belong to Rhodophyceae, 186 to Phaeophyceae and 133 to Chrolophyceae (Krishnamurthy, 1991). The surveys carried out so far along the east and west coasts of India and Lakshadweep and Andaman and Nicobar islands clearly show the impressive diversity and abundance of seaweed resources of our country and the total standing crop of the seaweeds is approximately 77,000 tonnes (wet). Out of 806 species, Tamil Nadu is represented by 428 species, followed by Andra Pradesh 79 species, Andaman and Nicobar 64 species and Orissa and West Bengal 6 species each.

Seagrasses: Geographic distribution of the seagrasses is well known in southeast Asian countries as well as in Australian and Caribbean coasts. Areas where seagrass records are scarce include parts of south America, Africa and Indian subcontinent (Das, 1996). There are 13 genera and 58 species of seagrasses distributed throughout the world. In India, there are 6 genera and 14 species and all of them have been reported from the east coast. Species of the genera *Halophila* and *Halodule* are found distributed throughout the east coast. From the Palk Bay region, 6 genera of seagrasses with 11 species have been recorded whereas 13 species from the Gulf of Mannar and 9 species from the Andaman and Nicobar islands have also been recorded.

Mangroves: The mangroves of India comprise 69 species excluding saltmarshes and other associated species, under 42 genera and 27 families. Of these, 20 mangroves species are either rare or endemic, but none of them entered into the red data book. The total area covered by mangrove forests in India is estimated to be approximately 4,250 sq km (Krishnamoorthy, 1997). The deltaic environs of India's east coast support extensive mangrove forests as a result of a general intertidal slope and heavy siltation. The largest stretch of mangroves in the country is in West Bengal, where the Sundarbans cover an area of about 4200 sq km. The Andaman and Nicobar islands located in the northeast Indian Ocean, account for an additional 1190 sq km. In addition, a considerable area of mangroves exists in the states of Orissa, Andhra Pradesh and Tamil Nadu. In India, totally, 1854 species of flora and fauna have been reported from the mangrove environs; of which, 412 are floral species and 1442 are faunal species, contributing 23% and 77% respectively.

Coral Reefs: A total of 199 species of scleractinian fauna belonging to 71 genera are hitherto recorded in India, including the Lakshadweep, Gulf of Kutchch, Palk Bay and Gulf of Mannar and Andaman and Nicobar islands. Of these, 155 species belong to her-

matypes and 44 species belong to ahermatypes. The Mannar Barrier reef is 140 km long and 25 km wide between Pamban and Tuticorin (lat. 8°47' - 9°15'; long. 78°12' – 79°14'). The Palk Bay reef is 25 - 30 km long, 200 m wide and centered between 9°17' N and 7915' E. The outer side of the reef contains ramose corals while the inner side has massive corals with large polyps and 94 species of corals belonging to 37 genera have been recorded from this region (BOBP, 1994). In the Nicobar islands, of the 42 genera identified, 39 are hermatypic. (Although the full extent of the coral diversity is still not known, 68 coral species belonging to 31 genera have been found in the Andamans).

Fish and Fisheries: Talwar (1991) reported 2546 species of fish belonging to 969 genera, 254 families and 40 orders. The Indian fish populations represent 11.72 percent of species, 23.96 percent of genera, 57 percent of families and 80 percent of orders of the global fishes. The marine fish production in India during 1999 has been provisionally estimated at 2.42 million tonnes (mt) which is 9.3% less compared to 2.67 mt of 1998. The pelagic fish group forms 52.9% of the total landings whereas demarsal finfish, crustaceans and molluscs together contribute 47.1%. The landings by mechanized modern units account for 65% of the production, while the traditional units, 35%, (Kurup et al., 2000). The crustacean landings of 3,99,570 t in 1999 contributed 16.5% towards the country's total marine fish landings. Group-wise contribution of crustaceans amounted to 41.43% by penaeid prawns, 38.67% by nonpenaeids, 0.52% by lobsters, 6.89% by crabs and 12.49% by stomatopods. However, the landings of 1999 suffered a decline of 19.79% over the previous year.

Birds: India offers a variety of habitats and it is of no wonder that it offers home for about 1200 species of birds. About 176 species, contained in 106 genera, 39 families and 11 orders are endemic to Indian subcontinent. Many of them are spill overs to Pakistan, Nepal, Bhutan, Bangladesh, Myanmar and Sri Lanka. Many species are relictual and 50 species and 11 genera are endemic to India exclusively. Besides, 106 endemic species of the subcontinent also occur in India (Saha, 1998).

Reptiles: Marine reptiles of India include turtles, crocodiles and sea snakes. Of the 12 living turtle families, only 2 families are marine which include 8 species, of which, 5 are found along the Indian coastline viz. *Dermochelys coriacea* (leather back sea turtle), *Chelonia mydas* (green turtle), *Eretmochelys imbricata* (Hawksbill), *Caretta caretta* (Loggerhead sea turtle) and *Lepidochelys olivacea* (Olive ridley). Three species of crocodiles are found in the subcontinent viz. saltwater crocodile (*Crocodylus porosus*) mugger (*Crocodylus palustirs*) and Gharial (*Gavialis gangeticus*). There are about 20 species of sea snakes reported from India.

Problems Relating to Coastal and Marine Biodiversity of East Coast of India

Major direct threats to the marine and coastal biodiversity are many and are interrelated. Some of the important threats are habitat destruction and conversion, introduction of exotic species, monoculture, pollution, hunting and poaching, over-exploitation and global changes. All these factors singly or combinedly cause erosion into the coastal marine biodiversity. The documented endangered marine life includes 8 species of marine mammals, 5 species of turtles, 1 species of hemichordata, 3 species of cephalochordata, 6 species of echinoderms, 2 species of xiophosurans, 15 species of molluscs, 10 species of crabs and 1 species in each of echiuroids and brachiopods (Ministry of External Affairs, 1996). The mangrove experts in India have found that out of the 52 species of marine fish dwelling in the mangrove area, 9 are vulnerable and 2 are endangered and out of the 41 invertebrates, 4 are vulnerable and only one species is critically endangered.

Issues Related to Coastal and Marine Biodiversity Conservation of East Coast of India

The government alone cannot achieve the goal of conservation of nature and natural resources. Thus, for the success of any conservation activity, the people should be roped in and entrusted some powers to make it a people's movement. Such types of conservation activities have not emerged yet at several places in India.

Women are not given much priorities in environmental related programmes in India and in the whole of Asia. One of the major constrains being faced by women is that no organized sector is coming forward to give any loan facility or financial support to them to undertake such environment related works.

Most of the open sea habitats lie beyond territorial limits. Moreover, the present methods for oil pollution control and still others are currently practised only in coastal waters and these should be extended to the offshore areas also. The coastal bird species visiting India are mostly from several other countries. An appreciable populations of 350 species, out of 1200 species of birds recorded in India are migratory in nature. They migrate to India, especially the east coast from the Siberian part of Russia and from some other counties. So conservation strategies should be evolved and structured involving all the countries concerned.

Indigenous knowledge of people of coastal communities is rich. This has not been utilized properly for formulating different coastal, marine biodiversity conservation programmes. Indigenous knowledge of people especially those who are dwelling in the mangrove, coral-reef, lagoon, island and other important coastal zone areas should be made use of for formulating policies and action plans with regard to local resource utilization and conservation programmes.

Brief Description of Ongoing Initiatives

Assessing the quality of the atmosphere, water and sediment and its impact on biota; pesticide levels in the edible fishes; monitoring coral reef health with reference to microbial diseases; evaluation of the bioresources through conjunctive use of conventional ground surveys and satellite remote sensing; application of remote sensing techniques to wetland ecology; biodiversity and molecular taxonomy of some commercially important marine organisms; assessment of marine biological resources of the Great Nicobar Biosphere Reserve and its ecology; biology and biodiversity of sea fans of Indian waters; biology of seahorses; investigations on the eggs and larvae of the fin and shell fishes; studies on the biology of marine mammals and shore birds using chemical studies and DNA; screening of marine microbes for bioactive compounds; resource estimation of stomatopods and popularizing the same as valuable seafood and technology development for production of chitosan from stomatopods; pilot scale cultivation of some economically important seaweeds; conservation of seagrass ecosystem; coastal forestation; preservation and culture of horse shoe crabs in Chandipur shore; Joint Forest Management approach to develop degraded mangrove forest area through co-operative societies in which women represent 30% of members; mangrove genetic resource centre and database; website creation for coastal and marine biodiversity and awards for environmental conservation and protection.

Key Gaps

a. **Gaps in Information:** There is urgent need for a more scientific means of acquiring and disseminating data for proper utilization by resource users and decision - makers, detailed quantitative baseline studies for temporal and spatial abundance of aquatic resources, quantitative measures of physico-chemcial correlates for determining biogeographic zones, studies on indicator species and quantification of the role of aquatic ecosystems and their components. Information available on the coastal biodiversity is lying scattered in different institutions as grey literature and the key actors like government agencies should use it while formulating the biodiversity polices. There are enormous gaps in knowledge concerning the status of marine mammals of the east coast of India. There are no population estimates of marine mammals especially those of dugongs and other endangered species. Incidental kills of marine fauna need to be documented and the species, thus killed with crafts and gears involved, should also be recorded. Stomach contents of animals of such incidental kills should be studied because such data are lacking. Lack of consistent studies on population dynamics for most of the marine reptile species preclude confident statements or even inference of reduction in population.

b. **Gaps in Vision:** The inherent value of biodiversity is multidimensional and vast which has not been properly evaluated and this has made the policy makers lack in vision in the areas concerned. Moreover, most of the actor authorities who are non-professionals are entrusted to look into the matter of biodiversity conservation and they fail miserably in implementing the programmes. Allowing more and more people to settle in the coastal areas with the increase in the number of fishermen settlements is posing serious threats to the coastal marine biodiversity and its habitats. Settlements and the resultant population increase in the coastal regions can become an acute problem in a decade or two.

   In the case of conservation programmes/projects, the work is undertaken till the aid is received from the funding agency and thereafter, it is discontinued as no local government fund is made available to continue the valuable, long term, result oriented programmes. This is true in the context of coastal and marine biodiversity conservation programme also and this could be considered as a gap in vision.

c. **Gaps in Policy and Legal Structure:** There are gaps in Wild Life Protection Act 1972, Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) and Convention on Biological diversity. Clear and concurrent pollicies that would coordinate and integrate efforts on biodiversity conservation, environmental protection and aquatic resources use are needed. Most of the state government policies, laws and legal structures reflect those of the Central Government. These are adopted in similar form and have not been moulded as per the requirement, feasibility and effectiveness depending upon the local problems.

d. **Gaps in institution and human capacity:** Management institutions for biodiversity conservation need to be built up primarily upon data and information gathered through basic and applied research. The scientific working groups and experts on coastal, marine biodiversity have not established effective links for exchange of information with the government agencies concerned. This gap should be plugged forthwith.

Action Required to Fill-up Gaps and to Enhance/Strengthen the Ongoing Measures

1. Setting up of Interstate Eco-regional Biodiversity Committee - To analyze the coastal development activities that take place in the ecoregion and interstate issues and suggest necessary time bound actions for the respective states for implementation to conserve biodiversity.
2. Expert Centres for Taxonomic Studies on Marine Biodiversity (ECTIMB) - These centres must be involved in regular sampling and identification of species and computerization of all comparable, valid data in order to establish a scientific database in addition

to holding a reference collection. They will prepare audio-visual aids and documentaries for education, tourism, training and research purposes. These centres can also be involved in identifying and locating endemic and endangered species of local flora and fauna, by involving experts and parataxonomists and can propose the policy and legal steps necessary to protect and conserve such species and their habitats and also provide training for those interested.

3. Maintenance of local community level biodiversity register for coastal and marine biodiversity - This register is to be prepared and maintained by the local communities themselves, with the help of the college/university departments concerned, through scientific documentation.
4. A permanent monitoring team is to be formed, along with a centralized documentation facility for each coastal state - This team will prepare scientific databases on a continuing basis with regard to coastal and marine biodiversity, water quality, soil characteristics and the impacts of climate and sea level changes and pollution.
5. Regulatory measures on the indiscriminate harvest of seaweeds - To control large scale destruction of seaweeds, a closed season for seaweed collection has to be introduced and a total ban on seaweed collection in fragile ecosystems such as coral reefs has to be introduced.
6. A National Level Standing Committee for Seagrass Conservation in the east and west coasts and islands of India - This committee will formulate and implement different programmes pertaining to seagrass biodiversity, with special reference to species and habitat conservation, evaluation and monitoring, sustainable uses, constraints, awareness, training and education.
7. Conservation of mangrove biodiversity through alternate livelihoods under IRDP - This is to provide the local people with alternate sources of fuel energy and fodder and also for protecting their hygienic condition and water quality.
8. Resource conservation through small-scale development projects within and around the mangrove areas - *Nypa* palms can provide many useful products to local people living near the mangrove areas especially in Andaman and Nicobar islands. Its leaves, juice or sap and the fruit can be used for a wide variety of cottage industries and for commercial purposes. Hence, small-scale development projects using *Nypa* palms can be established within and around the mangrove areas.
9. Demarcation of fishing zones for non-mechanized and mechanized fishing boats in critical habitats like mangroves, coral reefs and seagrass beds under CRZ - Boats can be allowed for fishing only in the deeper parts demarcated in the mangrove channels, coral reefs and seagrass environs so that boat operations will not hinder in any way these bioresources.
10. Establishment of breeding centres for commercially important ornamental fishes - This will provide alternate livelihood and gainful employment as additional economic benefit for the fisherfolk.
11. Formation of youth and women eco-clubs in fisherman and salt-swamp worker communities - These eco-clubs can address problems relating to understanding and tackling of critical issues of land/water/fisheries tenure, access to the seas etc., by the government and communities coming together.
12. Creation of Community Based Marine Biodiversity Protection Group (CBMBPG) - These groups can take care of the critical sites and initiate necessary protection action with the help of forest, fisheries and police officials.
13. Identification of highly disturbed/degraded sites for inclusion under Protected Areas - This will help increase the biodiversity without disturbance, thereby sustaining such biologically high risk areas.
14. Levying heavy tax (Environmental Protection Tax) on materials prepared by using biologically non-degradable substances -This high taxation procedure will reduce the bulk purchase of such materials, thereby reducing pollution and the revenue earned can be used for environmental and biodiversity conservation programmes.
15. Ecotourism and Awareness Creation - Centres for eco-tourism and awareness creation among the school children, fisherfolk and the public have to be established at suitably selected places along the east coast so as to protect the coral reef and other ecosystems from further deterioration.
16. 'Project Dugong' to conserve the endangered species of dugongs and their ecosystem - This will help protect this endangered species from extinction.
17. International co-operation in monitoring marine pollution in the Indian Ocean region - This is needed to monitor the ocean in selected sites to predict the pollution and suggest remedial measures.
18. Preparation of Coastal Resources Atlas of India - This will serve as the means for delineating marine and coastal areas of sensitivity that could be managed by surveying and systematic mapping of the coastal zone and proper exploitation and management of resources.
19. Translation of government acts/rules and regulations in the local/regional languages - This is to make available all environment related acts/rules and regulations and their periodic amendments in the local/regional languages for their better understanding by the industrialists (small scale), fisherfolk and common public.
20. Promotion of fishery practices in the Andaman and Nicobar region - To create more employment opportunities for women and tribes.
21. Quota allocation to the fishing vessels and use of resources through proper assessment of their values considering economical and cultural aspects - This kind of restriction shall help reduce the fishing pressure in the sea and the conflicts arising thereof.
22. Validation of the indigenous fishing practices on regional basis - This will help understand the performance of particular gear used in traditional fishing practices.

Eastern Ghats Ecoregion Biodiversity Strategy and Action Plan

Coordinator: T. Pullaiah
Coordinating Agency: Department of Botany, Sri Krishna Devaraja University, Ananthpur

Geographical Profile

The Eastern Ghats are located between 76°50′ and 86°30′ E Longitudes and 11° 30′ and 22° 0′ N Latitudes. They extend in a north-east south-west strike in the Indian Peninsula covering an area of about 75,000 Sq. Km. with an average width of 220 Km in the north and 100 Km in the south. They extend over a length of 1750 Km between the rivers of Mahanadi and Vaigai along East Coast of India across the states of Orissa, Andhra Pradesh and Tamil Nadu. The Eastern Ghats do not form a continuous range because of the great rivers Mahanadi, Godavari and Krishna cut across them. In the northern section of the Eastern Ghats most of the terrain lies about 400m with a few peaks exceeding 1100m. People conveniently divide Eastern Ghats into 3 regions, the northern section starting in Orissa and terminating near Guntur just south of the Krishna river, the middle section extending up to the border of Tamil Nadu with Andhra Pradesh and the last section entirely located in Tamil Nadu (Legris and Mohr-Homji, 1982). The component hills of middle section of Eastern Ghats include Nallamalais, Yerramalais, Palakonda, Velikonda, Seshachalam and Kambakkam hills whose average elevation is 750 m. in the last section the Eastern Ghats run in West-South-West direction meeting the Western Ghats in the Nilagiris. The component hills of Eastern Ghats of Tamil Nadu region are the Javadu hills, Kollimalai, Pacchamalai, the Kalrayans, Shervaroys, Alagar hills and a group of small hillocks together called Sirumalai or Chinnamalai group of hills lying in Tiruchirapalli, Dindigul, Karur and Sivagangai districts.

The region falls under tropical monsoon climate receiving rainfall from both south-west monsoon and north-east retreating monsoon. In the northern part the rainfall ranges from 120cm to 160cm whereas in the central and southern parts, it is 60cm and 100cm respectively exhibiting semi-arid climate except in the hilly peaks. The mean temperature in January ranges between 20°C and 25°C indicating a north-south increasing trend. The maximum temperature shoots up to 41°C during host season.

The wide and varied physiography of the Eastern Ghats encompasses in its fold equally wide array of major natural ecosystems often in their pristine beauty. Thus the varied major/minor hill ecosystems, flowing water systems, river/streams, a variety of erosive habitats (Running water ecology) in addition to placid lake/pond ecosystems all eagerly awaiting scientific explorations/studies for documenting their immense biodiversity. Further Eastern Ghats is a major source of water for drinking, for irrigation and for electricity generation. Major dams like Srisailam, Nagarjunasagar, Machkund, Sileru and a number of smaller dams have been constructed in this region. Hence there is every necessity to prepare a Biodiversity Strategy and Action Plan for this fragile region.

Vegetation: The vegetation in the Eastern Ghats can be divided into:

(a) Evergreen forests (b) Tropical semi-evergreen forests (c) Tropical Moist deciduous forests (d) Southern Tropical dry deciduous forests (e) Northern mixed dry deciduous forests (f) Dry Savannah forests (g) Dry evergreen forests (h) Dry evergreen scrub

Species diversity:

1. **Plant Diversity:** Eastern Ghats are rich floristic diversity. More than 2500 species of Angiosperms occur in this region which constitute about 13% of the flowering plants of India.

2. **Animal Diversity:** Much to the animal taxonomists delight, quite a few systematic studies do exist, documenting among others, at least well known groups of animal phylas, especially the higher groups viz. mammals, birds or avifauna, the herpetofauna or reptiles), fishes and the insect life (Entomofauna), happily enough, through organised comprehensive faunal explorations, especially during the mid-twentieth century.

Proximity Causes of the Loss of Biodiversity:

a. **Introduction of Exotics:** Several exotics have been introduced into Eastern Ghats. Some of them are causing havoc to native biodiversity.

b. **Habitat Destruction and Conversion:** Eastern Ghats are under severe environmental stress and many of the natural resources

therein are not being managed on sound ecological principles to ensure sustainable yields. The forest cover in the Ghats is diminishing at a much faster rate than the replenishment.

c. **Shifting (Podu) Cultivation:** Nearly 27 tribal communities with a total population of 11,08,839 inhabit the Eastern Ghats of Andhra Pradesh. Vegetation of a particular area is greatly influenced by past treatment, which is highly manifested in shifting cultivated Podu areas. The most significant feature, which has affected the vegetation of Eastern Ghats, is the practice of shifting cultivation, locally known as Podu cultivation. Extensive areas of Eastern Ghats are subjected to shifting cultivation.

d. **Industrialisation:** The precarious position of the existing biodiversity calls for adoption of some drastic steps by the Government. The revenue records reveal that in earlier days even the plains around Nallamalais were full of bamboo. Rapid industrialization and excessive exploitation of raw materials are some of the reasons for the disappearance of many plants and animals. Bamboo is being supplied to the paper mills in Rajahmundry, Bhadrachalam, Kurnool, Sirpur and a pulp factory at Devanagaram near Giddalur in Prakasam district.

e. **Dams and Canals:** The dams at Srisailam, Nagarjuna Sagar, Sileru and Machkund have submerged considerable part of the forests. In addition to this settlements around these projects increase exploitation of forests. According to latest estimates regarding the digging of canals and the construction of reservoirs for the Telugu Ganga Scheme, about 10,378 ha (7265 ha under the reservoir in Kurnool, Cuddapah and Nellore districts and 3113 ha under canals in the forest divisions of Atmakur, Nandyal, Proddatur, Nellore and Chittoor) of reserved forest have been cleared which may further deteriorate the verdant forests of Eastern Ghats to bring about the irreversible ecological disruption.

f. **Forest Fire:** Forest fire is an annual problem in Eastern Ghats. Mostly, fire is caused by humans either willfully or accidentally. Principally wild fire destroys young seedling and damages the quality of timber either by making hallows in the trunks or by charring the same. The rich humus is burnt and wasted. The permeability of the soil is also affected resulting in loss of fertility, soil erosion and siltation of water reservoirs.

g. **Cattle:** Biotic interferences has had a marked effect on the vegetation of Eastern Ghats leading to extinction of rare and valuable plants and animals. In Eastern Ghats herds of cattle, goats and sheep moving from place to place is a common sight. These animals come from the periheral villages.

h. **Unscientific Extraction of Non-Timber Forest Produce:** Tribals like Chenchus, Konda Reddis, Yanadis extract gum and resin by making incisions on trees like *Sterculia urens* (Gum Karaya), *Anogeissus latifolia* (Velama), *Givotia rottleriformis* (Poliki) and *Lannea coramandeliana*. This has led to the extermination of *Sterculia urens*, a typical gum yielding plant, in several areas in Eastern Ghats.

i. **Mining:** Mining in Eastern Ghats is one of the main cause for the loss of Biodiversity, Limestone is quarried extensively in Yerramalais, which led to the destruction forests. Bauxite is being mined in the Northern Eastern Ghats in vast stretches which is also leading to the extermination of valuable species. Coal mining Khannam district has resulted in clearance of vast stretches of deciduous forests. Other mining activities responsible for loss of biodiversity include phosphate mining, granite.

   In the past careless mining operations have brought devastation in the entire environment of the Eastern Ghats, destroying the highly valuable flora and fauna.

j. **Monoculture:** The Plantation programme by forest departments in Eastern Ghats are specifically of the monoculture type which have not had much success and made biological invasions into species composition and structures.

k. **Killing of Animals:** The onslaught of killing of different species of fauna like several snakes (King Cobra, Python), bison etc. has posed a serious threat to their very survival.

Ongoing Biodiversity Related Initiatives (including assessment of their efficacy)

i. **Government:** Much of the biodiversity in the Eastern Ghats owe their contined survival to the system of protected areas.
   a. Andhra Pradesh Tribal Development Project.
   b. Andhra Pradesh Forestry Project
   c. Medicinal Plant Conservation Area (MPCA) involving Tamil Nadu and Andhra Pradesh Forest Department.

ii. NGO's
   a. M.S. Swaminathan Research Foundation, Chennai
   b. Save the Eastern Ghats Organisation (SEGO) Chengam Taluk and Javadi Hills) - involved in work to traditional paddy varieties.
   c. Green Foundation (Thalli block, Dharmapuri District) - Conservation of Finger and other Millets.
   d. IRDT (Dharmapuri District) - Crops
   e. Low Extenal Input Sustainable Agriculture (LEISA)
   f. Conventional Centre for Development (CCD) (Ramnad, Madurai and Virudhunagar) - Medicinal plants
   g. Medicinal Plants Conservation Areas by FRLHT.

Required Actions to Fill Gaps, and to Enhance/Strengthen Ongoing Measures

i. Action to conserve and sustainable use (where relevant) natural ecosystems and wild plant and animal diversity.
   a. Sensitization of governmental agencies, NGOs and Panchayats on biodiversity issues is an urgent need.
   b. Special area programmes for Eastern Ghats to be initiated. Action: DRDA
   c. Land use planning through micro and macro watershed programme, and the role of women in collecting firewood and other NTFP must be highlighted, a database may be developed.
   d. Enabling the local communities to document region's flora and fauna and publish the same in local language and dissemination of information to the local communities.
      Action: University Faculty, BSI, ZSI and National Research Institutions.
   e. Study of the population status of all threatened plant and animal species (including medicinal plants) of the region.
      Action: University Faculty, ZSI, BSI, FRLHT
   f. Mapping of natural ecosystems to identify the zones of biotic interference through remote sensing for the immediate protection and conservation of species in the region. Action: Government Departments and Universities.
   g. Strengthening and promoting the peoples Biodiversity registers programme.
      Action: Deccan Development Society, CWS, Local community and NGO networks and University faculty.
   h. Medicinal Plants Conservation Areas by FRLHT
   i. Conducting awareness campaign in the rural and urban areas regarding the environmental conservation, ranging from protection of species to proper disposal of solid waste.
      Action: NGO networks, State Environmental Organisations and Universities.
   j. Listen to local communities on approaches to sustainable collection of forest products, and converting this learning into training materials for the governmental, non governmental and local communities, especially, gum yielding plants and medicinal herbs.
      Action: NGO networks, forest department and scientists.

ii. Actions to conserve and sustainable use agro-ecosystems and domesticated plant and animal diversity.
   a. Establishment of seed banks and networking for exchange of traditional knowledge regarding varieties of crops and breeds of Eastern Chats.

iii. Actions to conserve and sustainably micro-organisms: To safeguard the microbial diversity of Eastern Ghats, establish a Microbial Type Culture Collection Centre in the southern part of the country, possibly at Tirupati to identify, conserve, utilize and claim rights over the microbial resources of Eastern Ghats.

iv. Actions to achieve equitable decision - making, people's (including women's empowerment and participation, equitable sharing of benefits, cross-sectoral integration, policy and legal changes, financial measures and other such steps.
   a. **Strategy:** Development of Biodiversity as a discipline with a holistic approach encompassing social, scientific, cultural and ethical approaches.
      Action Plan: Designing curriculum on biodiversity at all levels in educational institutions.
      Actors: Universities, State level School Boards in collaboration with local grassroot CBOs and NGOs.
      Networking with educational institution including school, colleges, universities by mobilizing students.
   b. **Strategy:** Establish the linkage between biodiversity and local people's livelihoods both in negative and positive aspects. Shift from mere protection approach to management of biodiversity with local control over biological resources.
      Action Plan: Documentation and analysis of the linkages between biodiversity and local people's way of life.
      Actors: Anthropologists, Archaeologists, NGOs in collaboration with local CBOs.
      Action Plan: Capacity building at local community level to understand and take control over biodiversity resources for effective management.
      Actors: NGOs, CBOs, funding agencies, Government Administrators.

c. **Strategy:** Instead of sectoral approach policies should in harmony with other policy objectives at wider level.
Action Plan: MoEF should have an integrated approach in designing implementation and coordination of various policies and objectives with a priority for biodiversity.
d. **Action Plan:** Interlinking forest development policies and biodiversity conservation policies.
Actors: Different divisions in MoEF in collaboration with local CBOs and NGOs.
e. **Strategy:** Thrust should be given to development planning comprising the regeneration of biological resources and sustainable utilization of the same.
Action Plan: Biodiversity friendly development models at micro-levels have to be documented and action plans have to be prepared.
f. **Action Plan:** Strengthening the regulatory mechanism to control the industrial pollution affecting biodiversity.
g. Media strategy should be evolved at all level with appropriate medium.
Action Plan: Revival of local cultures and festivals to disseminate the message in local languages.
h. Biodiversity parks should be developed at Mandal/Taluk level exhibiting locally endangered plants and animals.
i. Biodiversity related products and local markets controlled by local people should be established. Promotion of biodiversity friendly products have to be prioritized.
j. Fishing activities by huge technology based fishing companies should be banned and only traditional fishing activities have to be permitted to conserve aqua biodiversity through the coastal areas and inland lakes and canals.
k. Inter-eco-regional networking and sharing of experience has to be facilitated.

Gangetic Plains Ecoregion Biodiversity Strategy and Action Plan

Coordinator: Jamal Khan
Coordinating Agency: Wildlife Society of India, Aligarh Muslim Univesity, Aligarh

The "Biodiversity Strategy and Action Plan for Gangetic Plains" is concerned with the portions of the Gangetic Plains (GP) falling in Uttar Pradesh (UP) and parts of Bihar, referred to as upper and middle GP. However, portions of the GP falling in West Bengal, Orissa and the Shiwaliks have been excluded. The GP eco-region occupies an area of 310894 km_ in the states of UP and Bihar, with 10308.43 km_ and 4202 km_ of the land under forests in the two states respectively. There are 255 communities staying in the GP with the upper GP being one of the most densely populated parts of India (576.16 persons/km_). The region is dominated by agriculture. However, despite the low forest cover in the region at least 12 of the communities are partially or fully dependent on forests for their livelihood. This eco-region has two National Parks (NP) and 24 Sanctuaries out of which one NP and 16 Sanctuaries are in UP and one NP and eight Sanctuaries are located in Bihar.

Biodiversity of the Site: A large portion of the GP consists of swamps, grasslands and muddy islets. These ecosystems shelter most of the floral and faunal diversity of the region. Moreover, the *terai* region of the GP is a vast repository of biodiversity and is a unique and important ecosystem. It has good sal forests interspersed with tall wet grasslands. Overall conservation of the *terai* is of vital importance as it supports species, which are exclusively dependent on the protection and availability of such habitats. The rich floral diversity of GP consists of 1458 dicot taxa (683 genera and 131 families) and 495 monocot taxa (187 genera and 26 families). In addition to this a large diversity of fungi (143), algae (765) and macrophytes (79) have been recorded from the Ganges. The region also supports a high faunal diversity in its terrestrial and aquatic ecosystems. The mammalian diversity in GP (90 species) is one of the richest in the country with 11 species recorded from the Ganges, including the Gangetic dolphin and the smooth coated Indian otter. However, only 38.7% of the species in GP have been classified under different threat categories (Gangetic dolphin is the only species which falls under critically endangered category), while for 61.29% of species, data is deficient for categorizing their exact status. Out of 477 bird species (37% of the country's total avifauna) reported from the region, only 42% are found in forests (198 of the species are found in moist deciduous forest habitats), while the remaining are found in grasslands, wetlands and in agro-ecosystems of GP. There are 41 key bird conservation areas in the GP, most of which fall under PA category. These are considered important bird areas due to the presence of Red Data Book species and also due to congregation of large number of waterbirds. The lowland forests and grasslands are also very important habitats for many bird species. The *terai* grasslands especially, are vital for bird conservation as they support a higher proportion of threatened/key species like the Bengal florican, Swamp francolin and Finn's baya. The region also has some good wetlands, important for the conservation of wintering waterfowls, and other life forms such as fishes, amphibians and Chelonians as well as for their social and cultural values. However, there is a general scarcity of information on most wetlands in GP. Although, the GP is not very rich in amphibian fauna (40 species, 11 of which are reported from Ganges) the reptilian fauna comparatively is very rich (42 species out of which 27 are from Ganges). Unfortunately, no systematic research and exploration has been conducted to assess the amphibian diversity of the region. Therefore, the records are scanty and even information on amphibian assemblages in PAs is lacking. In all 121 fish species have been described from various water bodies in GP. Five of these species (4.9%) are endangered, while, 14 (13.72%) are vulnerable. Lastly, as far as the agro-biodiversity of the region is concerned, while, the main food crop is wheat, rice is the next most important crop. The major cash crops are sugarcane and oil seeds. In addition to these, three varieties of pulses are also grown both as food and cash crops. Other crops grown are millets, maize, gram and vegetables.

Biodiversity Related Issues: The biodiversity along with the PAs, terrestrial ecosystems, rivers and wetlands of the region are under a range of threats. While the major threats to terrestrial wild plants are over-exploitation for raw materials, medicines, oils, dyes, gums, resins, dependence of local communities on forests for sustenance, timber, uncontrolled grazing by livestock, spread of exotic species and deliberate/accidental fires. The aquatic vegetation is also under threat from pollutants, which find their way into the aquatic ecosystem. The faunal diversity of the region is however, under threat from destruction, deterioration and fragmentation of habitat due to wrong development programs (large-scale agricultural expansion, industries, hydroelectric and irrigation projects) and wrong management practices like plantations both of mono-cultures and exotics, within PAs. In addition to these, poaching and hunting, not only of large and endangered terrestrial and aquatic mammals like tiger, rhino and elephants, but also of certain species of birds, amphibians, reptiles and fishes, thus posing a major threat to the biodiversity of the region. Fragmentation and resultant confinement has made the representative fauna of this region vulnerable to extinction due to demo-

graphic stochasticity. The GP is an important area for directing bird conservation efforts, as 32% of the threatened species in the country belong to GP. The bird diversity in the region has suffered from the declining forest cover, loss of various natural resources, poaching especially of migratory species, pollution and chemical contamination. Moreover, extensive fishing in the wetlands, not only disturbs the birds that use the wetland but also depletes the population of fishes, which constitute a major diet of many piscivorous birds. The water bodies in GP have also suffered due to aquatic contamination from discharge of untreated toxic industrial effluents and urban domestic sewage into the river system, which has not only affected the water quality, but also deteriorated their entire ecology and affected their biodiversity. Agro-biodiversity in GP has also witnessed a decline in traditional crop varieties like pulses, barley and jowar as the priority in the region has been to boost grain production and adoption of high yielding varieties. There has been a loss of indigenous breeds. Moreover, even though livestock numbers have increased they have become less productive. Unfortunately, the agriculture and animal husbandry departments have however, over the years played a passive role in agro-biodiversity conservation. Unfortunately, biodiversity conservation issues do not appeal even to the local people in GP.

Ongoing Initiatives and Key Gaps: To conserve the limited forest and wildlife of the GP, and halt the over exploitation of natural resources many governmental and non-governmental initiatives have been taken. While the governmental initiatives deal with various policy/legal measures, research projects and schemes, the non-governmental initiatives are practical actions for habitat or species conservation. While the policy measures include establishing and strengthening PAs in GP, development of forestry sector, fire protection and land conservation schemes, legal measures to conserve biodiversity deal with notifying reserve forests, sanctuaries, national parks and biosphere reserves. There are a number of Acts and policies, which directly or indirectly affect biodiversity in the region. There are also a number of international regulations, which have wide implications for biodiversity of GP, viz., CITES, CDB, and the Ramsar Convention, 1975. The administrative measures in GP are in the form of projects and schemes, initiated at the governmental level, like Project Tiger (2 in the GP). Moreover, to complement *in situ* conservation, the state governments in GP have established zoos, botanical gardens, deer parks and safaris. Furthermore, there are governmental research and development organizations as well as projects dealing with various conservation issues. Efforts are also being made to integrate conservation issues into economic and social sectors, through projects focussing on social, urban and farm forestry, assisted natural regeneration, afforestation, development of nurseries and pastureland, and employment generation and eco-development schemes. Moreover, initiatives have been taken to achieve participatory management of forests in the GP through joint forest management and tribal welfare programs.

The role of environmental activism and citizens' groups for biodiversity conservation in the GP needs special mention. While 'Ganga Mukti Andolan', is a movement by the local fishermen against river Mafia in Bihar, 'Sankat Mochan Trust', a Varanasi based NGO, 'Ecofriends', a voluntary group of Kanpur, and several other cultural and religious groups and voluntary organizations are playing a vital role in the region. There are also projects on biodiversity concerns in the area, like the *Terai* Arc Landscape Restoration. Moreover, there are several national and local NGOs which are conducting research programs in the region, like the World Wide Fund for Nature and Natural Resources-India (WWF-India), Bombay Natural History Society (BNHS), Kalpvriksh, Wildlife Society of India-Aligarh (WSI), Gorakhpur Environmental Action Group (GEAG), and Vikramshila Biodiversity Research and Education Center.

Despite the governmental and non-governmental initiatives for biodiversity conservation in GP, several gaps have been identified. A major lacuna is the absence of a centralized body of information and documentation on current status and documentation of-PAs, terrestrial/aquatic ecosystems, PA-people conflicts, flora, fauna, and effects of exotic flora on natural floral and faunal diversity. There is an urgent need for a nodal agency to monitor and develop database on wild and agro diversity in the region. While the area under PA network is low and unevenly distributed in GP, the research initiatives are lagging behind with most conservation efforts directed at large mammals. Ecodevlopment and JFM have also not been fully explored and applied. Unfortunately not only the forestry programs have been instrumental in promoting exotics at the cost of indigenous species, many of the grasslands in GP have also been converted to woodlands by raising plantations; Dudhwa and Hastinapur are a case in point. There is also lack in linkages in ex- and *in situ* conservation of flora and fauna, and improper management of small mammals. Several policy and legal issues in GP also need attention, viz., pending final notification of all sanctuaries in GP, and lack of policy on- grazing in PA system, freshwater, and use and maintenance of water bodies. Moreover, most amphibian and fish species have not been included in Wildlife Protection (Act), 1972.

Proposed Strategies and Action Plans:

1. **PAs, Terrestrial and Aquatic Ecosystems:** All plantations within PAs should be immediately stopped. Furthermore, management planning should be given priority and initiated immediately for ● Turtle sanctuary, UP ● Hastinapur WLS, UP ● Surhatal Bird sanctuary, UP ● All PAs except Valmiki TR and Kanwar Lake in Bihar.

   At the same time, to build viable partnerships for biodiversity conservation, it is imperative not only to allow local people limited access to resources, but also involve dependent communities in management and decision-making processes. Socio-eco-

nomic surveys should be carried out in and around each PA for proper planning and implementation of eco-development programs, especially focussing on exploring viable alternatives to reduce dependence of local communities on the PAs. Moreover, a complete economic valuation of biodiversity resources of each PA in the GP should be carried out. As there is no livestock grazing policy in the GP, it needs to be developed to reduce the high pressure on PAs and resulting conflicts. There should also be compulsory cattle immunization in and around each PA to curb the spread of livestock diseases to the wild animals. To raise people's awareness towards environment and biodiversity conservation there is a need to initiate conservation education/ awareness programs both for the local communities, as well as in schools/educational institutions both in rural and urban areas. Also developing Interpretation centers within each PA would go a long way in educating the people on values of the PA. The infrastructure of PAs in Bihar, needs strengthening and development. Feasibility studies and surveys should be conducted for developing corridors e.g. between Dudhwa and Katarniaghat and new sanctuaries for threatened fauna e.g., a Dolphin sanctuary in the Ganges, between Hastinapur and Varanasi; and also for boundary re-organisation in ● Hastinapur WLS ● Gogabil WLS ● Kushewarasthan WLS and ● Turtle sanctuary. There is also an urgent need for projects to monitor water quality and impact of pollution on biodivesity values of wetalnds in the entire GP. The agro-ecosystems in GP are also badly neglected and over burdened. For long-term conservation and sustainable use of agro-ecosystems it is necessary to undertake documentation of agro-diversity in GP and also to constitute district level committees to look after the various aspects of agro-diversity and work out conservation strategies involving local people.

The above actions would be implemented by UP and Bihar governments along with forest, agriculture, animal husbandry and irrigation departments, NGOs like, WWF-India and Center for Environment Education-Ahmedabad, educational institutions like Institute of Economic Growth-Delhi University and Department of Zoology-Patna University and Ministry of Environment and Forests (MOEF). The total financial outlay would be Rs. 226.4 crores (0-5 years), Rs. 157 crores (5-10 years), and Rs. 130 crores (10-15 years).

2. **Wild Plants:** As the flora of GP is not well documented, exploration and documentation of ● plant diversity ● ethno-botanical and ● medicinal plants is required to be carried out. Also *ex situ* conservation of rare and endangered medicinal plants should be done through cultivation. Agencies involved in the proposed activities would be National Botanical Research Institute, Botanical Survey of India, Medicinal Plant Board, Central Council of Research in Unani Medicine, Ministry of Health and Department of Botany- Aligarh Muslim University. The total financial outlay would be Rs. 7.5 crores (0-5 years), Rs. 4 crores (5-10 years) and 2.5 crores (10-15 years).

3. **Mammals:** Documentation of current status of small mammal communities should be taken up on a priority basis for each PA and ecosystem. Moreover, steps should be taken to strengthen Rhino re-introduction program in Dudhwa NP. Furthermore, while on one hand, studies on conflict and people's perceptions of canid conservation should be carried out for ● building public support for wolf and other threatened canids e.g., hyena. On the other hand poaching and illegal trade in wildlife products should be curbed through ● joint patrolling of PAs on Indo-Nepal border and ● establishing well-equipped anti-poaching squads in all PAs. Lastly culling policy on nilgai should be reviewed to solve the problem of crop depredation in GP. State forest departments, Department of Science and Technology (DST), WSI, MOEF, and the Governments of India and Nepal will be involved in implementing these actions. The financial outlay would be Rs. 3.25 crores (0-5 years), Rs. 2.5 crores (5-10 years) and Rs. 2.5 crores (10-15 years).

4. **Birds:** A review of PA management practices on endangered/endemic avifauna especially in Dudhwa and Valmiki tiger reserves should be done on a priority basis. Moreover, impact of agricultural practices and chemicals on birds of agro-ecosystems also needs to be done in the entire GP. Wherever, final notifications for bird sanctuaries have not been issued they should be issued and by laws for protecting migratory birds in non-PAs should be developed. Lastly, strict regulation of fishing net size in all important water bodies should be done. Agencies for carrying out the proposed actions are Indian Council of Agricultural Research (ICAR), MOEF, state governments and forest departments, BNHS, WSI and other local NGOs in GP. The financial outlay to carry out these actions would be 1.5 crores (0-5 years).

5. **Herpetofauna (HPF):** As there is no baseline information on most of HPF species there is an urgent need for ● monitoring and updating HPF database, ● developing HPF Atlas, ● exploratory surveys for life history data on Taxons, and ● capacity building programs. Moreover, the ongoing captive breeding programs should be reviewed periodically, along with exploration of new sites. Terrarium and vivarium should be developed for HPF breeding and education programs. Lastly, to stop over-exploitation of HPF there should be a ban on use of amphibians and reptiles in classroom practical and visual aids like computers should be used instead. State forest and education departments along with Department of Zoology, Dayalbagh University, Agra should be involved in HPF conservation in GP. The financial implications for these actions would be Rs. 2.5 crores (0-5 years).

6. **Fishes:** A total ban on fishing should be imposed to protect endangered fish species in ● Samaspur Bird sanctuary and ● Katarniaghat WLS. Moreover, to serve as model for technology transfer to other states, wild stocks for cryopreservation of germplasm, should be collected from rivers in GP. State forest departments, MOEF and NBFGR should be entrusted for carrying out these actions. The total financial outlay should be Rs. 3 crores spread over a 15-years period.

7. **Ganges:** To protect the fish resources of the Ganges from over-exploitation there should be regulation on fishing through ● ban on use of zero size mesh net and ● amendment of Fisheries Act. These actions can be complimented by reducing dependence of local fisher folk communities on fishing by ● encouraging alternative livelihoods, eg., aqua culture and ● providing technical and financial support to help them adopt alternatives. Moreover, to reduce water wastage, awareness programs should be targeted at agricultural communities along the rivers by ● promoting optimum river water for irrigation and ● adopting sprinkle/drip irrigation. Since the pollution levels in rivers of GP were found to be high, it is imperative that district level committees to be set up to monitor pollution levels. There is also a need to work out a legal framework for controlling and reducing pollution in rivers of GP, by penalizing and controlling pollution causing industries along river courses. As barrages and dams along river courses have disrupted the movement of aquatic fauna, feasibility studies for constructing migratory corridors along the Ganges should be conducted and an immediate ban on fishing below the barrages along all major water bodies should be imposed. River catchment areas should be developed by ● promoting use of bio- fertilizers and pesticides ● encouraging plantations of site specific commercially important trees and ● promoting agro-forestry practices especially along and near water bodies. Lastly, a Center of Excellence on Ganges should be set up in GP for undertaking ● regular monitoring of water quality of the Ganges and ● documentation and exploration of aquatic flora and fauna. State departments of fisheries, agriculture, irrigation, forest, pollution control boards, ministry of law, and Department of Zoology, Patna University, along with local NGOs can play a vital role in implementing these actions. The financial outlay for implementing the proposed actions for a 15-years period would be Rs. 103 crores (0-5 years), Rs. 51.5 crores (5-10 years) and Rs. 26 crores (10-15 years).

8. **Agro-biodiversity:** As there is hardly any documentation of the agro-diversity of the GP, it is imperative to undertake documentation of all crops, vegetables, fruits and livestock on a priority basis. Moreover, as GP has a large number of mango varieties special attention should be focussed not only to promote their conservation, but also to integrate them with the forces of marked demand both domestic and international. State departments of agriculture, ministry of agriculture along with agriculture universities in GP can be entrusted to carry out these actions. Finances to the tune of Rs. 4 crores (0-5 years), Rs. 2 crores each for 5-10 years and 10-15 years periods would be needed.

9. **Legal and Policy Related Issues:** To conserve the biodiversity of the GP, state and district biodiversity cells with representatives from forest, wildlife, irrigation, education, industry and the local NGOs should be set up. This should be complimented by amending Wildlife Protection Act (1972) to provide guidelines for project clearance, link management issues of PAs to needs of local people, and to bring "forest village" under a legal definition. State governments and ministry of law should be involved in these actions. These actions will have no financial implications.

10. **Capacity Building and Human Resource Development:** The first priority under this is establishment of an Envis Center on biodiversity of the GP. This action can be strengthened by establishing a UGC funded conservation monitoring Center for universities, which would provide advance training in conservation and management of biodiversity. The Center would focus on providing facilities to train university teachers and post-graduate students for conducting biodiversity conservation monitoring activities. Furthermore, specialization in Ecology, Environmental and Wildlife Sciences, and Environmental Economics should be introduced at post-gratuate level in all state universities in GP. The Department of Wildlife Sciences, AMU-Aligarh along with UGC can play a vital role in implementing the first two actions, the last action can be implemented by the state governments along with their education departments. The financial outlay to carry out these actions over a 15-years period would be Rs. 13.25 crores (0-5 years), Rs. 17.75 crores (5-10 years) and Rs. 23.25 crores (10-15 years).

    Finally it is suggested to set up a permanent inter-state committee or eco-regional authority for the GP, with representatives from all concerned governments, local people, NGOs and industry to oversee and enforce the proposed actions and monitor their outcome. The total financial outlay for the entire set of proposed actions would be Rs. 362.65 crores (0-5 years), Rs. 235.75 crores (5-10 years) and Rs. 187.25 crores (10-15 years).

North-East Ecoregion Biodiversity Strategy and Action Plan

Coordinator: R. S. Tripathi
Coordinating Agency: Department of Botany, North-Eastern Hill University, Shillong

1. Introduction to the North-East Ecoregion

This North-Eastern Ecoregional Strategy and Action Plan (NEEBSAP) is prepared as a part of the National Biodiversity Strategy and Action Plan (NBSAP) being prepared by the Ministry of Environment and Forests, Govt. of India, New Delhi with support from the Global Environment Facility (GEF). At the national level, the execution of NBSAP Process is being done by a Technical and Policy Core Group (TPCG), comprising of experts from various fields and is headed by 'Kalpavriksh', a Pune based NGO. The administrative part of the NBSAP process is being co-ordinated by the Biotech Consortium India Ltd. (BCIL), New Delhi.

The North-East Ecoregion covers eight states viz., Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim.

2. Objectives

The NEEBSAP aims to suggest certain strategies and action plans required for halting and mitigating the ongoing loss of biodiversity in the north-eastern region and promoting its conservation at regional level. While addressing the biodiversity conservation at all the three levels i.e. ecosystem, species and genetic levels, the NEEBSAP also emphasizes the conservation issues pertaining to the cultural diversity of north-east. The NEEBSAP covers wide range of natural as well as man-made terrestrial and aquatic ecosystems, wild plant and animal diversity, and domesticated biodiversity. The strategies have been formulated and actions are prioritized which are required to be taken up in the next 5 to 15 years in a phased manner in order to conserve the rich biological diversity of the region. The specific objectives of NEEBSAP are:

1. To collate and compile information on various aspects of biodiversity in north-east India.
2. To analyse the steps and initiatives taken for conservation of biodiversity in the region.
3. To assess the gaps in information and initiatives/actions.
4. To outline various strategies required for conserving the rich biological diversity of the region.
5. To present an action plan prioritizing the actions in a phased manner to achieve the broader goal of biodiversity conservation.
6. To involve various stakeholders in the biodiversity conservation planning process.

3. Range of Biodiversity

The North-East India is rich in biological diversity and contains more than one-third of the country's total biodiversity. In view of its importance from biodiversity conservation point of view, the region is one of the 18 hot-spots of the world. The region has at least 7,500 flowering plants, 700 orchids, 58 bamboos, 64 citrus, 28 conifers, 500 mosses, 700 ferns and 728 lichen species. The region is equally rich in faunal diversity. An estimated 3,624 species of insects, 50 molluscs, 236 fishes, 64 amphibians, 137 reptiles, 541 birds and 160 mammalian species have been so far described (Anonymous 1998b). The region is also rich in terms of genetic and ecosystem diversity. Some of the important gene pools of citrus, banana and rice have been reported to be originated from this region (Anonymous 1996). The ecosystem diversity of the region ranges from tropical ecosystems to alpine ecosystems in the Himalayan ranges and also includes diverse types of wetland, flood plain, riverine and aquatic ecosystems along the Brahmaputra-Barak river systems. Mountain Peaks and Glaciers in high Himalayan ranges of Arunachal Pradesh and Sikkim constitute another group of unique ecosystems. Besides, a variety of man-modified ecosystems such as jhum agro-ecosystem, wet rice agroecosystem and alder-based agroecosystem contribute towards rich ecosystem diversity. All these ecosystems are home to a large variety of indigenous wild as well as cultivated crops, plants and animals. An estimated 33% of the total biological diversity of the region is endemic.

4. Threats to Species and Ecosystem Diversity

Although the factors threatening the species and ecosystem diversity of north-east (Box 1 and 2) are more or less similar to those operating elsewhere such as habitat fragmentation, poaching and trade in wild flora and fauna, introduction of exotics etc. (Box 3), certain crucial factors causing problems in biodiversity conservation specific to north-eastern region have been described.

Box 1. Components of species diversity under threat

- Forest flora and fauna
- Agricultural crops
- Horticultural crops
- Domesticated livestock
- Biodiversity in aquatic ecosystems (e.g. Fish, aqatic flora and fauna)
- Insect diversity (e.g. butterfly)

Box 2. Ecosystems under threat

- Forest (Sacred forests, RFs, PAs, CFs)
- Aquatic (River, Lake, Bheels, Ponds, wetlands)
- River island
- Agroecosystems (Intensive cultivation)
- Alpine meadows

Box 3. Factors causing threat to Biodiversity

- Shifting cultivation
- Deforestation and habitat destruction
- Invasive species
- Introduction of exotics
- Popularisation of hybrid varieties
- Poaching
- Trade in wildlife including wildplants and insects
- Over exploitation of biodiversity beyond sustainable limit
- Change in food habit due to subsidized food grain distribution

5. Issues Relating to Biodiversity Conservation

- Land tenure issues
- Dichotomy in Forest Administration
- Gender and Equity issues in natural resources and biodiversity management
- Lack of inter-departmental coordination
- Effective management of private and community forests
- Smuggling of Timber across the international border
- Shifting cultivation
- Inter-state border dispute
- Insurgency
- Gregarious flowering of bamboo

6. Key Gaps

- Gap in knowledge
  - Information on urban biodiversity is scanty
  - Works on aquatic ecosystems of north-east are too meager
  - Species inventory in inaccessible areas of Arunachal Pradesh, Nagaland, Karbi Anglong and North Cachar hills of Assam, and parts of Mizoram and Manipur is yet to be made.
  - Poor information on Biosphere Reserves
  - Information on genetic diversity is extremely poor
  - Very little information on microbial diversity

  - Unique ecosystems such as River Islands e.g. Majuli need to be studied.
  - A large portion of insect, fish, mammalian and avian diversity remains underexplored.
  - Cultural diversity of more than 250 tribes of north-east is yet to be adequately described
  - Information on wild ornamentals and aromatic plants is scanty
- Gaps in vision
- Gaps in policies and legal structure
- Gaps in institutional and human capacity
- Gaps in biodiversity related research and development
  - Sharing mechanism of the existing information and knowledge
- Gaps in actions

7. Some Project Proposals Prioritized for Implementation Under NBSAP

Project 1. Identifying threatened and endemic taxa and economically valuable wild species for *in situ* conservation

Proposed Objectives and Actions:
- Identification of threatened, endemic and economically important taxa in each of the 8 states of north-east eco-region.
- Maping the areas of occurrence of each of these species
- Estimating the population size of each species

Project 2. Arresting the destruction of biodiversity and habitats caused due to inter-state border dispute

Proposed Objectives and Actions:
- Identification of vulnerable biodiversity rich areas falling in the disputed inter-state border areas.
- Maping these areas and declaring such areas as protected areas by the Govt. of India.
- Preparation of Management plan by the respective state governments and their implementation (status quo on ownership to be maintained for such areas)

Project 3. Control of poaching, illegal timber trade, theft of rare medicinal plants near international boundaries

Proposed Objectives and Actions:
- Identification of vulnerable points for such activities along the international borders.
- Maping these areas and working out strategies for control
- Support to strengthen the guard along the international borders to prevent such activities
- Educating the personnel of BSF and Assam Rifles posted in border areas regarding the importance of biodiversity and their role in controllong the illegal trade in biodiversity

Project 4. Eviction of encroachment by illegal immigrants/refugees causing destruction to natural habitats in Assam, Tripura, Mizoram and Arunachal Pradesh

Proposed Objectives and Actions:
- Framing and adoption of appropriate legislation for eviction of encroachments in reserved forest areas and PAs.
- Eviction of encroachment by illegal immigrants/refugees causing destruction to natural habitats in Assam, Tripura, Mizoram and Arunachal Pradesh
- Maping these areas and working out strategies for rehabilitation
- Preparation and implementation of rehabilitation plans in post-eviction period.

Project 5. *Ex situ* conservation of NTFPs, medicinal plants and important tree species

Proposed Objectives and Actions:
- Establishment of germplasm banks, botanical gardens, bambusetum, canetum, arboretum and herbal/medicinal plant gardens in different agro-climatic zones of north-east India.
- Establishment of demonstration cultivation farms for medicinal plants and NTFP species for popularizing their cultivation.
- Introducing the native tree, bamboo and cane species in the plantation programmes of the state forest departments.

Project 6. Conservation of sacred forests

Proposed Objectives and Actions:
- Preparation of a complete inventory of Sacred groves in the region - Meghalaya and Manipur
- Establishment of sacred grove regeneration models using the native species in an attempt to regenerate the degraded sacred forests of the region.
- Awareness campaign about the importance of sacred groves and effort to preserve the religious faith and beliefs wherever it is still strong
- Involving the traditional institutions in all these activities

Project 7. Conservation of village/community forests

Proposed Objectives and Actions:
- Preparation of a complete inventory of all types of community forests in all the 8 states.
- Regeneration of selected Village supply and safety forests of Mizoram
- Establishment of community forest regeneration models using the native species in an attempt to regenerate the degraded community forests of the region.
- Awareness campaign about the importance of community forests and capacity building among the village communities for effective management of community forests
- Involving the traditional institutions in all these activities

Project 8. Ecorestoration of river islands

Proposed Objectives and Actions:
- Preparation of a complete inventory of all river islands in the region needing conservation measures.
- Model ecorestoration works in Majouli river island for demonstration and replication.

Project 9. Ecorestoration of vanishing wetlands

Proposed Objectives and Actions:
- Preparation of a complete inventory of all wetlands in the region needing conservation measures.
- Model ecorestoration works for restoration of beels in north bank of Brahmaputra in upper Assam.

Project 10. Ecorestoration of mining sites

Proposed objectives and actions:
- Preparation of a complete inventory of all mined areas in the region needing rehabilitation and conservation measures.
- Model ecorestoration works for restoration of coal mined sites in Meghalaya and Assam.

Project 11. Identification of biodiversity rich areas outside the government protected areas such as sacred forests and other community conserved areas

Proposed Objectives and Actions:
- Identification of biodiversity rich areas outside the government protected areas such as sacred forests and other community conserved areas in all the 8 states of the region

Project 12. Studies on ethnomedicine, ethnobotany and ethnozoology , and documentation of traditional healers

Proposed Objectives and Actions:
- Studies on ethnomedicine, ethnobotany and ethnozoology
- Documentation of traditional healers
- Identification of areas from where these useful plants and animals are collected
- Conservation measures for these biodiversity rich areas

Project 13. Identification of critical and fragile areas

Proposed Objectives and Actions:
- Identification of critical and fragile areas

Project 14. Identification of ecosystem types, their mapping and status
- Identification of ecosystem types, their mapping and status

Project 15. Inventory and documentation of biodiversity in many unexplored/underexplored areas
- Inventory and documentation of biodiversity in many unexplored/underexplored areas of Arunachal Pradesh, Assam, Manipur, Mizoram, Nagaland, Meghalaya, Sikkim and Tripura

Project 16. Regulation for achieving sustainable use of biodiversity

Project 17. Value addition and promoting alternate sustainable livelihood options such as floriculture, pisciculture, apiculture, sericulture, mushroom cultivation, cultivation of medicinal plants, spices and aromatic plants

Project 18. Aanalysing existing laws and policies from biodiversity point of view and identifying points of amendments

Project 19. Revising the EIA guidelines for north-east and prescribing stringent EIA procedure for assessing the impact of developmental projects on biodiversity and more compensatory activities to mitigate the loss of biodiversity

Project 20. Capacity building of traditional institutions for conservation and equitable use of biodiversity

Project 21. Compilation and publication/registration of IKS for the purpose of IPR

Project 22. Creating database on biodiversity and related issues at regional level

Project 23. Training programmes on uses and value addition for communities

Project 24. Capacity building in taxonomy

Project 25. Awareness camps on importance, uses and conservation of biodiversity

Shiwalik Ecoregion Biodiversity Strategy and Action Plan

Coordinator: H.S. Mehta
Coordinating Agency: Zoological Survey of India, Solan

1. The Shiwalik hills are the chain of mountains running to parallel the Himalayas with approximately 800 kms in length and 8-40 kms in width which are extending from Uttar Pradesh to Jammu and Kashmir stretching across the sates of Uttaranchal Pradesh, Haryana, Himachal Pradesh, Union Territory of Chandigarh and the state of Punjab. There is a net work of drainages and major rivers like the Jhelum, the Tawi, the Beas, the Sutlej, the Yamuna, the Ganga, in additions to the tributaries of these rivers. This region is the life line and gate way for the enhanced biodiversity and prosperity of north-west for the states like Jammu and Kashmir, Punjab, Rajasthan, Haryana, Uttaranchal, Uttar Pradesh and Delhi in addition to union Territory of Chandigarh.

2. The era of Shiwalik system of rocks is called the age of Mammals which has lead the geo-scientists to probe into the mysteries of evolution. These hills are ecologically fragile and centre of endemism. There were once dense forests nearly two hundred years back with rich wildlife. More than 1000 species of plants inlcuding 350 economically important and 135 species of medicinal and aromatic plants are known. Nearly 2000 species of animlas with approximately 30% of vertebrates and 70% of invertebrates are known.

3. The various rivers passing through these hills have been rendering services of carrying nutrients from the forests of the main Himalaya and Shiwalik hills and increasing the land fertility and neighbouring states.

4. The excessive and liberal use of chemical fertilizers and pesticides for accelerating the growth in the farms, orchards and cultivation fields has led towards toxic pollution in the streams causing a severe damage to aquatic flora and fauna. The consumption of chemically strained varieties of food are health hazards.

5. There are several man made concrete and earthen dams constructed on the above said rivers and other minor hill streams developed for the generation of electricity and irrigation purposes which are responsible for bringing out green revolutions, industrialization and providing employment particularly in the northern sector.

6. Various developmental activities like mining i.e. extraction of sand, removal of boulders from river beds, extraction of timber, lack of coordination amongst various government, private sectors, research organizations and stake holders by way of inadequate Environmental awareness, education and training has led towards the loss of economically rich gene pool.

7. The displaced villagers and poor village folk from where the prosperity has reached to various adjoining states by way of construction of dams and generation of electricity remained under the shadow of poverty till today.

8. In view of the above lacunae and gaps, the strategies and actions were discussed through interactions of various state government agencies like Department of agriculture, Department of Forests, Department of horticulture, Universities and Central government organizations, NGO,s and stake holders including women folk concerned with the developmental activities falling in the Shiwalik region.

9. There is an urgent need for setting up Environmental education, awareness and training centre to cater the needs of northern states for conserving and preserving natural gene pool.

10. The distribution of Power and irrigation must be managed through a committee comprising of representatives of the benefiting states including stakeholders.

11. A cess may be levied to the benefiting states and the amount should be made available for the development of the effected and displaced villages.

12. A strong data base for the biodiversity is required to be developed for the area and the biodiversity register may be made available at the village level and the royalty must be fixed for the harvesting of bio-resources.

13. For the utilization of water resources and generation of electricity, only 60% of the water should be allowed and 40% must be ensured for the down flow(as practiced by the Britishers) with the construction of ladders for the breeding and migration of fishes from down stream to upstream and vice-versa to ensure development of fisheries and fisherman's livelihoods.

14. The canning industries, pickle industries, weaving, poultry farming, milk dairy, pigeries, animals husbandry, fisheries, food processing units, cultivation of medicinal plants, handicrafts i.e. basket making and plantation of soil binding species of of bamboo should be encouraged for the village folks especially women. The rules and regulations concerning the approval of pickle industries for the consumption of local fruits must be liberalized. The approval of locally available fruit processing units should be available at least in the state.

15. To avoid the man and wildlife conservation conflicts, a proper and effective management of wildlife is required.

16. The coordination between various government and research organization and stakeholders is required to consider the research priorities.

17. Monoculture should be discouraged and cropping of new economically important species of medicinal and aromatic plants may be encouraged.

18. Establishment of biological Parks for conserving the gene pool.

19. Formulation of policies for checking the over-exploitation of medicinal plants.

20. Establishment of special courts for speedy disposal of hunting and poaching cases.

21. Provision of special funds for taxonomic studies.

22. Encouragement in the form of subsidies for the use of bio-fertilizers, sowing of traditional crops, domestication of old poultry races and old gene pool of bullocks.

West Coast Ecoregion Biodiversity Strategy and Action Plan

Coordinator: M.N. Madhyastha
Coordinating Agency: Department of Biosciences, Mangalore Universtiy, Mangalore

Introduction

The West coast has a coastal length of 3446 km, characterized by a varied type of ecosystems/habitats with rocky, sandy and muddy zones, mostly open coast except 2 gulfs and small islands scattered along the coast. Further, a large number of wetlands, backwaters, estuaries and creeks, mangrove vegetations, mud banks, wedge banks, salt pans, salt marshes, lagoon, sea grass beds, corals, small or inaccessible islands and beaches supporting a plethora of flora and faunal attributes including turtles and aquatic birds. The West coast is spread along 5 states, Kerala (including Lakshadweep), Karnataka, Goa, Maharashtra and Gujarat.

Rich fishery potentials of the coast have resulted in many major and minor fishing harbours and mushrooming of the fishing vessels. Further, the coast supports diversified ecosystem types, culture and profession with different activities including fishing, industry, agriculture, tourism etc. Vicinity of the sea has given rise to a few major ports, and a 'Seabird' naval dockyard. Life activities of the common inhabitants are centered around estuaries and the marine fishery with 90% population depending on this for their livelihood. The coastal zone harbours greatest concentration and diversity of marine life and also has the most serious threats from the land-based activities.

The Marine National Park along Gulf of Kachchh and Dwaraka area, mangrove patches along Mumbai, Coral reef patches along Gujarat coast, Malvan, Islands off Karwar, basalt rock pillars of St Mary's Islands, mud banks and backwaters of Kerala coast and coral reef biota around Lakshadweep Islands are important areas attracting immediate attention on West coast. Six sites have been identified as critical habitats, whereas, others are to be protected from further deterioration.

Biodiversity Related Issues Along West Coast

The developmental activities along the coast and other regions pose severe threat to the existing living resources. Fishery resource harvesting is the major livelihood of the communities resulting in stress on resource and livelihood of fish folks. The impacts of technological advancement and exponential growth in industrialisation, modernisation in culture, population expansion etc. are reflected in the changes in lifestyles and in resource use patterns, resulting in erosion of the biological diversity. Hence the available natural living resources, traditional ecological knowledge and the indigenous practices should be conserved before it is too late. Furthermore, the multi scale impacts from industries and changes in policies etc., will sometimes question the ownership of the national natural resources.

Many of the coastal areas (Kochi, Mangalore, Goa, Mumbai, many sites along Gujarat) are of locations of major industrial operations and a few major ports, and fishing harbours. The anthropogenic activities exert enormous pressure on the coastal system as the activities are far beyond the carrying capacity of the area. As a consequence, the public amenities are being lost, some local fish population are at risk; the biological diversity is threatened or mostly seriously challenged and livelihood of many traditional fish flocks are in danger.

Among the major activities, which influence biodiversity and ecosystem health, the most important being the overfishing all along the length of the coast exploiting (over-harvest) nearshore and offshore marine resources. Unplanned industrialization along the coast has devastated many of the pristine coastal habitats by construction, pollution and human settlements. Coastal tourism, though essential to generate the economic stability of the country is a threat to biodiversity if not properly streamlined for sustainable development and monitored. Most threatened is the coastal stretch of Goa and some stretches along rest of the coastal states, including Kerala and Karnataka. Intensive aquaculture is an activity exerting adverse effects since two decades. Wetland reclamation due to population and industrial pressure has led to habitat destruction. Mining activities, dredging operations and sea wall construction all along the coast have resulted in the destruction of the niche of many of the coastal living resources. Many of the ecologically sensitive zones along the coast have been lost before knowing their ecosystem services due to the unproductive developmental activities leaving behind a very few coastal hotspots of biodiversity.

Coastal biodiversity has been threatened due to the indiscriminate exploitation of the resources and unregulated chemical,

physical and biological activities leading to irreparable alterations.

Ongoing Initiatives

The government agencies are responsible for conservational works through policies and legal frame works. Among them Ministry of Environment and Forests (MoEF), Ministry of surface transport and harbour, Department of Tourism, Ministry of Mining and Geology, Department of Ocean Development (DOD) etc., are responsible for the coastal resource management. The declaration of coastal stretches as Coastal Regulation Zone (CRZ), 1991 by MoEF under the environmental Protection act is the most important decision for the coastal management.

DOD has a major role in the survey and assessment of marine living resources. It is also responsible for protection and conservation of marine environments. Under the ICMAM project, a GIS based information system for critical habitats gathering the database, which is very significant for biodiversity.

Fishery Survey of India under the Ministry of Agriculture is responsible for survey and assessment of marine fishing resources in the EEZ along the Indian coast. During exploratory survey, one of the objectives was to identify the biodiversity. They are building up species inventory of marine fishery resources under different sponsored programs such as Marine Living Resource Programs (sponsored by Department of Ocean Development). They are also undertaking inventory of deep-sea crustaceans, Molluscs and Fin fishes, the biology of perch in Quilon bank and Wedge bank are also being undertaken. Bio-resource Inventory Program includes plans for implementation of marine bio-resources inventories, which are currently being finalized.

The Government of Kerala, Department of Fisheries has an autonomous society, called "Fishing Resource Management Society". This society plays a significant role in formulating and implementing Biodiversity conservation. The initiations can be strengthened and new interventions could be added, for the implementation of the program. (Sponsored by ICAR).

Other agencies include; Department of Ecology, Environment and Forests and Department of Biotechnology which sponsors a number of projects through various agencies including mangrove afforestation, degraded mangrove regeneration, and Green wall formation etc. The Central Marine Fisheries Research Institute is a central agency under ICAR, which has several branches at different regions. Many fisheries oriented in-house, sponsored, and centrally sponsored research projects are being undertaken all along the West coast. Similarly Central Salt and Marine Research Institute of Bhavnagar is undertaking various research tasks dealing with inventorying of seaweeds, marine algae and microbes.

A lot of research on various aspects of coastal ecosystem and resources has been studied/researched in research institutes, universities, and colleges. To name a few are NIO, NIOT, CMFRI, NEERI, CIFE, CES, various Universities, CMSRI etc., are having in house, sponsored and centrally funded projects, wherein, biodiversity related components are directly or indirectly involved.

Many concerned NGOs and individual groups have been working with coastal related problems (coastal ecosystem health and ecological diversity) making contributions in various aspects including conservations and inventorying of the biological diversity.

Key Gaps

The resource base of the coastal and offshore region is partially and pachthilly understood. The breeding ground of some of the fin and shell fishes are still not known. The available secondary information on these aspects need to be pooled and the gap be filled-in by generating field based information.

Many of the governmental initiatives of biodiversity/ecosystem conservation are failing due to inadequate logistics for the strict implementation of the existing rules. Political interferences, bureaucratic bottlenecks lobbying on the natural resources extraction have been, many a times overruling the positive initiatives.

Patchy and fragmented information, lack of expertise on taxonomy of several important groups, short sighted approach by the industry, policy makers, lack of awareness of importance and significance of biodiversity and absence of follow-up action and status reports on the ventures undertaken are some of the major drawbacks in managing the biodiversity.

Lack of concevement and appreciation of fieldwork vs laboratory research resulting in poor integration of the findings to practical utility in field.

Inadequate human and institutional capacity is also another major constraint in giving a holistic approach to the whole issues. Lack of coordination in the inter-ministerial departments in dealing with common properties is another key gap.

Major Strategies and Action Plan

In preventive approach, need based action, remedial and restorative technology, biotechnological approach for cleaner production, alternate and appropriate technology, community and stakeholders involvement in the policy development and implementing stage are some of the steps to be adopted at different levels of execution of the conservation strategies.

The Strategies and action plans are grouped into 7 major categories as follows. In addition to Creation of Coastal Zone Authority (CZA)

1. Arresting further loss of habitat and biodiversity
2. Biodiversity inventorying - Data Banks on Coastal resources
3. Awareness, Education and Training
4. Alternate Livelihood
5. Integration of the activities of line agencies on marine biodiversity
6. Equity and empowerment for women to involve in conservation exercises
7. Identification of indicators of changes of biological diversity

Most Important Actions Under the Above 7 Categories are Briefed Here.

- Creation of CZA with due representation from the line agencies, coastal states, academicians and NGO representatives to safeguard the coastal biodiversity interest in a holistic nature is being proposed.

- Though larger protected areas have been identified there is a need to extend this tag to smaller habitats harbouring endemic or rare species. Suitable ecologically sensitive areas need to be identified urgently and steps to be taken to give them protection. Creation of buffer zone around protected areas to conserve the sensitive species inhabiting this PA from contaminated water is to be given priority.

- Strengthening institutional capacity and networking the institutes towards identifying and implementation of biodiversity related issues.

- Compilation of the existing resource base and data and examining the gaps in the resource base, their distribution and life cycle pattern to chalk out the primary information generation on the gap in our knowledge so as to advice on harvesting the resources.

- Towards monitoring and management of biodiversity at multiple levels, actions need to be taken to; networking of large number of coastal marine habitats, capacity building, development of databases for various components, decentralization of responsibilities and initiatives into local groups.

- During fish resource harvesting over exploitation and by-catch are the major constraints; it is proposed to revise the existing fishing regulation and innovative implementation of the rules for minimization of the over-exploitation and wasteful by-catch.

- A need for stock assessment of the living resources from the west coast being felt for which suitable agencies should take responsibility.

- Coastal zoning for specific activities could be implemented for minimization of the conflicts and better management of biodiversity.

- A proper EIA for the new industrial instantiation and surveillance and monitoring of the existing industrial discharges by appropriate agencies is recommended.

- Impact of shore, inshore and offshore mining activities on the biodiversity and possible intervention for conservation

- Ever expanding port and harbour activities with chemical and biological invasions threatening the biodiversity - a need for regulation through proper remedial measures

- Sensitizing the stakeholders on biodiversity related issues creating awareness, educating public and imparting training towards steps/actions for conservation and protection of biodiversity for different strata of community

- Integration of activities of line agencies such as MoEF, DoEn, DBT, DST, Department of Space research, tourism etc., to be initiated.

- In marine fishery sector, women play a major role in handling and marketing the fishery products and the livelihood of the family is mainly controlled by their income. Hence, suitable steps to identify the role of women in biodiversity conservation and management of livelihood activities are felt.

- All efforts towards the conservation and management of biodiversity need to be identified through various indicators. There is a dire need to explore and identify suitable indicators of changes of biological diversity. A separate group/institution need to look into this program and come out with suitable suggestions.

Western Ghats Ecoregion Biodiversity Strategy and Action Plan

Coordinator: R.J. Ranjit Daniels
Coordinating Agency: Chennai Snake Park, Chennai

1.1 Introduction

In 1999, the Ministry of Environment and Forests, Government of India, prepared a National Policy and Macrolevel Action Strategy for Biodiversity through a consultative process. The document was a macro-level statement of policies, gaps and strategies needed for conservation and sustainable use of biological diversity. It was however felt necessary to prepare detailed action plans at sub-state, state, regional and national levels based on this framework document. Towards this end, the Ministry has accessed funding from the Global Environment Facility (GEF) for preparing the National Biodiversity Strategy and Action Plan (NBSAP).

The NBSAP project envisages the assessment and stock taking of biodiversity-related information at various levels, including distribution of endemic and endangered species and site-specific threats and pressures. Key features of this project include emphasis on gender sensitive decentralised planning, and the use of interdisciplinary working groups to involve all sectors concerned with biodiversity conservation. Detailed action plans (at sub-state, state, and regional levels) so prepared will be consolidated to develop the national level action plan.

Government agencies, non-governmental groups and village communities are already contributing towards conservation of biodiversity. However, there is still a need to consolidate and coordinate these efforts, to launch new initiatives to plug the gaps in information and action, to put developmental processes and planning on a more ecologically sound footing, and to promote people's management of their surrounding natural resources.
Such a process of consolidation and new initiatives through a series of plans and strategies at local, state and national levels, cannot be successful without public participation. It is proposed to prepare the NBSAP through a process of widespread consultation and participation across India (Source: National Biodiversity Strategy and Action Plan: A Call for Participation).

1.2 Brief Background

The Western Ghats ecoregion is comprised of a hill chain running north-south between the river Tapti and Kanyakumari. The 160,000sq km thus defined form a part of 6 south Indian states viz., Gujarat, Maharashtra, Goa, Karnataka, Tamilnadu and Kerala. The ecoregion experiences an average annual rainfall of 2500 mm. Subject to the geographical orientation and topography, rainfall is locally much higher crossing 10,000 mm a year.

Topographically, the highest and most rugged parts of the Western Ghats are in the south - roughly south of 13 degrees north latitude. Hills here rise more than 1800 m ASL; the peaks reaching over 2600 m in the Nilgiris and Anaimalais. Unlike the Himalayas, the underlying rocks in the southern Western Ghats (Goa and southwards) are archaean dating back to 2 billion years.

Table 1.1 Distribution of Endemic Vertebrates in the Western Ghats

Class/States	Gujarat	Maharashtra	Goa	Karnataka	Tamil Nadu	Kerala	Total
Mammals	0	1	1	8	10	12	14
Birds	2	9	13	17	19	18	19
Reptiles	4	13	17	36	71	69	97
Amphibians	3	19	9	50	44	65	94
Fishes	2	30	7	50	43	72	116
Total	11	72	47	161	187	236	340
Per cent	3.0	21.0	14.0	47.0	55.0	70.0	

Source: Nair and Daniel 1986; Swengel 1991; Daniels 1992, 1993, 1997 a&c; Dutta 1997; Das 1997; Easa 1998; Menon 1999; Nameer 1998; Kunte et. al., 1999; Rema Devi, personal communication 2002; Gaonkar 1996; Johnsingh 2001.

The Western Ghats are amongst the 25 biodiversity hot spots globally identified. The ecoregion is known for its high levels of biodiversity and endemism. For instance, excluding the migratory birds, there are 938 species of vertebrates in the Western Ghats, 36% being endemic (Table 1.1). Eleven per cent of the more than 330 species of butterflies in the Western Ghats are endemic. Similarly, nearly 40% of the 4000 species of flowering plants are endemic. The diversity in many other groups of animals and lower plants remain to be fully understood.

Around 200 species of flowering plants found in the Western Ghats find a place in the *Red Data Books* prepared in the nineties by the Botanical Survey of India. Many of these plants are endemic to the Western Ghats. Endangered mammals in the Western Ghats include the Tiger, Elephant, Nilgiri tahr, Liontailed macaque, Nilgir langur, Slender loris, Brown palm civet, Malabar civet, Nilgiri marten, Grizzled giant squirrel, Spiny dormouse and others. Of the 78 species of Indian birds identified as 'globally threatened' by the Salim Ali Centre for Ornithology and Natural History, the Nilgiri Wood Pigeon, Lesser Adjutant Stork and Nilgiri Laughing Thrush are known from the Western Ghats. The pigeon and the laughing thrush are endemic.

Very little is understood of species extinctions in the Western Ghats. It is presumed that a large number of species of endemic trees are already locally extinct in the Western Ghats. Local extinctions are widespread making the ranges of many species of endemic plants and animals disjunct in the Western Ghats. Amongst higher animals, the Redfaced Malkoha once known from the Western Ghats of Kerala and Tamilnadu is probably extinct. The malkoha is presently known only from Sri Lanka.

The magnitude of biodiversity, endemism and local extinctions in the Western Ghats render it a hot spot of biodiversity. Added to this are the several indigenous forest dwelling human communities who have traditionally evolved with the tropical forests and mountain ecosystems in the Western Ghats. As an effort to conserve this ecologically important and fascinating hill ecosystem, an ecoregional Biodiversity Strategy and Action Plan is a must.

1.3 Scope

The term 'biodiversity' is being taken in its holistic sense, to encompass the following levels, including related ecological and evolutionary processes:

Natural Ecosystems: eg. forests, mountains, grasslands, wetlands, etc.

Wild Species and Varieties: species of plants, animals and microorganisms existing in their natural state and the genetic variation within each of these species.

Agricultural Ecosystems: eg. farmlands, pastures, capture fisheries, aquaculture.

Domesticated Species and Varieties: species of crops, livestock (including poultry), captive-bred fish, pets, and micro-organisms in *ex situ* collections and the genetic variation within each of these species (source: National Biodiversity Strategy and Action Plan: A Call for Participation).

1.4 Objectives

- Conservation of biodiversity of all kinds listed above
- Sustainable use of biological resources, implying their use in such a manner as will not imperil their long-term existence, or will not in other ways threaten biodiversity
- Social, economic, ethical, cultural, scientific and economic dimensions, including gender relations and equity.

(*Source:* National Biodiversity Strategy and Action Plan: A Call for Participation)

1.5 Contents

The Strategy and Action Plan consists of

- A detailed profile of the Western Ghats ecoregion including origin, history, physiography, biodiversity and human ecology
- A discussion of the various factors responsible for loss of biodiversity and continued pressure on biodiversity
- An outline of the various recommendations made for the conservation and sustainable use of biodiversity/biological resources both published and unpublished
- A specific action plan for the ecoregion
- An outline of the process involved in the development of the action plan and
- Appendices including lists of species, etc.

1.6 Brief Discussion of Methodology Adopted

The methodology adopted is as follows:

- Review of literature
- Interviews and discussions with individual scientists and others with knowledge of the Western Ghats

- Sourcing data and information through the internet
- Preparation of background paper and circulating the same for inputs and comments
- Brainstorming meetings with scientists, activists, students of law, forest department officials, other government and non-government agencies, industrialists and representatives of tribal organisations
- Posting the minutes of the meetings on the world wide web (http://ces.iisc.ernet.in/hpg/cesmg/nbsap1.html, http://ces.iisc.ernet.in/hpg/cesmg/nbsap2.html, http://ces.iisc.ernet.in/hpg/cesmg/nbsap3.html) and soliciting comments
- Circulating questionnaires
- Peer review of the draft strategy and action plan
- Adoption of comments/suggestions that emerged during the peer review and
- Finalising the action plan.

Western Himalaya Ecoregion Biodiversity Strategy and Action Plan

Coordinator: S.P. Singh
Coordinating Agency: Department of Botany, Kumaon University, Nainital

The Region

The Western Himalayan Ecoregion (WHE) encompasses a wider ecological breadth than the entire Indian sub-continent because of the combined effect of the ranges it covers in altitude, latitude and moisture regime. The Eastern Himalayan region compares well with the WHE in altitude (many peaks exceeding 6000m), but has a narrower range in latitude (27-29° N lat. and 88-97° E long. compared to 29-36° N lat. and 74-81° E long. in WHE) and moisture. The climate of WHE extends deeper into colder and drier parts of the gradients than that of the eastern Himalaya. Then, WHE nurses a much greater region of the plains through the services of its ecosystems than any other region, largely because of its river connections. It represents an extraordinary combination of tropical and temperate forests with the unique characters evolved within the boundaries of youthful and ever-rising mountains. WHE is one of the centres of evergreen oaks with unique ecosystem properties, hence of global significance. An evergreenness that combines characters of deciduous species is shared also by pine, maple, a fact with which the world in general is unfamiliar. Our pine stands are partially naked during a few weeks of summer, while throughout the world pines are known for leaves with several years (up to 12 yrs) of lifespan. In the west, maple is a symbol of deciduousness, but our maples also include evergreen species.

The Main Features of Biodiversity in Terms of Numbers are as Following:

- The WHE region supports over 4500 species of angiosperms, over 20 species of Gymnosperms, 350 species of Pteridophytes, 985 species of Bryophytes, 550 species of Lichens and a large number of algae and fungi (exact number not known).
- WHE is richer in endemic legumes than the eastern Himalaya with as many as 35 taxa being endemic to this ecoregion. In addition, this ecoregion is also rich in endemic ferns, containing 19 species as against 14 in Eastern Himalaya.
- North WHE of India supports 238 species of orchids belonging to 72 genera and 5 subfamilies.
- Most of the Western Himalayan forests have ectomycorrhizal associations. These have over 100 fruiting fungi of which more than 50% are ectomycorrhizal. Trees of an oak species alone may support nearly 300 other species on their body that include ectomycorrhizae and other fruiting fungi, angiosperm epiphytes, lichens, mosses, gall forming wasps and parasites, acorn eating birds, mammals and insects, and others.
- Of the 17 medicinal plants recorded in the Red Data Book of Indian Plants, 15 species are known from the Western Himalayan area.
- In the WHE as many as 39 crop species are known to be under cultivation (of a total 166 plant species cultivated in the country). These are further divisible into over 150 varieties.
- Of the total species (675) of wild edibles from Indian Himalaya, 440 species are known from the WHE belonging to 268 genera and 124 families.
- About 300 fodder (279 to be exact) species from Western Himalaya belonging to 185 genera are commonly used. Of these, 112 species are trees, 67 species shrubs, 37 species are climbers/lianas and 63 species are forbs and grasses.
- The mammalian fauna of WHE also exhibit a combination of elements from the Palaearctic, Mediterranean and Oriental regions. Owing to diverse habitats and eco-climatic conditions a large number of mammals (nearly 33 % of Indian species) are recorded in this region.
- This region is known to have as many as 1063 species of birds (nearly 80 % of the total species reported from India), including ca. 300 species of winter visitors from the Palaearctic region. It is interesting to note that WHE as well as Eastern Himalaya have almost equal number of bird species (640 and 675 species in the Western and Eastern Himalaya, respectively).
- The region falls under the Endemic Bird Zone (D02) according to the Bird Life International.
- The reptiles and amphibians are relatively less studied groups of organisms in the WHE. Owing to their Stenothermic (cold blooded) nature, they are largely confined to sub-tropical and warm temperate regions i.e. below 2000 m. It is estimated that there are about 90 species of reptiles belonging to ca. 50 genera and 16 families in the region.
- Hussain (1995) has catalogued a total of 124 species of fishes belonging to 66 genera, 27 families and 8 orders from Uttaranchal and Himanchal Pradesh. Forty four species of fish have been described from Jammu and Kashmir. A complete inventory of fish fauna for the entire WHE is not available.
- According to an estimate there are about 85,000 species of invertebrates in India. WHE, by most conservative estimate, may support up to 20 - 25,000 species. According to an estimate this region may support as many as 25 species of land mollusks (of the 37 reported from the country).

- Estimated number of species in various insect groups within WHE, as per the records of Zoological Survey of India (1995) include 415 species of butterflies (of 1450 species in India), 162 species of Odonata (dragonflies), ca. 35 species of Plecoptera (Stone flies), 49 species of Isoptera (Termites), 43 species of Dermaptera, ca. 50 species of Hemiptera (bugs), 30 species Carabidae, and over 200 species of Hymenoptera (superfamilies Vespoidea, Apoidea, Chalcidoidea and Proctotrupoidea. One of the larger insect groups (Hymenoptera: Ichneumonidae) is known to have about 300 species in the WHE (Zonathan, 1995).

The Gaps

An assessment of why despite the initiatives of the government in terms of legislation and schemes, the goal of biodiversity conservation is still to be achieved is summarised:

a. **Gaps in Information (Research and its Dissemination):** An acute lack of information about the biological resources of the State is probably a major hindrance in formulation of strategies and plans. In addition to outdated inventories, there is a total lack of knowledge on the ecosystems and ecosystem function to equip planners and policy makers adequately.
b. **Awareness:** The policy makers and planners are not adequately informed about various aspects of biodiversity conservation. Due to lack of such awareness among the masses, citizens' movements for environment and biodiversity conservation are not being initiated. Even officials of the forest departments are not aware of the key concerns of conservation, e.g. regeneration is still not considered in forestry plans.
c. **Participation and Village Level Institutions:** Unlike the other parts of western Himalaya (i.e. Uttaranchal), Jammu and Kashmir have a total lack of village level institutions from where conservation work can be initiated at a grassroots level. The recently held Panchayat elections may be used to form such local groups which can decide about management of forest areas close to habitations. The initiative in the form of Joint Forest Management that has been introduced is neither participatory enough and nor self-sustaining for a successful future. In general women are responsible for fuelwood and fodder collection from the forests but their participation in forest management is negligible.
d. **Vision:** A long term vision for the conservation of biological diversity is lacking. Such a lack of vision is the reason for lack of properly trained manpower or lacking of training facilities, under-utilization of whatever trained personnel are there. Unless there is a vision, any strategies formulated to conserve biological diversity will never form a main component of the state policy.
e. **Monitoring System:** A major lacuna in the past has been the absence of a monitoring system to assess the success or failure of projects against prescribed objectives. Such assessments help in suggesting any new initiatives or changes required for effective conservation and also meeting peoples' aspirations.
f. **Gaps in Policy and Legal Structure:** It appears that the necessary policy and legal framework exists for biodiversity conservation in the state. The Forest Conservation Act (amended, 1997) provides sufficient legal protection to the forests. However, there are major lacunae such as the ban on tree cutting does not include seedling, saplings and even young trees or health of ecosystems such as water bodies are not given due importance. Also, the area under protected areas network is inadequate, e.g. the Kashmir valley has only about 3.8% of its area protected whereas the Jammu region has 4.22% area under protection.
g. **Gaps in Institutional and Human Capacity:** Institutions remain sectoral, and requires an integrated approach which has never become a part of forest management training. There are numerous Institutes in Uttaranchal but their contributions to the region have been negligible. Higher education too has not played any significant role. Agricultural universities have remained mostly 'plains-centred' in UA though in Himachal Pradesh have contributed to the economic development. Agricultural universities have focussed only on agronomic production based on fertilisers and pesticides with no concern for biodiversity. Government agencies neither have any understanding nor done any exercise to relate developmental activities with environmental sustainability. For example, neither is ecotourism being promoted by sensitising the tourists in the area concerned nor is the area being prepared for ecotourism. The governmental institutions are in place to conserve biodiversity and provide research inputs. However, grass root organisations are lacking in the state and thus the mass awareness movement about the movement utility of biodiversity is missing. After a gap of nearly 22 years the Panchayat elections were held in the state of Jammu and Kashmir with a heavy turnout. These are village organisations and have the potential to initiate biodiversity conservation and steps should be initiated to involve these.

Some Important Issues and Recommended Action Plans

The vast stretches of alpine meadows and snow that occur beyond the altitudes of forests represent an additional ecological dimension of the region. These are the areas where many species may migrate as global warming occurs.

The young and rising Himalayan ranges are highly vulnerable to landslide and erosion. Overexploitation of natural forests for commercial purpose in the past, and ongoing exploitation of medicinal plants and poaching, chronic disturbance of forests for day-to-day living of the people suffering from poverty, invasion of exotic species and inappropriate planning processes have severely stressed both the diversity and ecosystem functioning in the Western Himalaya. Though there is a ban on tree cutting biomass removal continues at unsustainable rates.

Important issues and related strategies and action plans concerning the ecoregion are as following:

Value Ecosystem Services and Biodiversity of WHE and Incorporate them into "National Accounting"

Recognise the biodiversity and ecosystem services of WHE and incorporate them into the national accounting to enable the people of the region to conserve natural forests and other ecosystems. India must have a certain area under protective (forest) system to sustain its productive systems (agriculture) and the ongoing economy based on the consumptive traits of several million people. This needs to be seen in view of the economic policy which seeks solving the problem of unemployment and economic growth by promoting consumptive traits. It is ironical that the more the consumptive trait we aim at achieving the more is the need of having a larger and healthy protective system with the capacity to dampen the effect of gaseous wastes and to control soil erosion and destabilising hydrological and other forces. Therefore, a certain proportion of protective ecosystems should be kept away from the consumption-based economy. Apart from the various ecosystem services associated with natural forests, WHE plays a special role of nursing the adjacent plains through the river connections. It is because of the "natural subsidy" from WHE, the Great Gangetic plains have been able to sustain agriculture and other human activities for several millennia. The three WHE states need to join hands not only to strengthen their claim for payment for providing ecosystem services, but also to restore the health of the ecosystems and the biodiversity therein.

Incorporating ecosystem services into national accounting may mean, as an example - providing cooking gas at an affordable price to the people living in the WHE or national support to generate enough hydroelectricity in the hills to meet the people's need of cooking food and of keeping rooms warm, at least until forests revive their self-regenerating capacity. WHE States have a high potential for electricity generation, and that could be realised with the support of the Central Government. The latter should invest in electricity generation in return of the ecosystem services the remaining areas of the country are getting from the forests of WHE.

Integrate Ecology, Economics and Equity Issues

The organic food production by hill farmers (free of toxic chemicals) can be treated as a kind of ecosystem service, but it is being maintained at the cost of natural forests and women's health. Address the sustainability of all resource at a particular location at once. This ecologically sound way of food production can be justified only when necessary steps are taken to provide alternative sources of organic matter (e.g. strengthening community and individual farm forestry) so that it does not lead to deforestation and drudgery-reducing tools for women (e.g. thrashers, dehuskers, etc.). Integrating ecology, economics and social equity is important to achieve sustainability. Several more steps may be required to make women's participation effective, and to enable them to express effectively.

It is notable that the "save seeds movement" ("*beej bachao andolan*") was born in the villages of WHE without any input from the scientific or administrative world. By cultivating diverse crop varieties these farmers are allowing evolution to continue. This should be treated as a major biodiversity and sustainability initiative by the hill farmers, and payment should be made to them for this kind of ecological service to the world.

Problems of fresh water lake degradation, particularly in Kashmir and Nainital, have connection to the lack of understanding of ecosystem services and connection between lake and its watershed. The lakes could be restored and managed by valuing services provided by the ecosystem processes.

Develop and Expand Participatory Management in the Region Around the Van Panchayat Model of Uttaranchal

Let the Uttaranchal's time-tested Van Panchayat (VP) be the sole institution for community forest management, and the basis for participatory management of forests and biodiversity also in other States after making necessary modification to suit the area-specific requirements of the people. **The VP model should not be unnecessarily disturbed by JFM or other such institutions imposed without the prior acceptance of the people.** JFM cannot be a substitute of VP, but it may damage it severely. If required, the positive points of JFM could be incorporated in the functioning of VPs. VPs doing well should be given incentives. The VPs could work in many villages almost without any outside financial support, while JFM is a project based exercise, with no arrangement for its sustenance after the expiry of the grant.

The Need for an Effective Participation

Participatory approach is generally taken as an "add on" to an activity; therefore it fails to yield results. In a way, participatory approach amounts to a healthy and expanded form of democracy. It is far greater an exercise than is being held out. It warrants creating conditions conducive to the participation of the people. For example, the hill women need to be provided labour and time saving tools that give relief to them from the day-to-day drudgery and enable them to play their participatory role. It calls for sensitisation of the bureaucracy, scientists and others so that they can effectively collaborate with the people who are weaker and

often work in a helpless condition. This also calls for seeking opinion of experts by "powerful" bureaucrats in an honest way, not merely for the sake of listing their names in support of decisions already taken. **Building an environment for participation is necessary in all walks of life**. Clear-cut tenure systems and certainty of rights are required to encourage people to participate in conservational activities. New technologies and forest approaches would be required to achieve effective participation.

Challenges of Changing Goals of Forestry

The modern forestry has to be ecological with the goal of conserving biodiversity and ecosystem integrity. The "sustainable yield of goods" is no more the overriding factor. To deal with this situation, the forestry services need to be drastically modified to include experts who can address the issues of conserving biodiversity and ecosystem integrity in the world changing at an unprecedented rate. The forestry service at present consists only of pure administrators with training that is no more useful for managing forests as home to biodiversity and provider of precious ecosystem services, kept away from the market.

Give Importance to Natural Regeneration of Forest Trees

The over-emphasis on plantations, protection of individual trees (e.g. ban on tree cutting over 1000 m altitude), and promotion of a few fast growing individuals (plus trees) have trivialised the importance of natural tree regeneration, that makes the basis for the perpetuation of forests, forest dynamics and evolution.

Make necessary changes in Forest Acts to safeguard the process of regeneration (seed crop, seed germination, seedling recruitment and establishment, and their becoming seedling and then trees). The three states of WHE could combine their resources to improve the understanding of regeneration processes as many important species are common.

Treat the Management of PAs as a Specialised and Separate Service

Keeping this in view a separate service at ecoregional or national level could be created. Recruitments should be made from those who have expertise in wildlife management, ecosystem aspects, socioeconomics with specialisation in participatory management, etc.

Review the Blanket Ban of Tree Cutting Periodically and Make the Laws More Area - and Forest Type - Specific

The blanket ban on tree cutting has halted forest degradation but has caused new problems, as excessive lopping of broadleaved species and expansion of chir pine, has stifled progress in the development of forest-based local economy, and has reduced the unit of conservation from forest ecosystem to individual trees, which is irrational. Excessive lopping of tree branches (so much so that trees stop producing leaves) along with grazing and, litter collection and burning have created a regime of chronic disturbance (slow, invisible but persistent disturbance, never allowing a system to recover, and it crumbles as the effects of chronic disturbance accumulate in time), which degrades forests, particularly by damaging regeneration.

A chir-pine forest system, which thrives on disturbance including tree cutting, could, therefore, be used for developing enterprises at community level or by a suitable village level organisation. Similarly, alder which is an early successional species with a short rotation cycle (8-10 yrs) can be used to generate economy. This disturbance-dependent tree species is a great nitrogen-fixer, colonising effectively landslips and other such sites. Thus there is a need to have decentralised laws which effectively consider local needs, system-attributes and participatory approach.

The other aspects that need to be addressed include: poaching, over-exploitation of medicinal, aromatic plants and lichens, free grazing, extreme fragmentation of vegetation, degradation of forests outside protected areas, lack of inter-state cooperation, and impact of global warming, which perhaps has already begun to affect the Himalayan biomes. Many of the issues listed above are interconnected. **A positive step in any one area may bring about favourable results in many other areas.** For example, to facilitate women's participation it is important to reduce the burden of daily workload by providing labour saving devices, developing resources to meet the needs of organic agriculture next to homestead and empowering her constitutionally. This one step may lead to the improvement of forest conditions, child health and enterprise development. By breaking the cycle of low-quality cattle and low-quality fodder, we can improve forest regeneration as well as the people's economy. There is a need to educate people to bring about a change in attitude. Making people to "respect other species" and value the life-supporting services that natural ecosystems give, warrants a deeper understanding of the issues that confront humans. The exercise of bringing about the necessary cultural changes should, perhaps, begin with the decision makers.