# Culture and Biodiversity Thematic Strategy and Action Plan

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1. The Thematic Working Group on Culture and Biodiversity is part of the National Biodiversity Strategy and Action Plan being prepared by Ministry of Environment and Forests, Government of India.
2. The objective of this group was to identify nature and extent of inter- relationships between wild biodiversity and different aspects of culture. The group was also to assess the current status of these relationships and to suggest a strategy and action plan to strengthen and/or revive these relationships in the present context.
3. The methodology adopted by the group was participatory. The group held several meetings of its members and consulted a large number of persons in the country for developing this report.
4. The report is presented in two Volumes. Volume I contains description and an analysis of various aspects of culture and biodiversity in the country. It also contains the recommendations. Volume II contains the contributions prepared by group members as well as the special invitees.
5. There are six substantive sections in the report that deal with positive and negative links between culture and biodiversity, religion and biodiversity, weakening of links between culture and biodiversity, initiative to revive and/or strengthen positive links between biodiversity.
6. The positive links between cultural and biological diversity have been examined from the point of view of individual species, habitats, and landscapes. The practices having positive links with biodiversity include totemic species, species of ritualistic importance, seasonal restrictions in hunting, ritual use, resource use diversification, territoriality, etc. Under habitat protection are included sacred groves, sacred ponds, trees and tanks, annual ritual hunt, shifting cultivation, the supply and safety forests, and Bishnois, and landscapes such as Rathong Chu in Sikkim.
7. A search of random literature reveals that perhaps there are hardly any traditional cultural practices in the country that have any significant negative impact on biodiversity. However, we have listed several practices that may have some negative impact. These practices are annual ritual hunt, hunt of particular species and shifting cultivation.
8. The section on religion and biodiversity brings out clearly that all religions in the country, especially Hinduism, Buddhism and Jainism have strong ethos related to biodiversity conservation.
9. Several traditional practices that have positive impact on biodiversity are becoming weak due to internal factors and/or external factors. Such phenomenon have been observed at species level and also at habitat level, e.g. sacred groves and sacred ponds, tanks and trees, shifting cultivation.
10. A number of examples of revival and/or strengthening of traditions having conservation value have been cited from different parts of the country and also among different communities. Examples have been given where religious ethos have been used in rejuvenating barren landscapes and protection of domesticated crop varieties.
11. Based on the analysis of the materials presented in the report, the group suggests the following recommendations.

## Sacred Groves

It is recommend that an inventory of sacred groves should be prepared urgently for all the states in the country. The inventory among other aspects should include location, area under the grove, ownership and management, cultural and biological dimensions, nature and extent of degradation and nature and extent of threats.

**Action:** The MoEF is best suited to undertake this task. All State forest departments should be advised to prepare such inventories in their respective states. In view of the multi-dimensional nature of SGs, a multidisciplinary team needs to be set up. The institutions that could contribute significantly are Anthropological, Botanical and Zoological surveys of Government of India. Besides state level NGOs, lead colleges/schools and Panchayati Raj Institutions may also be involved in this process.

It is recommended that efforts should be made to map the nature and extent of vegetation cover in the SGs through out the country.

**Action:** The Forest Survey of India should be advised to develop suitable methodologies for mapping the vegetation cover in the SGs. For ground truthing support from a number of institutes, NGOs and communities currently working on biodiversity related issues could be elicited.

In absence of a policy on SGs, it is recommended that the MoEF develop a policy document on SGs. In this context it may be noted that in the document - National Policy and Macro-level Strategy on biodiversity - The MoEF, GOI, 1999 under section 1.4 Approach, item vii (pg. 13) writes "Sacred groves are the rich heritage of India. occuring in various parts of the country sacred groves harbour ecosystems at pristine level. These would be treated as special areas deserving full protection and conservation".

**Action:** MoEF may constitute a Working Group for this purpose involving forest departments, environmental lawyers, anthropologists, ecologists and representatives of Panchayati Raj institutions and communities. Experience learnt in Kodagu (see appendix III in this report) will be of immense help in this regard.

There are many groves that face threats, internal as well as external. It is recommended that in such cases campaigns should be undertaken to strengthen the SGs. The campaign could be in the form of yatras, exhibitions, workshops, printed literature, etc. (for details see Alkazi in this report, appendix II.5 in Volume II), especially aimed at people who live in the vicinity of the SGs who may be made aware of the ecological functions performed by the SG and motivated to protect them.

**Action:** The existing networks of NGOs, functionaries of SGs and academicians could be entrusted with this responsibility. The travelling exhibition on SGs and several publication on SGs prepared by Indira Gandhi Rashtriya Manav Sangrahalaya, Bhopal (IGRMS) could be used effectively for this purpose. The experience learnt in Kodagu, given in appendix III, could be widely shared with such networks, institutions and individuals.

## Sacred Ponds

In view of aquatic conservation value and the dearth of data available on sacred ponds in the country it is recommended that Statewise inventories of the sacred ponds should be made throughout the country.

**Action:** MoEF could involve its institutions like Salim Ali Centre for Ornithology and Natural History (SACON), Wildlife Institute of India (WII), Indian Institute of Forest Management (IIFM), and State Irrigation Departments, academic institutions and NGOs for preparing such an inventory.

It is recommended that in view of the importance of sacred ponds in conservation of aquatic biodiversity, MoEF should prepare a policy document on sacred ponds.

**Action:** MoEF may constitute a task force for this purpose involving fisheries departments, irrigation departments, forest departments, environmental lawyers, anthropologists, ecologists and representatives of Panchayati Raj institutions for developing a policy document.

## Tanks and Trees

It is evident from the materials presented in section 3.2.3 that the cultural tradition of planting trees and other vegetation on tank embankments plays an important role in conservation of biodiversity. And in view of the considerable decline in number of tanks, it is recommended that a multidisciplinary research should be initiated to document the cultural and biological dimensions of tanks and trees in the country.

**Action:** MoEF could entrust this responsibility to IIFM, Bhopal, Gandhi Peace Foundation, New Delhi, Centre for Science and Environment, New Delhi and other relevant institutions.

## Role of Religion in Conservation

From section 4, it is evident that religious ethics in all religions of the country have to a varying degree a strong positive bearing on biodiversity conservation from species, to habitats, to landscapes. It is recommended that this religious ethos could be effectively used in declaring bare mountain tops and other degraded lands as sacred sites. Such sites could be designated variously depending on the religious faith.

**Action:** MoEF could initiate on an experimental basis in some parts of the country this approach and evaluate the response of the people. Such a responsibility could be assigned to G. B. Pant Institute of Himalayan Environment and Development; the institute has rich experience and expertise in this kind of work. For details on this topic see the note prepared by S. P. Singh given in Appendix II.10 in Volume II.

## Annual Ritual Hunt, And Other Hunt In the Country

It is evident from section 5.2 that the practice of annual ritual hunt is wide spread in the country among tribals as well as non trib-

al communities. It is also evident that a number of animals indeed are hunted every year. However, qualitative or quantitative data in terms of people involved, the quantum of animals and species hunted is not known at all. It is therefore recommended that systematic studies in different parts of the country should be initiated immediately to understand fully the nature and extent of impact of these practices on faunal biodiversity.

**Action:** MoEF could interest this task to Anthropological Survey of India, GOI. Anthropology and Zoology departments in the universities and colleges could also be involved in this task. Besides the State Tribal Welfare Departments could also contribute significantly. NGOs like Wildlife Trust of India and others could also be involved.

## Shifting Cultivation

As noted in section 5.3, in many parts of the country, the jhum cycle has reduced drastically, and therefore has become unsustainable. This has resulted in loss of biodiversity. Although strictly speaking, this practice belongs to domesticated biodiversity, but in view of its impact on wild biodiversity, we thought it appropriate to flag it here.

**Action:** The above concerns of the group should be shared with the Thematic Working Group dealing with domesticated biodiversity, and they be requested to develop a set of appropriate recommendations.

## Seasonal Restrains in Hunting

From section 6.2, it is evident that the traditional seasonal restrictions/taboos on hunting have been relaxed among many communities, and in many regions of the country like Bastar, Nagaland, etc. It is recommended that awareness campaigns should be undertaken among identified communities/areas in the country emphasizing the conservation concerns.

**Action:** Centre for Environment Education, Ahemdabad may be requested to develop suitable campaign material.

## Role of folk music and drama and oral legends

From section 8 it is evident that rich folk music and drama and oral legends having profound impact on biodiversity conservation exists in all parts of the country. However, this rich material is scattered and often very difficult to access. It is recommended that such materials from libraries and other places should be retrieved and a database be created.

Action: MoEF may request any one or more of the Institutes like: Sangeet Natak Akademi, Delhi, Komal Kothari's collection, Jodhpur, American Institute of Ethnomusicology, Gurgaon, Folklore Dept. University of Mysore, Indira Gandhi National Centre for the Arts, New Delhi, etc. to create a databse as mentioned above.

# Domesticated Biodiversity Thematic Strategy and Action Plan

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## I. Brief Introduction

The Thematic Working Group (TWG) on Dom. bd, presents a set of broader macro level Strategies and Action Plans (SAPs) for the conservation and use of domesticated bio-diversity (dom. bd.) in an equitable and sustainable manner in India. These SAPs are framed based on the key suggestions which emerged during the two meetings: on September 29, 2000 at the Development Research Communication Center, Calcutta and on August 11, 2001 at the University of Agricultural Sciences, Bangalore, the inputs received from the members and the information collected from different sources/occasions. Adequate emphasis is given to caste, class, gender and regional dimensions of the use of dom. bd. The domesticated biodiversity was approached under three major headings, viz: (a) Agri-diversity with special focus on dry land field crops, homestead farm diversity and diversity in tribal agricultural system along with the agro-ecosystem diversity; (b) Livestock diversity which includes milch and draught animals, small ruminants, and poultry; and (c) Other forms of dom. bd. which includes cultured fish species, honeybees, camels and pet dogs. In addition to this, focus was given to the Informal Knowledge and Technology System which includes Indigenous Agricultural Knowledge and Technologies (IAKTs), Ethno Veterinary Medicines (EVMs) and local/traditional/indigenous institutions associated with Dom. Bd,.

## II. Major Issues Addressed

The current knowledge on dom. bd. was used to address the following major issues:

### 2.1 Relationship With the Other Forms of Biodiversity

Forms of domesticated bio diversity like native honeybees are playing crucial roles in enhancing the overall diversity in the nature. In a few cases, native livestock breeds and plant species become necessary to maintain the overall balance of the local ecosystem. For instance, the grazing habit of domesticated animals like buffaloes and camels is found to be controlling the weed population in the surrounding eco-systems of Rajasthan. This, in turn, is helping the nesting habitat of bird colonies. However, crop husbandry in a broader context also contributes to the decline of biodiversity as a given piece of land where diverse native plant species were growing originally was converted into agriculture to grow a few 'domesticated' plant types. Similarly, domesticated livestock population, when crossed the threshold limits, (from the point of carrying capacity of ecosystem), became detrimental to forest diversity through over grazing or higher grazing intensity. An understanding of these intricacies is essential while assessing the links between domesticated and other forms of biodiversities.

### 2.2 Institutions, Indigenous Cultures and the Equity

Conservation and use of dom. bd. is closely associated with the religion, culture and lifestyles of indigenous and folk communities. For instance, it is a taboo among the pastoral communities to sell the female breeding stock. It is a custom even today to maintain the breeding bull as a 'temple bull' or as a community resource in Tamil Nadu, Rajasthan and many other parts of India. Similarly, traditional fishermen communities are following the custom of restraining in fishing during the period of fish brooding. The deep and sophisticated ecological knowledge of bio-diversity has given rise to cultural rules for conservation reflected in notions of sacredness, taboos and other forms of 'institutions'. Focusing on these 'institutions' prevents a mere mechanistic approach to the conservation of dom. bd. Above all, the conservation of dom. bd. addresses the livelihood security issues of the marginalized majority in the rural areas. This, obviously strengthens the equity dimension of conservation of biological diversity in India.

### 2.3 Dom. Bd. and the Informal Knowledge and Technology Systems

Conservation and use of dom. Bd. had been influenced historically, by two strains of informal knowledge and technology systems; Indigenous Agricultural Knowledge and Technologies (IAKTs) and Ethno Veterinary Medicines (EVMs). This is important to note that these informal knowledge and technology systems are used exclusively on dom. bd. and they, in turn, are depending heavily on the bio-diversity. For instance, the indigenous 'protection' measures are employed mostly on native crops and local breeds of animals. And, these protection measures are depending on the local plant diversities such as the herbs, shrubs and plants available in the locality. In this way, dom. bd and bio-diversity are linked with each other which is strengthened further by IAKTs and EVMs. This interplay of informal knowledge and technology systems, dom. bd and bio-diversity has to be harnessed effectively to evolve eco-

friendly, culturally compatible, low cost technologies for sustainable development

### 2.4 Women, Dom. bd. and Food Security

Rural women have been playing historically a key role in the selection, conservation and management of domesticated biodiversity in India. Though their immediate objective is to meet household food and nutritional security, there are a variety of reasons why women have taken up this role. A study reveals that the homestead farms under women's custody consists on an average, 1500 plants belonging to 50 different species in Kerala. Rural women all over India are responsible for maintaining back yard poultry and preserving the local breeds therein. The Adivasi women in Andra Pradesh are known to rear the renowned Aseel poultry breed in their back yard. Women's ingenuity in this regard is not confined to kitchen garden or back yard animal husbandry but is also extended to dry land farming also. The farm women are found to be the custodians of unique local varieties of paddy, pulses, ragi and other millets in many villages in dry belt of South India. The significant initiative by the Scheduled Caste women of Andra Pradesh, amply proves that if access to land, technology and information is given, women can play a lead role not only in the conservation of bio-diversity but also evolve an alternative public distribution system based on it. This provides strong justification for a gender sensitive approach to food security through the conservation of dom.bd. in India.

### 2.5 Valuation of Dom. Bd

The value of biological diversity is difficult to define and estimate, nevertheless, some discussion of the issues involved is very essential. Economists recognize two main types of value: the use value and the nonuse value associated with bio-diversity. Use value is attached to the utilitarian benefits which may accrue directly or indirectly or even in the future (called 'option' value) to the user. The direct use value of bio-diversity can be of consumptive, productive or non-consumptive in nature. A local variety of food crop provides several indirect use values such as taste, palatability, cooking quality, disease and drought resistance, supply of more fodder and so on. A study conducted by Navadanya indicates that dry land farmers growing paddy and ragi have more preference for the indirect 'non-market' benefits than for the grain yield in South India. Similarly, it was very well established that the breeding goal of pastoral nomads in livestock is not primarily to increase the meat and milk yield. They also consider local requirements such as survival under high environmental risks, draftability, good mothering instincts, herd ability, ability to walk long distances or climb steep slopes, aesthetic preferences and even loyalty to the owner!

The nonuse value is the 'intrinsic' value independent of its use; direct or indirect, present or future, attached by individuals for its continued existence. The cultural or religious values of biological diversity is a form of nonuse value. Besides, the biological diversity provides two categories services; information and insurance which are fundamental to the very progress of human society.

#### 2.5. Valuation of Dom. Bd

If all these 'real' benefits of dom. bd. are properly assessed, acknowledged, valued and made to reflect in the market transactions, its value may increase much higher, even higher than that of the modern high yielding crop variety or livestock breed. But, the present markets, institutions, political setup and the value system fail to capture and reward these benefits fully. These failures result in the systematic under valuation, leading to sub optima; less than the socially desired level of conservation of dom. bd., the issue is focused mainly in the report.

### 2.6 Spatial Distribution of Dom. bd., and Their Vulnerability

For the purpose of exploration and collection of agi. diversity, the National Buaro of Plant Genetic Resources (NBPGR) has delineated the country into 10 diverse phyto-geographical agro ecological zones and 39 sub zones. Among these, the Western ghats and the North-Eastern Himalayas are the two 'hot spots' of biological diversity in the world. Within these are several specific regions which merit special attention for the purpose of conservation of agro biodiversity. A few such regions are: (a) River beds of Eastern Uttar Pradesh for conservation of cucurbits vegetables.(b) Nangangudu taluk in Mysore district of Karnataka for an unique variety of banana called "Rasabale" (c) Garwal and Kumaon hill regions of Uttaranchal for uridbean and minor fruits; both tropical and temperate species. (d) Homestead forms of Western Ghats regions of Karnataka and Kerala for fruits such jackfruits and unique varieties of vegetables, flowers and medicinal plants. (e) Salt and heat affected regions of Gujarat and Rajasthan for salt and drought tolerant species of Triticum species (f) Adilabad district of Andhra Pradesh for landraces in rice which are tolerant to abiotic stresses with superior kernel quality. (g) For nondomesticated wild and under utilized crops -North Kanra district in Karnataka, Aravalli hills, Rajasthan and the Western Himalayas region.

In the case of livestock breed, there is a 'critical' stage/number, below which if population falls, the restoration is impossible. Species wise, the list of breeds deserving attention for conservation initiative in this respect are Ponganur, Rathi, Sahiwal, Krishna Valley, Vechur, Malnad Gidda, Amrithmahal, Umbalacherry, Kangeyam, Nar, Sahiwal (cattle breeds) Jaffarabadi, Bhadawari, Nili-Ravi, Pandharpuri, Toda,

(buffalo breeds ), Kheri, Bonpalo, Nilgiri, Hassan, Bannur (Mandya), Changthangi, Vembur,Kachakatty black (sheep breed), and Jamnapari, Sangamneri, Tellicheri (Malabari), Surthi, Beetal, Chegu, Jakhrana, Gohelwadi, (goat breeds). There are still several uncharacterized breeds such as Kanchu Mekha a dwarf goat variety, extensively found in the Eastern Ghats region of Andhra Pradesh, which is yet be acknowledged as distinct breed. The spatial distribution of these unique plant varieties and livestock breeds and their vulnerability to extinction and survival must draw a special attention while envisaging policies and programs to conserve them.

### 2.7. Forms Conservation:

The Dom. Bd. has two distinct options; *in situ* (on farm) and *ex situ* (in gene bank) for conservation. Both these methods of conservation; *in situ* and *ex situ*, have their own merits and demerits which are worth evaluating before embarking a particular form or a combination of these two forms for conservation.

## III. Causes for the Loss of Domesticated Biodiversity

Introduction of Hybrids/HYVs in agriculture and cross breeds in livestock is the most fundamental cause for the loss of dom. bd. There are several factors which 'aid' to this process of loss of dom. bd. in a country like India. These include; (a) overriding market considerations leading to commercialization and farm mechanization; (b) over emphasis on consumptive criteria like preferring more 'quantity'- grain yield neglecting the 'quality' parameters like nutrition, health, taste, palatability as well as fodder requirements; (c) focusing more on the irrigated farming system while planning the agricultural development instead of higher agro-eco systems like watershed; and (d) a high time preference for money (i.e. high discount rate) wherein immediate direct, private benefits are preferred more than the benefits in the distinct future. In addition, Govt. policies such as input subsidy and price policy which support only HYVs and the international treaties such as the GATT agreement which push through rigorously high tech corporate agriculture have all acted as the root cause for the loss of dom. bd. in India. Commercial application of agri biotechnology, in this background, can 'potentially' pose a major threat to the very survival of bio-diversity. Present formal education system which is unable to create curiosity and respect for traditional wisdom, grass root creativity, indigenous knowledge and technologies also contributes to the loss of domesticated biodiversity. Encroachment and consequent privatization of common pool resources such as "gomala" land is the most serious cause for the loss of dom. bd; especially the livestock diversity in India.

## IV. Stake Holders, Major Initiatives and the Gaps

Farmers, including tribals, and women within them, individual livestock owners, communities of livestock herders, fishermen and others who depend directly or indirectly for their livelihood on dom. bd. are the primary stakeholders. Scientists, Government. research and development (R&D) bodies, farm organizations and NGOs who work for the conservation of dom. bd. or speak on behalf of the primary stake holders are the secondary stake holders. Industry and corporate sectors who commercialize the R&D efforts, international agencies and the donors who help the conservation of dom. bd are the tertiary stake holders. The 'stakes' of secondary and tertiary stake holders needs to be clearly defined. Any stakes claimed by them while commercializing the dom. bd. or the related knowledge and technologies through IPR system needs to be viewed seriously so that the interests of primary stake holders and their sovereign right is not compromised.

Self motivated ecological farmers, women and the indigenous communities are the natural repository of information and the associated knowledge and technologies surrounding the dom. bd. They are mainly responsible for *in situ* - both on-farm and in-house (ex. seed) conservation of dom, bd. ex situ, especially the *in vitro* conservation of dom. bd. is carried out by the Government R&D institutes like NBPGR, which is used mostly for further R&D purposes. The initiatives by Honeybee network and Community Biodiversity Registry are instrumental in the documentation and exchange of information related to dom. bd. The main gaps perceived in this respect are: (1) Inadequate institutional support for small and subsistence farmers in the dry regions who are using the agro biodiversity. (2) No incentive or compulsions for large and commercial farmers to conserve and use agro biodiversity especially under assured irrigation. (3) Isolated and sporadic nature of ecological farming experiment confined to a few cases. (4) Inadequate agrarian reforms in assigning property rights over land and other natural resources to women, marginal and indigenous landless communities. (5) Inadequate emphasis, under government R&D setup, a mechanism to involve the primary stakeholders for a participatory and decentralized *in situ* conservation. (6) Inadequate co-ordination and coalition among the NGOs, grassroots organizations and others to influence the policy making process effectively.

## V. Proposed Strategy and Action Plan

Based on the various issues addressed, threats falling on dom. bd., major initiatives by the stake holders and the gaps noticed in this regard, the following STRATEGIES AND ACTION PLANS (SAPs) are identified to conserve and use Dom. Bd. in an equitable and sustainable way in India. In addition, key recommendations emerged in various workshops and seminars such as NAAS - NBPGR workshop (1997), International Conference on Ethno-veterinary Medicine Alternative for Livestock Development held in Pune (1997) and other occasions are also considered.

### Strategy 1: Collective efforts to enhance the access of primary stake holders, especially of women, to livelihood source

The primary stakeholders, due to their low socio-economic status are individually weak in 'bargaining'. Hence, collective actions are very crucial to enhance the capability of the primary stakeholders to conserve and derive full benefits of the conservation to achieve food and livelihood security objectives in a sustainable way. (A1) Strengthen and Extend Ongoing Initiatives such as Community Grain and Gene Fund program of Deccan Development Society, Hyderabad, Seed Sangha of GREEN Foundation Bangalore and Beej Bahao Andolan, Garhwal. (A2) Encourage Women's Co-Operatives to conserve and exchange dom. bd (A3) Extension Through Women Workers, (A4) Plant Multi Purpose Tree Species that serve the purposes of fuel wood, fodder, food. in the avenue sides and other common places and Give Usufruct ( Patta ) Rights to Poor.

### Strategy 2: Insitu conservation, improvement and exchange

An elaborate arrangement to *in situ* conservation along with participatory crop improvement for direct exchange of plant genetic materials among farmers/communities themselves is required. The *in situ* conservation is very consistent with equity, security and cultural values associated with Dom. Bd. Further improvement and exchange of the genetic resources need to be undertaken with active involvement of the primary stakeholders who conserve them. (A1) National Action Plan for Participatory *in situ* Conservation and Development, (A2) A 'Controlled' *In situ* Conservation System for the varieties threatened for extinction (A3) Develop Agri. Diversity Catalogs, (A4) Create Agri Diversity Exchange System encouraging Seed Fairs/Melas and empower the communities to exercise control over exchange and use.

### Strategy 3: Integrating dom. Bdconcerns into forest and environmental policies

Policies and programs related to forestry and environment have not given adequate emphasis on Dom. Bd There are several mutually supportive linkages, as discussed in the section 2.2.1, among forestry, environment and Dom. Bd In order to strengthen these linkages, it is necessary to integrate Dom. Bd. concerns in to forest and environmental policies and programs(A1) A National Action Plan on Underutilized/Wild Food Crops, to undertake documentation, conservation, use and exchange by giving priority to specific locations like Himalayas and Western Ghats, regions. (A2) Promoting the Cultivation of Wild Relatives -wild foods, vegetable, fruits, medicinal plants, ornamental plants like orchids initially in the surrounding kitchen garden/homestead farms. (A3) A National Action Plan for Tribal/forest dwellers' Agriculture -equal focus on jhum or shifting agriculture so as to retain its positive aspects for agro biodiversity and cultural sensitivity, while tackling the negative side. (A4) Include Time Tested Herbal Healing Practices in our Primary health Care Delivery both for human and animals- training and orientation of govt. health staff/community health workers in utilization of medicinal plants.

### Strategy 4: Protection and promotion of native apiculture

Native honey bees symbolize a perfect interface among agro biodiversity, forestry and ecosystem diversity. In spite, the native apiculture did not find a place it deserves in the polices and programs aimed at the development of the sectors mentioned above. Hence a separate strategy to protect and promote the native apiculture is required. (A1) To Maintain the Native Strains in Pure Form: -like Apis cerana, without any contaminations and strict control against the introduced exotic species such as Apis mellifera which are suspected to cause diseases such as Thisac brood on our native strains. (A 2) Large Scale Promotion of Apiculture in both rural as well as urban areas. (A3) Training youths from tribal and forest dwelling communities to promote apiculture. (A4) Large Scale Planting 'bee trees' while taking up forestation program both in rural as well as urban areas.

### Strategy 5: Agro ecosystem based planning and development

Agro ecosystem based planning helps to harmonies conservation values with that economic issues that may arise while conserving and using of dom. bd. (A1) Agro Ecosystem Based Crop and Livestock Planning - keeping in mind the assigning the responsibility of planning on natural resources to the Gram Sabha and the customary rights of indigenous communities such as adivasi, the watershed can be taken as an ideal unit for planning and development. Local varieties and breeds need to be incorporated in to farming systems under watershed development. (A2) Assign Top Priority to Land Care and Management Systems -conserve prime farmland from conversion to non-agricultural uses, preserve the loss of the biological potential of the soil, check different kinds of soil erosion, restore the soil fertility through agro forestry and other arable practices. (A3) Treat Water As a Social/Public Resource - a strong public policy for regulation of water use; especially surface and ground water, improve traditional rainwater harvest and underground storage methods, recycle rainwater and home-used (waste) waters., (A4) Strengthen Conservation of Living Aquatic Resources -restoration of tanks for multiple uses in South India, regulate the land use in coastal areas., (A5) Research to Anticipate the Likely Consequences of Climate Change on Agriculture - explore the funding source to undertake systematic research to evolve mechanism for coping with them.

### Strategy 6: conservation of animal genetic resources

As mentioned in the section 2.2.3, the indigenous livestock breeds are more vulnerable to reach the 'critical' stage/number below

which if population falls, the restoration is impossible. Keeping this in view, the following general actions are suggested to conserve animal genetic resources in India. (A1) Systematic Survey and Assessment of the Indigenous Livestock Breeds, (A2) Ensuring of Pure Lines and Conservation, (A3) Periodic Monitoring of Threatened Breeds like Ponganur, Vechur, Ongole , Amrithmahal and Krishna valley (A4) Increased Role for Developmental Agencies like NABARD.

### Strategy 7: Specific Livestock Breeding Programs

A livestock breed improvement program must help to conserve and make the breed fit well to the local climate, cultural and economic conditions. Multi-purpose breeding rather than a specialized single purpose breeding (as practiced in the developed countries) should be followed in our country. The breeding strategy must complement the multipurpose farming systems, in which livestock, crop and tree production are integrated to produce food, fiber, energy, fuel and wood while maintaining the soil fertility and overall sustainability of the system (A1) Promote Herd Societies, (A2) Selective Breeding to Meet the Desired Goals of Farmers and Communities, A3) For Small Ruminants applications of "Open Nucleus Group Breeding" involving the local community. (A4) For Poultry - Improved village-level disease management strategies and location specific programmes to conserve and popularise the indigenous breeds like Aseel, Kadakanth, Chittagang, Maly and other breeds in different parts of India. (A5) For Canine - conserve indigenous dog breeds such as Rampur, Mudhol and Himalayan breed. (A6) For Other Animals - there is an urgent need to study and document the status of indigenous breeds of horse, camel, pig, donkey, yak , mithun and ducks and prepare A National Action Plan to take up remedial measures so as to arrest their degeneration..

### Strategy 8: Grazing and fodder development

Adequate opportunities for grazing and supply of fodder are the essential pre requisite to conserve indigenous livestock population. Increasing the supply of fodder from agriculture, non agriculture as well as the wild sources, restoring the traditional CPR institutions such as the Gomala (grazing) lands are the two essentially required action plans in this respect (A1) Increased Supply of Fodder and Feed for Livestock, (A2) Strengthen Village Grazing lands "Gomala" as CPR Institution Strict Legal Action Against The Encroachment Of The CPR Land, institutionalization of indigenous management knowledge governing the CPR and empowering fully the Panchaythi Raj institution to take control over the CPRs in India.

### Strategy 9: Conservation of cultured fish diversity

Fresh water bodies like rivers, ponds and tanks are the main sources of indigenous cultured fish species in India. Several government departments are managing these water bodies which have poor coordination and give rare attention for conservation of cultured fish species. Hence, cultured fish species are the neglected item under fish fauna. (A1) Enhance the Availability of Seeds, (A2) Research Studies, to assess the status of indigenous fishes, their composition and breeding behavior (A3) *In situ* propagation of desired ichthyo, (A4) Strengthening the Community Based Management through training, credit, marketing and technical assistance to fisher folk. (A5) Include Endangered species Under Wild Life Protection Act.

### Strategy 10: Development of supportive technologies for dom. Bd

Blending various technology systems is required to conserve and promote the use of dom. bd. in equitable and sustainable ways. The actions required in this respect are: (A1) Liberal Promotion of Time Tested and Compatible Technologies like IAKTs (Indigenous Agriculture Knowledge and Technologies), EVMs (Ethno Veterinary medicines) , watershed development, dry farming technologies and organic farming technologies (A2) Selective Use of Conventional Breeding and Vegetative Propagation, so that varieties/breeds evolved will relay more on internal resources, IAKTs/EVMs and remain under the control of farmers, women and the community. Encourage participatory plant/livestock improvement methods. (A3) Very Careful and Restrictive Application of Bio-technology mostly for conservation purposes when the species/variety/breeds are at the verge of extinction., to control pests and disease where all other measures have failed, for eradication of deadly weeds causing harms to ecosystem. Enforcement of rigorous bio-safety measures preceded by a transparent and systematic Environmental Impact Assessment are must in all these cases.

A broader consensus thorough public debate and discussion, involving farmers, environmentalists, scientists, NGOs and other stakeholders on commercial application of bio-technology in agriculture and ways and means to ensure a "social control" over it are very essential.

### Strategy 11: Informal Knowledge and Technology Systems

Conservation and use of Dom. Bdhad been influenced historically, by two strains of informal knowledge and technology systems; Indigenous Agricultural Knowledge and Technologies (IAKTs) and Ethno Veterinary Medicines (EVMs). There is a mutually supportive roles and interplay as discussed in the section 2.2.2 among informal knowledge and technology systems , dom. bd and biodiversity. These mutually supportive roles have to be harnessed effectively to evolve eco-friendly, culturally compatible, low cost technologies for sustainable development. (A1) Systematic Documentation and dissemination, of IAKTs and EVM of both individuals as well as communities in local vernacular A2) Systematization and Scaling up whenever required for larger application. Ensure

that they remain under community control (A3) Promotion of Healers' Associations and Networks, (A4) Debate and Legislation on IPR related to IATKs and EVM to understand the intricacies in the context of WTO and arrive at a consensus.

### Strategy 12: Market And Policy Reforms

These reforms are required to correct various forms of 'failures' in the policy and market arenas which come in the way of appreciation and proper valuation of various 'forms' benefits and services provided by Dom. Bd.discussed in the section 3.2.4. These must result in the higher values for Dom. Bd. and ultimately higher benefit to those conserve them leading to optimum production and supply of the products and services of Dom. Bd.in India. (A1) Subsidy and Price Support for the Products of Dom. Bd, to begin with consider the crops such as Ragi, Jower and other minor millets and link it up with the present Public Distribution System (PDS). (A2) Incentives for Conserving of Dom. Bd. awards, rewards material as well as non material forms at individual as well as the collective level can be envisaged. The initiatives of National Innovation Foundation of India can be further strengthened in this respect. (A3) Declare 'Ecological Farms' as Biodiversity Heritage Spots, (A4) Institutional Credit and Insurance, (A5) Publicity and Propaganda by making use of govt. owned mass media; TV and radio (A6) Cooperative Marketing and Traditional Food Resorts, (A7) Avoid Concentration in Seed Market in the hands of a few firms/MNCs

### Strategy 13: Educational reforms to include dom. Bdconcerns

Education curriculum on biological and agricultural sciences for the students at schools and college levels needs to be modified and reoriented so as to include various values and benefits along with the equity, cultural and ethical dimensions of Dom. Bd To create interest and respect on diversity in young minds, innovative methods are called for. (A1) Create Curiosity in Students' Mind Innovative methods like Biodiversity Contests by creating a "bio-diversity contests fund" in each state to conduct contests, quizzes, essay writing and other such competitions for school and college students, (A2) Syllabus Modification include IAKTs/EVM into agricultural/veterinary curricula (A3) Maintain Niche Diversity Center in Schools and Colleges, (A4) Training and Reorientation for Scientific Community on the issues on equity, gender, food security, ethics, sustainability, culture and informal knowledge and technologies related to dom. bd (A5) Alternative Methodology to Value the 'Total Benefits' of Dom. Bd.:

## V. Prioritization and follow up

**Prioritization:** The TWG has formulated 57 Action Plans to achieve 13 broader Strategies, in order to conserve and use Dom. Bd in an equitable and sustainable way in India. Nearly 65 percent of these actions are classified as 'Medium Term' as they require a duration up to 5 years for implementation. Similarly, next 30 percent action plans require 'immediate to short term', (up to two years duration) and the last five percent are long duration actions. To implement these actions, in nearly 58 percent cases, clear programs mostly by the state and central governments are required. In 22 percent cases, policy reforms are required. To implement 15 action plans R&D initiatives and in 4 cases building of 'institutions are called for.

As the time and resources available to implement these action plans are limited they have to be pursued in a prioritized way. Though prioritization is a subjective exercise, by looking into specific socio-economic context of a country like India, livelihood security of the people and the ecological security issues associated with Dom. Bd can be taken as two bottom lines in this respect. In addition, other criteria such the time period (which needs be implanted immediately) and cost effectiveness (which requires relative smaller resources such as 'the development of national action plans, conduction workshops) have to be considered while prioritizing the actions related to the above mentioned two sub themes. There are a few actions which are addressing the possible negative implications of items such as biotechnology and IPRs, on Dom. Bd and consequently on the above mentioned two priority objectives. And finally, actions on policy reforms and building of institutions will have long term implications on the conservation and use of Dom. Bd. All these criteria are taken into account while prioritizing the actions which address the above mentioned two top priority objectives. As these two objectives are closely interlinked, many actions prioritized overlap with each other. The table below gives such prioritized actions along with the possible agencies to implement the same.

**Table: Prioritized Action Plans along with the Proposed Implementing Agencies**

**A. On Livelihood Security Objective**

| S. No. | Action Plan | Implementing Agency |
|---|---|---|
| 1. | Strengthen and Extend Ongoing Initiatives | Central Ministry of agriculture with the support of the NGOs like DDS and GREEN Foundation |
| 2. | Encourage Women's Co-Operatives | Min. of Agriculture With key NGOs |
| 3 | Plant Multi Purpose Tree Species: | Government (State) - Departments of Forestry and Revenue jointly |

| S. No. | Action Plan | Implementing Agency |
|---|---|---|
| 4. | Create Agri Diversity Exchange System | NGOs with State Govt. Department of Agriculture/ Horticulture |
| 5. | A National Action Plan on Underutilized/ Wild Food Crops | NGOs with Ministry of Forest and Environment, ICAR |
| 6. | A National Action Plan for Tribal/Forest dwellers' Agriculture | NGOs with Ministry of Forest and Environment, ICAR and SAUs |
| 7. | Periodic Monitoring of Threatened Livestock Breeds | State Veterinary Colleges/Department and NGOs |
| 8. | Promote Herd Societies: | IVRI, NDRI, State Govts. Veterinary Colleges and NGOs |
| 9. | Increased Supply of Fodder and Feed for Livestock | IVRI and NDRI along with State Departments of Agriculture and Livestock |
| 10. | Strengthen the Village Grazing lands "Gomala" as CPR Institution | Central Govt. with State Government – State Revenue Department |
| 11. | Strengthening the Community Based Management for Cultured Fish | State Fishery Department along with Fishery Colleges or R&D centers, active involvement of NGOs |
| 12. | Systematization and Scaling up of IAKTs and EVMs | Key NGOs like SRISTI/DDS/GREEN Foundation/ ANTHARA/SEVA with the support of NIF and Min. of agriculture ICAR/IVRI/SAUs |
| 13. | Promotion of Healers' Associations and Networks | Key NGOs like ANTHARA/SEVA with the support of Min. of Agriculture/ICAR/IVRI/SAUs |
| 14. | Debate and Legislation on IPR, related to IATKs and EVM including the application of agri. bio-technology | Key NGOs like Honey Bee Network, Research Foundation, Gene Campaign, Forum for Biotechnology and Food Security with support of Min. of Agriculture and other Depts. |
| 15. | Subsidy and Price Support for the Products of Dom. Bd | Min. of Agriculture Govt. of India |
| 16. | Institutional Credit and Insurance | The NABARD along with Min. of Agriculture Government of India |
| **B. Ecological Stability Objective** | | |
| 17. | Maintain the Native Strains in the Pure Form | Ministry of Forestry and Environment (Central) along with State Govts. and SAUs |
| 18. | Large Scale Planting of 'bee trees' | Ministry of Forestry and Environment (Central) along with State Forest Deportments |
| 19. | Agro Ecosystem Based Crop and Livestock Planning | State Department of Agriculture and Forestry |
| 20. | Assign Top Priority to Land Care and Management Systems | State Department of Agriculture and Revenue Department to prevent conversion |
| 21. | Treat Water as a Social Resource | Ministry of Forestry and Environment, Water Resources (Central) along with State Govt. |
| 22. | Conserve Living Aquatic Resources | Ministry of Forestry and Environment (Central) along with State Govts. |
| 23 | Research to Anticipate the Likely Consequences of Climate Change | ICAR and other R&D institutions with SAUs |

**Implementation and Follow Up:** Various central Ministries, R&D initiations, NGOs, State Developmental Departments, SAUs and others are considered as the possible agents to implement prioritized and other action plans mentioned above. The Central Ministry of Agriculture, along with its R&D institutions such as NBPGR and SAUs together assigned the responsibility of implementing 25 or 30 percent of the action plans. Other Central Ministries such as Environment and Forestry, Rural Development, Health together assigned the responsibility to implement nearly 20 percent of the action plans. The key NGOs are also assigned the responsibility of implementing nearly 17 percent of the action plans and almost 30 percent for various state development departs such as agriculture, horticulture and others. As the Central Ministry of Agriculture, Govt. of India and its R&D institutions such as ICAR as well as SAUs have to play key role, a committee under the Ministry of Agriculture can be set up to co-ordinate and oversee the implementation of various SAPs. In addition to the scientists from the concerned R&D institutions, adequate representations should be given to the NGOs, farmers and communities associated with the conservation and use of Dom. Bd. The TWG on Dom. Bd. may be assigned the role of advocacy, guidance and evaluation of the progress in the implementation of various SAPs periodically.

# Economics and Valuation of Biodiversity: Thematic Strategy and Action Plan

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## 1. Brief introduction about biodiversity theme

### 1.1 Constitution of the Group

The Thematic Working Group on Economics and Valuation of Biodiversity (TWGEVB) was constituted as part of the NBSAP process in India. It had nine regular members; several special invitees joined the Group from time to time. They included coordinators of several other Thematic and Regional Groups and TPCG Members, and two external advisors who are linked to this Thematic Group.

### 1.2 Functioning of the Group

The Group carried out extensive literature search and reviewed the methodologies of valuation. It held consultations with a large section of scientists, researchers, policy makers and representatives of corporate sector etc. Since the report should have an Action Plan, a case study approach is adopted. For this purpose, several case studies are invited from among the practitioners and researchers from India and abroad.

### 1.3 Links between the Groups

The thematic Group on Economics and Valuation had direct links with several other Thematic Working Groups, the major ones are Livelihood and Life Styles, Domesticated Biodiversity, Wild Animals, Wild Plants, Terrestrial Ecosystems, Natural Aquatic Ecosystems, Micro-organisms, Access, Benefit Sharing, and Education and Training.

## 2. Brief Description of major biodiversity related issues of the theme

### 2.1 What is Economics of Biodiversity?

The discipline of economics is commonly understood to deal with production, consumption, generation of wealth and welfare to humankind. Hence valuation is part of its methodology. Biodiversity is enabled by a number of resources, renewable and non-renewable ones. But attributes of biological diversity are often seen as secondary as they have no immediate productive values; and their loss or gain are seen to represent no immediate costs or benefits. What is new in this Economics of Biodiversity then? Essentially, it is introducing the appropriate economic methods and tools to deal with natural and biodiversity resources and to redress some of the new concerns in the emerging world today. Three major concerns are dealt under this theme.

- First, the effects of structural adjustment (SAP) and economic reforms process that India has launched since 1991: The major ones that affect biodiversity at large are:
    - Resource allocation on biodiversity related activities (such as forestry and wild life protection, eco-development and restoration, advocacy, research, training and so on);
    - The growth of MNC's in the pharmaceutical and drug sector overshadowing Indian medicinal system;
    - liberalisation affecting the export and import of biodiversity linked products; hence a new domain of pricing mechanisms;
    - Structural change in domestic food processing (from traditional to modern food processing as an industry); changes in quality and styles of life; and
    - Growth of corporate culture.
- The second concern is about the 'break away state' in the relationship between biodiversity and economics or between ecology and economics. Apart from economic functions, natural and biological resources also contribute in several other ways to the ecology, briefly termed as ecological functions. As part of NBSAP, they need to be valued together. Furthermore, in decision-making regarding the management of natural resources, the values that communities and individuals put to biodiversity on cultural, livelihood, survival and spiritual aspects of life need to be accounted for.
- Thirdly, in every society, there are many stakeholders who are involved in production, distribution and consumption. When it comes to biodiversity, they are local communities, small business dealers, state agencies, corporate sector, tourists, multi-national corporations, scientists, exporters and importers, and many more. The relationship between different stakeholders can also be asymmetric, depending upon the political and money powers, and other social relations. Thus the concern is identification, prioritisation and budgeting for stakeholders.

## 3. On Going Initiatives as part of the NBSAP Process

The Working Group basically addressed to these three basic concerns of the NBSAP process in India. The major steps or initiatives from this Working Group are summarised below:

### 3.1 Budget allocation:

In the central and state government budget presentations in India, there are no exclusive financial resource allocations under the heading 'biodiversity'. However, both at the central and state government levels, several budgetary allocations are made which have indirect and to some extent direct bearings upon biodiversity. Such budgetary methods have no positive influence on biodiversity conservation. The state biodiversity resources in India has been severely affected by the Economic Reforms Process, as evident from the falling rate budget allocations on biodiversity conservation.

### 3.2 WTO and Biodiversity Conservation

The WTO Final Act contains the following four major agreements, which have relevance to environment and trade. They are:

- Agreement on Agriculture
- Agreement on trade related aspects of Intellectual property rights (TRIPS)
- Agreements on Subsidies and Countervailing Measures, and
- Agreement on Technical Barriers to Trade (e.g., SPS).

Among them, the most relevant Agreements directed for biodiversity conservation are on Agriculture, Intellectual Property Rights (IPRs), and on Sanitary and Phyto-Sanitary (SPS). The 1988 New Policy on Seed Development (NPSD) liberalised import of high quality seeds, which in conjunction with the general economic liberalisation regime has opened the Indian seed market to foreign seed producers. The ostensible strategy of the NPSD can affect the farmers in India. TRIPs Agreement of GATT 1994 provides much stricter patent protection to the intellectual properties related to trade; but Indian farmers are not given sufficient information, education and time to get on to this new culture.

### 3.3 A Barriers to forest products trade

In recent years there has been a proliferation of additional policies and regulations that have the potential of becoming new barriers to the forest products trade. These barriers include:

1. Export restrictions by developing countries to encourage domestic processing of tropical timber for export;
2. Environmental and trade restrictions on production and exports in developing countries that affects international trade patterns;
3. Quantitative restrictions on imports of unsustainably produced timber products, and
4. The use of eco-labelling and green certification as import barriers.

### 3.4 Command and Control Methods

Pollutions affect the biodiversity resources very adversely. In India the Central and State Pollution Control Boards are established after 1986 Environment Protection A/-+0ct, to stop and reverse the process through technically established (and not society based) environmental standards (e.g., MINAS). Such command-and-controls (CAC) instruments are in the form of fines, penalties and threats of legal action for closure of the factories and imprisonment of the owners who violate the environmental laws and regulations. They have not worked at all, despite of several orders from Supreme and High Courts.

3.5: Market Based Instruments in India

Market based instruments such as tax-standards approach or incentives for establishing combined effluent treatment plants, introduction of user charges or prices, deposit refund schemes, incentives for relocation etc., are being introduced, but rather too slowly.

The price based instruments are in the form of taxes and subsidies to deal with detrimental and beneficial environmental externalities in production and consumption. The pricing system for most of the biodiversity products does not function well. Under the NBSAP process, for several reasons, it is intended to bring transparency and 'rights to information' on the margins between the collectors' price and the market price:

- For the collectors and local communities it should be an empowerment and income avenue,
- Even the local communities should realize its true worth or value,
- The gains from the natural resource extraction and use should by and large be based on *in situ* distributional benefits,
- It should be corrective for sustainable rates extractions (based on the concept of carrying capacity), proper use of land and water resources and ecological conservation.

### 3.6 Key Gaps in Economics of Valuation of Biodiversity

The first revelation was the fact that even the economic valuation are not being carried out on biodiversity resources, leave the

issue of ecological valuations apart. After surveying a large number of existing case studies the Group reached to the conclusion that there is a need to fill this gap very significantly. Specifically the areas to be addressed are:

- Valuation of wetlands, marine and coastal resources
- Valuation of Water and budgeting of water resources
- Valuation of Forest as a biodiversity resource: Redefining JFM
- Teaching of the techniques of valuation: Gap between research and practice
- Data base on biodiversity resources
- Redefining Community based strategies such as stake holder analysis
- Specifically addressing to the issue of medicinal plants and domesticated animals
- Introducing multi-disciplinarily in valuation approaches

## 4. Proposed Strategy and Action Plans

### 4.1 On Budget Allocation

Government Budget allocation for the Ministry of Environment and Forests is at present a mixed bag. It be related to biodiversity areas and activities, and not based on anthropogenic activities. In order to work out the specific rates of resource allocation for various components, an Expert Group may have to go in to these. The degree of criticality of these areas, the livelihood dependency on them, the long term sustainability of those resources etc., will have to be used as the relevant criteria. Budget allocation can be based on (i) research and development, (ii) for protection and conservation, (iii) for promotion and awareness, (iv) for short term and long term planning etc.

Till such time a formula is worked out, the present Thematic Working Group recommends maintaining a 3% share of total revenue expenditure and another 3% share in capital expenditure exclusively for natural resource development in the states. At the MoEF level, at least 6% of GDP be allocated for all activities including biodiversity, and 3% exclusively fro forestry and wildlife preservation, but addressed to biodiversity.

### 4.2 Sharing the Responsibility on Resource Mobilisation

The responsibility of resource mobilization is not only with the government abut also lies with the corporate sector, external donor sector and public at large This sharing mechanism also need to be fully understood and worked out at least once in five years. There is the need to introduce proper market based instruments to budget and regulate the use of biodiversity related resources. Specifically in the area of water resource management, use of forest resources and marine resources, the types of market based instruments would differ. Separate studies are required to be carried out on this issue of appropriate instruments, to look in to who gains and who loses from such market based instruments.

### 4.3 Action and strategy regarding WTO-GATT matters

1. A share of profits made from the new variety goes, on behalf of the communities, into a National Gene Fund. The Gene Fund should be the recipient of all revenues payable to the farming communities under various heads. The use of the money should not be restricted to conservation or for maintaining *ex situ* collections only.
2. The attempt at global standardization and uniformity by way of TRIPs agreement is in conflict with the main thrust of the Rio Earth Summit of 1992 that set out the conditions for sustainable development. These two reveal two contrasting types of international approaches and norms. While the 1992 Earth Summit and the 1993 convention on bio-diversity (CBD) focused on 'diversity' as being fundamental to sustain life and development, TRIPs and WTO are pushing for 'conformity' to international standardized norms on patents, services, labour, investment and what not, irrespective of their history, ecology, level of economic development, etc. The areas of intellectual property that the TRIPs agreement cover are: copy right and related rights; trademarks including service marks; geographical indications including appellations of origin; industrial designs; patents including the protection of new varieties of plants; the layout-designs of integrated circuits and undisclosed knowledge including trade secrets and test data. There is the need for perfect transparency in the patent and TRIP regulations down to the farmer levels.

### 4.4 Action Oriented Role for the Corporate sector

A key entry point for corporate sector is through NBSAP where its knowledge and expertise can be utilized effectively. It should form part of its legitimate interests in its representation to the government on polices and programs, guidelines and other management supports. It should also respect and support the livelihoods and rights of communities dependent on biodiversity, and promote cultural diversity and values relevant to biodiversity. In fact, the companies may develop a formal biodiversity policy or incorporate biodiversity into its existing environmental policies. They should keep abreast of the discussions and developments relating to national guidelines for incentive measures, biosafety, equitable benefit-sharing, intellectual property rights, monitoring of biodiversity indicators and other related topics.

Several action components are proposed to achieve these.

- Act together with the farmers on at least two counts. First, they will have to get to the business of investing on 'seed development and supply of infrastructure'; second, they should enter in to a clearly defined ' buy back system, ensuring the right price.
- Interact closely with the state and central governments to pickup the threads hand in hand to promote biodiversity conservation. Financial resource pooling is one such approach. This is a matter of sharing responsibility in financing biodiversity conservation between the corporate sector state and central government, a process initiated by CII already.
- Develop in-house biodiversity policies and strategies to manage the biological resources the company affects and also respect the concerns of local communities and other stakeholders. Methods for education and training to instill a biodiversity conscious culture within company management should be explored.
- Share information, knowledge and practices with the local communities to develop a herbal based drug sector.
- Adopt measures, which ensure sustainable use of biological resources. The measures may be explored for the moral responsibility of corporate sector going beyond monetary and material consideration such as respecting the sanctity of critical natural habitats and threatened species.
- Create awareness regarding the need for appropriate intellectual rights regimes, respecting the knowledge, innovations and practices of indigenous and local communities and ensuring that collection and use of biological and genetic resources is done within a framework/guidelines of such respect.
- Engage in active partnership amongst corporate sector, research institutions and biodiversity conservation organizations as well as with the general public and with local communities for the management of important species and ecosystems.
- Instituting incentives and awards for members of the corporate sector who adhere to a definition of "progressive" in terms of being biodiversity-friendly and respectful of local community livelihood rights.

### 4.5 Action on pricing policies

Under the NBSAP process it is intended to reduce the gaps and margins between the collectors' and the market price on biodiversity related resources. A direct approach of transactions from farmer to consumer should be developed (as is being done in Karnataka state). Other measures required are:

- The local collectors and communities should be the price setters, and they should be educated to realize its true worth or value,
- The gains from the natural resource extraction and use should by and large be based on *in situ* distributional benefits,
- It should be corrective for sustainable extraction rates (based on the concept of carrying capacity), proper use of land and water resources and ecological conservation.

### 4.6 Strategy and Action Plan on Valuation

The major recommendations for the NBSAP process based on the experience with the methodology of Valuation are:

1. Studies on economic valuation of various ecological functions of biodiversity should be encouraged. There should be more research on methodologies for estimating non-use values.
2. The economic benefits of biodiversity enjoyed by the private sector companies including MNCs require special attention and there should be some mechanism to capture a portion of these benefits for investing biodiversity conservation programmes.
3. A Social Science based research institution be identified by MoEF, which can undertake studies on valuation on a continual basis, almost on the lines of EIA for project clearance. It should initiate to bring out a publication on rapid and cost effective valuation methodologies for valuing biodiversity.
4. Some of the specific actions required in valuation are:
    - For assessing ecological losses, the structure of the forest ecosystem is to be estimated by three main ecological attributes viz. Importance value Index (IVI), population dynamics and species diversity, where as the functioning of the ecosystem is to be ascertained with the help of bio mass studies, litter fall and transfer of mineral within the various biotic and abiotic compartments of the ecosystem.
    - All the forest types, as classified by Champion and Seth, the major ecological function(s) and appropriate methodology of valuation be identified and demonstrated.
    - Specific attempts be made to bridge the data gaps on all types of biodiversity resources.
    - Precisely developed model studies of ecological valuation be developed (to explain the problems of double counting, problems of benefit transfer methods, contingent valuation method, cost benefit analysis etc.).

### 4.7 Action/Strategies on Natural Resource Accounting.

The progress on this at the national scale is very much limited. Some of the lessons fro the on-going exercises are listed here for further actions.

- The data base requirements for Natural Resource Accounting are quite high. Central Statistical Organisation should have a separate wing to collect the necessary data exclusively for natural resource accountings.

- More and more studies on valuation be built-in the NBSAP process to address to aspects such as depletion, degradation, preservation, inter-generational values, dose-responses etc.
- Environmental economists and statisticians should continue to demonstrate the possibilities to adjust the domestic products for all the natural resource related issues, some of which may not directly appear in the traditional income accountings (e.g., biodiversity).

### 4.8 Strategy/Actions on Indian medicinal systems

Under the NBSAP process, special attention must be given to develop Indian medicinal system. Several newer directions of actions and strategies are required for this:.

- Regular assessment of demand from the Ayurvedic and cosmetic sectors;
- A comprehensive study needs to be undertaken on the economic impact of ayurvedic industry on biodiversity conservation (using green accounting principles).
- A forum to bring together industry, Forest Department, NGOs and others needs to be established. They should deliberate upon the matters such as rates of extraction, federating on processing standards and management, pricing system etc.
- Finally, the legislation should distinguish different intermediaries and collectors of medicinal plants from forests. Sale of such products by cooperatives such as Girijan Co-operatives and other federations should not be equated with private contractors and middlemen of drug companies. Accordingly, 'prior intimation' provision of clause 7 of the proposed Biodiversity Legislation Bill should not apply to the former. Furthermore, the question of them being subjected to producing 'legally procured certificates' prior to transacting the raw materials to the Ayurvedic industry directly be examined again.

### 4.9 Strategy/Action regarding Joint Forest management

Considering that JFM already covers over 13 percent of the recorded forest area of the country and the area is likely to increase even more in the future, attempt should be made to include biodiversity conservation as one of the explicit objectives of the JFM programme. Some of the major actions needed are:

- There is the need to explore the link between biodiversity conservation and long term sustainability and community linkages of JFM.
- For this, the JFM Cell in MoEF should be restructured. There are a large number of studies on the performance of JFMs all over the country. Therefore, the National JFM Network and News Letter should carry the messages on biodiversity related issues and findings. Training programmes on alternative economic valuation methods should be organised for the officials of the Forest Department as well as NGOs active in the field of JFM.
- At the time of JFM micro-plan preparation, biodiversity conservation strategy should also be included in the micro-plan. Instead of using the standard Cost-Benefit Analysis, Stakeholder and Multi-criterion Analysis are to be introduced in the NBSAP process.

## Abbreviations

| | |
|---|---|
| AnGR | Animal Genetic Resourcesc |
| ASDP | Adjusted State Domestic Product |
| AUSAID | Australian Agency for International Development |
| BCPP | Biodiversity Conservation and Prioritization Plan |
| BOD | Biological Oxygen Demand |
| BPL | Below Poverty Line |
| BPM | Ballarpur Paper Mills |
| BV | Bequest Value |
| CBA | Cost Benefit Analysis |
| CBD | Convention on Bio-Diversity |
| C&I | Criteria and Indicator |
| CISMHE | Centre for Indian Studies on Mountain and Himalayan Ecology |
| COD | Chemical Oxygen Demand |
| CPR | Common Property Resources |
| CR | Contingent Ranking |
| CSE | Centre for Science and Environment |
| CVM | Contingent Valuation Method |
| DANIDA | Danish International Development Agency |
| DC | Damage Cost |
| DFID | Development Fund for International Development |
| DFO | Divisional Forest Officer |

| | |
|---|---|
| DUV | Direct Use Value |
| EEC | European Economic Commission |
| EIA | Environmental Impact Assessment |
| ENDP | Environmentally Adjusted Net Domestic Product |
| ESDP | Environmentally Adjusted State Domestic Product |
| ETS | |
| EU | European Union |
| EV | Existence Value |
| FAIDA | Food and Agricultural Integrated Development Action |
| FAO | Food and Agriculture Organisation |
| FD | Forest Department |
| FDES | Framework for the Development of Environmental Statistics |
| FPC | Forest Protection Committee |
| GDP | Gross Domestic Product |
| GEF | Global Environmental Facility |
| GIS | Geographical Information System |
| GTZ | |
| GW | Giga Watts |
| HFD | Haryana Forest Department |
| HH | Household |
| HP | Himachal Pradesh |
| HRMS | Hill Resource Management School |
| ICRISAT | International Council for Research in Semi-Arid Tropics |
| IIHR | |
| ILRI | |
| IOC | Indian Oil Corporation |
| IPR | Intellectual Property Rights |
| ITC | Indian Tobacco Company |
| ITDG | |
| ITCM | Individual Travel Cost Method |
| IUCN | International Union for Conservation of Nature |
| IUV | Indirect Use Value |
| IVI | Importance Value Index |
| JFM | Joint Forest management |
| JVS | |
| KFW | |
| KM | Kilometer |
| M | Metric Cube |
| MBI | Market Based Instruments |
| MNC | Multi-national Corporations |
| MoEF | Ministry of Environment and Forests |
| MPI | Market Price Index |
| MPTDC | Madhya Pradesh Tourism Development Corporation |
| MSY | Maximum Sustainable Yield |
| MT | Metric tonne |
| NAEDB | National Afforestation and Eco-Development Board |
| NBSAP | National Biodiversity Strategy and Action Plan |
| NCA | Net Cropped Area |
| NCT | National Capital Territory |
| NDP | Net Domestic Product |
| NGO | Non-Governmental Organisation |
| NPV | Net Present Value |
| NSDP | Net State Domestic Product |
| NTFP | Non-Timber Forest Product |
| NWDB | National Wastelands Development Board |
| NUV | Non-Use Value |

| | |
|---|---|
| OECD | Organisation of Economic Cooperation and Development |
| OECF: | |
| OV | Option Value |
| PE | Preventive Expenditure |
| PV | Present Value |
| R&D | Research and Development |
| RLC | Relocation Cost |
| RPC | Replacement Cost |
| RSC | Restoration Cost |
| SA | Stakeholder Analysis |
| SAP | Structural Adjustment Programme |
| SC/ST | Schedule caste and schedule tribes |
| SDP | State Domestic Product |
| SEEA | System of Environmental and Economic Accounts |
| SIDA | Swedish International Development Agency |
| SM | Simulated Market |
| SNA | System of National Accounts |
| TCM | Travel Cost Method |
| TD | Tourism Department |
| TERI | Tata Energy Research Institute |
| TEV | Total Economic Value |
| TVS | TV Sundaram |
| UK | United Kingdom |
| US | United States |
| USA | United States of America |
| UNDP | United Nations Development Programme |
| UNSTAT | United Nations Statistics |
| UV | Use Value |
| VFC | Village Protection Committee |
| WRI | World Resources Institute |
| WWF | World Wildlife Fund |
| WUA | Water Users' Association |
| WTA | Willingness to Accept |
| WTP | Willingness to Pay |
| ZTCM | Zonal Travel Cost Method |

## Local Terms Used In The Report

| Chapters | | | |
|---|---|---|---|
| **Three** | **Four** | **Five** | **Six** |
| Rampatre | Kendu | Trapa | Ayurvedic |
| Mohuva | Sal | Malbar kino | Panchayat |
| Karanji | Dhir | Fir/spruce | Cenchuriyia and sutan |
| Singli-mingli | Khair(kil) | Bank oak | Chakriya vikas pranali |
| Dhup | Salar | Mohru oak | |
| Amla | Bel | Karsu | |
| Anar | Sisham | Maple | |
| Katha | Khera | Katha (acacia katechu) | |
| Arya Vaidya Pharmacy Ltd. | Fir | Chil (pinus roxbughis) | |
| Adivasi | Deodar | Deodar (cedrus deodar) | |
| Tendu leaf | Oak | Venchur | |
| Mahuva flower | Sain | | |
| Kadikal | Axe hewn (karries) | | |
| Pungam kernels | Dimdimas | | |

| Three | Four | Five | Six |
|---|---|---|---|
| Poochakai | Side slabs (passellas) | | |
| Chikakai | Hakares | | |
| Anola | Round ballis | | |
| Chironji | Logs geltus | | |
| Oppage | Khair billets | | |
| Janapara vigyana samsthe | Kail | | |
| Bhabbar | Chil | | |
| Patta Balwadi | Kokat | | |
| | Simbol | | |
| | Neeja | | |
| | Popular | | |
| | Sirse | | |
| | Kikar | | |
| | Goldmore | | |
| | Mulbery | | |
| | Talaabs | | |
| | Haigad | | |
| | Tarai | | |
| | Bhiga | | |

# Education, Awareness And Training Thematic Strategy and Action Plan

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The Education, Awareness and Training (EAT) Thematic Working Group (EATTWG) met three times, of which two meetings were in a workshop mode, with several other individuals present. Certain challenges for Biodiversity education were identified in the context of which the EATSAP has been prepared.

## Challenges For Biodiversity Education in India

1. Conservation of diversity is neither a value nor an activity that can be undertaken in isolation of an appreciation of diversity - diversity of cultures, languages, lifestyles, beliefs, etc. Diversity and variety are a given in India - they are so inextricably a part of our lives, that we are not even necessarily conscious of them. They are a part of our lives, and traditionally, there has been an inherent acceptance, understanding and appreciation of diversity. And it is this appreciation of diversity, including of biodiversity that has sustained the richness of life around us.

   An important educational challenge is to see how we can keep alive this larger appreciation of diversity in our lives. Today's development paradigm is towards decreasing diversity in all walks of life and in collapsing it. True diversity is today getting replaced by 'brand diversity'. With a proliferation of brands, there is an illusion of diversity, while it is almost the same thing that is being sold under different names.

   Specifically related to this aspect are development policies that undervalue biodiversity. Whether it is forestry programmes that use exotics for afforestation or agriculture policies that promote monoculture, they have not internalized the need for biodiversity in various aspects. There is an urgent imperative, therefore, to reach out to policy makers and decision makers, not only to sensitize them to these issues, but also to provide them information on alternative development paradigms and models and authentic, specific, micro-level data and information on which they can base their policies and decisions.

2. Linked to this is the need to conserve our traditional knowledge and indigenous systems, to document them, and to find innovative ways to build conservation systems based on them as well as integrate them into the present-day conservation values and techniques.

   The formal education process also does not give recognition or value to traditional knowledge and the knowledge of communities, accelerating the process of erosion of this knowledge. Educational planning has to be done so that not only is this knowledge recognized, but also given legitimacy and value.

3. Decisions regarding the environment cannot be generalized, because they are governed by local physical, geographical, economic and socio-political realities. Hence a 'one size fits all' approach to making policies, laws, and programmes is not always the best. While there can be guidelines and principles specified on which decisions can be taken at the local level, biodiversity-related policies are not likely to work if they over-specify details, leaving no flexibility at the field level. This too is an understanding that policy makers need to internalize.

4. Another challenge for biodiversity education is to bring about the realization that biodiversity conservation must involve various stakeholders. In a country like ours, where the lives of most people are closely linked with bio-resources, both as users and as traditional conservers of these resources, it would be impossible to conserve biodiversity without multi-stakeholder partnerships. Our policy makers and decision-makers need to be sensitized and oriented so that this becomes the fundamental premise for developing policies, laws and initiatives for biodiversity conservation. Significant initiatives have been made in this direction, especially in the area of Joint Forest Management. This needs to be consolidated and built upon in various other areas of biodiversity conservation.

5. With multi-stakeholder participation becoming a reality, there is also a need to reach out to the various stakeholders simultaneously, and capacity-build them to participate effectively in conservation and management of resources.

6. The points above underscore the importance and urgency of reaching out to the forest departments, agriculture departments, and other such organs of the government (both central and state), which take decisions that impact our biodiversity, and which need to be urgently sensitized. There is a need to reach out to various levels of these agencies, to orient and educate them, on an ongoing basis, with regard to emerging biodiversity concerns, perspectives, thinking, etc.

7. A fundamental challenge confronting educators today is that education itself is alienating us from our resources, from our environment, from our traditions, from knowledge of our environment. Textbooks and classroom teaching do not help the child to learn about what it can see and experience. In fact, real life experiences of the child are not recognized as valid, or taken cognizance of. This leads the child to keep academics and real life in two compartments, and not relate the one to the other. This is inimical to the spirit of environmental education. There is an urgent need to close the loop and demonstrate the links of textbooks to life around us.

8. If we have to conserve our biodiversity, our education has to re-emphasize the value of diversity in every walk of life. It has to bring home that our diversity is our strength. From this, an understanding of the value of biodiversity and its conservation will follow.

9. Today's education is leading to alienation of young people from the immediate environment and its resources. Policy frameworks, which do not give stakes to communities in their resources further, alienate people. In this situation, a key challenge before education today is how to re-awaken the sense of ownership of biodiversity among the people. For it is only with this that the traditional care and concern that communities gave to their resources and for environment will be rekindled.

   This would need re-thinking on education itself, at a fundamental level. This will happen only when educational planners and administrators are sensitized to these needs.

Laws that do not have popular support will not work. Policies whose implications are not understood cannot be interpreted into effective action. A resource whose value is not communicated will not be valued and conserved. And for all this, education and communication are necessary. But a challenge facing the educational community today, with regard to biodiversity education, is the fact that Education and Communication are not adequately recognized as tools that are integral for biodiversity conservation. Education is seen as an add-on, as a luxury, as something to pay lip service to, perhaps. But it is still not seen as an integral part of a management strategy.

The commercial world understands the importance of advertising and knows what results it can bring. Therefore, not only is advertising an essential part of a marketing strategy, but also, sufficient budgets are allocated to it. In the conservation world, even when education is recognized as a legitimate activity, nowhere near adequate resources are set-aside for this. Education efforts therefore get reduced to tokenism – with a poster printed here, and a film made there.

It is essential that those involved in making policies and programmes for biodiversity conservation recognize the key role of education, integrate it into the strategies for conservation, and resource it adequately.

## Strategy

The groups that Education, Awareness and Training efforts have to reach are wide and varied. The messages are complex. Hence a great diversity of approaches is needed. While there is probably no section of society that falls outside the purview of biodiversity education, the following have been prioritized as most significant.

1. Public awareness
2. Formal education system
3. Government agencies and decision makers
4. Information systems to facilitate decision-making
5. Formal training system
6. Industry
7. Specific professional and occupational groups
8. Groups with special needs

## Elements of a Successful EAT Strategy

It is important to look at conservation strategies used over the past few years in India and elsewhere from a conservation point of view, to analyze what has worked and what has not, and to identify the effective communication strategies, or elements. Learnings from some of these include:

1. Using an icon or a single message, which is easily recognized, but which forms the fulcrum on which a deeper conservation action rests, for example in Project Tiger
2. To identify 'lead' individuals as key resource persons, and create forums for them to address the systems/sectors they belong to
3. To identify key entry points that would effect systemic changes, for example, by 'greening' of textbooks
4. To reach key groups, targeting at a leverage point, which will lead to change, for example, making the judiciary environmentally sensitive
5. By using the diversity of our country as a basis of design, such as done by NCERT, which provides a curriculum framework, which is then adapted by the states to create their own curriculum and textbooks
6. Using the specialist knowledge and experience of India's vast network of institutions and NGOs, as well as information systems like the ENVIS
7. Using the multiplier effect
8. Developing partnerships that utilize the complementary strengths of various organizations, as key to avoiding duplication and for synergistic convergence of ideas and efforts.
9. Using existing opportunities, such as the few hundred zoos and botanical gardens for EE
10. Developing a cadre of environmental educators to effectively plan and carry out strategic educational interventions.

## Public Awareness and Reaching out to Local Communities

### Communities in rural and tribal areas

India has had a strong conservation tradition, with a diversity of practices and beliefs. There is a need to develop innovative and creative ways of sustaining, protecting and encouraging such conservation traditions, in the contemporary context. Some examples of ongoing initiatives include Joint Forest Management and Ecodevelopment, and a wide range of NGO initiatives such as promotion of home gardens by the FRLHT, documentation and dissemination of grassroots innovations by the Honey Bee network, training of animal health care workers by Anthra, sustainable use of forest resources by the Soligas in BRT Hills sanctuary and community monitoring for the same, etc.

The crisis for occupational groups and communities that depend on biodiversity is not just of loss of biodiversity, but also of the loss of community knowledge associated with its use. While documentation of local biodiversity and community knowledge is required, appropriate safeguards need to be built in and understood in the light of IPR issues.

It is important that Ecodevelopment and Joint Forest Management are properly understood as development tools, and the institutional mechanisms to facilitate these created.

### Desired Actions

1. **Work with communities to strengthen community knowledge**
   Document, develop and widely disseminate popular District Biodiversity books/booklets. Learnings from the Literacy Mission experience on developing locale-specific, popular, simple readers could be basis for this. These booklets would which document traditional knowledge of biodiversity. This must be done by/with local people, not just by outsiders, and should include:
   a. Traditional community systems of teaching, learning and training.
   b. Information, knowledge and understanding of agrobiodiversity that rests in rural communities and how it is affected by market forces
   c. Traditional home gardens, and the biodiversity therein.
      The documentation should not only consist of descriptions of knowledge systems and their use, but also information on the threats to its survival. Particular emphasis must be placed on practices recognizing environmental limits to sustainable exploitation of the resource.

2. **Enhance biodiversity documentation**
   In the context of biodiversity registers, a mechanism needs to be evolved to link local barefoot taxonomists with scientists of BSI/ZSI/Fisheries Survey of India, and other such relevant institutions. For this organize workshops (national as well as at ecoregional/biogeographic zone levels) to develop institutional mechanisms and capacity building for scientists and 'barefoot taxonomists' to interact with each other. This should include:
   a. Development of material in a variety of formats (print and AV), including identification keys, for 'barefoot taxonomists' to enhance identification and information in biodiversity registers.
   b. Discussion and documentation of identification and classification methods used by barefoot taxonomists.
   c. Discussion on IPR issues

d. Joint training programmes in different regions using the experience of preparation of CBRs so far, including that of resource monitoring in the BRT Sanctuary by the Soligas.

3. **Enhance awareness of current biodiversity issues among local communities**
Develop, in simple formats with examples and illustrations, and widely disseminate in several local languages, books and booklets on
   a. National and global values of local biodiversity, agro biodiversity and related knowledge and the needs and ways of protecting them
   b. IPRs, and innovative practices in benefit sharing
   c. Negative consequences of exotics, hybrids and invasive species, and where information is available, on how to control them.
   d. Threats to biodiversity
   e. Environment and biodiversity related laws.

   Specialist EE agencies must take up responsibility for developing simple formats and content and regional agencies, including universities can integrate locale-specific content and disseminate among communities they work with.

4. **Education and communication for strengthening ecodevelopment**
   a. Prepare directory of individuals, NGOs, CBOs, institutions specifically working in and around PAs.
   b. Capacity build the above and government functionaries in education and communication and participatory work, to enable them to work more effectively.
   c. Using existing material and case studies such as those of Vivekananda Girijan Kalyan Kendra in the Biligiri Rangaswamy Temple Sanctuary4 on ecodevelopment, develop basic reference material for CBOs, in local language and simple formats to enable NGOs, CBOs and community groups to take up these activities.
   d. In areas where there are significant human-wildlife conflicts, develop and offer through state nodal agencies, locale-specific information and training package to support or strengthen sustainable biodiversity based livelihoods, and methods to mitigate conflicts, including methods to tackle crop depredation.

5. **Strengthen education and communication for effective Joint Forest Management**
   a. Enable wide sharing through various media, of experiences of JFM including analyses of success and failure of these experiences and learnings from these.
   b. Foster capacity building of NGOs to facilitate JFM
   c. Sensitize relevant local departments to the JFM process, and its step-by-step implementation.

6. **Develop ecotourism as a means of income for local communities**

MoEF needs to set up a mechanism with the Tourism Ministry to establish nationally acceptable guidelines for recommended practices, codes of conduct and certification procedures. For this, experiences of Ecotourism, such as that in Kanchendzonga, and in other parts of the country, may be used, and if necessary, pilot projects done, to firm up a set of principles that ecotourism projects must follow. A national workshop may be organized to facilitate this. Pilot projects based on these principles and detailed guidelines can then be done in various representative situations in the country.

For pilot projects:

   a Select tourism sites for pilot projects, ensuring a representative range of situations (including stakeholders and ecosystems) for the country.
   b Organization of stakeholders' meeting at selected sites.
   c Set up interpretation and other facilities and hand over to the appropriate government and community institutions.
   d Develop local strategies for conservation education through the sites, defining roles of various stakeholders, and assessing capacities.
   e Conduct training programmes for stakeholders, including officials, community groups, tour operators, and hotels for the functioning of the interpretation programme and other facilities.
   f Develop and implement educational programmes for local communities
   g. Give local communities a stake (economic) in ecotourism especially at heritage sites.

7. **Strengthen understanding of impacts of tourism and the role of local self-government institutions in sustainable tourism**
   In areas of high tourist visitation, and potential visitation, conduct workshops with local authorities and local communities, including on
   a Rights of panchayats regarding tourism development in the area, and expectations from tourism industry.

b Management of tourism sites
c Visitor behaviour in tourist sites.
d. Sustainable volumes of tourist traffic
e. Appropriate regulatory infrastructure

8. **Popularize technologies for sustainable development**
   Prepare and publish popular material in local languages documenting the use of ecofriendly technologies.

9. **Document and disseminate experiences of environmentally sound farming**
   Using learnings from the Honey Bee Network experience, document success stories of farmers who are following traditional systems of cropping with good yields, of farmers who are cultivating traditional crops, which are on the verge of extinction. These case studies should be widely disseminated in local languages using farmers' networks, extension workers, NGOs, CBOs, media, etc.

10. **Develop communication skills of key groups in diverse ways (including oral communication) to support biodiversity education and communication**

11. **Strengthen community conservation**
    An innovative education/communication strategy needs to be designed to strengthen traditional protection of community-conserved areas, keeping in mind that that these traditions are in different contexts and are of different types. Organize a national workshop with the objective of developing the nature and scope of an enabling and innovative scheme to strengthen community conservation.

12. **Strengthen media especially radio and traditional media to give relevant messages for biodiversity conservation.**

## Communities in urban areas

There is a critical need to educate urban citizens about the impacts on biodiversity of their consumption, and the ecological implications of urban lifestyles, as well as their increasing alienation from natural resources. There is a need for much greater public awareness, which can lead to action within cities for biodiversity conservation.

People living in urban areas are aware of wildlife and biodiversity in natural areas, but often do not appreciate biodiversity in their own surroundings.

Involving urban communities more actively in ward-level issues can help bring a measure of responsibility and thought to local natural resource management. Sites such as museums, zoos, botanical gardens can become an excellent educational resource to create awareness about the local resource conservation traditions, local culture, flora, fauna, and ecosystems. Interpretation and awareness programmes at such facilities need to be strengthened.

### Strategy

1. Popularize environmental best practices especially in ward level forums.
2. Promote awareness programmes about how individuals and communities can contribute to larger scale environmental conservation.
3. Enhance awareness about ecosystem services
4. Facilitate citizens groups to bridge the gap between awareness and action
5. Enhance networking among nature clubs
6. Promote people's initiatives to inventorize urban environmental assets.
7. Enhance awareness of macro biodiversity conservation and loss
8. Promote awareness of lesser-known foods and the linkages of biodiversity with nutrition.
9. Link consumer education to lifestyles
10. Enhance the role of museums, zoos, and botanical gardens

#### Desired Actions

1. **Popularize environmental best practices**
   a. Document and publicize, through media and NGOs, best practice case studies related to reducing impacts of urban lifestyles and consumption, waste management, water conservation, energy conservation, greening urban spaces, ecorestoration of biodiversity rich habitats, etc.
   b. Capacity build public awareness/relations cells in municipal corporations and councils, and NGOs to develop, adapt and

widely disseminate education/communication material to promote awareness among the urban populace on the above mentioned issues.

c. Develop methods to reach these to ward and locality level civic forums.

d. Develop small booklets, posters, slide shows etc about services provided by different ecosystems and natural areas in urban environs. Disseminate these to NGOs, nature clubs, and youth groups for use with their audiences.

2. **Facilitate citizens groups to bridge the gap between awareness and action**
   There is a need to link public awareness efforts to advocacy and action. For this, document and popularize through media, NGOs and in local languages, cases of where public awareness has led to advocacy and action, especially in the case of biodiversity conservation. These could also have sections on 'what to do when...'

3. **Networking nature clubs**
   Networks of nature clubs, birding groups, youth groups should be supported/enhanced for conducting rapid surveys/monitoring of key species. This is especially important when things need to be done in a campaign mode, as in the case of the disappearing the vulture.

4. **Enhancing awareness of macro biodiversity conservation/loss**
   Identify case studies of examples where a) there have been unintended or indirect loss of biodiversity due to some major development intervention, and b) where biodiversity has been saved/conserved due to various types of intervention. Generic learnings should be brought out from these examples, and these case studies should be popularized, in the mass media, to policy groups, training institutions and NGOs.

5. **Promoting awareness of lesser known foods**
   Initiate a biodiversity campaign in collaboration with commercial agencies for promotion of lesser-known varieties, such as of rice or mango, in order to create a demand for these, which in turn will induce farmers to cultivate and conserve these varieties.. Organize a workshop to orient well known individuals writing on food, hosts of TV programmes on recipes and home management on the importance of agro biodiversity, and work out ways of reaching this through these individuals to the general public.

6. **Link consumer education to sustainable lifestyles**
   There is a need to more closely link consumer education and moving towards more sustainable lifestyles. Advocacy groups, legislators working on consumer issues need to take this into account. To facilitate this, organize a national workshop with following as outputs
   a. Strategy for linking consumer education to environmental issues and lifestyles, especially in urban high consumption families/sectors of society.
   b. Awareness strategy to reach consumers
   c. Work out ways of networking urban consumers with farmers producing diverse, lesser-known foods.

7. **Enhance the role of museums, zoos, and botanical gardens**
   a. Organize workshops for managers, curators of museums, zoos, and botanical gardens on the potential of such sites for conservation education, tools such as interpretation, and the need for proactive environmental awareness campaigns and outreach activities by these facilities.
   b. Develop interpretive programmes in a range of facilities, including city parks, botanical gardens, zoos, museums (not only those devoted to natural history), college museums, places of worship (which have biodiversity related legends/practices), monuments etc.

Support may be accessed from ICOM for digitizing information on collections of natural history museums.

## Formal Education Systems

The movement of Basic Education launched by Mahatma Gandhi in 1937, was perhaps the first serious attempt at relating education in schools to local environmental needs.

The NCERT has worked consistently towards incorporating environmental concepts in textbooks, as also training teachers for EE. The National Curriculum Framework for School Education, 2000 too recognizes the importance of EE.

Much has been done for strengthening EE in schools through initiatives like the Scheme for Environmental Orientation to School Education (EOSE) of the Ministry of Human Resource Development (MHRD), the work of the Centres of Excellence of the

Ministry of Environment and Forests and the MoEF National Green Corps scheme. The MHRD through the NCERT is working towards environmentalizing curricula and textbooks and in teacher training. Various states have also taken both curricular and co-curricular initiatives.

An innovative recent initiative is the 'Environmental Education in School System (EESS)' is a subcomponent of the India Environment Management Capacity Building Project undertaken by the Ministry of Environment and Forests (MoEF), Government of India, and supported by the World Bank. Centre for Environment Education is the Consultant to MoEF for the implementation of this project. Phase I (completed) involved a detailed study of the status of infusion of environmental concepts in school curricula in the country and the status of teaching of EE in schools. This was undertaken by the Bharati Vidyapeeth Institute of Environmental Education and Research, Pune. Phase II is underway, and involves pilot implementation of the programme in eight states at the middle school (Std VI, VII, VIII ) mainly through impacting the teaching of Science, Social Studies and Languages and through extra and co-curricular activities. The participating states are Andhra Pradesh, Assam, Goa, Jammu and Kashmir, Maharashtra, Orissa, Punjab and Uttaranchal.

Over the years, several NGOs have also responded to the need for EE in the formal school system, and have made efforts to enrich the school experience, both for teachers and students. There are several examples of school-based EE in the country, including those of Kerala Shastra Sahitya Parishat, Uttara Khand Seva Nidhi, the Bharati Vidyapeeth Institute of Environment Education and Research, the Hoshangabad Science Teaching Programme, the Nature Clubs of India programme of the WWF for Nature India, the work of the schools of the Krishnamurthy Educational Foundation, efforts of Vivekananda Kendra, especially in Arunachal Pradesh, CEE's National Environmental Education Programmes for Schools, and several hundred initiatives taken by concerned parents, teachers and others in the community.

Some of the ongoing mechanisms that support extra-curricular school-based environmental education include:

- National Green Corps of the MoEF
- Scheme for Environmental Orientation to School Education of the Ministry of Human Resource Development
- Many schools and NGOs access support under NEAC to conduct a variety of awareness programmes and have developed educational material.

While innovative small-scale projects should be encouraged, a mechanism needs to be worked out to help integrate such learnings into the mainstream state-run national and state-level school systems. Both innovators and state-run education agencies need to be able to share experiences and constraints. These experiences need to be analyzed for the extent to which they are able to provide area-specific, culture-specific, activity and discovery-based teaching learning environments, with matching teacher training.

Such a mechanism requires decentralized capacity building, which NGOs can become partners in. The formal school administration at national and state levels, the SCERTs, textbook bureaus and related state agencies must help create decentralized capacities, not only administrative but also academic.

### Vocational and Technical Education and Training in Schools

Vocational education may be used as a method of creating awareness about and capacities to use ecofriendly technologies. However this would require development of specialized textbooks, teachers, teacher training etc.

### Traditional knowledge systems

Formal education, as well as NGO-driven extra-curricular initiatives need to widen their scope and give due importance to traditional knowledge.

There is also a need to learn from traditional teaching-learning methods, at home, and through the codified guru-shishya parampara. Modes of transfer of knowledge from one generation to the next need to be documented, learnt from, and encouraged as alternative paradigms.

The institutions of the formal system, as well as academic institutions can help by validating traditional knowledge systems and methods of transfer of information, and providing insights into the nature and scope of indigenous knowledge.

### Desired Actions

1. **Extend the EESS experience**
   a) Facilitate widespread sharing and use of the experience of greening textbooks and that of teachers and other stakehold-

ers in the pilot implementation in 8 states.

b) Education Depts. in all states should make available time and space to integrate the findings of the study of Phase I into future curricula and textbooks to be developed in the state, and the learnings from the pilot implementation phase, into the processes of textbook and curriculum development of other states.
c) Develop and deliver a strong orientation and exposure programme for staff in SCERTs, DIETs, textbook bureaus and related institutions which provide insights into the best EE initiatives, projects, materials in different parts of the country, as well as help state education departments plan for how best these can be integrated into the schools system.
d) Realign pre and in-service training of teachers, based on EESS experience and the larger school based EE experience in the country. This would also involve development of a national policy to integrate EE in pre and in service teachers training.
e) Develop mechanisms for providing career-based incentives to participating teachers.

2. **Strengthen the Scheme for Environment Orientation to School Education to develop innovative projects and materials**

3. **Enhance the role of NGOs and scientific institutions in school-based EE**
   Recognizing the role of NGOs in strengthening EE in schools, initiate a scheme for involving NGOs in school programmes and for supporting (including capacity building and financial support) NGOs in each district, using the NEEPS experience.

   Locale-specific biodiversity education, can play a key role in building positive attitudes among children, teachers and the community. Small locale-specific projects can greatly help to enhance regular school textbooks, which are generic for the entire state and therefore not able to go in depth into specific local issues. State of the art approaches need to be developed for location-specific biodiversity education.

4. **Enhance EE in states opting for Education Guarantee Scheme**
   a. Take stock of Shiksha Mission and HSTP experiences in MP.
   b. Identify NGOs in each state and district, especially in UP, Rajasthan and Orissa (states which have shown an interest in adopting the EGS model) to help strengthen EE in EGS and create locale-specific material.

5. **Enhance development of locale-specific biodiversity related material**
   Create special focus within existing schemes like NEAC, EOSE, and the NGC to develop biodiversity related material for schools, support biodiversity documentation by students, melas, and other activities. Also enhance these schemes with capacity building of NGOs for school-based EE.

6. **Enhance integration of ecofriendly technologies and sustainable use concerns in Vocational and Technical Education and Training**
   MHRD could set up a working group with selected high schools, polytechnics, Krishi Vigyan Kendras, small scale industries association, to work out possible sectors for vocational education, using ecofriendly technologies, and sustainable use of biodiversity. This would include developing course outlines, and working out mechanisms for instituting the courses.

7. **Strengthen interaction of EE agencies with teachers' networks**
   a. Identify networks of teachers in various states, such as the Science Teachers' Association of Manipur, All Goa Science Teachers Association and Maharashtra Geography Teachers' Association, and strengthen their activities.
   b. Strengthen interaction of EE agencies with these associations.

8. **Encouraging integration of traditional knowledge systems in formal systems (reference IK subtheme SAP)**
   a. Research and document systems of teaching and learning in indigenous knowledge systems. In some fields such as the performing arts, martial arts, indigenous medicine etc. this has been already done extensively. This could be used as a model for documentation in biodiversity related fields.
   b. Take up action research projects to try these out as mechanisms for revitalizing traditional knowledge, as well as for providing locale-specific education.

### Using sacred groves/ponds/lakes as resources for EE.

The BVIEER has been using sacred groves in the Sahyadris as effective educational resources for biodiversity awareness, for schools in the vicinity. This and other similar experiences could be extended to other schools near sacred biodiversity rich areas. This can be done through the NGC scheme of the MoEF. Nodal and Resource Agencies of NGC can facilitate development of appropriate educational material in local languages for this. School programmes can work with communities to declare such areas as mini-community-protected/conserved areas.

## Higher and Professional Education

A Supreme Court ruling of 1991 directs all colleges to introduce a course on environment in all undergraduate courses. The key institutional structure for incorporating environment and biodiversity concerns into colleges is the University Grants Commission (UGC); that for technical education are the All India Council for Technical Education (AICTE); and the Indian Council for Agricultural Research (ICAR) for agriculture education. These would be the key institutional structures for incorporating environment and biodiversity concerns into the respective streams.

Despite the Supreme Court ruling of 1991, most colleges have not actually introduced environmental courses.

There is also a concern that in existing of life science courses there is inadequate fieldwork requirement.

Several universities do offer postgraduate courses in Environmental Science. The biodiversity component in these Environmental Sciences needs to be assessed.

At the systems level, there is a need to integrate biodiversity and environmental concerns into specific professional courses, especially those professions that influence use of, and impacts on natural resources, and environmental management. These include agriculture, some engineering courses, law, and communication/journalism. In medical education greater emphasis is required on linkages between biodiversity and the formulation of drugs. The role of biodiversity in natural pest control and its relation to epidemiology and environmental health is needed to be understood and incorporated. The ICMR and IMA have a role in this.

There is a great need to promote taxonomy as a discipline, as well as to enhance expertise in under-explored areas of biodiversity (e.g., lower plants, animals and micro organisms). There is a dearth of specialist courses on different aspects of conservation biology and environmental remediation.

Several NGOs have been working with colleges to involve undergraduate and post graduate students in different regions to take up a variety of biodiversity studies, close to their own place, along with their teachers. Examples of colleges having taken up such studies, include those of Project LifeScape of Indian Academy of Sciences, Bangalore; of RANWA in Pune; the students' field studies and dissertations done at the Bharati Vidyapeeth Institute of Environment Education and Research, Pune; CEE South's Environmental Quality Monitoring programme in 9 districts with 20 undergraduate colleges; CEE's educational materials under its EnviroScope series for colleges, etc. The learnings from experiences such as those of Indian Academy of Sciences, CEE, Ranwa and BVIEER would be useful for developing appropriate curricula and material for colleges.

### Desired Actions

1. **Follow-up on Supreme Court ruling for introducing environmental course at undergraduate level**
   a. UGC to follow-up with all universities to report on how far and in what manner colleges have taken up the introduction of undergraduate course on environment in all faculties.
   b. UGC to work with universities to include dissertation projects based on biodiversity related field-studies at undergraduate and postgraduate levels for disciplines including Life Sciences, Environmental Sciences, Economics and Social Sciences, with credits for the same.
   c. UGC to work with MoEF to identify and contract an agency to develop and initiate teacher-training modules in biodiversity education at college level, including for refresher training.
   d. UGC to support development of bibliography on materials already available.
   e. Refresher courses for college teachers should have biodiversity components.

2. **Foster EQM, biodiversity mapping and census projects**
   a. University life science departments to develop and foster linkages between colleges and State Forest Depts. in order to include college students in environmental quality monitoring and wildlife census work.
   b. State Forest Depts. should initiate periodic training in monitoring and census techniques for college teachers, students.

3. **Promote taxonomy as a discipline**
   There is a need to revive interest among botany and zoology faculties and students in taking up taxonomy. To help in this, a grants scheme could be started for faculty and students to:
   a. Produce inexpensive and popular field guides on local flora and flora
   b. Take up action research for developing programmes to help build a cadre of parataxonomists drawn from the local community, working closely with college teachers/students

4. **Introduce specialist courses on conservation biology and environmental remediation**
   Identify and support a few universities and institutions to develop curricula and offer these courses. The intake to these courses should be limited and placement of graduates should be thought through as carefully as the syllabi.

5. **Strengthen Environmental law training**
   Bar Council of India should direct all universities offering law courses to introduce Environmental Law as part of their regular programme. The experiences of NLSIU, CPR EEC, WWF, Cochin University and others should be considered while devising the course curricula, teaching material and methodologies.

   Documentation of key environment and biodiversity related lawsuits is ongoing at these institutions; there is a need to develop these as course material and introduce these into existing law courses.

6. **Strengthen Environmental engineering training**
   In order to sensitize engineering course students to environment and biodiversity concerns, especially vis a vis impact on natural resources of professions including civil, mining, chemical, and production engineering etc., there is a need to:
   a. Develop basic course guidelines, materials on environmental concerns, as well as discipline-specific content on energy conservation and efficiency, minimizing impact, remediation, regulations, etc.
   b. Direct all engineering colleges to adopt such courses.

7. Integrate environment and biodiversity concerns in print and AV Journalism courses
   University departments of journalism, EMRCs can be focal points for
   - introducing specific environment and biodiversity related courses in the existing formal programme as electives.
   - organizing 'continuing education' sessions on these aspects for contact classes in a distance-learning mode.

For this
   a develop web-based distance learning modules
   b identify individuals across the country who can be guides for journalists taking up the courses.
   c Publicize widely to all print and AV journalists and university departments as electives.
   d Work with UGC and universities to expand the curriculum for undergraduate as well as postgraduate programmes in communication and journalism to include environmental journalism as an important subject. Where possible, this can be done by broadening existing subjects such as development communication or development journalism.
   e Introduce student awards for environmental reporting and film- making.

8. **Integrate biodiversity concerns into agriculture education and research**
   Initiate a participatory process of ICAR, SAUs, specialized institutions supported by ICAR, KVKs to examine the integration of biodiversity concerns into agricultural education and research.

   For this, organize national and regional (biogeographic region wise) workshops to develop guidelines, create interest and stakes among the formal agricultural education and research community, estimate budget and timeframe.

   An input into this workshop could be a document gleaning out and consolidating the concerns for conservation of domesticated biodiversity, agro ecosystems, livelihood security of agriculture based population, nutrition related concerns, indigenous knowledge etc from the relevant NBSAP documents ICAR should also,
   - Commission studies for all faculties for incorporating BD concerns in undergraduate and postgraduate courses, to be done with agencies identified by MoEF (drawing upon the expertise available in the institutions/individuals of the TWG on Domesticated Biodiversity).
   - Commission a project for revamping student projects/field experience terms to include biodiversity studies.
   - Arrange to modify syllabi to incorporate biodiversity concerns.
   - Work with MoEF to identify and contract agency/agencies to develop appropriate instruction material for different faculties, and also work for instructor orientation.
   - Document success stories in organic farming and initiate efforts to replicate them in different biodiversity contexts, through the SAU research efforts.
   - Incorporate farmers' indigenous knowledge into formal curricula.

9. **Strengthen agricultural extension education in SAUs**
   a. Assess technologies developed by the SAUs, to select those that are supportive of biodiversity conservation, and are espe-

cially appropriate for women and marginal farmers. These should be tried out in field situations with community groups, through NGOs, specific line departments (agriculture, women and child welfare etc). Learnings from these to be shared with researchers and community groups. Selected successful technologies to be absorbed in schemes of line departments.

b. Capacity-build SAU extension faculties in innovative methods of extension, using examples of technologies supportive of agro-biodiversity conservation.
c. Focus on dissemination of technologies in a farmer-friendly manner that provides options of farming as per resources available (land amount and quality, money, labour) with especially small and marginal farmers, rather than only crop specific packages.
d. Strengthen women's colleges and courses in agriculture.
e. Especially evolve guidelines for integrating impacts of technologies on the role of women in farming.
f. Develop guidelines for agricultural researchers to use diverse parameters for evaluation of a product, process or technology, not just production and productivity.

## Government Agencies and Decision Makers

### Central and State Planning

The Approach Paper to the Tenth Five Year Plan discusses the connection between environment conservation and economic development: "There is enough empirical evidence to establish that environmental conservation must go hand in hand with economic development because any economic development which destroys the environment will create more poverty, unemployment and diseases and thus cannot be called even economic development."

The linkages between livelihoods and biodiversity/other natural resources and sustainability issues need to be understood and internalized by all Planning Commission working groups and built into the designing and budgeting for the programmes finally taken up.

Another area that requires attention, especially in the light of increasing decentralization, is the need for capacity building at various levels.

A mechanism needs to be worked out to strengthen the understanding of biodiversity related information and concerns, as well as education, awareness and training tools, and integration of these in detail into the planning process at national and state level for future five year plans. Programme and schemes need to adequately budget for awareness, training and capacity building activities. This requires that planners be exposed to the role of education, awareness and training as tools of change, and the extent of resources required for these.

**Towards this, it is felt that the following government agencies and decision makers in the following systems need to be addressed:**

- Planning (Central and State)
- Legislature (Central and State)
- Executive/Administration (Central and State)
- Local self government institutions
- International - Government agencies negotiating on behalf of India in international fora

#### Desired Actions

1. **Orient national planning agencies**
   Biodiversity concerns need to inform the planning process, especially for sectors that directly impact biodiversity use and conservation for example Education, Women and Child Welfare, Agriculture, Chemicals and Fertilizers, Commerce and Industry, Forests and Wildlife. Orientation programmes for working groups in the planning process are necessary. It is also important to support these groups with usable sector-specific information. A mechanism could be set up by MoEF towards this. Towards this, it would be useful to:
   a. Set up 'shadow' working groups in advance of the Planning Commission's working groups. Groups and individuals who have developed the thematic SAPs could form the nucleus of these 'shadow' working groups. The task would be to prepare sector-specific briefing documents on biodiversity use and conservation and the relevant linkages for the Planning Commission working groups. These notes should also have specific recommendations for education, awareness and training requirements in these sectors.
   b. Based on these notes, a presentation and orientation kit containing overall biodiversity concerns, as well sector-specific recommendations could be prepared.

c. Presentation workshops for the relevant Planning Commission working groups, could then be organized when they are set up for the next plan.

2. **Orient state planning agencies**
   a Orientation material and presentation kit on the lines of that prepared for the Planning Commission need to be prepared for use at State Level. Adaptations should take into account local biodiversity concerns and can be based on state SAPs.
   b A series of seminars and field visits should be organized for State Planning Boards and working groups on the issues of biodiversity, conservation methods and technologies. These seminars should focus on how biodiversity concerns and possible solutions can be integrated into various programmes and schemes at state level.

   For example, in schemes related to agriculture, components for facilitation of seed banks at Panchayat level, agricultural technology, IPM, INM need to be integrated; in schemes for watershed development, the use of local grass, shrub, tree species, local forage vegetation on village commons and also the concepts of protection/conservation of village commons need to be promoted; in schemes for rural development, women and child welfare, and support to self help group, components on providing opportunities for products and technologies that aid biodiversity conservation and which can be used for income generation need to be integrated; in schemes for housing, the use of such technologies that reduce external high cost inputs and use local materials such as bamboo for roads and buildings can be integrated; in schemes for social forestry, the use of local indigenous varieties that communities desire need to be promoted and exotics discouraged.

3. **Enhance recognition of EAT as a tool of change**
   Education and Communication are not adequately recognized as tools that are integral for biodiversity conservation. Education is still not seen as an integral part of a management strategy. Planners need to be exposed to the role of EAT in biodiversity conservation, and the scale of resources required for these to be effective. Documentation and discussion of case studies of how EAT can lead to change, at national and state levels is required. For this:
   a Develop a format for identifying and documenting case studies of education, awareness and training related initiatives in biodiversity conservation activities, including both successes and failures, and the resources required for EAT activities.
   b Commission media persons, and NGOs, for documentation of such case studies.
   c Material produced out of this should be disseminated to relevant agencies and individuals involved in national and state planning.
   d These case studies should also be made available to the agencies that would be taking up the implementation of the NBSAP, so that they can integrate actions for capacity building (at the desired level and scale) in projects and programmes being taken up as part of the NBSAP implementation.

## Central and State Legislative

There are about 2500 people's elected representatives in the Lok Sabha (545) and the Vidhan Sabhas (about 2000).

It is necessary to strengthen mechanisms for reaching biodiversity-related concerns to elected representatives, not only for shaping environmentally sensitive policy in the country, but also as a means of effecting sustainable development initiatives in their constituencies. It is important that members raise constituency-specific environment and biodiversity issues with a well-informed and balanced perspective, at parliamentary, assembly or local levels.

Existing or ongoing initiatives for orienting elected representatives to environment and development concerns include occasional programmes organized by institutions such as the National Institute of Rural Development (NIRD), Hyderabad and the Centre for Policy Research in Delhi. The Centre for Science and Environment provided a detailed package on watershed management and drought to MPs. Sanctuary Magazine is dispatched to MPs regularly.

Opportunities for reaching out to elected representatives include newsletters and magazines such as Panchayat Raj Update and Yojana, which are sent out regularly to MPs.

### Desired Actions

1. **Identifying channels to reach elected representatives**
   As preparation for reaching various political parties, make directories of:
   a. Relevant legislative committees at state and central level.
   b. List of individuals to be contacted in each political party.
   c. Agencies that have orientation programmes and publications for elected representatives, or are conducting research and advocacy on policy issues.

2. **Servicing information needs of elected representatives**
   a. Develop a presentation kit on major biodiversity issues for the country. This kit can be adapted to the state level with state specific issues. The kit may contain various media products, e.g. booklets, CDs, slide shows, films, website, etc.
   b. Document and disseminate case studies and information on environmentally sound development policy and examples of where it has been put into practice
   c. Set up a mechanism in order to bring information and experiences relating to innovative strategies for conservation and sustainable development from across the country and the world to policy/decision makers. The mechanism should be one that can be easily accessed and provides regular and updated online information, to policy/decision makers. This mechanism could have as components email and web discussions, seminars, regular mailers on topics of interest, meetings with groups and individuals, request based supply of information.
   d. Organize 'Greening Politics' seminars open to all political parties to discuss how sustainable development may become part of their own agendas. Such discussions may also help elected representatives to bring about environmental improvement in their own constituencies.
   e. Provide forums for regular dialogue with other stakeholders especially biodiversity-dependent rural communities.
   f. Network groups and individuals using the platform of their existing forums, i.e. committees, party meetings, party magazines, newsletters etc.
   g. Foster the development of study groups at the constituency level to facilitate, document and disseminate information, and generate dialogue, on local biodiversity issues. These groups must include the concerned representatives, key local politicians (whether in or out of elected office), locally active environmental NGOs, academics, journalists and representatives of occupational categories whose livelihoods are closely linked to the conservation of biodiversity resources.

## Administration

At the Central government level, besides the Ministry of Environment and Forests, the Government of India's Ministries of Human Resource Development, Health and Family Welfare, Non-conventional Energy, Energy, Irrigation, Food and Civil Supplies, Agriculture; Urban Affairs and Employment, Rural Development; Small Scale and Rural Industries; Women and Child Welfare; Tribal Welfare; Chemicals and Fertilizers; Coal and Mines; Commerce and Industry, Tourism and Transport; and Defence are directly linked to biodiversity.

There are several Central and state sponsored schemes related to natural resource management and sectoral resource development, such as for ecodevelopment, joint forest management, and for promoting medicinal plants.

The programmes may not however adequately reflect concern for biodiversity especially impacts on biodiversity. It is essential that the values of biodiversity be understood, and appropriately integrated into central and state programmes and schemes.

There is a need for the bureaucracy to understand biodiversity concerns and develop pro-conservation attitudes. Biodiversity concerns and the learnings from the Ecodevelopment, Joint Forest Management, EOSE schemes need to inform the various other Centrally sponsored and state sponsored developmental schemes, such as those for Women, Youth, Farmers, Employment (urban and rural), Watershed development, Micro credit, Social forestry. This would help convergence, and make access and use of schemes easier and can help promote sustainable biodiversity-based livelihoods. Equally important is reformulation of schemes to create space and resources for capacity building.

### Desired Actions

1. **Integrating biodiversity and capacity building concerns into developmental programmes and schemes**
   a Develop a forum for interaction with key ministries and departments both at Central and State levels, on biodiversity related issues, especially to introduce the NBSAP and specific sector SAPs as appropriate.
   b Workshops/meeting of key functionaries of Ministries directly related to biodiversity (e.g. Agriculture, Employment; Rural Development; Women and Child Welfare; Tribal Welfare; Chemicals and Fertilizers; Coal and Mines; Commerce and Industry, etc) should be organized by the MoEF and/or the National Development Council to discuss the implications of the NBSAP and to work out ways of integrating recommendations into the programmes and schemes of each of them. These meetings and the plans emerging from them should especially integrate actions for capacity building at various levels in the new projects, programmes, and schemes being taken up.

At the state level, programme and scheme wise consultative groups need to be set up to work this out in detail, and especially integrate biodiversity related curricula in capacity building/training programmes related to these schemes.

## Local Self Government Institutions

In the rural areas of the country, Panchayat Raj Institutions exist/are being formed as per the provisions under the 73rd Amendment,

and the related state acts. All the state legislatures have not yet fully implemented the related state acts, especially for devolving funds to the local self-government bodies.

There are examples from Kerala and West Bengal that show how villages are using the provisions under the 73rd amendment to plan and use local resources according to local needs. However, in the majority of the country, at the local level, there is yet inadequate understanding of the powers available to local self-government bodies, and how the provisions may be used to enhance and sustainably use local resources.

Several institutions and NGOs are conducting training programmes for local elected representatives, especially women sarpanches, to explain constitutional provisions. Such forums can provide an opportunity to integrate biodiversity and natural resource management concerns into training and capacity building programmes.

Increasingly, several small-scale development projects are taken up/facilitated by local self-government institutions. It is essential to assess the environmental impacts of these. Such EIA processes can help build capacities in communities to make informed decisions about all development projects being taken up in their area. It is important to build capacities of and systems within local self-government institutions to assess environment impacts of development projects. The experience of capacity building for and actual conduct of EIA for small-scale projects under the World Bank supported District Poverty Initiatives Programme can provide useful insights.

For tribal areas, programmes and schemes of the Ministry of Tribal Affairs are intended to support and supplement the efforts of other Central Ministries, the State Governments/UT Administrations and voluntary organizations through financial assistance, and to fill critical gaps taking into account the situation of the Scheduled Tribes. These comprise schemes for educational development, economic development and social development. Most of these schemes are administered by the Ministry of Tribal Affairs and are mostly implemented through the State Governments and UT Administrations and Voluntary Organizations as Central Sector or Centrally sponsored schemes. (Source: Website of MoTA)

The Panchayat Extension to Scheduled Areas (1996) has been enacted, as part of the process of empowering local self-government bodies. This empowers the Tribal Panchayats and Gram Sabhas to have control over minor forest produce, minor minerals, minor water bodies, in addition to the provisions under Eleventh Schedule of 73rd Amendment.

While the enactment of PESA is definitely a major step forward, empowerment of Gram Sabhas or Tribal Councils is needed to strengthen protection of community-conserved areas, including forests, wetlands, grasslands, marine/coastal areas, that are protected/conserved for various reasons, of which sacredness is only one.

### Desired Actions

1. **Enhancing sustainable natural resource management through Panchayat Raj Institutions**
   a. Develop model course syllabi, materials and tools for orientation of Panchayat Raj institutions on biodiversity concerns. These should include local biodiversity concerns, and their links to national and global biodiversity concerns; threats to biodiversity; linkages between biodiversity erosion and local livelihoods; opportunities for sustainable use and enhancing livelihood security; methods to document local biodiversity; case studies of best practice; accessing support, etc. These programmes should help local panchayats to assess the status of their own natural resources, and aim at working out equitable and locally appropriate solutions for management in the current context.
   b. Adapt model materials for locale specificity by the State Institutes of Rural Development, and relevant NGOs.

2. **Develop capacities of Panchayat Raj Institutions to assess environmental impacts of small-scale developmental projects**
   a. Develop guidelines for environmental impact assessments for small-scale development projects, using the experience of the DPIP
   b Assess the experience under the DPIP of developing capacities of individuals and local institutions for conducting EIAs.
   c. Based on this, develop a methodology for widespread sharing with of the need for impact assessments of small-scale development projects, the processes for assessments, for accessing information and capacity building. Agencies working with local self-government institutions have a key role to play in this.

3. **Develop integrative mechanism between Ministry of Tribal Affairs and the MoEF focusing on biodiversity and sustainable development issues**
   Since biodiversity conservation is intimately related to the welfare of tribal communities, a joint mechanism of the MTA and the MoEF is desirable to dovetail efforts. For example, EOSE was a centrally sponsored scheme of the MHRD but had representation of the MoEF in the Empowered Committee. A scheme to promote innovative educational initiatives for biodiversity conserva-

tion while taking into account tribal welfare should be started. Nodal agencies may include nodal agencies of the EOSE who have \experience of handling such educational schemes, and the Tribal Research Institutes.

3. **Empowering tribal panchayats**
   Develop an orientation programme to help tribal communities realize their rights under PESA, develop guidelines for tribal panchayats, as well as for NGOs and state TRIs, on how tribal self-rule may be facilitated. This would involve:
   a. Development of content
   b. Development of communication tools and methods
   c. Development of delivery mechanism through TRIs and NGOs

## International

India is signatory to major international conventions and treaties regarding biodiversity. These include, besides the Convention on Biodiversity, the UN Framework Convention on Climate Change, Montreal Protocol, Kyoto Protocol, CITES, the Convention on Wetlands of International Importance, especially as Waterfowl habitat (Ramsar Convention), Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), and UNESCO's Man and Biosphere Programme.

The Ministry of Environment and Forests is the nodal agency in the country for participation in international agreements relating to environment, cited above. A deep understanding and sensitivity to biodiversity concerns is essential for those involved in these discussions. It is equally important for those involved in trade negotiations and other treaties.

The Ministry of External Affairs (MEA) and the relevant ministries who negotiate environment and trade treaties should be able to access inputs from different stakeholders in the country to evolve the position or stand that they need to take on behalf of the country when key issues come up for discussion and for conferences of parties of different treaties.

Learnings from the process of development of the NBSAP in India and the experiences of the multi-stakeholder consultations, media campaign, school competitions organized in the country as preparation for the World Summit for Sustainable Development should be used by the MoEF to develop a framework of enhancing civil society awareness about and participation in developing the national perspective for various international negotiations.

### Desired actions

1. **Enhance public awareness about international treaties**
   a. Using the experiences of the NBSAP India process and the WSSD preparation process, develop a framework for public awareness about all key international treaties related to environment (including trade related treaties), and methods of soliciting inputs from a variety of stakeholders in the country.
   b. Take up public awareness activities and processes for development of India perspectives for each of these treaties, using this framework.

2. **Orientation of India representatives**
   Develop a mechanism such as a multistakeholder seminar, for orientation of India representatives and for garnering inputs into the development of India's position for every COP or international meeting where key issues come up for discussion, with regard to the treaties mentioned above.

## Information systems to facilitate decision making

Data gathering and data dissemination are two aspects of information servicing to facilitate decision-making.

Some of the widest national data collection and statistical systems in the country are the census and the National Sample Survey Reports. Environment and natural resources related data collection systems include those of the Botanical Survey of India, Zoological Survey of India, Fisheries Survey of India, Survey of India, the National Remote Sensing Agency, the Space Application Centre and related state agencies, the Coastal and Ocean monitoring Predictive System (COMAPS) under the Department of Ocean Development, the Forest Survey of India, annual wildlife census conducted by the State forest departments, research studies conducted by agencies such as the BNHS, WII, SACON, universities etc., and flora and fauna lists by several NGOs, nature and youth clubs in the country.

Some data gathering institutions also have a mandate for information dissemination and public education and awareness, such as the BSI and the ZSI. ENVIS, INFLIBNET, Municipal Environment Status Reports (ESRs) are information systems.

A major concern in information gathering and availability is that local level data is generally not available, or where available, not easily accessible. With increasing decentralization, panchayats, taluka and district administrations are making the decisions that impact local development. These decisions are not necessarily guided by environmental concerns or based on natural resource or biodiversity related information. This may be both a human resource issue as well as an information availability issue. This also links up with the Right to Information.

For rural areas, techniques to generate local data already exist, such as Participatory Resource Mapping and Community or People's Biodiversity Registers. Where these have been used, techniques like participatory resource mapping lead to much greater resource literacy and better local decision making in respect of sustainable resource use. The necessity of the link between data providers and data users is well illustrated in such situations. Such links should be consolidated and institutionalized without becoming bureaucratized.

In rural areas, while techniques for local level data gathering exist, such exercises are not mandatory. The techniques for gathering and using such data also require some measure of capacity building, especially in panchayat institutions and women members. There is also a need for developing systems that can help local communities monitor development outcomes relative to resources used.

In urban areas, while municipal corporations are required by law to make their annual environmental status reports, most cities do not yet have a single ESR. Where prepared, these are not actually used in planning, nor are they easily available, to citizens groups or others who could use them. In some cities, ESRs have been prepared, but they are not updated annually.

Each state produces district gazetteers, which record a variety of information. Such gazetteers have been prepared for most districts. The preparation of gazetteers is however not systematic. However, despite often being outdated, they continue to be a very useful source of information.

### Desired actions

1. **Documenting and publishing local biodiversity information**
   A gazetteer-like document for biodiversity, which would be easily available to those interested (including bureaucrats, academics, students), should be prepared and regularly updated for every district, and significant biodiversity rich areas outside protected areas. This would involve
   a. Developing a format for the content
   b. Identifying sources of information and methods of information collection
   c. Developing a mechanism for updation

To start with, a state biodiversity gazetteer should be developed for every state

2. **Information related to protected areas**
   a. Prepare a gazetteer-like document for each PA and for proposed new PAs, containing information on the wealth of biodiversity and conservation issues. Evolve guidelines for this and allocate responsibilities within the PA management for this.
   b. Encourage local colleges and institutions to undertake regular monitoring studies of protected areas, and to take part in census work. This process and the involvement of institutions, faculty and students may be incentive driven.

3. **Develop proactive and strategic information dissemination**
   The MoEF has the ENVIS system, which is a mechanism to provide and update data and information about various environmental aspects. Under the IEMCBTAP, about 90 nodes on various disciplines have been set up.

   MoEF ENVIS Focal Point should support the ENVIS Centres and nodes to proactively disseminate their biodiversity related information to various sectors of society, and especially to relevant government departments. This would entail:
   a. Workshop on planning strategic communication activities, especially considering the information implications of implementing the NBSAP.
   b. Evolving guidelines for the ENVIS centers and nodes for strategic communication and information dissemination, based on this workshop.
   c. MoEF to make appropriate financial allocations to the Centres and nodes to support above activities.

   This may mean that ENVIS Centres will need to define for themselves how and to whom they will disseminate information.

## Formal Training Systems

There are several training institutes and systems for administrators and managers in India. These include the cadre-based systems for induction and in-service training of the national and state civil services, public service commission and the IFS. Besides, there

are specialized institutes for in-service professionals and NGOs, for short-duration subject specific training courses. These include the Lal Bahadur Shastri National Academy of Administration, the Administrative Staff College of India, and the Institute of Advanced Studies, academies/institutes at state level for induction training for state public service commission staff, the Indira Gandhi National Forest Academy, the Indian Council of Forest Research and Education, the Indian Institute of Forest Management, the Wildlife Institute of India, the regular training courses of State Forest Service and Forest Range Officers in the country.

There are over a 100 institutes in India, involved in rural development related training in India. These include the National Institute of Rural Development and the State Institutes of Rural Development, as well as NGOs, university departments and other academic institutions.

The National Institute of Urban Affairs (NIUA) is a premier institute for research, training and information dissemination in urban development and management. It conducts a variety of urban management related training programmes including management of urban environment.

However, the biodiversity content in these training programmes needs to be enhanced. This has to be done in two ways: by integrating biodiversity concerns in sectoral training programes, as well as by initiating new courses. Besides several new areas have been identified during the NBSAP process, which need to be addressed in regular in-service training for staff in various developmental sectors.

**Desired actions**

1. **Strengthen biodiversity-related training for administrators**
   a. Incorporate induction and in-service modules on biodiversity related issues, including environmental economics in all national and state administrative training academies. For this, working groups must be set up by Department of Personnel and Training, GOI and other state training mechanisms to review syllabi of long and short duration courses, and especially foundation courses for biodiversity and environment content.
   b. Special locale and need specific courses/modules and related material and training methodologies should then be worked out.
   c. Initiate regular faculties/departments of environment in the national and state training institutions. The YASHADA experience could be a basis for this.

2. **Strengthen biodiversity-related training for Forest management staff**
   a. MoEF should set up a process and consultative group drawing upon national institutes and individuals involved in NBSAP to develop outlines for induction and foundation training level modules for IFS and all other levels of forest department personnel.
   b. Based on these outlines, a variety of material suitable for these courses, as well as effective methodologies need to be worked out by the training institutes, and EE agencies.
   c. Maximum concentration of training on biodiversity issues needs to be given to front-line staff.
   d. Develop mechanism for continued capacity building.
   e. Arrange training programmes and refresher courses for protected area staff on new and emerging aspects of biodiversity use and conservation.

3. **Strengthen biodiversity-related training for urban managers and planners**
   a. Training for urban managers and planners needs to include content (with case studies and examples) on understanding biodiversity conservation in urban areas, identifying and mapping biodiversity rich areas and planning for minimizing impact of urbanization on biodiversity, use of biodiversity resources by urban populations, conservation/ecorestoration of biodiversity rich habitats, preparation, publication and use of Environmental Status Reports.
   b. Institute short-duration effective training programmes on the above for urban planners, through NIUA, All India Institute of Local Self Government, the state administration academies, and several other institutions.
   c. Set up a mechanism at state level to ensure that staff of municipal authorities undergo such training.

4. **Strengthen biodiversity related training for scientists and researchers**
   Researchers involved in various aspects of natural resource conservation need orientation/training on biodiversity so that they effectively plan for linking research with conservation of biodiversity.
   a. Courses on enhancing understanding of biodiversity and issues related to biodiversity should be developed and offered through premier national training institutions and offered from time to time, in a planned manner, for the major national research institutions working on different aspects of biodiversity.

b. Training institutions can also work out methods for continued capacity building of researchers, through online and distance modes, e-discussion groups etc.

### Industry

As a sector that has major impacts on, and dependence on, biodiversity, it is critical to create greater sensitivity in it towards conservation, sustainable use, and equity issues. Efforts to promote cleaner production and environmental awareness include those through certification processes, seminars, etc. The Environment Management Division of the Confederation of Indian Industry (CII) helps build in-house capabilities in Indian industry to address environmental issues effectively and pro-actively. This is done through seminars, workshops and training programmes. The National Institute of Small Industry Extension Training, an organization of the Ministry of Small Scale Industries and the Small Industries Development Bank of India (SIDBI) capacity build small-scale industries in environmental issues and assist them in finding solutions for treatment and remediation.

The approach needs to be sector, scale and region specific. Priority should be given to industries, which are major consumers of biomass, propagators of biomaterials (e.g. seed-sellers)and those, which impact biodiversity. The priority sectors identified are Pharmaceutical, Paper, Agro and Food Processing, Mining, Tourism industries.

EIA methodologies and requirements need to be re-examined and legislated, to include biodiversity concerns. There is a need to train EIA consultants in biodiversity concerns.

#### Desired actions

1. **Enhance linkages with sector-wise associations**
   Organize workshops with sector-wise industrial associations, FICCI, CII, Regional Development Boards, and the Ministry of Industrial Development. The outcome of the workshops should be plans of action for capacity building, specifically for
   a. Developing systems for equitable distribution of benefits with communities, arising out of use of traditional knowledge
   b. Developing systems for environmentally sound cultivation and harvesting of biodiversity resources, which are being used for large-scale production
   c. Documentation of information on waste minimization; optimization of resource use; environmental impact with a bearing on resource quality; resilience of ecosystems; handling of hazardous wastes;
   d. Development of comprehensive local databases to help integrate 'production' and 'protection'
   e. Facilitating financing to small scale industry for cleaner production and waste minimization.
   f. Examining the extraction and substitution process of resources, and how processes should be reworked to integrate biodiversity and livelihood concerns.
2. **Awareness about EIA methodologies**
   Organize workshops for EIA consultants for orientation to biodiversity concerns.

## Specific Occupational and Professional Groups

### Armed Forces

In the past few decades, several initiatives have been taken to enhance awareness of environmental issues among defense personnel, and for specific conservation work.

Awareness programmes have been taken up at the National Defence Academy, the Defence Services Staff College and several other units, through talks and slide shows, as well as through nature camps. Units in several parts of the country have done tree plantations and reforestation work. The Eastern Army Command has instructed local artillery units to suspend firing on the ranges in the Torsa River area when the annual elephant migration takes place. Army patrols in Bhuj have been instructed to report on the sighting of endangered species and to prevent disturbance by visitors to the nesting grounds of flamingos. The Army Environmental Cell organizes an annual three-day Army Environmental Meeting, attended by representatives from all five Army Commands, the Navy and Air Force, the Territorial Army, the Border Roads and the Ministry of Environment and Forests, and institutions such as the BNHS and WWF India.

A general awareness of the wildlife and biodiversity of India, in different ecosystems and biogeographic zones, hot spots of biodiversity, endangered species etc would be of use and may in the long-term help in making biodiversity values one of the considerations in siting of defence installations. In biodiversity rich areas, individual units/battalions can have a special role, which will have to be worked out, based on the region and the conservation imperatives there, such as reporting of sightings of wildlife, assistance in CITES related work in coordination with Wildlife Preservation, assistance in soil and water conservation measures on land outside defence installations, forestry.

The ex-servicemen wing can help personnel who are retiring to take up post-retirement activities such as initiating and supporting nature clubs, association with CBOs and NGOs, involvement in civic improvement activities, and livelihood-related training for e.g. organic farming, composting, water management etc.

A detailed planning exercise should be done jointly by Ministry of Environment and Forests and Ministry of Defence for developing the nature and scope of interventions and suitable training and orientation programmes at various levels.

**Desired actions**

Set up a joint services programme to evolve programmatic inputs, including required capacity building, in the following areas:

1. Recommendations and guidelines for all permanent defence installations to take up environmental best practices, such as those for greening using appropriate species of plants, energy and water conservation, water harvesting where appropriate, waste management.
2. Introducing modules on environment, and biodiversity (highlighting the role of the defence services) in induction and refresher courses for various levels.
3. Area specific interventions in critical biodiversity-rich areas, where the defence personnel can play an important role, in assistance in controlling poaching/illegal trade, scientific monitoring and reporting, sightings, mountain conservation etc.

## Mass media (print and television)

Some newspapers and television channels do have specific features and spots on environment related topics. This should be encouraged. Especially, success stories of conservation should be highlighted.

More important, there is a need to go beyond special 'environment beats', and analyze news on a regular and routine basis, for implications for sustainable development. This can happen when media owners and managers and journalists have an understanding of and commitment towards sustainable development.

Some constraints that working journalists face is lack of time to build up their understanding or attend training programmes etc. Also, stories are not always followed up.

**Desired Actions**

1. Conduct consultations with media owners and managers to help evolve policies towards responsible environmental reporting.
2. Seek and establish linkages with donor agencies and non-governmental organizations involved in biodiversity-related activities to sponsor space and time in the media to focus attention on biodiversity.
3. Develop distance, web-based, training and orientation programmes on environment and development issues for working journalists and free lancers, which can be paced as per individual requirements and time constraints. These long-distance programmes may also have contact internships with specific organizations in different cities.
4. Develop/foster e-groups of environmental agencies and interested journalists to ensure speedy and accurate reporting of issues.
5. Promote and encourage investigative journalism on environment and biodiversity, and institute awards for outstanding work in this field.

## Judiciary

The Judiciary needs to have access to relevant material including case-material to effectively interpret environmental legislations.

**Desired Actions**

1. Assess existing orientation/training programmes and reorient these to include biodiversity concerns.
2. Prepare a directory of experts and practitioners of environmental law.
3. Prepare and widely disseminate information about compilations of cases pertinent to environmental law among potential users, perhaps on a special website devoted to this.
4. Arrange orientation and frequent refresher programmes for judges and lawyers.

## Financial Institutions

Financial institutions, which finance small, medium and large projects (industrial or otherwise) should be sensitive to possible impacts of projects on biodiversity. While most banks have their own training colleges, the centralized in-service training for the banking sector as a whole happens through Reserve Bank (Bankers' Training College, Bombay), Indian Banks Association (IBA) and National Institute of Bank Management (NIBM), Pune. A short course could be developed and offered regularly and as part of its existing programmes to sensitize personnel of financial institutions to environment and biodiversity concerns.

### Desired actions

1. Assess and include course content on environment, environmental impacts of possible projects, procedures for impact assessments, and overall understanding of sustainable development in in-service and induction orientation to staff of financial institutions funding large projects, industrial and rural development banks, and institutions supporting micro credit.
2. Training institutes for other govt. services also, such as for Engineering, Medical, Audit, etc. should set up mechanisms for assessing and integrating biodiversity concerns into their training programmes. The respective SAPs under the NBSAP mechanism should be accessed for this.

### Groups with special needs

There are an estimated 70 million people with disabilities in India, and as an integral part of society they too must be made aware of their responsibilities towards conservation. They too must be seen as consumers of natural resources, who have as much of an impact on the environment as any other group.

"Active participation in the community" or inclusion, is indeed the biggest challenge for people with disabilities today. There are signs of hope - inclusion is supported by law; there are examples where people with disabilities have been involved in environmental education events.

"The Persons with Disabilities (Equal Opportunities, Protection of Rights and Full Participation) Act, 1995" came into force in the year 1996. This law is an important landmark and is a significant step in the direction of ensuring equal opportunities for people with disabilities and their full participation in nation building. The Act provides for both preventive and promotional aspects of rehabilitation like education, employment and vocational training, job reservation, research and manpower development, creation of barrier-free environment, etc.

Article 23 of the UN Convention on the Rights of the Child, 1989, (which India has ratified) states that "State Parties recognize that mentally or physically disabled children should enjoy a full and decent life in conditions which ensure dignity, promote self reliance and facilitate the child's active participation in the community."

Many people with disabilities have made a significant contribution to the field of disability, not only by initiating rehabilitation services, but also helping to raise awareness about disability issues and campaigning for disability rights. The very fact that they have been discriminated against often results in their being able to relate to other social issues, sometimes in ways that reveal more sensitivity.

The possibility of developing people with disabilities as environmental spokespersons by sensitizing them to conservation issues has not been adequately explored. Interestingly, out of the responses to the questionnaires, two persons have said that they feel that people with disabilities do articulate their views strongly. The story of Caroline Casey clearly illustrates the above conviction.

People with disability could earn a livelihood through conservation/environment related jobs. Options include gardening or working in nurseries, and vermiculture. The Association for People with Disabilities, Bangalore, has been running a horticulture training programme for people with disabilities with the basic objective to create employment for youth with disabilities. Around 25 youth are trained every year, after which most find employment. Tasks that are a part of gardening or working in nurseries are so diverse that a match could be made to the abilities of people with disabilities. The nature of the tasks itself could incorporate physical therapeutic exercises (stretching, reaching, etc), and facilitate transfer of skills into other life situations (e.g. filling water cans up to a certain level). Also the activity of tending to plants is a low stress activity which could be therapeutic for disabled people whose life circumstances are sometimes very stressful.

There are examples where children with orthopedic, mental, multiple, visual and hearing disabilities have been involved to some extent in activities like bird watching, nature camps, outdoor adventure skills, audio visual programmes and vermicomposting. It is important for people with disabilities to be able to have a chance to contribute to their neighbourhood or community.

Environmental education efforts can help in facilitating inclusion. This needs to be done at various levels: with people working in the field of EE; with people working in the field of disabilities; with people in charge of public facilities to enhance accessibility. Environmental educators need to be sensitized to be able to deal with people with disabilities, and to understand that in most cases, all that is required is sensitivity to some special needs that a group may have, and a realization that there is often a very thin dividing line between ability and disability.

People working in the field of disability need to be networked with environmental agencies, to build up an understanding of environmental issues, to evolve suitable EE programmes in the required formats, and ways of maintaining continuity for specific groups.

Access is a major issue for crutch, walker and wheelchair users. Most public places of nature education have physical barriers that bar entry to these users, such as a flight of steps. Most parks, zoos and museums in our country have not considered the needs of disabled individuals in their planning and design. Even if the entrance barriers are overcome, there are always more to contend with: cobbled pathways in parks; sign or information boards which persons with visual impairment cannot read easily; exhibits in museums which are far above the eye level of a wheelchair user, to mention just a few. Even programmes organized for the general public are not without barriers to information. A leading environmental group in Pune discovered this, when a young participant complained that she could no longer lip-read during a public lecture when the lights were switched off for a slide show.

The Persons with Disabilities (Equal Opportunities, Full Participation and Protection of Rights ) Act, 1995, provides that the appropriate government and the local authorities shall, within the limits of their economic capacity and development, provide for ramps in public buildings. Increasingly, groups of disabled activists in some cities are beginning to realize the need for strong advocacy of their needs, and have been catalysts for many initiatives: spreading awareness on disability issues to key target groups like architects, city planners, etc; focusing energies on a certain public building (s), to ensure the modifications are made to enable access.

While efforts like those of Arushi, Bhopal must be promoted, it is equally important to focus on access to public places that are yet to be built. In this connection it is interesting to note that the Central Zoo Authority (CZA), (which was created in 1992 under Section 38 of the Wildlife (Protection) Act), became a regulatory body for the enforcement of mandatory standards and norms for the management of zoos. The National Zoo Policy 1998, states in its section on Amenities to visitors that "Ramps shall also be provided for the benefit of visitors in wheel chairs for approach to animal enclosure and other civic amenities." One needs to gauge to what extent such rules and policies actually make a difference on the ground.

### Desired Actions

An overarching strategy to facilitate inclusion of people with disabilities into ongoing environmental education programmes is collaboration between groups working in the two fields.

Possible mechanisms for networking and raising awareness about environment and disability issues are:

1. **Enhancing the scope of the National Green Corps**
   Schools for disabled children should be included in the scheme for the National Green Corps of the Ministry of Environment and Forests. Special educators should be included in the capacity building training for master trainers. At least a few schools for disabled children from each district should be part of the NGC.

2. **Special module on disability and environment in the BEd. course**
   Where children with disabilities are concerned, the current thrust is for inclusive education, where efforts are being directed to facilitate the education of children with special needs in regular classrooms. A component on disability and environment in the BEd. course syllabus would reach out to a large workforce of teachers, who would then already be sensitized to the needs of disabled children, to be able to effectively include them in environmental education programmes that they may initiate.

3. **Developing and sharing of resources**
   Development of a set of basic resource materials would help give an impetus to EE for people with disabilities. This should include:
   a. Material on perspectives and methods of EE for people with disabilities should be developed for the use of educators. This material should be widely disseminated among organist ions and schools working in the field of disability, EE agencies, and mainstream educators.
   b. Material to enhance awareness about environmental issues should be developed in formats (including both Braille and audio) for the visually impaired, in at least a few Indian languages.

   The process for development of such material should involve a workshop of educators, special educators, agencies who have had some experience of EE for children and adults with disabilities, etc

4. **Enhancing participation in National Environmental Awareness Campaign (NEAC)**
   The Ministry of Environment and Forests, should make a policy to involve and encourage agencies working in the field of disabilities to participate in NEAC. The Regional Resource Agencies can be asked to make a special effort to involve such organizations. An even greater impact would be achieved if EE for the disabled could be declared as one of the focal subjects or themes of the NEAC for one year. Special material and guidelines could be developed for the participating NGOs.

5. **Linking to ongoing programmes/schemes**
   At a local level, groups who are involved in environmental education programmes need to extend their expertise to groups working in the field of disability. NGOs and citizens groups organizing activities like outdoor camps and field visits, communi-

ty level programmes or campaigns (for example, clean up drives or anti plastic campaigns), seminars etc should make a special effort to include groups that are not mainstream. Newsletters and websites on environment education should highlight experiences of where this has been done.

6. **Enhancing access to sites and information at sites likes zoos, museums, and parks**

# Health and Biodiversity Thematic Strategy and Action Plan

Coordinator: A.V. Balasubramanian
Coordinating Agency: Centre for Indian Knowledge Systems, Chennai

## Introduction

Biodiversity in the form of plants and animals from the major resource base of Indian Health Traditions. It provides the basis for health by means of food and medicine. The Thematic Working Group decided to identify the links between health and biodiversity by collecting information from literature as well as from various stakeholders. It was decided to place special emphasis on stakeholders, whose views are generally not heard in the planning process, namely - folk healers, raw drug collectors and households.

## Major Issues

The relationship between Nutrition/Agriculture and Biodiversity is very poorly studied and understood. In terms of bioresources, for over a century modern botanical studies have been carried out on the occurrence and distribution of medicinal flora across various geographical zones of India. Traditional medicine has a vast, comprehensive and deep understanding of plants. It is estimated that in Ayurveda, Siddha and Unani traditions, medicines make use of about 2000 plant species while folk traditions use over 9,500 plant species. A large number of animal species (including birds, reptiles, insects etc.) are also used. The "back bone" of the traditional medicinal system is indeed the folk systems whose carriers range from generalists like herbal healers to specialists like Traditional Birth Attendants (TBAs) and Bonesetters, and also include the vast knowledge of home remedies, food and nutrition, that is found extensively in each household. The ISM establishment has a large infrastructure which however suffers from major draw backs - it is very poorly endowed (receiving less than 5% of the total health budget), it shows no official "awareness" (leave alone giving help or recognition) of the folk traditions and the folk traditions are under a threat of erosion due to diverse reasons.

## Ongoing Initiatives

During the last 25 years there have been some hopeful initiatives in the NGO sector to strengthen and revitalize Folk Health Traditions. These have included - formation of sangams of Vaidyas, strengthening the resource base (especially medicinal plants), detailed studies/documentation about specific sites/tribes and some moves to recognize/honor Nattu vaidyas. The efforts of SHODHINI network and the subsequent emergence of WAH (Women and Health Initiative) have given particular emphasis to the assessment of biodiversity and its relation to health needs from the women's perspective. The government has publicized a draft policy on ISM inviting comments, and a Natural Medicinal Plants Board has been constituted. The Planning Commission has set up a Task Force on promotion and cultivation of medicinal plants. The All India Coordinated Research Project on Ethnobiology is a very important initiative. There is a great deal of public discussion and awareness about Traditional Knowledge and Biodiversity and a Traditional Knowledge Digital Library Project has been launched. In the year 2001, the Government of India had come out with a draft National Policy on ISM, which is the most comprehensive post independence statement on that subject.

## Recommendations

### A. Nutrition and Biodiversity

Studies that examine/illustrate or have a lesson in terms of the links between Health and Biodiversity are very few. They need be analyzed in detail and lessons from them incorporated into the plans. Also, more such studies need to be planned. Two types of diversification would help national as well as household food and nutrition security, - diversification within food grains, i.e. millets and legumes besides cereals and diversification between food grains, horticulture (fruits and vegetables) and livestock products. The government needs to formulate agriculture policy/programs based on the local food pattern and ensure production of traditional food crops (along with new hybrid crops and cash crops) as well as their availability to be in local markets, Public distribution systems, Anganwadi, mid-day meal programs and hospitals. In the case of subsistence dependent communities the Government should - maintain their traditional access to water and forests. Only they can we ensure their health. This is particularly important during time of crisis or stress (e.g.) Drought period.

### B. Folk Traditions

**Need For Information**: There are no estimates at a National or state level about folk medicinal traditions, in terms of their numbers, distribution, specialization, transmission of knowledge etc. It is suggested that some baseline statistics on them can be obtained by

compilation and analysis of detailed information available with NGOs or academics who have detailed knowledge about folk traditions in small areas or about specific communities/tribes, making these estimates part of an exercise such as the National Sample Survey (NSS), and eventually working towards a special study of Folk Health Traditions as part of the 2011 census operation.

All India Coordinated Research Project on Ethnobiology: The All India Coordinated Research Project on Ethnobiology (AICRPE) is an eye opener in terms of the great richness and diversity of folk medical knowledge. The results of the studies need to be made public. First and foremost all the people who gave the information need to be the recipients of the synthesized results. Also, the development of location oriented production technology for the upliftment of the tribal communities, needs to be given importance.

**Perceptions of Nattu Vaidyas:** In the perception of the Nattu vaidyas themselves, some of the important recommendations emerged. Efforts can be initiated by the State and Central Government as well as private bodies to recognize and publicly honor outstanding Nattu Vaidyas who are carriers of the traditions. Cultivation of difficult to obtain species and the species identified as being suitable for cultivation in home gardens, can be supported. Contracts to collect NTFP should be given to local communities including NGOs, Vaidyar Sangams. Small-scale pharmacies can be set up at the local village/district lead to be manage locally. Efforts should be made towards the introduction of a certification procedure for all products that make use of natural products and biodegradable products with the mark - "Bio-friendly". Bodies must be created for organization, regulation, upgradation and promotion of local healer development and dissemination of information on traditional healing in local language and for networking. Communities, health workers, and supervisors, program planners and educators must be educated on the traditional foods and concepts of diet - time, seasonality and festivals, role and importance of herbs in primary health care, importance of environment, impact of environment degradation on peoples health and the means for its conservation.

**Needs of women:** Particular attention should be paid to the needs of women as well as to make an assessment of the relationship between health and biodiversity as seen from a woman's perspective. The experiences of SHODHINI network and the recommendations of the Woman and Health Initiative (WAH) serve as a good starting point on this matter.

### C. Bioresources for Health Care: Plants and Animals

Some of the immediate tasks are - completing the unfinished task of inventorying floristic, faunistic and microbial diversity in the under or unexplored regions, execution of flora of India and fauna of India work within a definite time frame, and making detailed assessments of threat status of all medicinal plants.

*In situ* conservation strategies: In the context of medicinal plants the most effective way of undertaking conservation of inter and intra-specific diversity is by creating a network of *in situ* forest reserves across different forest habitats that may exist in a country. The size of the forest reserves in tropical forests could be 200 to 500 hectares size each. In the high altitude forests, it could be around 50 hectares. A network of such forest reserves will act as "*in situ* gene banks" of the medicinal plants of the country. These *in situ* gene banks can provide breeders and growers access to the wild genetic resources for cultivation programs. It is far cheaper than cryo-preservation of any other *ex situ* approach. Each gene bank should be located in different forest types and across the altitudinal range existing in the State so that across a network of 10-15 gene banks, one can capture the entire range of inter-specific diversity of the medicinal plants of the State.

***Ex situ* conservation programs:** Policy intervention is, urgently needed to encourage and facilitate investments into commercial cultivation of medicinal plants. 'Polyculture' models for cultivation of medicinal plants where the species mix is based on natural associations, may be preferable to mono-culture cultivation. It is also advised to grow plants organically in their native agro-climatic locations and in habitats where they are naturally distributed.

**Cultivation:** It is estimated that all over India, there are only around 20,000 hectares under cultivation of medicinal plants. The extent of cultivation is inversely linked to prevalence of easy and cheap collection from the wild, lack of regulation in trade, cornering of the profits from wild collection by a vast network of traders and middlemen and absence of schemes of industry for providing buy-back guarantees to growers. Cultivation of medicinal plants is also difficult due to lack of standardised agronomic practices for most species and unavailability of sources of quality planting materials. Policy measures to promote cultivation of medicinal plants therefore need to facilitate industry's role by way of providing incentives to industries for sourcing of their raw material from cultivation and for their investments in agricultural research. There is simultaneously also a need to regulate indiscriminate and destructive collection of medicinal plants from the wild, particularly for endangered species. In the context of medicinal plants, there is a special case for encouraging organic systems and Polyculture models instead of the conventional mono-culture models currently prevalent in agriculture and agro-forestry. Given India's large population and food security needs, it is not wise to shift agricultural lands committed to food crops to growing medicinal plants. There is, therefore, a special case for encouraging in an organised way, (on the AMUL milk model) an "area" approach wherein in a contiguous area, thousands of small, marginal farmers

and tribals can be encouraged to grow medicinal plants in their household gardens, bunds and wastelands rather than promoting big farmers, and large plantations strategy. The bottlenecks for cultivation need to be addressed - providing remuneration prices/buy back guarantee and generating information on agronomic production and economics of cultivation.

**Quality Control and Technology Inputs:** We need to, urgently develop creative pharmacognostic methods based on traditional knowledge. The current official standards are only related to the botany and chemistry of plants, but ignore their biological activity. There is need for technology interventions related to post-harvesting viz., drying and storage of medicinal plants. Help needs to be given for processing by communities at village level, to obtain better returns. Also, support is needed for quality control, marketing, labeling.

**Trade:** Harvest in the wild, must be regulated. Corrections needed in the supply side are - (i) well laid out inventory of medicinal herb occurring in the wild; (ii) statistics of their incremental aspects for ensuring that only the periodic increments are removed scientifically; (iii) rejuvenation of the degraded forests with the regeneration of medicinal plants; (iv) cultivation of endangered and extinct species in forest nurseries and on degraded common properties (CPs). There are some successful interventions in terms of sale, in Kerala, Gujrat etc. that can be tested.

**Community based Initiatives:** There are some promising community based initiatives that can serve the twin objectives of conservation and delivery of health care. One such initiative is the Kitchen Health Garden (KHG) initiative. The KHG programme can be a very important method to combine biodiversity with Health and Nutrition involving the committee in a big way. Some factors that can help are - creating awareness that home remedies are the first line of action for ill health, focussing on a few common complaints initially, clinical trials to validate simple medicinal plant based treatments, for common complaints. Nutritional plants can be included in the medicinal plant packages. Allopathic physicians require pharmaceutical and pharmacognosy training on medicinal plants. The Government should come with regulations for incorporating these in regular medical training.
Animal Products: In the context of the use of animal products in traditional medicine, studies need to be undertaken on the use of animal products by folk practitioners other than tribals, and in various ISM texts and the sustainable use and harvest of many of these animal products.

## D. ISM Policy

ISM should explicitly recognize the existence of and support the strengthening and revitalization of tribal/folk traditions besides the classical traditions. The Government role should be that of a facilitator rather than the sole actor and non-government agencies must also be involved in the planning and implementation of all aspect of ISM. There must be emphasis on the use of ISM epistemology in research, drug development and standardization.

Some of the key recommendations pertaining to medicinal plants are:

- It is necessary to offer remunerative prices for cultivated herbs and to make the price of produce collected from the wild at such a level that cultivation is desirable;
- Conservation must be based on a network of forest based *in situ* gene banks paying attention to inter and intra specific diversity of medicinal plants;
- The scope of the National Medicinal Plants Board needs to be enlarged so that it serves the need of not only the pharmaceutical industry but also the non-commercial users (folk practitioners, households etc.);

The recommendation of the planning commission Task Force on preservation, promotion and cultivation of medicinal plants are also oriented largely to the big corporates. Involvement of local communities, traditional healers etc in these activities has been ignored.

The ISM policy should also be revised and expanded taking specific note of the recommendations that have emerged from the WAH network which has produced a critique and specific suggestions based on the requirement of women.

IPR and Traditional Knowledge: In the context of various efforts to document traditional knowledge it is important that the method to recompense be in place before, the information being recorded is made public. It has been stated by experts that - "By designing the structure of the traditional knowledge database appropriately, it is possible to make the knowledge available to all and at the same time retain the control necessary for benefit sharing to be operationalised".

# Laws, Policies, Institutions and Planning Thematic Strategy and Action Plan

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## Introduction

Laws and policies concerning conservation of biodiversity have to meet two distinct but interrelated objectives: first is the scientific objective of biodiversity conservation, that is to ensure the preservation of all ecosystems, species and genes, and of associated biological processes and second is the ethical objective of conserving and protecting biodiversity to ensure a just and equitable distribution of the costs and benefits of biodiversity conservation among human beings living in different parts of the world, between the existing and unborn generations and also between human beings and other species. In other words, ensuring equitable distribution of resources across species and across generation of species.

In order to meet these twin requirements, laws and policies have to gear themselves to confront the threats facing biodiversity conservation by various developmental project demands. Conservation endeavors result in displacement of local people from their habitats and resources, hence, laws and policies have to provide space for people's rights. Law has to develop mechanisms to counter the increasing internal as well as external biotic pressures based on principles of democracy, so that livelihood needs of the local forest dependent people is not disturbed. In the changed scenario, biodiversity laws have to deal with newer threats arising out of patent laws, biopiracy and genetic swamping, among others; while at the same time protecting the human, cultural and environmental rights of the affected people. This involves a large scale overhauling of laws.

The laws and policies governing biodiversity in India have been analyzed from certain broad principles of justice and equity, and learnings from international environmental laws and human rights of the local people. Spaces within the existing laws that provide for the incorporation of such principles have been identified.

Conservation of whole eco-system forms the core of planning and suggestions for legal and policy changes of the thematic group. At the same time, the centrality of the plan is to bring people into the fold of conservation endeavors and make them beneficiaries as well as participants in the process in a broader governance structure. Considering the irreversible role of statutory laws in guarding biodiversity, laws should remain the instruments for protective enforcement purposes. At the same time customary laws and their role in the context of that culture should be recognized. Therefore, the purpose and objective of this plan is to enlarge people's space in biodiversity conservation, recognition of their rights by law and governance through decentralized and democratic institutions and mechanisms, in ways:

That would promote and enhance both biodiversity conservation and the legitimate survival and development needs of poor communities; and
That would simultaneously achieve these distinct but complimentary goals.

Three of the prevailing major laws dealing with conservation of wildlife and forests, have been studied/reviewed here:

The Indian Forest Act, 1927;
The Forest (Conservation) Act, 1980; and
The Wild Life (Protection) Act, 1972.

Analyzing laws with regard to biodiversity conservation would require a comparison with certain basic principles of conservation, equity and equality, strategies and plans that are essential to conservation of biodiversity. The principles that are proposed to guide policies and laws concerning conservation and protection and livelihood of people are given hereafter:

### 1. What to conserve and how much to conserve

Any selection for conservation of a particular geographical area, species of flora and fauna should be made through a process of scientific selection of sites mainly for two significant reasons:

Conservation sites have to be chosen only where restriction on use of biological diversity resources especially on poor communities, many of them tribals, living in close proximity to this biodiversity resource, is minimal. So that conflict between local people and state does not emerge; and resource constraints/depletion also necessitate the need to prioritize areas for biodiversity conservation through scientific selection of sites.

These two reasons therefore entail decision making at following levels:
- The extent of the country/state/region/district that should be under biodiversity conservation;
- The extent of specific biodiversity conservation areas that should be either in the form of Protected Areas legally notified or through community conserved areas i.e., the cover/size of particular area; and the species to be conserved/protected

### Extent of Conservation Areas

The conservation area network in the country or a region should ideally be based on the following criteria:

#### Representation of diverse ecosystem

1. **Exceptional biodiversity values**
   Areas of strategic importance for biodiversity conservation: These could be corridors between two priority areas, breeding grounds of animals, migratory path of faunal species or endangered species or even watersheds or other ecologically significant function areas without which the priority areas cannot be conserved.

2. **Areas free from biotic interference should be conserved**

3. **Areas to be conserved on the basis of the Precautionary Principle through Environmental Law**

**Action Point:** There should be exchange of information through a working group on biodiversity related issues for conservation benefit sharing, legal change, human and ecological health, livelihood across various recognized institutions, departments/ministries such as, Tribal Affairs, MoEF, Ministry of Health, Social Justice and Empowerment, Bombay Natural History Society (BNHS), Wild Life Institute of India (WII), Forest Research Institute (FRI), Commission for S.C. and S.T. The meeting should have the mandate for application of precautionary measure for protection and conservation.

### The Present Legal and Policy Framework with Respect to Creation of Protected Areas.

In India following classification of Protected Areas (PAs) is in existence:
**Category I:** Legally recognized and demarcated areas, in the form of National Parks, Sanctuaries and Reserved Forests established under the provisions of the Wild Life (Protection) Act, 1972 (WLPA) for the former two categories and the Indian Forest Act, 1927 (IFA) for the latter.

**Category II:** Those PAs established through administrative orders such as the Tiger Reserves, Elephant Reserves, Biosphere Reserves, Ramsar Sites and World Heritage Sites.

**Category III:** Those areas though not strictly statutory protected areas as in the above two categories, but which are given some degree of legal protection from ecologically destructive activities, for e.g. protected through the notification under the Environment (Protection) Act, 1986 (EPA)

## The Indian Forest Act, 1927

There exists space for local access of resource under the Act (Creation of Village Forests under Section 28-A). Commercialization and control over forest resources features the Act and are predominant operatives.

Section 3 of the Act deals with the power to constitute Reserve Forests. It is clear from the section that none of the principles discussed above are taken into account in the selection of areas to be declared reserve. Also, despite the change in the thrust of forest policies after independence whereby forests were looked at from an ecological, livelihood and social perspective, very little consideration was given to ecological reasons in constitution of reserve forests. While it is a fact that in many instances reserve forests are the last storehouses of biodiversity, it is seldom recognized and acknowledged.

**Action Point:** Reserved forests should be constituted only in consonance with the principles stated above.

Necessary legal changes need to be done in Section 3 to incorporate and seek suggestions from the forest department, revenue department and scientific communities on ecological values of the era and a consultation with local people on livelihood rights

before declaration of any area as Reserve Forest. Legal changes should also take into account, wherever applicable the rationale behind the following substantive definitions of forests.

There can be at least three different types substantive definitions of forest
- Ecological (mangroves, deciduous etc);
- Economic (commercial, production, conservation, etc); and
- Social (tribal, lok-aranya, raj-aranya, dev-aranya, brahm-aranya; etc).

For any effective conservation of biodiversity, the manner and principles on which forest is defined make a significant difference for administration and implementation of the law. For instance, it would certainly make the following differences:

If forests are to include wetlands or desert flora the implementation of the law through various government departments would have to be different; and

It is hence necessary that in principle the type of definition of "forest" that is required must be clearly and comprehensively articulated. That will also decide the scope of the Act in terms of the ecosystems it can deal with for conservation and commerce.

Forest to the extent possible should cover all the ecosystem coming not only under the geographical boundary of the forest but necessary and complimentary ecosystem that the forest is adjacent to.

**Action Point:** Inclusion of a comprehensive definition of forest is required in IFA to provide clarity and meaning to the term forest for its ecological, social, cultural and economic values;

The criteria for declaring any areas Reserve Forests (RF) should be ecological and not mere commercial.

## Wild Life (Protection) Act, 1972

In the present form and operation the sections 18, 35 and 38 dealing with formation process and establishment of PAs do not give due weightage to most of the criteria listed above.

Section 18 which concerns the creation of a Santuary should clearly articulate as to what is deemed to be 'adequate significance' for the purpose of creation of a sanctuary, elaborating circumstances, why a particular area is of adequate ecological significance.

Adequate legal and institutional mechanisms should be set up to ensure, scientific studies on the ecological, faunal, floral, geomorphologic, or natural significance of an area intended to be declared protected, negotiation with the local people on the declaration of the area protected. Work out a governance structure for the same.

A socio-economic impact assessment of declaration of an area protected on local people should be done by setting up appropriate legal and institutional mechanisms under the WLPA.

It is necessary to have a detailed independent set of guidelines regarding the criteria to be considered when an area is proposed to be declared as sanctuary.

The guidelines should specify, besides explaining the 'adequate significance', the importance and extent of ecosystem representation, value and significance of that ecosystem, the strategic importance of the area (for e.g. corridor), and lastly the species and faunal value in that particular ecosystem.

The declaration of national parks is made under Section 35 with the following reason:

Section 35 of the Act pertaining to creation of national park should clearly articulate as to what is of 'importance' for the purpose of declaration of a national park. This as observed in the case of a sanctuary, ought to have a detailed set of guidelines as the criteria that must be considered when an area is proposed to be declared as a national park. At present there are no such guidelines or recommendations on selection of sites as national parks.

**Action Points:** Scientific Institutions such as the Wildlife Institute of India, The Forest Research Institute, Botanical Survey of India (BSI), zoological Survey of India (ZSI), Central Marine and Fisheries Research Institute (CMFRI) should be involved in working out the criteria to be taken into account while declaring areas as protected.

Protected Areas should be set up with the purpose that there is representation of each biological diversity that is of significance for conservation of the ecosystem.

## Adequate Coverage of Areas for Conservation

The adequate/ideal areas for conservation have to be determined on the basis of at least two factors:

- The minimum extent of an ecosystem type needed for it to retain its natural characteristics and diversity and to evolve naturally;
- The minimum size for supporting viable population of all the floral and faunal species inhabiting the area.

**Action Point:** Determining the adequate size of a conservation area is an elaborate process. Neither the Wild Life (Protection) Act, 1972 nor the Indian Forest Act, 1927 stipulates any minimum area for conservation and protection for the Reserved Forests, National Parks and Sanctuaries. Although it may be impractical to specify any fixed areas for National Parks and Sanctuaries, however it is desirable that guidelines be specified about the minimum areas needed for conservation of certain species.

### Conservation of species

The principle of inter-species as well as inter-generation equity demands that all species of flora and fauna be conserved irrespective of their contemporary known utility to human being.

### The Wild Life (Protection) Act, 1972

**Inter-Species Equity:** The Wild Life (Protection) Act, 1972 (WLPA) is perhaps the only legal instrument to ensure the realization of the principle of inter-species equity, the belief in the right of each known visible species and unknown or invisible species to live and proliferate. Protection accorded in its present form under the Act does not help in ensuring sufficient protection of all species that contribute to survival of their fellow species. This would also ensure the equilibrium of predator and prey population.

#### Observations

The Act provides legal protection to various faunal and floral species in varying degrees. Plant species get only notional protection under the Act as only six species of plants are included for protection in Schedule VI. Further, criteria for inclusion of the species are not specified.

Categorization of species into different Schedules under the WLPA does not comply with this principle, though there is a need to give immediate attention to mega species. However, in practice protection and conservation of other species that have significant value for ecological equilibrium are being sidelined.

It is therefore important that the Act takes into account the interrelationship among the various species. There is also a bias in favor of protection to large mammals and birds, more than other wild life species.

**Action Point:** On what criteria should be Schedules be devised needs to be worked out. Suggestions have varied from inclusion of CITES listed species in Schedule I to putting globally threatened species in Schedule I.

## Principle of Intergenerational Equity

Intergenerational equity calls for fairness in utilisaiton of resources across human generations of past, present and future. This requires that a balance be attained between meeting the livelihood demands of existing societies and ensuring that adequate resources are available for future generations/posterity. In other words, ensuring sustainability of resources across generations of human species should be the golden principle of existence of human society.

**Action Point:** It is recommended that a body of economists, environmentalists, natural and social scientists be constituted to assess domestic livelihood, industrial and public services dependence and need of forest resources. The committee should also have the mandate to propose environmental friendly alternatives for the use of forest resources.

## Ensuring Intra-Generational Equity In Managing Biodiversity

Intra-generational equity refers to the fairness in utilization of resources among human members of present generations, both domestically and globally. The application of this principle would imply that the livelihood requirements of communities living in an around the conservation areas must be fully taken care of by recognition of local rights through legal and institutional means.

#### Observation

There is lack of invocation of the section 28 of Indian Forest Act, 1927, that gives scope for creating village forests to meet local forest resource needs.

The same holds true for the Panchayat Raj (Extension to Scheduled Areas) Act, 1996 (PESA) that provides extensive scope for decentralized natural management through local institutions.

There are however, major contradictions within laws, which makes it difficult to ensure inter-generational equity. At the same time, the class, and gender inequities are largely unaddressed by laws, policies and institutional means in India.

**Suggestion**
In their present form laws lack adequate provisions to ensure access of local communities to sustainable use of biodiversity. Therefore amendments in the laws are required to provide scope for decentralized governance of resources.

**Action Point:** Scientific study to assess needs to be done on resource needs of local people living in areas rich in biodiversity, that are under protection or proposed for protection specifically to access their dependence on forests, existing threat to sustenance of biodiversity because of human habitat in and around that area.

A National Committee should be constituted to assess the extent of livelihood dependence of local communities and their contribution to ecosystem conservation (while one may wonder success of various committees of the state in history). The committee should have an equal representation of people's institutions, conservation activists, representatives of the National Commission on Scheduled Castes and Scheduled Tribes, Ministries of Tribal Affairs, Social Justice and Empowerment, social scientists and natural scientists (which includes wildlife scientists. However, a clear distinction needs to be made between a scientist and a single species protection activist. Usually in committees the representation of single species protection advocates is more apparent than scientists and people's rights activists).

## Indian Forest Act, 1927

The Indian Forest Act (IFA) classifies forests into Reserve Forests (Section 4), Village Forests (Section 28), Protected Forests (Section 29), and Reservation of Trees (Section 30). These four categories have different implications on rights of the communities living in and around these areas.

**Action Points:** It is important to review the Act to make scope for negotiation of rights that can be accessed legally and governed locally by the dependent people. Uttaranchal Van Panchayat system is a best example for community managed forests with a clear legal basis for governance, that is unambiguously laid out, a similar governance structure needs to be worked out for other states.

Section 35 of the Act empowers the State Government to regulate and prohibit activities in any forest or wasteland for the purposes specified in the section such as, protection against storms, winds, soil erosion, protection of roads, bridges and preservation of public health. It provides for consultation with the owner of such forestland (in instances where it is privately owned) and not with the community dependent on such forests, in case there are any such dependent communities. This provision needs to be extended to all communities, as there are chances of quoting false reasons for protection of forest areas used by local communities.

A similar provision should be incorporated in the Act for mandating community consultation while declaring any forest area as protected.

## Wild Life (Protection) Act, 1972

The Wild Life (Protection) Act, 1972 (WLPA) has many provisions that are invoked to severely restrict the traditional resource use of dependent communities.

**Action Points:** There should be a legal provision for local livelihood need assessment. This need assessment should be done by experts in livelihood areas and preferably under the guidance of a advisory committee consisting of social scientists and wildlife experts.

After doing the need assessment of communities and ecological sustenance a plan should be evolved in a participatory manner to legally allow local governance over forest control and resources. The forest department should however continue to have its role as a protective agency to prevent destruction from outside forces.

## Equitable Sharing of benefits with Non-State Actors

The meaning of "equitable sharing of benefits" relates to ensuring a fair economic return to those individuals or groups from whom genetic or other biological, intellectual, cultural or economic resources were obtained.

**Action Points:** Non timber forest produces amount to bulk of the direct benefit arising from biodiversity protection. A policy for equitable sharing of benefits must therefore focus on this crucial output from forests. Several scientific, legal and policy actions need to be taken for protection as well as equitable sharing of NTFP. Some of the suggested measures are as follows:

- Study of the conditions of availability of Non Timer Forest Produce (NTFP) across the country needs to be done.
- List of traditional NTFP right-holder communities needs to be made across the country in order to consolidate traditional rights.
- Ban on collection of any variety of NTFP shall be supported by a scientific study on the unsustainability of harvesting/collecting that particular variety of produce.
- NTFP rules of various states need to be streamlined so as to meet the issues of equity and equality in terms of benefit sharing, access and marketing.
- There needs to be compatibility of rules in marketing and collection of NRFPs across the states.
- There is a need to standardize names and terms of NTFPs at national level to avoid confusions arising out of different names for same species in different states. Thus to help in regulation of collection and address conflicts arising from different names.
- Adequate emphasis shall be given to conservation, marketing, distribution and sustainable collection of NTFPs of all kinds and not just to the ones that have market value.
- Natural Resource Based Items shall be protected from the point of view of intellectual property.
- People's Biodiversity Registers should be prepared across the country. In order to ensure authenticity of the document writers and the document itself, it should be endorsed by the local Gram Sabha, Gram Panchayat, D.F.O. and the District Collector.
- Abstract of all such reports should be registered with the Council for Scientific and Industrial Research (CSIR).

## Right to Information

The principle of Right to Information as applied to biodiversity conservation would imply that communities are informed and consulted on all matters concerning their individual and community interests in decision making.

Mechanisms under all conservation related laws should be evolved for appropriate checks and balances to guarantee the right to information.

The right to information of communities should include both information about activities that are related to conservation of biodiversity as well as activities that are harmful or pose threat to livelihood of local people dependent on biological resources (that is inclusive of land and water).
Land acquisition is an area where right to information specifically needs to be incorporated as the operation of the Land Acquisition Act makes a number of presumptions for its successful results:

First that there are land records on the basis of which people can claim their rights; for among majority of the rural Indian population, especially amongst the tribal population such records of rights do not exist.

Second there prevails a wrong presumption that the notification issued under the forest laws will actually reach the project affected people. However, there is no provision in the contemporary forest laws that holds official machinery accountable if the notifications do not reach the concerned people.

Third there is no provision of compensation for common properties Non-Timber Forest Produce (NTFP).

### Suggestion

One space that can be extended to consult communities on socio-economic impact is the Environment Impact Assessment Notification, 1994 that provides for public hearing for environmentally damaging activities. However, the rights of the citizens are very vague and are in need of urgent reforms.

New methods have to be worked out so that people are informed about any activity that is harmful to the biodiversity on which their survival is critically dependent.

A system of accountability should be incorporated in all the legislations intending to acquire lands by making the officials accountable if the notifications do not reach the people.

## Free, Fair and Negotiated Settlements of Rights and Public Participation

The concept of free and fair settlement of rights emanates from the principle of right to information. Communities should have not just right to be informed but to take part directly on issues concerning their livelihood.

Right to information should imply not only the right to be consulted on the choice of area and the extent of the area to be conserved but also in determining the arrangement for benefit sharing from the conserved area.

First, people should be accorded the opportunity to participate in official socio-economic development decision-making processes and activities that will directly affect and have impact on their lives and well being.

Obtaining information is a prerequisite for the major role played by the public, which participates in decision-making, especially in environmental impact or other permitting procedures.

The Indian Forest Act, 1927 and the Wild Life (Protection) Act, 1927

The Indian Forest Act, 1927 (IFA) permits very minimal participation of local people in the management three categories of forests:
- Protected Forests
- Reserved Forests
- Village Forests

**Action Point:** Community consultation should be made a mandatory requirement for any program that will affect local communities, for example, conversion of the status of forest for exclusive protection, hydel projects, industrial projects etc.

### The Wild Life (Protection) Act, 1972

**Action Point:** The Land Acquisition Act, 1884 (LAA) is the legal basis for acquisition of land for conservation under the WLPA. LAA lacks scope for democratic processes in acquisition of land. There is also a need to make necessary changes and include provisions for consultation with project-affected person's negotiation, right to information and transparency in the process of acquisition. Hence, a set of rules have to be evolved on these processes, so that by definition and spirit one could call (land acquisition process) it a negotiated settlement of rights.

### Forest (Conservation) Act, 1980

There is a circular issued by the MoEF (No. 11-30/96-FC (Pt.) dated: 26.02.99) to the Chief Secretaries of all the States and Union Territories regarding the scrutiny of proposals submitted for diversion of forest land for non-forest purposes under the FCA, emphasis has been given on the significance of consultation with local people on the requested non-forest use of forests.

**Action Point:** This circular should be disseminated to all the Aam Sabhas-Gram Sabhas in all the states. Also, the MoEF annual report should reflect the number of such processes held annually across the country.

### Joint Forest Management and Eco-development Program

Changes should have to be made in design of the eco-development programme to integrate traditional knowledge and provide livelihood options that are culturally sensitive and relevant to the community.

Appropriate selection of place, dissemination of project proposal amongst the locals, experts in forestry and community development is necessary. Need assessment is required, duplication of programs like this in places such as Uttaranchal, where a community management institution such as van panchayat is already in place should be avoided.

Sustainability of these programs needs to be evolved by linking them with existing institutions like van panchayat, gram sabha and community organizations for long term impact even after funding is over.

Lastly, an evaluation of the existing eco-development and joint forest management across the country is required. As such there are evaluations of these programs done by various people and organizations on their planning, implementation and impact. A compilation of these findings is necessary to see if both the programs need an overhaul in terms of perspective and implementation.

## Compensating Communities for Restrictions on Biodiversity Use

There may be situations in which even limited/minimal extraction biodiversity resources may endanger the biodiversity. In such instances, considerations of inter-species and inter-generation equity may require complete restrictions on biodiversity extractions-it may be necessary to create inviolate zones.

However it has to be borne in mind that communities in the vicinity of precious biodiversity are usually precariously placed from

the perspective of survival. Therefore decisions to restrict their access to biodiversity must be taken with utmost care and through transparent process.

**Action Point:** The rational for this decision must be shared both with independent experts and the affected communities. They must be given full opportunity to legally challenge this rationale. In the event that access to biodiversity is restricted or barred, the state must be legally bound to provide alternative livelihoods in tune with the socio-cultural practices.

**Action Point:** For conservation of biodiversity a system for reward on custodianship of biodiversity and knowledge should be developed. It is important that the reward is to be in the form of assertion of community rights over public lands and water within geographically defined territory.

## Public Trusteeship for Biodiversity Rich Areas

### Biodiversity to be held as a Public Trust by the government

Areas that are rich in terms of biodiversity must be regarded as being held in trust by the State. This is essential for the long term conservation as well as utility to the community dependent on such biodiversity. The doctrine should be made applicable not only to those areas on which the community has de jure right but also where they have de facto right or even where they derive no direct benefit.

#### Strategy

With reference to natural resources the Public Trust doctrine has to ensure the livelihood security of the local communities such as fisherfolk, nomadic grazing communities, forest dependent communities, shifting cultivators etc.

## Scientific Inputs in Matters Relating to Biodiversity Conservation and Use

In matters relating to conservation of biodiversity scientific inputs are taken as the basis for drawing out the management plan and conservation strategies. However, the attempt is to blend modern scientific/conservation inputs with the traditional conservation practices of the local people.

## Specific Legal and Policy Issues

### Centre and State Relations

The relation between the Central Government and the State Government is of strategic importance to biodiversity conservation, since conservation responsibility is in most instances shared one. However, the exact nature of this shared responsibility is nebulous. One consequence of this is the conflicts that take place between the Central Government and the State Governments on conservation of forests. Therefore, clarity is best exemplified in the case of forest laws.

The Sarkaria Commission report on the Centre-State relations pointed out that, by enacting the Forest (Conservation) Act, 1980 the Union legislature has occupied only one aspect of the concurrent field, viz., "conservation of forests". The legislative and executive competence with respect to the remaining aspects of the subject "forests" remains with the states. However, there is no detailed analysis of State and Central laws concerning biodiversity in terms of conflicts arising out of differences in powers vested with them. The Commission basically concentrated on the Forest (Conservation) Act, 1980

#### Specific recommendations

As far as possible the Government of India should give clearance under section 2 of the FCA simultaneously and with the project clearance.

The Forest Conservation Act, 1980 as an umbrella law (covering State as well Central forests) should have clear mandate of protecting all forests across the country irrespective of forests being fully or partially managed or governed by any other prevailing law of the country. However, no provision of the act in any future amendment to the Act, should curtail local livelihood interests of the people.

It is important to review complementarities and contradictions emerging from forest conservation between State and Centre laws and powers vested in them.

**Action Points:** Specific details on the nature of Centre-State relation with respect to varied aspects of biodiversity conservation and use needs to be clearly worked out.

There are areas of confusion with the overlapping of power to de-notify forest areas between the Central and State Act. This needs to be resolved. The conflicting provisions in the Forest (Conservation) Act, 1980, the Wild Life (Protection) Act, 1972 and the Indian Forest Act, 1927 with respect to dereservation of forest land need to be resolved with suitable amendments.

#### Convergence of Laws

Prior to 1980, forest was a state subject and the states have legislated many laws which now need to be taken into consideration for a review of conflicting provisions in the interest of conservation. These relate to exploitation of raw materials for industrial purposes, such as Saw Mills Acts/Rules of different states, rules concerning transit and felling of timber, Acts for regulating the collection of Non Timber Forest Produce (NTFP) etc. Besides these Rules and Acts which have direct impact on forest produce, there are also various revenue, tax and laws which have direct impact on forestry work.

**Action Point:** All state laws having implication on biodiversity need to comply with the overall national policy framework for biodiversity conservation. Provisions in the Acts and Rules relating to biodiversity conservation need to be replaced on a priority basis for conservation. For this purpose state-wise analysis of the laws has to be undertaken to identify contradictions and complementarities with central laws.

For any conservation goals to be achieved, synchrony of views, interests, laws and policies of the State and Central governments is of paramount importance. This would also mean, respect to customary laws of several tribal areas, especially in the northeastern states. Overall, the local and central laws have to display convergence for better protection of biodiversity in India.

## Conflict Resolution among Laws

### The Forest (Conservation) Act, 1980

The Forest (Conservation) Act, 1980 like the Indian Forest Act, 1927 (IFA) is a 'Use Law' since it transfers the power to the Central Government to decide on the use of forestland for non-forest purposes. To that extent, it supersedes the IFA, which confers power on the state government (section 27) to denotify a reserve forest. Further, complication arises due to the fact that the Wild Life (Protection) Act, 1972 (WLPA) confers power on the state legislature to denotify a sanctuary or national park. This is further complicated by the fact that forest is in the Concurrent List whereas land is in the State List of the Constitution of India. All these compound in following consequences:

- Land being used for ecologically harmful activities; and
- High likelihood of denotification of protected areas partially or fully.

#### Suggestion

All issues pertaining to conversion of status of forest and also land such as, denotification of protected and reserve forest should be brought under the purview of the Forest Conservation Act. Suitable institutional mechanisms should be set up to deal with issues of use of State land and forests.

### Forest Administration Structure

The current administrative apparatus for conservation of biodiversity, which includes making technical decisions as well as policing, are in the hands of the state apparatus. Three basic questions arise in such a situation (Gadgil and Guha 1995) are:

Does the administrative apparatus have at its disposal the information needed to make appropriate decisions?

Is this apparatus adequately motivated to maintain biodiversity?

Is this apparatus competent to carry out effectively the task of regulating human intervention in the interests of the maintenance of biodiversity?

In light of the above following suggestions emerge:

There is a need for specialization in forest service, people should be either trained in specialized areas of biodiversity related issues, or should have adequate educational background for the same; some areas of specialization are:

- Forest Conservation
- Wild life and Protected Area Management Services
- Timber and NTFP
- Social Forestry-Community Participation/Organization

Forest Administration should also have adequate training in scientific research and community development.

### Institutional Arrangement for biodiversity conservation

In the contemporary conservation context, there is paramount need for constitution of institutional and legal structures in order to meet the demands of biodiversity conservation both within and outside the PAs. Conflict between local livelihood interests and conservation are increasingly emerging in many of the PAs. This is mainly because of three reasons:

- Displacement of local communities from their habitat;
- Curtailment of usufruct rights; and
- Increasing conflict between people and wildlife.

Given the present situation two approaches emerge, the traditional exclusionist approach and the community based approach (observed by Singh, 2001). The exclusionist approach works on the premise of keeping local resource extraction from conservation areas. Pragmatic advocates of conservation of biodiversity prefer the latter approach.

### The Community Centered Approach

This approach recognizes the full rights of the local people over traditional use of biodiversity. The community is vested with the power to decide on management aspects encompassing use of resources. In all these cases, the main question is: how much control does the community as a whole, as opposed to some members of it, have? Many of these conditions are in the absence of full legal control and tenurial security, and therefore "communities" or rather individual members of such communities, are unable to stop elements from outside or inside who are destroying the biodiversity.

#### Suggestion

A balanced model is required which would include both rights/control and responsibility, as also appropriate checks and balances to ensure that no one with authority has the leeway to misuse it; but the rights need to be complete. This also supports the argument for decentralized governance of natural resource, where such checks and balances can be attempted.

The major ideological rationale for exclusive state control over natural resources has been the alleged irresponsibility of local communities in their access over natural resources. It is suggested that unless these communities are kept in tight rein, all restrain would be thrown to the winds, and short-term acquisitiveness and greed for striving for accumulation would predominate biodiversity use. However, it is now a acknowledged fact that if local communities are empowered, they can act collectively as responsible custodians of the biodiversity that is situated in the vicinity of their physical locations. But it has also been that such responsible community behavior in relation to biodiversity is neither uniform nor universal.

Comparative studies on the management of biodiversity (Singh, S et al: 2000) has revealed that if local communities are entrusted with the protection of biodiversity, in an appropriate facilitating environment and with the fulfillment of certain conditions, the results are likely to be favorable. But, at the same time, it is not the case that local communities in all circumstances respond optimally if entrusted with unrestricted access to local biodiversity. Therefore it cannot be stated that the goals of biodiversity conservation would be best met, if local communities were entrusted with absolute, unmediated, entirely unregulated control ovr biodiversity.

There is no denying of the fact that the structure of the administration of public land including forest remains essentially colonial in nature. While reform of agricultural land was pressed forward following independence, the management of public land has remained frozen. There is thus a need for a drastic reorientation (Gadgil and Guha, 1995).

Lands could be divided into three categories:

- Lands devoted to ecological security (included in this category are PAs);
- Community-managed lands devoted to providing livelihood security through a production system compatible with biodiversity conservation. For example, Van Panchayat; and
- Commercial plantation activities.

Given this framework, the forest and other departments together with people would play the role of joint managers of lands devoted to ecological security or to livelihood security.

This management system should be worked out and implemented on the basis of a detailed decentralized land use planning exercise which would start afresh with land capability rather than the nature of bureaucratic control over land as the starting point.

Once an appropriate land use plan, with emphasis on the urgency of biodiversity conservation and livelihood security, is worked out, then its proper implementation could be organized, not as a centralized bureaucratic exercise, but as a location specific, people oriented exercise. This calls for the strengthening of the village and district level planning geared to ensure that the twin considerations of ecological security and livelihood security are given due weight.

The separation of the objectives, functions and management systems for the three main categories of land use-Protected Areas, community forests and farm forests must be the starting points of the governance structure.

Higher level institutions such as science and technology departments must support endeavor such as local level value addition to biodiversity resources through technical inputs. Rejecting modern science and technology would be suicidal. One can develop such a system by linking it with the system existing in the Panchyati Raj (Extension to Scheduled Areas) Act, 1996 (PESA).

Relevance of PESA to Natural Resource Use and Conservation

The PESA formulation opens significant windows of opportunity for tribal communities to construct alternate community-based structures for delivery of justice. However, before these opportunities can be realized, a host of extremely difficult questions need resolution. The broad framework of the model of governance could be the base for developing the governance structure for management of biodiversity.

## Suggestions

### Management of biodiversity

**PESA is an Act that empowers the Gram Sabha of a village.**

PESA, while empowering communities to control their natural resources, needs to have a component on the responsibilities of communities in conservation of wildlife and ecosystems.

One of the responsibilities of the Gram Sabha would be to ensure that there is sustainable harvesting of Minor Forest Produce (MFP).

Laws like the Wild Life (Protection) Act, 1972 should consolidate conservation as well as uses of wildlife found in customary laws and practices of people.

### Customary modes for conflict resolution

**Review of customary modes for conflict resolution from the perspective of gender equity issues.**

It is essential that provisions are made to incorporate the environmental principles such as the inter-generational and intra-generational equity.

There is need for far greater understanding, based on empirical research, about what are the principal traditional modes of justice adjudication in major tribal groups in Schedule V areas.

Even in Schedule VI areas such an exercise is necessary.

The experiences in Schedule VI areas must to taken into account while also dealing with issue relating to biodiversity conservation.

Some of the other major issues on which the law must be unambiguous include the following:

On which type of issue should gram sabhas be empowered to adjudicate? Should their jurisdiction be voluntary or mandatory? If the two parties desire to access alternate institutions, which would prevail? What would be the procedures and powers to summon witnesses, secure justice and enforce decisions? What would be the powers, if any, of the gram sabha to award punishments?
There are also other issues related to the interface between the community-based and formal systems. Would their jurisdiction be concurrent or exclusive? Which agency/agencies would be bound to implement the decisions of the gram sabha? What powers would the gram sabha enjoy for the enforcement of its decisions? What would be the appeal mechanisms?

### Ownership over NTFPs

Even as PESA empowers communities to gain control over natural resources, it is necessary to emphasize conservation aspects of

natural resource management, because the traditions of indigenous communities are falling apart as they are increasingly becoming a part of the larger political, social and market system.

**Conclusion:** Societies have evolved over the years in the history of India and had consequent resource use structure defined in the prevailing paradigm of political economy of resource use and regulation. Each society at different points of history had folk, cultural, social and legal regimes to govern forest resources. The binary of demand and supply determined the legal structure to control forests and in the late 20th century, biodiversity in India. In the friction of demand and supply the resultant scarcity, what has emerged is the need for conservation of biodiversity in light of its limited coverage from most of the ecological zones of India. Observation of people's rights activists is that laws and policies have failed to turn the colonial approach of resource control to democratically shared concerns. Therefore, an attempt has been made to propose conservation and democratic principles for a fair and transparent governance of natural resources that can guide both laws and policies concerning conservation of biological diversity in India.

# Livelihoods, Lifestyles And Biodiversity: Thematic Strategy and Action Plan

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## 1. Introduction

India is a country of mega-biodiversity. It is also a country of mega-diversity in livelihoods dependant on natural resources and the biodiversity in them. Today this covers a vast majority of our rural population.

These livelihoods and biodiversity are inseparably linked. Over the years, dependence on biodiversity for their daily needs has generated a rich heritage of indigenous biodiversity knowledge and conservation values in local communities. While conservation continues to be a way of life for a number of communities across the country, there are evident changes in lifestyles among others. Nevertheless, resource dependant communities are the strongest potential allies in biodiversity conservation.

## 2. Major Issues

- Historical state appropriation and control over common property resources has disempowered local communities to manage resources to meet livelihood needs and priorities. Though denied legal access, resource dependence continues. This denial of legal access and controls and restructured people-resource relationships has resulted in a breakdown of collective accountability, responsibility and interdependence.
- This kind of trend has been exacerbated by internal factors within communities, including inequities of class, caste, gender, and age; changing lifestyles and norms; demographic patterns including localized increases in population, and other such factors.
- In many areas, with intensified extraction and commercialization of resources, accelerated by market driven globalization, the lifestyles and aspirations of these adivasis and resource dependant communities are changing. They are also becoming increasingly vulnerable to forces destroying resources for short-term gains. The same village man or woman who worships a tree can be driven to fell it for wages if his/her livelihood is snatched away.
- There are several examples of resistance to development projects that displace people and destroy their natural resource base. Such resistance has literally come under fire. For example, the adivasi protest against bauxite mining in Kashipur and the Koel Karo dam in Takpara.
- In fact, resource dependant communities have been squeezed and face threats of displacement, by both conservation programmes and development projects.
- The vast majority of resource dependent communities have no real say in the declaration of Protected Areas and development projects implemented in the National Interest.

## 3. Initiatives and Gaps

- The present official and dominant notions of biological resource utilization and biodiversity conservation are governed by the interests of the more privileged sections of society with little direct dependence on biodiversity which do not reflect the biodiversity related livelihood needs and priorities of the largest group of primary stakeholders. This is because present utilization and conservation polices have been framed through social processes which reflect the unequal power between diverse social groups.
- Biodiversity has multiple uses and multiple users with potentially conflicting ways of managing the resource. This is so even within local resource dependant communities having diverse livelihoods and resource related needs. Besides, there are prevailing inequalities of class, caste, gender and age that need to be addressed within local community institutions.
- Hence, there is an urgent need to put in place more democratic and equitable mechanisms for redefining biodiversity conservation and use strategies which provide a legitimate voice to the vast majority of local communities dependent on bio-diverse resources for their livelihoods in articulating their differentiated concerns and priorities.
- This requires initiating a holistic review of existing policies, laws and development interventions to enable primary stakeholder groups of dis-privileged women and men with biodiversity based livelihoods to become key partners in achieving the goals of conserving biodiversity while being able to sustainably use local natural resources for their livelihoods.
- In the context of the prevailing structure of unequal economic and political power, developing institutional mechanisms that foster a strong democratic process giving legitimate weightage to the voices of disprivileged groups of biodiversity depend-

ent women and men in decision making is required.
- Securing local resource rights and management authority along with conservation responsibility, in the context of market driven globalization is critical both for protecting livelihoods and the biodiversity on which they are dependent.

## 4. Proposed Strategy and Action Plans

In order to address the above mentioned issues and concerns the following strategy and action plans have been proposed:

### 4.1 Strategy and Action Plans for Forest based Livelihoods

**Strategy I: Promote a shift towards devolving management authority (based on evolving collective norms and responsibilities for conserving diversity) over communally used forest land resources to democratic and gender equal/balanced community institutions or Gram Sabhas/Panchayats with secure rights over all timber and non-timber forest products as well as eco-system services.**

**Action IA:** Security of rights and flexibility in exercising management authority: Management of forest lands used by local communities should be devolved to village institutions either under section 28 of IFA or under PESA or under State Gram Panchayat Acts.

Where there is other form of community management practices prevailing such as in the states of the North East, or in areas where communities have evolved their own institutions and practices, the existing management models can be strengthened.

**Category:** High priority to develop framework guidelines

**Details:**
- The guiding principles for exercising rights and management authority should be based on collectively evolved norms on principles of equity, gender equality and conserving diversity.
- The rights regime to recognize and accommodate varying degrees of rights and responsibilities for multiple stakeholders, with safeguards for resource dependant poor.
- Women's independent rights should be ensured by making allocation of rights on the basis of adulthood instead of the household, including widows/divorced/destitute women who return to their natal village.
- Local level demarcation for CIs/user groups based on existing livelihood uses. For example, exclusive rights for women's groups over management of NTFPs.

**Responsibility:** Govt. of India (MoEF), State governments and PRIs to implement

**Time frame:** Initiate within one year

**Action1B:** Constitute a multiple stakeholder committee at the State level, with representatives of CIs and their Federations, FD and NGOs, to evolve guidelines/rules and regulations for the devolved form of community institutions. This should include CIs in forest and Taungya villages, JFM, CFM and ecodevelopment areas.

**Action 1C:** Ensure sufficient autonomy for Community Institutions (CI) taking up conservation and management of forests, with safeguards for equity.

**Action ID:** Clear statement in guidelines for, recognition, valuing and revitalization of indigenous knowledge of local biodiversity through creating legitimate space for its use in local forest management. and combining this with sensitization of all stake holders including FDs to such knowledge by organizing training programmes for them conducted by knowledgeable local women and men as the resource persons.

**Action IE:** Develop appropriate designs for CIs to protect interests of the weaker forest dependent user groups, especially in heterogeneous village communities with changing resource related needs. Enhance capacity of women and other disprivileged and voiceless groups to exercise their legitimate rights to participate in local forest management decision making and entitlement to the produce and services.

**Details:**
- Encourage formation of homogenous user groups as sub-groups within CI, acknowledging their specific interests and giving weightage to their concerns in decision making.

**Strategy II: Initiate holistic forest sector reforms with multi-stakeholder participation which take into account the multiple livelihood functions, often based on customary rights, of the uncultivated common lands legally designated as state owned forests over time.**

**Action II A:** Initiate comprehensive surveys of those lands declared to be forests, where no such surveys have been undertaken upto the present. These should record their existing livelihood uses and users and should be undertaken through transparent and participatory processes involving Gram Sabhas, representatives of Revenue and Rural Development Departments and Mass Tribal Organisations and other community organisations.

**Category:** High priority

**Responsibility:** Govt. of India to initiate state governments to implement

**Action II B:** In the case of already demarcated forests, undertake detailed studies of the diversity of livelihood uses through sample surveys representing diverse eco-systems and livelihood systems as a part of NSS on a regular basis.

**Action II C:** Management of forest lands used by local communities should be devolved to village institutions either under section 28 of IFA or under PESA or under state Gram Panchayat Acts.

**Action IID:** Review forest related laws and weed out contradictions between them in the light of forest sector reforms.

**Action IIE:** Focussed development interventions in forest and taungya villages where forest dweller communities in them have been victims of exploitation, discrimination and neglect. These villages need to be converted into Revenue villages with land rights for inhabitants.

**Category:** High

**Details:**
- Ensure access to all development interventions/programmes from development administration
- Preferential implementation of employment generation and resource regeneration programmes including agro-forestry
- Legitimate access to forest produce with responsibility to local CIs for conservation and sustainable use.

**Responsibility:** GOI to initiate, State governments to implement, involving forums of forest workers.

**Strategy III: Create space for Community Institutions (CIs) of forest dependant user groups to develop collective norms for regenerating, conserving and exercising prudent extraction of NTFPs giving priority to local consumption needs. Move towards abolishment of contract systems, for procurement, storage, value adding and sale, and eventual de-nationalization of NTFPs, in order to enhance livelihoods depending on diversity in forest resources.**

**Action IIIA:** Develop a framework of operational models to implement PESA amendment on NTFPs.

**Details:**
- Disseminate information on PESA provision to all Gram Sabhas where applicable.
- Demarcate catchment areas of NTFPs that comes under the jurisdiction of GPs under PESA provision.

**Action IIIB:** Gram Sabhas to be authorized, by the State Governments, to issue collection and transport permits, and certification of origin for NTFPs collected.

**Action IIIC:** Encourage collectors' organisations to collect, store, process/add value, transport and market NTFP to enhance incomes. Provide training and capacity building to emerging collectors groups, for access to appropriate and innovative technology for NTFP value addition, quality and standardization etc.

**Action IIID:** The State to organize and finance market intelligence system and make it available to the collectors and their forums.

**Strategy IV: Move towards greater community participation in the management of PAs with a focus on livelihood security of forest dependant people living in and around them.**

**Action IVA:** Explore adoption of IUCN's other categories of PAs, such as community reserves, people's protected areas, to enable to enable greater community participation in new areas.

**Responsibility:** GoI, MoEF, PA authorities and State wildlife authorities

**Action IVB:** Implement Joint Protected Area Management (JPAM) in existing PAs with residential traditional communities to ensure conservation and livelihood security.

**Category:** High

**Details**

- Participatory research to understand the ground situation regarding livelihoods, complementary/conflicting needs of villagers and wild life.
- Designing and organizing institutional structures for PA management CIs with a standing committee on people and PAs within each Wild life Advisory Board.
- Formal agreement between communities and FD for each PA.
- Appropriate legal and policy changes in WLPA.

**Action IVC:** Recognise traditional community rights in conservation, (with appropriate modification/reform arrived through consultation), using Section 24-2C of the WLPA. Provide legal recognition for conservation traditions and initiatives.

**Action IVD:** Set up forums at the PA, Divisional and State levels for discussing and resolving issues in PAs as there are conflicting issues related to relocation, crop damage and threats to human life by wildlife, all this impinging on livelihoods.

**Action IVE:** Involve people to manage eco-tourism in PAs.

**Action IVF:** Explore other options 1) where livelihoods are affected and 2) where existing livelihoods have become destructive, unacceptable or unviable

**Category:** High priority

**Details**

- Provide alternative employment opportunities on a priority/reservation basis in PA-related work and in other work outside of PAs. Identify sustainable livelihoods.
- Create a conservation compensation fund (with joint management mechanism) to compensate in cash and kind for lost livelihood opportunities.

**Strategy V: Bring about changes in policy, forest administration, style of management by Forest Department that enhances ownership by communities and move away from past alienation mode.**

**Action VA:** Create forums for participation of multiple-stake holders, with adequate representation of the forest dependent communities, their federations and NGOs, for discussing and resolving issues related to conservation and livelihood needs in forest resources.

**Action VB:** Institutional review of FDs and reorientation of forest services training to cope with the emerging challenges and redefined mandate.

**Category:** High priority

**Details:**

- Focus on integrating local knowledge in forest management
- Participatory planning processes for making Forest Working Plans/PA Management Plans from the micro-plans at village level
- Participatory management with concern for equity and empowerment of disadvantaged forest dependant groups
- Evolving a consensus/resolving conservation -livelihoods conflicts

**Responsibility:** MoEF

## 4.2 Strategy and Action Plans for Pastoralists

**Overall Strategy:** Pastoralists play an important role in the conservation of indigenous livestock breeds (such as one humped camel, Toda buffalo, Nari and Malaimadu cattle, Deccani sheep). These breeds harbour a wide variety of adaptive traits, being able to cope with harsh climates and landscapes and resisting diseases that affect crossbreeds. It is imperative to conserve them and the pastoral livelihoods they support.

**Strategy I: Develop lands use policies that conserve and protect grazing lands and ensure legitimate space for the livelihoods of pastoralists.**

**Action IA:** Review/formulate State and National level grazing policies in consultation with pastoralists and herders organisations in order to conserve resources and ensure livelihood security.

**Category:** High

**Details:**

- The recent initiative for getting a land use policy framework developed should specifically include documentation of customary pasture lands and migration routes of nomadic pastoralists and other herder communities. The existing land use category of 'wastelands' under Revenue Departments should be reviewed and a specific category of customary pastures be included to prevent such lands being allocated for other uses on the assumption that they are lying 'waste'.

**Responsibility:** GoI and ICAR to initiate process in collaboration with the Planning Commission and state Planning, Rural, Animal Husbandry, Forestry and Revenue Departments

**Action IB:** Legitimize and protect grazing rights of pastoralists on village commons including gauchar and other revenue lands and facilitate development of their associations/cooperatives for furthering their livelihood interests.

Review traditional and customary grazing rights in consultation with representative organisations of pastoral groups and identify policies and programmes, that prevent them from exercising their rights, and hence need change.

**Responsibility:** Gram Sabhas, Panchayati Raj Institutions (PRIs), Animal Husbandry department, Forest Department and State Revenue Departments.

**Action IC:** Enable organisations of pastoral groups to establish linkages with local community institutions to negotiate use and assume/share responsibility in revitalizing and managing grazing lands.

**Details:** Organize pastoral groups to form sub-groups within village level and other local institutions to assert their needs/rights collectively and take responsibility for evolving rules and norms for sustainable and equitable to management of the resource.

**Strategy II: Protect livelihood security of pastoralists by revalidating their customary use of those lands which have been declared government owned forests within an agreed framework evolved through negotiations for ensuring protection of natural biodiversity encouraging sustainable use of forest resources by pastoralists.**

**Action IIA:** Legitimise grazing rights on forestlands within a framework of conservation with sustainable use evolved through transparent negotiations.

**Category:** High

**Details:**

- Ensure clear documentation and publicity of legal and customary grazing rights within each forest range/division to initiate a dialogue on the subject.
- Evolve guidelines with grazing codes/norms for cutting fodder, seasonal grazing, rotational grazing, considering the carrying capacity of forests and number of animals allowed for grazing.

**Action IIB:** In areas where natural grasslands/pastures have been declared as 'forests', the forest Working Plans should not treat them as 'blanks' for afforestation. Where such local eco-systems have already been damaged due to plantation of exotic tree species in natural grasslands as in Kutch, H.P., Uttaranchal, the Toda areas in the Nilgiris), the Working Plans should provide for removal of

the exotics for promoting eco-restoration.

**Action IIC:** Ensure representation/space for pastoralists in village institutions, to participate in for Joint/Community Forest Management and Watershed Development as well as in PRIs/Gram Sabhas in the case of nomadic pastoralists who are not settled residents.

**Category:** high, immediate.

**Details:**
- MoEF and MoRD to issue guidelines to all Forest and RD Departments requiring representation/membership of pastoralists on village institutions concerned with managing common/pasture lands. Microplans to be prepared/modified after considering needs of pastoralists.
- Grazing rights of pastoralists should not to be restricted to forests/common lands adjacent to their villages in recognition of the larger landscape used by them.

**Responsibility:** MoEF/MoRD with State Forest/RD Departments, JFM, CFM, Watershed, Eco-Development committees

**Action IID:** Allow grazing in PAs especially during monsoons when availability of other grazing areas is limited. Initiate Joint Protected Area Management with pastoral groups after evolving location and ecosystem specific norms for conservation with sustainable use, through transparent processes of negotiation and consultation.

**Action IIE:** Review and control the population of wild animals considering the carrying capacity of PAs, where their proliferation has resulted in over grazing of grasslands and adversely affected livelihoods of pastoralists.

**Responsibility:** MoEF, State Forest Departments, in consultation with pastoralists groups and PRIs and NGOs.

**Strategy III: Review the existing mandates of AH departments and ensure that conservation of livestock diversity is included in them through appropriate policy changes at national and state levels. Promote animal health and livestock extension services addressing the special needs of the pastoral groups, integrating their indigenous ethno-veterinary knowledge and supporting them for conservation of livestock diversity.**

**Action IIIA:** Ensure that Government Veterinary facilities are equipped to address the needs of both small and big indigenous animals of pastoralists.

**Details:**
- Revise veterinary curriculum, so that the students are informed about the significance of pastoral livelihoods for livestock production and conservation of indigenous livestock diversity and accept pastoralists as partners rather than backward people to be talked down to.

**Responsibility:** State AH Departments, Veterinary Council of India with the help of NGOs specialized in pastoralists and on animal health issues.

**Action IIIB:** Recognise, reward and strengthen traditional veterinary healers. Ensure through relevant Departments conservation and growth of medicinal plants on grazing lands.

**Strategy IV: Promote linkages between concerned government departments (AH, FD, Revenue) in order to enhance the livelihoods of pastoralists.**

**Action IVA:** Organise workshops/forums at the state level in which pastoralists and the three departments can engage in a dialogue.

**Details:**
- Focus on the multiple uses, functions and nutritional/medicinal qualities of diverse types of livestock, particularly for subsistence that have been ignored.
- Strengthen pasture development programmes with the involvement of pastoralists.

**Responsibility:** State level Committee of NGOs, AH and FD.

**Action IVB:** Explore and support initiatives for value addition and processing at the local level and upgrading marketing efforts in order to enhance livelihoods of pastoralists.

**Action IVC:** Review the educational facilities so as to address the emerging needs of pastoralists and integrating/reinforcing important elements of their culture and traditions.

**Strategy V: The need to recognise the intellectual property rights (IPRs) of pastoralists and other traditional domestic animal raisers in the light of the growing interest in making use of the genetic traits of indigenous livestock breeds.**

**Action V:** Initiate a discussion/debate involving all stake holders, especially pastoralists and livestock keepers in order to recognise those maintaining superior local breeds and ensure compensation for information regarding indigenous breeds.

**Category:** High

**Details:**
- Evolve a format for description of breeds.
- Document local breeds and indigenous knowledge associated with animal breeding through staff of AH department.

**Responsibility:** National Bureau of Animal Genetic Resources, Karnal/ICAR

## 4.3 Strategy and Action Plans for Coastal Livelihoods

**Strategy I: Stop industrial Aquaculture that degrades the coastal resources and promote sustainable practices that enhance livelihoods of fisher people.**

**Action I A:** Honour the Supreme Court Judgement banning Aquaculture in the CRZ, and withdraw the Aquaculture Authority Bill. This is necessary for the protection of coastal biodiversity and the fragile ecosystem harbouring it and also for securing the livelihoods of communities dependant on the renewability of these resources.

**Category:** High priority, immediate

**Details:**
- Declare the environment impact study of Aquaculture invalid. This review/study is unconstitutional as it has been done by Marine Products Export Development Authority (MPEDA), the violator and the petitioner in this case

**Responsibility:** GoI, MoEF and MoA

**Time Frame:** Within 6 months

**Action 1 B:** Promote traditional and improved traditional Aquaculture practices to secure and enhance livelihoods of communities dependent on the resource.

**Responsibility:** State Governments, Fisheries Department, MPEDA, PRIs and CMFRI and mass based forums/federations of fisher folk

**Strategy II: Legislative mechanisms to ensure sustainable fishing and promote ecologically sensitive and appropriate technology**

**Action II A:** Enact a Marine Fishing Regulation Act (MFRA), by Parliament, for the entire EEZ. This is necessary to stop the indiscriminate exploitation of marine resources by the mechanized sector, which has been destroying coastal biodiversity, coastal livelihoods and traditional fishing practices

**Category:** High Priority

**Details**

- The Majumdar Committee (1978) and Murari committee (1997) have already recommended enactment of the MFRA by GoI.
- Since marketing (Export and Import) is a crucial factor linked to fishery resources import export policy of the country need to be harmonized with the MFRA

**Responsibility:** GoI for initiating the process and ensuring co-ordination with MoA and MoC and representative organisations of fisher folk. MoA to hold consultations and draft the MFRA and introduce it in Parliament.

**Time Frame:** 2 years

**Action II B:** Upgrade traditional fishing gears with appropriate technology so as to retain their ecological sophistication

**Strategy III: Safeguard the livelihoods of fishing community from cheap imports/dumping of fish.**

**Action III:** In order to protect the National Fisheries Sector and the livelihoods of the fishing Community, (from cheap imports under GATT and GATS) imports need to be curbed and regulated with the enactment of a National law.

**Category:** High, immediate

**Details**
- Ministry of Commerce to constitute A drafting group with representatives of fishers organisations, MoA, MoL, CMFRI and Coastal MPs.
- Incorporate the above draft into the proposed MFRA. Till such time use all available regulatory mechanisms to minimise fish imports.
- The National Fishery Policy should also reflect this concern.

**Responsibility:** GoI to initiate the process with MoA, MoC and MoL (Law), Ministry of Labour and representatives of fisher's organisations.

**Time Frame:** Urgent - immediate - prior to the next round of WTO negotiations in March 2003.

**Strategy IV: Enable community ownership, control and management of coastal resources.**

**Action IV A:** Grant community property rights to coastal communities dependent on the resource for their livelihood to strengthen their collective say in addressing emerging challenges.

**Category:** High and basic

**Details**
- Rights to govern the resources to be recognised and included in PRIs (in line with Schedule V areas).
- This needs to be coupled with enabling measures like aquarian reforms.
- Space for individual pursuit to be recognised within community norms. (Community consultation and common approval for individual actions)

**Responsibility:** MoA, MoEF, and Ministry of Local Self-Government and coastal state governments, community Institutions

**Action IVB:** Extend community rights and benefit sharing mechanisms to fishery and non-fishery resources, while specifying coastal and marine resources under Integrated Coastal Management.

**Category:** High

**Details**
- Exploitation of non-fishery resources (extraction of minerals, petrochemicals, seaweed, seawater desalination, organisms for drug industry etc) in coastal and marine regions has caused loss of livelihood, living space and displacement of coastal communities. Hence community rights over these resources and share in benefits is needed.

**Responsibility:** GoI to pursue with MoEF, MoA, and Ministries for mining, petroleum, Department of Fisheries, and Coastal

Management Authorities.

**Action IV C:** Reconstitute electoral constituencies along the coastal region for increased representation of coast dependent communities in PRIs, State Assemblies and Parliament.

**Details**

- Empirical observations have shown that the current electoral constituencies are vertically placed in the coastal regions, whereas the community lives horizontally along the coast. As a result, coastal/fishing communities become a minority in these governance systems. Realigning and demarcating constituencies will increase their space in governance and decision making.

**Responsibility:** Election Commission, GoI and State Governments

**Strategy V: Mangroves, a vital resource for coastal lives and livelihoods, to be protected and regenerated with the active participation of coastal communities.**

**Action V:** Enhance the scope of CRZ (and later the Integrated Coastal Management) to all mangrove patches and stretches, irrespective of their size and proximity to the coast. Record and document the dependence of communities. Involve local user groups in protection and regeneration.

**Category:** High priority

**Details:**

**Responsibility:** MoEF to enhance scope of CRZ to all mangroves and ensure community participation.

**Time Frame:** Two years

**Resources required:** All money earmarked for seawall construction. Earmark budgetary support to Coastal Panchayats for Mangrove regeneration programmes

**Strategy VI: Acknowledge coastal communities as strong allies and involve them in the protection/conservation of coastal and marine resources.**

**Action VI A:** Strengthen implementation/enforcement of the CRZ notification, by including PRIs/CIs on the Coastal Management Authorities.

**Action VI B:** Involve coastal communities in the management of coastal and marine PAs.

**Responsibility:** MOEF, State Governments, Fisheries Department, PRIs and local community institutions.

**Strategy VII: Empower fishing communities to organize and manage their own community institutions(CIs) for pursuing their livelihood needs (to meet the challenges of globalization and the market economy) and using the coastal resources sustainably.**

**Action VII A:** Encourage fishing communities to organize themselves into self-governing cooperatives (or appropriate form of CI) in every fishing village with 100% membership of fisher people (to ensure that, there is no space for vested interests to usurp them). Strengthen and upgrade traditional CIs where they still exist/function.

**Responsibility:** Cooperative and Social Welfare Departments, Panchayats, NGOs.

**Action VII B:** Special Schools, colleges and Technical Institutions need to be set up in coastal regions for the coastal community, to equip them to meet emerging challenges.

**Responsibility:** MoE, Department of Fisheries, Department of Social Welfare, CMFRI, PRIs, and Women's Commissions and NGOs.

**Strategy VIII: Enhance livelihoods of fisher people by encouraging value addition**

**Action VIII:** Promote value addition, diversification of products and produce and marketing, taken up by women's group/cooperatives within the fishing community. Link up with other livelihood groups/artisans for environmentally friendly packaging and accessories in value addition process.

**Responsibility:** State Departments of Fisheries, MoI, MoC, and Community co-operatives

**Strategy IX: Move towards ecologically and socially sound coastal tourism.**

**Action IX:** Enforce norms for Coastal Tourism to protect coastal ecology and livelihoods for communities. Current tourism development has been detrimental to coastal ecology and has encroached on the livelihood and living spaces of coastal communities, due to lack of sensitive planning and implementation.

**Category:** High priority

**Responsibility:** MoEF, DoT, PRIs and Coastal Management Authorities

**Strategy X: Enforce norms for Industrial and infrastructure development along the coast.**

**Action X:** Strict adherence to the CRZ notification is necessary to check the (prevailing) indiscriminate use of coastal lands for setting up industries, captive ports and highways. Industrialization and infrastructure development along the coast has been destroying mangroves and the attendant ecology, natural estuaries and fishing grounds, effecting resource availability and the livelihoods of coastal communities, alienating and displacing them.

**Responsibility:** MoEF, Coastal Zone Management Authority, MoI, Ministry of Surface Transport, State Pollution Control Boards, Community Institutions and Panchayats.

**Strategy XI: Enhance the scope of CRZ for conserving coastal resources and securing coastal livelihoods in the context of emerging intensive developments along the coastal region**

**Action XI:** Review the amendments to the CRZ that have diluted the sprit of conservation of coastal resources and community rights

**Category:** Urgent

**Details**

- Ban golf courses which are now permitted in the Special Economic Zones (SEZ) in CRZ III zones.. Golf courses are water intensive and use chemical fertilizer and pesticide. This would have negative impacts on the ground water table and also seepage of chemicals to the ground and other waterbodies, effective coastal agriculture, fish and microorganisms.
- No SEZ in regions of community living spaces, ecologically sensitive areas.
- Restore the rights given to traditional coastal communities in the original CRZ notification. ('Traditional rights and customary uses' recognized in the original notification 1991, for settlement rights of the community, have been diluted and substituted by 'local inhabitants' in the latest amendment dated January 2002)

**Responsibility:** MoEF, Coastal Zone Management Authority, Community Institutions and Panchayats.

# Micro-organic Biodiversity Thematic Strategy and Action Plan

Coordinator: B.N. Johri
Coordinating Agency: G.B. Pant University of Agriculture & Technology, Pantnagar

Microorganisms are ubiquitous and 'do not follow borders". As an integral component of varied natural ecosystems they thrive as parasites, predators, symbionts and as closely associated partners' of plants, animals and other microorganisms. Man himself harbours a multitude of microbial forms and therefore any biodiversity scenario in the context of natural and man-made ecosystems is unthinkable without their consideration. Explorations of extreme habitats carried out during the last three decades show that microbial forms live happily at pH values approaching zero, temperatures reaching as high as 1130C, and as low as below freezing, depths of sea approaching 11, 000 m, saturated salt solutions and host of other similar extreme conditions. This has now led to recognition of a 'deep hot biosphere' with its unique microbial animal assemblages and nutrient dynamics. Microorganisms contribute extensively in agriculture and forestry by way of nutrient cycling, organic matter decomposition and soil and crop health management. In human and animal health, they are central to the availability of drugs and therapeutic proteins, vaccines and diagnostic tools.

They are the harbingers of daily foods such as curd, cheese, idli, mushrooms and others besides being the central point of industrial development leading to the manufacture of antibiotics, enzymes, fine chemicals and a host of other secondary metabolites. Most microbiologists maintain that "unless microbial exploration is carried out, the country will face disastrous industrial and economic consequences".

## Living Modified Organisms (GMO, GEM)

The entire field of biotechnology is rapidly expanding and microorganisms are the basic tools for this technology. One can call this "man-made" biodiversity and applications of such modified organisms in agriculture, medicine, bioremediation, industrial chemicals are well documented and exploding exponentially. The potential is mind boggling! Some countries favour their use, others hesitate, many others question the biosafety aspect and several reject their use. We, in India, cannot ignore this enormous development in genetically engineered microbes. Will they be the ultimate answer to quality food and adequate food and thus alleviate poverty? Will they be the ultimate answer to biotic and abiotic stresses to various crops ? Will they be the answer to rapid urbanization, leading to decrease in cultivable land ? At the same time, considering our huge rural population with rudimentary education, the biosafety aspects are even more crucial. The uncontrolled release of GEMs is dangerous and undesirable. The NBSAP must take this scenario under serious consideration. The DBT has laid down elaborate guidelines for laboratory and field safety of GEMs. The regulatory mechanisms that are in place today, must be both rational yet flexible, disciplinary yet balanced and must have sufficient monitoring capabilities.

### Major Issues

Classical cultivation of microorganisms using methods developed over the ages has led to the recovery of barely 0.5 % of the microbial diversity that is now traceable with the advent of new molecular biological tools. Obviously this diversity needs innovative methods of cultivation in the laboratory and exploitation of their potential. Of course, techniques now available, make it possible to exploit and detect DNA without the isolation of the organisms. But this needs to be practiced in India. Taxonomic changes are taking place based on gene sequencing data. In India, over the decades, the classical taxonomist has been neglected. Today the new generation of molecular biologists cum taxonomist is yet to mature.

India, with its vast and varied ecological systems has potential to contribute significantly to microorganism biodiversity both nationally and internationally. However, we know very little about the total microorganism diversity in India with the exception of fungi where the traditional mycologist has played a major role in cataloguing the existing diversity. This does not however imply that fungi have been investigated and catalogued in their totality. This is a cause of concern since Gadgil had indicated that in a set of 2500 species, microorganisms made up for app. 17.6% of the possible taxonomic component. The major issues relate to not only a detailed data base of microorganisms especially in the extreme habitats but extended facilities for conservation beyond the only available Microbial Type Culture Collection Centre at Chandigarh. This situation can and needs to be changed by ensuring the availability of trained manpower, which interalia means special, long term academic curricula that encompass classical taxonomy,

molecular biology, biotechnology and diagnostic analysis. The availability of critical analytical instrumentation/tools, data bases, expert scientists at different levels and sites in the country is a must. Microbial Diversity must not be taken in isolation. It must be integrated with the advances in Biochemistry, Chemistry and Medicine. Today, nanotechnology is becoming a major scientific area. Microbes are ideal partners in this science.

## Ongoing Initiatives and Key Gaps

Non-availability of trained taxonomists was appreciated by the scientific community over a decade ago which has culminated in the operation of an All India Coordinated Project on Taxonmy (AICOPTAX) by the Ministry of Environment and Forests wherein Centres for Bacteria and Archaea, Fungi and Viruses are in operation. The Department of Biotechnology has supported a number of diversity associated R&D projects in various parts of the country through which useful gene pool is being generated and characterised forms deposited at the MTCC, Chandigarh. In addition, the National Biodiversity Resources Board under the DBT has initiated a programme to inventorize the existing microorganism resources in the country as a digitized database. On the conservation front, the Indian Council of Agricultural Research (ICAR) has recently approved the establishment of a National Bureau of Agriculturally Useful Microorganisms. These initiatives are vital steps in closing the gap between the reality and the expectation of microbial diversity that surely exists in this vast geo-agro-socio structure of India. These are surely to be appreciated. But are they sufficient? Are they adequate? One needs to have an optimal resource level in terms of both manpower and finance. A short term effort is not likely to succeed. A long term plan and support must be initiated.

## Proposed Strategy and Action Plans

The proposed strategy to fill up the vast gaps in our understanding of Microorganism Diversity comprises of habitat based exploration, establishment of regional network of specialized Conservation Centres, Creation of Centres of Excellence for groups of relevance in agriculture, health, industry and environment, and a training component to build up a committed pool of taxonomists during the coming decade. Each network needs to coordinate with a designated nodal centre that will in turn interact with IMTECH and/or a second such centre in the country however REGIONAL CENTRES should have full autonomy. It is suggested that a centre for Central Zone (Bhopal/Indore), Southern Zone (Bangalore), Western Zone (Pune) and Eastern Zone (Calcutta) be set up. MTCC (Chandigarh) will serve the northern zone as also a National Centre for repository of new and novel organisms.

The proposed exploration emphasizes surveys of pristine locations such as shallow and deep marine ecosystems; natural and artificial salt pans and playas of Maharashtra, Gujarat and Rajasthan; arid and desert region of Andhra Pradesh, Madhya Pradesh, Chhattisgarh, Leh, Ladakh and Rajasthan; natural lake systems such as those comprising of Lonar in Maharashtra, Chilka in Orissa, salt lakes of Gujarat/Rajasthan; fresh water lakes of North Eastern and Himalayan regions, Madhya Pradesh, West Bengal and others; estuarine sites comprising of waterways of Kerala, Sunderbans in W.Bengal; mangrove ecosystems along the coasts of Tamil Nadu and Goa; natural forests such as those represented by Corbett National Park, Bharatpur Bird Sanctuary, Silent Valley, forests of Bastar region in Chhattisgarh and others; mining areas in Chhattisgarh, Jharkhand, Orissa, Karnataka and other; glaciers and high altitude lake ecosystems; hot springs, sulphur springs and other similar extreme habitats. Adapted microorganism diversity requires exploration in man-made ecosystems such as those based on pesticides, industrial effluents and agricultural practices; oil deposits and oil spills in marine and coastline areas. Exploration exercise will be based on both, traditional and molecular methodologies in order to build up a gene pool for bioprospecting and search for non-culturable forms in order to assess the community structure. To achieve rapid answers, bio- prospecting for new and novel molecules has to be based on microarrays and tools of proteomics. A genomic database has to be built up at Microbial Type Culture Collection, IMTECH, Chandigarh that will be accessed by researchers through appropriate networking facilities.

The above suggestions will involve not only high financial input and long-term commitments but also skilled manpower which is just not there but must be created. In addition, exploration of unique habitats for novel gene pool too is not a simple exercise considering the vast expanse of this country. On a priority basis therefore immediate exhaustive surveys are proposed for Lonar lake in Maharashtra; saline desert playas and salt lakes of Rajasthan; mangroves and coral reefs; mushrooms of Bastar forests; endophytic microorganisms of plants and gastro-intestinal tracts of ruminant and non-ruminant herbivorous animals, high altitude habitats in Central Himalayas and pristine habitats of NorthEastern regions. These surveys could act as a model system for others to follow. The human resource training component in taxonomy including identification, molecular methods, conservation strategies and rapid exploration is of immediate significance for which besides IMTECH, Agharkar Research Institute, Goa University, Osmania University, IARI, IVRI, University of Delhi South Campus, Tata Energy Research Institute, G.B. Pant University of Agriculture and Technology, University of Madras, M.S. Swaminanthan Research Foundation, NEHU, M.S. University and others can be utilized.

Currently available molecular microbiological tools permit detailed analysis of the community structure in natural ecosystems using *in situ* DNA methodologies. Considering the major problems associated with static productivity in particularly rice-wheat rotation, environmental issues associated with heavy use of agrochemicals, increased emphasis on organic agriculture and the

general environmental concerns, it is proposed to prepare a Molecular Microbial Fingerprint of the community structure of all the major agro-ecological zones as digitized information and utilize it to monitor biological change on a long-term basis. This will help in sustainable development besides acting as a marker of change in indigenous microbial community structure. Current EU regulations on the use of bioinoculants already require information concerning biological displacement, if any, on account of extraneous addition of a microbial preparation for soil health and plant productivity. In the short-term, this action plan requires standardization of methodologies on some select soils over two years time, followed by training and networking of several institutions in the country to develop a national plan for five years; other ecosystems can be added up since tools and techniques remain unchanged.

Strong international linkages in the taxonomy component are necessary with organisations such as ATCC, DMSZ, BCCC, and IMI for training of researchers and exchange of ideas. It is proposed to develop both, short and long-term linkages besides holding of specialized workshops with the participation of subject experts. Such an exchange will also be useful in setting up of Centres of Conservation and strengthening of identification services.

# Natural Aquatic Ecosystems Thematic Strategy and Action Plan

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Wetlands are defined as 'lands transitional between terrestrial and aquatic eco-systems where the water table is usually at or near the surface or the land is covered by shallow water'. The value of the world's wetlands are increasingly receiving due attention as they contribute to a healthy environment in many ways. They retain water during dry periods, thus keeping the water table high and relatively stable. During periods of flooding, they mitigate flood and to trap suspended solids and attached nutrients. Thus, streams flowing into lakes by way of wetland areas will transport fewer suspended solids and nutrients to the lakes than if they flow directly into the lakes. The removal of such wetland systems because of urbanization or other factors typically causes lake water quality to worsen. In addition, wetlands are important feeding and breeding areas for wildlife and provide a stopping place and refuge for waterfowls. As with any natural habitat, wetlands are important in supporting species diversity and have a complex of wetland values.

## Wetland Distribution

Wetlands in India occupy 58.2 million hectares, including areas under wet paddy cultivation. Majority of the inland wetlands are directly or indirectly dependent on the major rivers like, Ganga, Bhramaputra, Narmada, Godavari, Krishna, Kaveri, Tapti. They occur in the hot arid regions of Gujarat and Rajasthan, the deltaic regions of the east and west coasts, highlands of central India, wet humid zones of south peninsular India and the Andaman and Nicobar and Lakshwadeep Islands.

## Wetland Values

Wetlands provide many services and commodities to humanity. Regional wetlands are integral parts of larger landscapes, their functions and values to the people in these landscapes; depend on both their extent and their location. Each wetland thus is ecologically unique. Wetlands perform numerous valuable functions such as recycle nutrients, purify water, attenuate floods, maintain stream flow, recharge ground water, and also serve in providing drinking water, fish, fodder, fuel, wildlife habitat, control rate of runoff in urban area, buffer shorelines against erosion and recreation to the society.

Wetlands are often described as "kidneys of the landscape". When hydrologic conditions in wetlands change even slightly, the biota may respond with massive changes in species composition and richness and in ecosystem productivity.

## Threats to Wetland Ecosystem

Wetlands are one of the most threatened habitats of the world. Wetlands in India, as elsewhere are increasingly facing several anthropogenic pressures. Thus, the rapidly expanding human population, large-scale changes in land use/land covers, burgeoning developmental projects and improper use of watersheds have all caused a substantial decline of wetland resources of the country. Significant losses have resulted from its conversion threats from industrial, agricultural and various urban developments. These have led to hydrological perturbations, pollution and their effects. Unsustainable levels of grazing and fishing activities have also resulted in degradation of wetlands.

**Acute Wetland Losses**

- Agricultural Conversion
- Direct deforestation in wetlands
- Hydrologic alteration
- Inundation by dammed reservoirs

**Chronic Wetland Losses**

- Alteration of upper watersheds
- Degradation of water quality
- Ground water depletion
- Introduced species and extinction of native biota

## National Wetland Strategies

1. **Protection**
   The primary necessity today is to protect the existing wetlands. Of the many wetlands in India only around 68 wetlands are protected. But there are thousands of other wetlands that are biologically and economically important but have no legal status.
2 **Planning, Managing and Monitoring**
   Wetlands that come under the Protected area network have management plans but others do not. It is important for various stakeholders along with the local community and corporate sector to come together for an effective management plan. Active monitoring of these wetland systems over a period of time is essential.
3 **Comprehensive Inventory**
   There has been no comprehensive inventory of all the Indian wetlands despite the efforts by the Ministry of Environment and Forests, Asian Wetland Bureau and World Wide Fund for Nature. The inventory should involve the flora, fauna, and biodiversity along with values. It should take into account the various stakeholders in the community too.
4. **Legislation**
   Although several laws protect wetlands there is no special legislation pertaining specially to these ecosystems. Environment Impact Assessment needed for major development projects highlighting threats to wetlands need to be formulated.
5. **Coordinated Approach**
   Since wetlands are common property with multi-purpose utility, their protection and management also need to be a common responsibility. An appropriate forum for resolving the conflict on wetland issues has to be set up. It is important for the ministries to allocate sufficient funds towards the conservation of these ecosystems.
6. **Research**
   There is a necessity for research in the formulation of national strategy to understand the dynamics of these ecosystems. This could be useful for the planners to formulate strategies for the mitigation of pollution. The scientific knowledge will help the planners in understanding the economic values and benefits, which in turn will help in setting priorities and focusing the planning process.
7. **Building Awareness**
   For achieving any sustainable success in the protection of these wetlands, awareness among the general public, educational and corporate institutions must be created. The policy makers, at various levels along with site managers need to be educated. As the country's wetlands are shared, the bi-lateral cooperation in the resource management needs to be enhanced.

### Use of Remote Sensing and Gis in Wetland Management

Remote sensing data in combination with Geographic Information System (GIS) are effective tools for wetland conservation and management. The application can be thought of in the following areas

- Flood zonation mapping
- Inventory and monitoring of irrigation and cropping pattern
- Water quality analysis and modeling
- Mapping changes in the river course
- Delineation of extinct river course
- Water resource management
- Habitat mapping using microwave remote sensing

### Lotic Ecosystems in India

Springs, hill streams, headwaters, and rapids: these habitats are characterized by high gradient, often high altitude, usually high dissolved oxygen and low temperature and rocky substrate. The entire middle and lower Himalayas is richly traversed with such kind of habitats. A few of these are also found in western and eastern ghats besides Vindhyan system in the central India. These systems harbor few phytoplankton and macrophytes. Many of the fish and invertebrates living in these habitats have adaptations such as suckers, flattened depressed bodies, and laterally expanded fins to resist being swept away by the current. Usually the water is more transparent resulting in high penetration of light, which promotes abundant algal growth on the submerged rocks, constituting an important food resource for fishes and invertebrates. The chaotic nature of these habitats result in mosaic microhabitats, and the sampling of few hundred meters may yield more species than any other freshwater habitats. However, for obvious reasons, there has been very limited study of biodiversity in these habitats. The fauna of rapids is known to have a very high rate of endemism, but it is one of the least well - known habitats and hundreds of species probably still await discovery.

These habitats are threatened by deforestation, which increases the temperature and the sediment load, dam construction that creates high gradient sectors within the reservoir and alters the flow pattern downriver, or canalization, which reduces the heterogeneity of the riverbed, and thus the number of available ecological niches.

### Categories of Freshwater Habitats

- Springs, hill streams, headwaters, rapids
- Freshwater swamp forests and small streams in lowlands and foothills
- Large rivers, riverine lakes and floodplains
- Estuaries
- Lakes
- Marshes and swamps
- Peat swamps, black water streams, black water lakes
- Caves and aquifers and
- Artificial freshwater habitats.

## Lotic Ecosystems in India

The Indian sub-continent, bounded by the Great Himalayan Arc in the north and by deep sea in the east, west and south, is traversed by large number of rivers, which played a major role in shaping the history of human civilization in the sub-continent.

## Threats to Indian Lotic Ecosystems

1. **Pollution**
   Water pollution and freshwater depletion are currently viewed as the top environmental problem in Asian region. In India pollution of surface waters has become more severe and critical near the urban areas due to high pollution loads discharged within short stretches of rivers from urban activities.

   It is believed that the major source of pollution in Indian rivers are point sources, viz. domestic sewage, industrial effluents etc as most of the information available concerning pollution in Indian rivers are those of point sources of pollution. Very little is known about the non-point sources of pollution.

2. **Alteration of Natural Flow Regime**
   Five critical components of the flow regime regulate ecological processes in river ecosystems: the magnitude, frequency, duration, timing, and rate of change of hydrologic conditions. These components can be used to characterize the entire range of flows and specific hydrologic phenomena, such as floods or low flows that are critical to the integrity of river ecosystems. The natural flow regime organizes and defines river ecosystems.

   Water development projects have dramatically affected the ecology of river systems throughout southern Asia including India, which has not only resulted in loss of biodiversity but also given rise to inter-state and international conflict. The migratory species including river dolphins are vulnerable to the effects of interrupted movements and habitat degradation caused by these projects. Almost all the rivers in India have either dams or barrages creating a physical barrier for the migratory species, and diverting the river water for irrigation or other purposes. It has devastating effects on the flow as well as biota of the rivers.

## Threats to Lotic Biodiversity

### I. Pollution

Toxicity of metallic ions diminishes benthic abundance as well as catfish population. The impact of industry wastes on aquatic life including fish is most severe in streams and tributaries with low rates of summer flow especially in the minor tributaries of the Ganges. Inputs of agro-chemicals through surface run-off not only make the river system a repository of toxic chemicals but also render it eutrophic, especially the small rivers having less discharge.

### II. Habitat Alteration

1. **Withdrawal of water from rivers**
   The annual runoff in the Ganges basin is about 469 billion m3. Of this 85 billion m3 of water is diverted by canal projects and by hydroelectric and storage reservoirs for irrigation, power and flood control. Canal projects account for a little over 60% of the impounded water.

2. **Construction of dams, embankments and barrages**
   Canal projects and flood control measures are two major factors that are especially responsible for the destruction of breeding habitat for major carps.

Large water - diversion projects have not only affected freshwater fish and fisheries, but have caused reductions in estuarine and marine fish populations. Reduction of freshwater inflows reduces the amount of nutrients flowing into downstream areas and increases salinities. The effects of dams and barrages on fish faunas in tropical areas are poorly known but likely to be great.

3. **Construction of bridges and approach roads**
   Developmental activities related to transportation also destroy the habitat of many aquatic fauna. Construction of bridges on the river including the approach roads destroys the floodplains, which is a breeding ground of many fish species.

4. **Mining activities in the rivers**
   Extensive mining especially of sand and china clay from the river bed also severely affects the bottom fauna besides the river flow. River Son and River Ganga bears the brunt of extensive sand mining in Bihar at several points. China clay is being mined from the Ganga near Rajmahal.

5. **Channelization of rivers**
   Channelization typically involves the realignment, clearing, widening and lining of the stream channel, usually for flood control. Among other effects, channelization may reduce stream length, create uniform habitat conditions (reduce habitat heterogeneity), modify the hydrologic cycle, drain adjacent wetlands, eliminate instream cover and riparian vegetation, degrade water quality and alter trophic relationship.

### III. Competition for Water

Existing competition for water for various purposes and the ever-growing need for water becomes a serious threat to the loss of lotic ecosystem and freshwater biodiversity.

### IV. Introduction of Species

Introduced species occasionally replace native species in natural habitats through competition or predation, but most replacement occurs in altered environments that provide the introduced species an ecological advantage.

### V. Over exploitation of Aquatic Resources

Overfishing occurs in many rivers of India but it has not been the subject of detailed studies or analyses. Exploitation of other aquatic fauna is also prominent in most of the rivers. Killing of freshwater turtles as a food source is a cause of great concern.

## Strategy and Action Plan for Biodiversity Conservation of Lotic Ecosystems of India

1. **Maintaining the Integrity of River Systems**
   a. There is no "surplus" water; any large-scale withdrawal will have ecological consequences.
   b. The floodplain is an integral part of the river.
   c. An alluvial river must be allowed to migrate.
   d. Rivers need to maintain their natural temporal and spatial variability

2. **Purposeful Research on the Riverine Ecosystem and its Biodiversity**
   There is an urgent need to prepare a bio-map of all the major lotic ecosystems and associated wetlands and flood -plains in India. The scientific study must be associated with socio-economic aspects. Proper Environmental Impact Assessment (EIA) must be accomplished prior to any developmental work.

3. **People's Participation Is Crucial**
   If proper education and awareness programmes are conducted the common mass can be involved in conserving the rivers. It is more important to effectively implement the existing legislative measures than to have more and more legislative measures, however, if need be new legislative measures must be enacted. People should be encouraged to adopt low cost technologies for wastewater treatment in decentralized manner.

## Marine Ecosytem of India

The oceans cover over 70% of the planet's surface area and account for 99% of the volume that is known to sustain life. Coastal ecosystems such as estuaries, coral reefs and mangrove forests, also contain significant diversity and are highly valuable for coastal communities. (Wetlands are a collective term that includes mangroves, estuaries and all water bodies).

The biota of marine habitat also exhibits a diversity of survival strategies not found on land. The numerous planktonic life forms of

the ocean drift passively in the water, relying on ocean currents to transport them to new nutritional sources and new habitats. Filter feeders sieve plankton and other floating material for food; they range from microscopic zooplankton through barnacles and sea anemones to baleen Whales.

Until today marine biodiversity is less well known than terrestrial biodiversity due to the logistic difficulties of explorations and surveys. We know astonishingly little about marine life, even in the most familiar seascapes.

### Diversity of Marine Ecosystems in India

1. **Coastal Ecosystem**
   Coastal zone represents 18% of the earth's surface, providing space for 60% of the human population, since about 70% of the world's cities with population more than 1.6 million are located in the coastal zone. 90% of the world fish catch is obtained from this zone. Interestingly, the hydrosphere of the coastal zone is only about 8% of that of the world ocean but represents about 18 to 33% of total primary production. In India about 8000 km of coastline (including islands and archipelagoes) with different habitat types harbor a rich biodiversity. There are three major divisions of coast in India viz. east, west and island coasts. All these three regions have their uniqueness in their biodiversity assemblage and productivity.

2. **Coral Reef Ecosystem**
   Coral reefs form the most dynamic ecosystem providing shelter and nourishment to thousands of marine flora and fauna. They are the protectors of the coastlines of the maritime states. A few genera of corals are supposed to be older than prairies. This unique ecosystem is most productive because of its ability to retain and recycle nutrient elements within the ecosystem as well as within animal-plant associations.

   In India, all the three major reef types (atoll, fringing and barrier) occur, and the region includes some of the most diverse, extensive and least disturbed reef areas of the Indian Ocean, many of which are among the least scientifically known. The mainland coast of India has two widely separated areas containing reefs: the Gulf of Kachchh in the northwest, which has some of the most northerly reefs in the world, and Palk Bay and Gulf of Mannar in the southeast. There are patches of reef growth on the West Coast, for example at Malvan. The Andaman and Nicobars have fringing reefs around many islands, and a long barrier reef (329 km) on the west coast. The reefs are poorly known scientifically but may prove to be the most diverse in India and those in the best condition. The Lakshadweep reefs are oceanic atolls but these are equally poorly studied.

## Strategies for Coral Reef Conservation in India

### Strategy I Analyzing the Short Comings in Coral Reef Conservation in India

#### Recommendations

- Understand the problems facing coral reefs by assembling information from within India and nearby countries
- Determine the true economic value of reefs so that rational decisions can be made on the cost of management
- Transfer that understanding via education to the principal users, the public and decision makers
- Focus management around the user to ensure compliance with and assistance in resource management
- Incorporate reefs into marine protected areas to buffer the reefs against outside damaging influences.
- Control damaging practices and monitor the effectiveness of control.
- Promote sustainable uses to realise the full economic potential of healthy reefs
- Monitor the effectiveness of management so that procedures can be adjusted to ensure long-term sustainability.

### Strategy II Understand the Coral Reef Problems

#### Recommendations

- The coral reef areas in India should be determined using satellite and aerial images with ground truthing. Assistance may be needed from large agencies such as the National Aeronautics and Space Application Centre.
- These data should be used to find out the status of the coral reefs and how they are changing.
- National programmes to monitor the status of coral reefs should be implemented.
- The knowledge base of scientists, tourists operators, SCUBA divers and local users should be combined to determine the status of reefs and how they have changed during living memory.
- Central and State Government may convene national and local committees including user groups, local government authorities, tourism developers, scientists and Non governmental organizations (NGOs) to advise on sustainable management of coral reefs.

## Strategy III Determine the True Economic Value of Coral Reefs in India

**Recommendations**

- Direct 'extractive' values like fisheries, aquarium fish and other animals, ornamental products and sand production.
- Potential 'extractive' values like pharmaceutical drugs and species developed for future Mariculture activities.
- Direct 'non-extractive' uses such as tourism and educational and research values.
- 'Indirect use' values such as the commercial species that migrate to other areas the physical barrier, role in protecting the shoreline, the value in extending Exclusive economic zone.
- As well as the less tangible 'non use and aesthetic' values of high biodiversity habitats for endangered species and roles as part of the global environment.
- Determination of coral reef fisheries, how these are being exploited (catch per unit effort) and the dependence by local fishermen on reef fisheries.
- Determination of other values of coral reefs and potential economic losses if these values are foregone through reef degradation.
- Assessment of the current and potential future income from coral reef tourism and the contribution of health of reefs towards attracting tourists to India.

## Strategy IV Coral Reef Conservation Education

**Recommendations**

- Information on the nature and value of coral reefs should be provided to all users, students and public using appropriate methods. e.g. many fishermen will not read written material whereas videos and talking are effective.
- Summaries of the status of coral reef resources and sustainable management methods should be prepared for decision makers and development agencies donors and banks.

## Strategy V Focus on Management of Coral Reef Around the Stakeholders

**Recommendations**

- National and state governments of India should devolve sufficient responsibility for the management of coastal resources to local authorities at the village level.
- Legislation for coastal reef resource management should include the involvement of the users especially fishermen.
- Developers especially those involved in tourism should consult directly with local users on resource management and then employ local people to compensate for restrictions on resource use.

## Strategy VI Incorporate More Coral Reefs in Marine Protected Areas

**Recommendations**

- Large areas of relatively undamaged marine habitat including good coral reefs should be designated as marine protected areas and management plans developed to involve all users.
- Assistance for training, planning and management of MPAs should be requested from international donors, particularly to staff, local authorities with education officer and MPA Range officers.
- Tourism operators should be involved in the management of MPA and be prepared to fund some of the management.

## Strategy VII Control Managing Practices

**Recommendations**

**Pollution**

- Emphasize the treatment of sewage at the source or divert them away from coral reef onto the land or as deep ocean outfalls.
- New domestic and industrial development should be 'encouraged' to treat sewage as it is cheaper to install sewerage lines and systems during construction.
- Tourism developments near coral reefs should have full secondary or tertiary treatment and adequate methods for removing garbage
- Guidelines should be provided to Governments villagers and developers on the range of appropriate methods for treating sewage at all scales.

**Sedimentation**

- Government should request that developers and farmers minimize the amount of sediment that is lost into rivers and the ocean.

**Overfishing**

- Fishermen should be discouraged from using destructive methods (dynamite, cyanide, bleach, poisons and other local means) through education, local cooperative discussion and where possible be provided with other employment.
- Anchor damage should be minimized either by encouraging anchoring on sandy areas, or with better designed anchors, or through the installation of permanent mooring buoys for tourist operators in Lakshadweep and Andaman and Nicobar Islands.
- Remote reefs require special protection through international treaties to control damaging practices that destroy parent fish stocks and poaching.

### Strategy VIII Promote Sustainable Uses

**Recommendations**

- Selective Sustainable Fishing And Harvesting in all the coral reef areas in India.
- Controlled harvesting or aquarium fish in all the coral reef areas of India.
- Mari culture of reef species for stock enhancement.
- Limited fish cage culture and rack culture of pearl shell edible oyster and algae.
- Removal of the excess production of sand in coral reef areas especially Andaman and Nicobar Islands.
- Snorkeling and scuba diving and other tourism activities.
- Advice on sustainable methods of establishing tourism ventures should be given to developers, which may require government interventions to ensure that environment departments and universities are involved.
- Reef users require information on sustainable harvesting practices and assistance to develop markets for those products.

### Strategy IX Monitor the Effectiveness of Coral Reef Management in India

**Recommendations**

- A committee of experts by the National coral reef Committee should monitor ALL MPAs and other managed areas in India for the effectiveness of management particularly to assess whether the health of reefs is stable.

## 3. Mangrove Ecosystem

Mangrove is one of the most extraordinary ecological formations occurring almost exclusively in the tropics. Like the tropical rain forests, the mangroves have also played a very important role in the economics of our coastal population for thousands of years, providing a wide variety of goods and services including wood production, support for commercial and subsistence fisheries, aquaculture, salt production and shoreline and coastal erosion control.

Mangroves are salt-tolerant forest ecosystems of tropical and subtropical intertidal coastal regions near river mouths. Between latitudes 30oN and 30oS, the shoreline marsh vegetation is replaced by mangals (a community of mangroves is termed as mangal).

### Biodiversity of Mangrove Ecosystem in India

India is rich in marine biodiversity along the coastline of 7,500 km with exclusive economic zone of 2.02 million sq km supporting the most productive ecosystems such as magnroves, coral reefs, estuaries, lagoons, and backwaters. Of these ecosystems, mangrove is significant in this country. However, mangrove ecosystem is little understood for its biodiversity. The knowledge on occurrence and distribution of mangrove species is inadequate. In this regard, the Ministry of Environment and Forests (Govt. of India) New Delhi documented the mangrove biodiversity in India, through a funded project that was carried out by Dr. K. Kathiresan, Centre of Advanced Study in Marine Biology (Annamalai university).

Statement of problems relating to mangroves

- There is no accurate data on the extent of mangroves.
- There is no proper coordination among local people, private sectors, industries, forest officials and non-government service organizations, in conserving and management of mangroves.

### Causes of the Loss of Mangroves

**Wild animals and plants**

The mangroves serve as a wild life sanctuary especially in Sundarbans, Orissa and Bay Islands. The wild life like tigers, crocodiles, snakes etc. save the mangroves in those places. Sometimes the wildlife may pose problems to the mangroves. For instance, in Andaman, spotter deer population, in the absence of carnivores, increases that causes grazing loss of mangroves.

**Commercial plants and animals**
Sometimes, the wildlife from mangroves of Sundarbans and Orissa are commercially exploited.

**Habitat destruction and conversion**
Mangroves face serious problems due to urbanization, human settlement, industrial and sewage pollution. Though it is common issue in India, the best example is Bombay. In Kerala, embankments are constructed to prevent the entry of seawater, and then for raising coconut trees. This has resulted in destruction of mangroves. Shrimp culture has been developed after clearing mangroves in some places of Andhra Pradesh, Tamil Nadu and Orissa.

**Introduction of exotics**
Prosopis sp. Competes rarely with back mangroves in few sites like Muthupet, Tamil Nadu. There is a peculiar situation in the Cochin Backwaters, where most of the mangroves were destroyed. A water fern, Salvinia sp. has practically taken the entire Cochin backwaters due its tremendous growth. This exotic variety clogged the waterways and also reduced the fishery resources in mangrove waters.

**Monoculture**
In general, the afforestation programmes, which involve mainly Avicennia spp. are being implemented in India. The species that are growing like weeds, do not allow other plants to grow luxuriant. Hence, the biodiversity is getting lost.

**Poisoning**
In Sundarbans, the tigers are poisoned with pesticide chemicals for hunting.

**Hunting and poaching**
Poaching of animals like spotted deer, wild boar, python, cobra, crocodile, migratory birds occurs in mangroves of Sundarbands and Orissa.

**Over exploitation**
There has been a growing trend for over-exploitation of fishery resources. The best example is Hoogly - Matlah estuarine system of the Sundarbans where there is a large-scale destruction of estuarine fish and prawn seed resources (Chaudhuri and Choudhury, 1994). These will have a serious impact on future yield of fishes.

## Root Causes for the Loss of Mangroves

**Sustainable development**
There has been more of utilization that conservation, due to increase in mangrove dwelling communities, and hence the process is non-sustainable.

**Alienation of citizens (local communities) from natural resources**
The non-sustainable utilization of mangrove resources is becoming serious due to exploding population of local communities.

**Social Political and economic inequities**
Illiteracy and poverty are the root causes of socio, political and economic issues.

**Inappropriate or contradictory policies and laws**
Laws are to be made stringent and policies are to be implemented, taking the confidence and participation of the local communities. Above all, our laws and policies should be long-term gain, not of short-term. For example, Khar Land Development programme in Maharashtra.

**Over-centralization of decision-making?**
There is no such for mangrove ecosystems.

**Lack of administration coordination?**
The State Level Steering Committees on mangroves need to be properly functional in all maritime states. The Committee must have proper representation from all the stakeholders of mangroves in conservation and management of mangroves.

## Major Actors and their Current Roles Relevant to Biodiversity

**Government (MoEF. DOD, COAST GUARD etc.)**

Ministry of Environment and Forests (Govt. of India) has constituted a national level committee on mangroves to coordinate all the research activities related to mangroves in this country and to approve and monitor all the management action plans concerned with conservation and management of mangroves in different maritime states. Similarly, each maritime state has a Steering Committee to coordinate all the research activities, to formulate management action plan and to submit it to the Union Ministry for funding.

The Union Ministry has initiated the establishment of mangrove genetic resource centre in Orissa. It also has been developing data base network and websites.

Department of Ocean Development sanctions project concerned with mangrove ecosystem and its regeneration.

**Local communities, rural and urban**

The local communities have their own associations like fishermen associations that regulate their fishing activities.

**Donors**

The Research Institutions contribute to the study of biodiversity in mangroves through their students.

**Industry and corporate sector**

Some industries in Gujarat have come forward to take up mangrove afforestation, at a large scale.

## Gaps in Mangrove biodiversity

**Gaps in information**

There are gaps in information of different groups of organisms especially with bacteria in different states. Funding is not a constraint to implement the projects, but the taxonomists need to be motivated and encouraged.

**Gaps in vision**

Karnataka fishermen are of a wrong belief that the mangroves reduce the fish catch. This wrong belief needs to be changed by conduction awareness programmes.

**Gaps in policy and legal structure**

There are gaps on policy and legal structure in protecting mangroves. Unless they are made stringent, it is difficult to conserve mangrove. To cite an example, the local people are allowed to collect dead shells, without knowing the repercussions of the collection of ecological imbalance.

**Gaps in institution and human capacity**

Research findings are accumulated in academic institutions, but they have not properly reached the needy people. The Union Ministry has initiated training and capacity building programmes on biodiversity and the programmes need to be extended to all the stakeholders of the resources.

## Major Strategies to Fill These Gaps and to Enhance/Strengthen On Going Measures

Required action to fill up gaps and enhance/strengthen on going measures

**Action to conserve and sustainable use**

- The dependence of people on mangrove ecosystem has to be reduced to a greater extent. The fodder and firewood requirements of the local people need to be satisfies.
- The hydrological conditions of any mangrove region should not be changed and if maintained carefully, the plantation is not even necessary.
- The degraded lands are to be rehabilitated with people's participation. The people having mangrove in their private lands are to be motivated to save the resources.
- The industries and private sectors are to be involved in compensatory afforestation programme.

**Action to conserve and sustainable use of commercial plant and animal diversity**

Cultivation of commercial animal and plants will ensure conservation of the species in nature and sustainable use of them. The mangroves of high medicinal value need to be encouraged for commercial plantation.

**Action to conserve and sustainable use of microorganisms**

There is no such action in mangrove ecosystem, but the use of microbes from mangroves is at research level only. Use of polythene bag should be prevented in the fragile mangrove ecosystem, as they are microbially not degradable so easily.

## 4. Seagrass and Seaweed Ecosystem

Seagrasses occur in the infratidal and midtidal zones of shallow and sheltered localities of sea, gulf, bays, backwaters and lagoons. They are submerged monocotyledonous plants and adapted to the marine environment for completion of their life cycle under water. They occur along the east and West Coast and Andaman and Nicobar Islands. They form a dense meadow on sandy and coral rubble bottoms and sometime in the crevices under water.

## Strategies for the Conservation of Sea Grass Eosystems in India

### Strategy I Determine the Role Sea Grasses Play in the Maintenance of the Coastal Zone and the Economic Value of the Resources

**Recommendations**

- Undertake an analysis over time to monitor the status of seagrass and measure the rate of expansion or reduction of seagrass area. This is an extension of activities should be initiated by Space Application Centre and other Universities working on GIS mapping involved.
- Assess the impacts of habitat changes on the associated fisheries and interactions within the ecosystem.
- Implement and evaluate the restoration of critical sites using transplant techniques including maintaining the biodiversity of restored sea grass beds and investigating resilience.
- Evaluate both direct (e.g. fisheries) and indirect (e.g. Organic matter, nursery and spawning ground, function, erosion control) goods and services from seagrass beds including the potential if the seagrasses are damaged.

### Strategy II Determine How Seagrass Beds Respond to Environmental Changes and Stresses

**Recommendations**

- Undertake intensive studies on the dose-responds to pollution, sedimentation and changes in temperatures and salinity.
- Make simulation experiments and models to assist management predict the effects on seagrass-depenedent fish and prawn fisheries, endangered dugongs and sea turtles over a wide range of space and time scales.

### Strategy III Determine How Land Use Patterns and Human Activities Affect the Structure and Functioning of Seagrass Beds

**Recommendations**

- Analyse the socioeconomic impacts including causes and effects of human activities.
- Help develop consistent national policy on coastal resources (seagrass) management.

### Strategy IV Determine How Different Habitats Connect and Interact (Between Coral Reefs, Seagrass Beds, Mangrove Forests and Soft Bottom Resources)

**Recommendations**

- Investigate how the ecosystem are physically linked.
- Investigate the nutrients flow between them.
- Investigate animal migration patters among the ecosystem.
- Assess how human impacts these linkages between habitats.

### Strategy V Establish the Scientific and Socioeconomic Principles for the Integrated Management of the Coastal Resource

**Recommendations**

- Incorporate seagrass beds in marine protected areas.
- Translate this information and understanding to government and the public possibly through a seagrass Information Network for India.

- Introduce information technology.
- Standardise and organize data acquisition and handling.
- Undertake a massive information campaign at all levels of society about the values of seagrasses and the threats facing the resources.

## 5. Estuaries and Lagoon Ecosystems

"Estuaries" are semi-enclosed and sheltered coastal bodies of water. They have been the focal point of the maritime studies and activities. As they are semi-enclosed they provide natural harbour for trade and commerce. They are also effective nutrient traps and provide a vital source of natural resources to man and are used for commercial, industrial and recreational purposes. Biodiversity in this ecosystem is very impressive. They are the best settling places for clams and oysters. They also act as nursery ground for a variety of shrimps and some finfishes.

Since the estuaries and lagoons are known for their high productivity, these help in large-scale production of fishery wealth, both shellfish and finfish, thus sustaining the fisherman population around these areas and helping in making available protein rich food to the populations around. Estuaries are the feeding and nursery grounds for several species of coastal marine organisms and thus contributing in maintaining faunal diversity of coastal waters. Since estuarine and lagoon areas are inhabited by varied fauna along with the associated fauna of the mangroves in their environs these areas assume high significance in respect of biodiversity.

The large quantity of biomass production in some of the estuaries and lagoons in the form of mangrove forests provide fodder, fuel wood along with other material useful for making fishing crafts and gears. Estuaries are also of great value, since these help in navigation to enter the seas easily for fishing and commerce.

The vast mangrove forests developed along many of the estuarine areas act as breakers for coastal habitats to check wind speed during cyclones and high velocity land ward winds. These areas also act as buffer zones capable of receiving heavy river discharges during monsoons. These areas gained importance during recent times with the advent of brackish water aquaculture for fish, prawn and crabs in a big way. These areas not only provide the natural seed for aquaculture practices, but also provide requisite quality of culture medium easily.

The estuarine areas are also of recreational significance to the neighboring urban population, since they provide waterfront along with sea, thick greeneries of mangroves, thus promoting tourism.

### Threats to Estuaries and Lagoons

During the recent times, many of the estuaries and lagoons have been subjected to ruthless rampage, extensive damage and even total destruction as a result of great pressure of population, industrialization at the adjacent areas along the riverbank and urbanization. Furthermore, man made changes in upstream, viz., construction of dams and barrages upsets the free flow of water thus affecting the ecological balance. Indiscriminate deforestation in catchment areas, removal of vegetation along riverbanks and urbanization caused heavy siltation of estuaries and lagoons. Erosion and sedimentation are thus constantly reshaping estuaries for better or worse. Dredging operation and reclamation of land in estuarine areas near the mouth also contribute significantly in the stability of the estuaries.

Aquaculture activities near estuaries taken up in recent times brought about multiple threats to this environment viz., conversion of mangrove areas to aquaculture ponds by cutting them, large scale prawn seed collection practices in the coastal lagoons and estuaries leading to destruction of larval forms and juveniles of different coastal organisms resulting in depletion of coastal faunal resource., It is estimated that the seed collectors are destroying 181.4 million seed of economic and uneconomic varieties of brackish water in fish along with much higher number of other crustaceans and invertebrate larvae, after retaining only the seeds of tiger prawn in Sundarban Biosphere Reserve in West Bengal. The aquaculture activities around estuaries and lagoons resulted in accumulation of organic and inorganic wastes to estuaries and lagoons causing eutropication.

Human activities around the estuarine environment resulted in the degradation of this ecosystem in recent times as is seen in other ecosystems. Increasing population, urbanization and the industrialization has had its share in degrading this fragile ecosystem by large scale reclamation of land near estuaries, swamps, marshes and mangroves for various purposes, dredging activities in the estuaries for navigation, reducing the river discharges to a very less extent for various reasons, discharging untreated urban sewage and industrial effluents and finally the recent brakishwater aquaculture activities.

Perpetuating this pristine habitat for the posterity is not difficult if eco-awareness is practiced by policy makers and the stakehold-

ers in the following aspects.

### Strategies to Conserve Estuarine and Lagoonal Biodiversity

- Banning the reclamation of estuarine areas for all purposes except ecofriendly aquaculture and strict adherence to coastal zone regulations.
- Discharge of urban sewage, industrial effluents and aquaculture wastes to be allowed after proper treatment.
- Stoppage of cutting mangrove forests for converting them into aquaculture ponds and taking afforestation of mangroves where they were already cleared.
- Maintaining optimum levels of river flows for the sustenance of estuaries.
- Creating awareness among fishermen to avoid overfishing of juveniles in estuaries and not do damage numerous larval and juveniles of coastal organisms while collecting prawn seed, thus protecting the coastal biodiversity.

## 6. Pelagic and Benthic Ecosystems

The patterns of biodiversity are determined by the availability of light in the sea. The pelagic ecosystem is dominated by plankton, which is classified on the basis of size as picoplankton (0.2 to 2 mm), nanoplankton (2 to 20 mm), microplankton (20-200 mm) and mesoplankton (>200 mm). In terms of trophic structure, the plankton can be grouped as phytoplankton and zooplankton. The former comprises of chlorophyll-bearing algal cells, the diatoms and flagellates.

The second important group among the pelagic organisms is the nekton. The fish constitute the dominant taxon in the nekton, about 4000 species of fish are known from the Indian Ocean, of which about 50% occur in Indian seas. Majority of these species occur in coastal waters supporting valuable fisheries.

### Threats to Pelagic and Benthic Ecosystems

Human activity has resulted in the introduction of many substances into the marine environment and it is main cause of marine pollution. Humans have increased the rate of sediment flowing into the sea from land through rivers and other sources. Soil is eroded through deforestation, agriculture and poor land management. Toxic substances and excessive nutrients from untreated industrial waste and sewage contaminate marine sediments. Shellfish beds have been polluted such that the fishery is no longer commercially viable e.g. contamination of bivalves by human pathogens has created health risks. In non-contaminated habitats, overfishing of pelagic and benthic resources has led to depletion and the lack of resource management encourages the complete removal of breeding populations of most of the commercial and non target organisms.

Development has also caused massive alteration of the physical environment and coastal engineering has smothered or destroyed many pelagic and benthic habitats. Constant dredging of shipping lanes causes these habitats to be completely disrupted as well as release pollutants, which have settled in the sediment. These dredged sediments are usually dumped in another part of the sea because it is cheaper, causing burial of more benthic communities and increased sedimentation of the surrounding seafloor. Pollutants are then readily transferred throughout food webs through bioaccumulation and biomagnifications.

### Management Needs for Pelagic and Benthic Ecosystems

Pelagic and benthic communities are sensitive to human impact and serve indicators of environmental change. Some echinoderms are extremely sensitive to environmental change and are used as indicator species. Some annelid species survive well in benthic habitats, which have become polluted, and their presence confirms high levels of pollution.

The ecological value and economic importance of pelagic and benthic communities are seldom realised. This is because they are submerged and seldom seen. Unlike the terrestrial environment where the long-term and short term changes can be observed easily and are often sufficiently dramatic to attract attention of human whereas it is difficult in the marine ecosystem.

Activities, which impact on pelagic and benthic habitats need to be examined and appropriate management action taken to prevent further unwanted abuse of the system. With proper management pelagic and benthic resources can continue to perform their significant functions and remain useful to humans.

### Marine Productivity in India

Intensive exploration during the International Indian Ocean Expedition (1959-65), it was revealed that some of the world's highest values of primary production are in the upwelling regions of Somalia and South of Arabia. Based on the measurements made by

several vessels during different seasons Qasim (1977) estimated the production of the Indian Ocean at about 4×109 tonnes. But there is quite a large variation both in space and time in the Indian Ocean in general and coastal areas in particular. The reasons for these seasonal and spatial variations can be attributed to various factors.

**Recommendations**

- Augment and broaden the scientific capabilities of the research vessels of different departments
- Acquire and analyse comprehensive observational data to describe the physical and chemical structure of the marine environment
- Describe the key processes involved in circulation of water, sediment and chemicals in the marine environment'
- Acquire and analyze data to describe and model the physical and chemical process controlling the productivity of regional waters within the Indian region
- Conduct coastal research to understand more fully the ocean's interaction with the land
- Develop marine and coastal forecasting of weather related phenomena
- Develop an integrated remote sensing program

## Human Impacts on Marine Biodiversity

Though human impacts on marine and coastal biodiversity are less understood and publicized than those on its terrestrial counterpart, their potential effects are no less threatening. The direct threats to marine and coastal biodiversity can be divided into five interrelated categories: pollution (from land based and other sources), overexploitation of marine living resources, introduction of alien species, habitat degradation caused by coastal development, and global climate change and ozone depletion.

Some of the harmful human impacts on marine biodiversity stem from ignorance and lack of understanding of the importance of marine biodiversity and how it can be affected. Marine resources and biodiversity have traditionally been undervalued, which puts marine resources on a lower priority level vis-à-vis land biodiversity. Unregulated use of resources, increased demand for the resources and rapidly expanding coastal development put the marine resources at considerable risk.

## Conservation, Status, Threats and Problems

India has signed and ratified several international conventions relating to oceans and related activities. The important ones are the following: MARPOL 1973/1978; London Dumping Convention 1972; Convention on Civil Liability for Oil Pollution Damages (CLC 1969) and its Protocol 1976; Fund 1971 and its Protocol 1979 and Convention on Biodiversity (1992). Many acts and rules related to coastal and marine activities exist in the country. The following are the important ones. Indian Fisheries Act 1897 and its Amendments 1920 and 1980; Indian Ports Act 1902; Merchant Shipping Act 1974; Wildlife Protection Act 1972; Water (Prevention and Control of Pollution) Act 1974; Indian Coast Guard Act 1974; and Marine Zones of India (Regulation of Fishing by Foreign Vessels) Act 1981 and Environment Protection Act 1986. As per the Coastal Regulation Zone notification, the coastal states must prepare a Coastal Zone Management Plan identifying and classifying the CRZ areas within 1 year from the date of CRZ notification (Ministry of Environment and Forests Notification, August, 1994). The CRZ notification also states that during the interim period until the coastal zone management plans are prepared and approved, all developments and activities within CRZ should not violate the provisions of this notification.

As per the Environmental Protection Act, 1986, Coastal Regulation Zone Notification 1991, the following activities are banned in the land part of the country. 1. Setting up and expansion of new industries, fish processing units except those, which require waterfront. 2. Manufacture or handling or storage of disposal of hazardous substances and discharge of untreated waste and effluents from industries, cities or tows and other human settlements. 3. Dumping of fly ash from thermal power stations and other solid waste dumping. 4. Land reclamation, bunding or disturbing the natural course of seawater. 5. Mining of sand, rocks and other substrate materials other than raw minerals. 6. Drawal of ground water within 200 m of high tide level. 7. Any construction activity between the low and high tide line, and 8. Altering of sand dunes and other natural features including landscape changes.

## Marine Biodiversity Conservation in India

India has a long coastline, of about 8000 km, stretching along ten states and two archipelagos. The coast is indented by a number of rivers, which form estuaries at their confluence with the sea. The complex coastal ecosystems comprise of estuaries, lagoons, mangroves, backwaters, salt marshes, mud flats, rocky shores and sandy stretches. Besides, there are three gulfs, one on the east coast, the Gulf of Mannar and two on the west coast, Gulf of Kachchh and Gulf of Kambath. The two island ecosystems Lakshadweep and Andaman and Nicobar Islands add to the ecosystem diversity in India. The Gulf of Mannar, Gulf of Kachchh and the two island ecosystems have rich coral reefs harboring valuable marine biodiversity.

The continental shelf of India occupies 4,14,686 sq. km. (including Islands), which represents about 0.55% of the surface area of the

Indian Ocean. The Indian EEZ has 1.8 million sq. km (most reports say 2 million.) area and represents about 2.7% of the Indian Ocean. In India the EEZ on the west coast (including Lakshadweep) constitutes 42.5%, Andaman and Nicobar Islands 29.7%, and the east coast 27.8%. The following are Marine protected areas of India.

## General Strategies for Conservation and Management of Marine Ecosystem

### Marine Biodiversity

#### East Coast of India

Although the east coast is highly productive, there are signs that this environment is under pressure. Several bays and estuary systems are under threat from degradation, for example Palk Bay, Gulf of Mannar, Pulicat Lake, Chilka lagoon and Krishna and Godavari estuaries. Major seagrass losses have occurred in Palk Bay and Gulf of Mannar. Major fisheries are under threat or in decline. The prawn fishery suffered major collapse some years ago, and some species show that its spawning population is reduced to dangerously low levels.

#### West Coast of India

There is a strong case for the establishment of a multidisciplinary research facility in the west coast to develop an understanding of the region's marine resources and ecosystems. The major demand for marine science is to build the basic knowledge needed:

1. For the continuing sustainable use of marine resources, including traditional uses by Lakshadweep islanders;
2. For the continuing success of growing commercial fishing, and aquaculture and pearl industries;
3. To understand the marine environment that supports oil and gas industry; and
4. Supportive research activity such as mapping of seabed topography, studies designed to improve understanding of biodiversity and biological processes, the design and implementation of monitoring fisheries development, and development of an understanding of industry impact programs, and research supporting sustainable on the marine environment.

#### Recommendations

- Undertake strategic and coordinated surveys and inventories of key marine habitats (coastal, benthic, pelagic and deepwater);
- Collect and improve baseline knowledge and understanding of flora and fauna;
- Develop biographic models to explain the origins, derivations and evolutionary trends of Indian fauna and flora;
- Characterise and identify representative habitats;
- Assemble available data to support regional development plans;
- Improve understanding of biological processes in India's oceans;
- Identify measures that will assist the development and future employment of scientists;
- Identify potentially threatened species and their habitats;
- Develop and encourage use of indicators of marine biodiversity at ecosystem, species and genetic levels;

## Strategies for Conservation of Marine Ecosystem of India

### Strategy I Better Undersatnding of India's Coastal, Continental Shelf and Adjacent Ocean Basins

#### Recommendations

- Develop and implement a programme of systematic research to investigate the framework of the entire continental margin, using appropriate vessels and a full range of geoscientific tools
- Investigate the distribution, architecture and evolution and crustal dynamics of India's continental shelf sedimentary basins;
- Develop new models describing the evolution of continental shelf and adjacent ocean basin and their interaction with the biodiversity.

### Startegy II Mapping India's Seabed

#### Recommendations

- Develop and implement a systematic national program to swath-map the seabed, and to sample the seabed substrate and benthic biota of the Indian coast.
- Refine and implement techniques to assess seabed environments cost-effectively and rapidly, with habitat description
- Develop a digitized coastal seabed mapping database containing all existing bathymetric data
- Develop a coordinated research program to examine the relationship between biology and the physical environment and develop surrogates for mapping biological habitat and biodiversity.

- Develop and provide comprehensive information, maps and databases on the topography substrate character and benthic biota in the Indian marine coast
- Develop standards and formats for recording seabed data
- Develop a repository for samples of the biota associated with the seabed
- Upgrade the storage and curation of samples in National museums and research departments.

### Strategy III Maintenance of Marine Ecosystems Throgh Sustainable Management Parctices

**Recommendations**

- Conduct integrated, multidisciplinary research programs in marine ecosystem,
- Increase knowledge and understanding of the structure and dynamics of Indian marine ecosystems on a regional scale;
- Provide a strategic and conceptual framework within which local research can be conducted
- Provide a framework for assessment of ecological impacts
- Provide the knowledge base to implement integrated ecosystem management practices, develop, implement and evaluate appropriate indicators of ecosystems
- Develop, implement and evaluate monitoring strategies to assess trends in ecosystem
- Encourage development and use of new and cost-effective monitoring methods
- Establish baseline data sets through existing and new monitoring programs
- Develop methods of regional environmental assessment
- Maintain 'state of the marine environment reporting'
- Assess the severity of existing threats to the structure and function of marine ecosystems, continue to utilize marine radio tracer technology in monitoring sediment movements in near-shore zones;
- Identify potentially threatening processes, threatened species and their habitats
- Identify unique or vulnerable habitats and communities
- Assist in the development of generic guidelines for the management of Marine Protected Areas
- Enhance socio-economic research to incorporate human-use information

### Strategy IV Understanding the Impact of Land-Based Human Activities on the Marine Environment

**Recommendations**

- Develop technique to distinguish sources of nutrients
- Identify land use practices
- Develop a strategic approach to assess the impacts of coastal zone development
- Study the responses of marine populations to various land-based inputs
- Conduct studies of the processes of nutrient cycling
- Conduct algal bloom research
- Further develop nutrient and phytoplankton dynamic models
- Conduct ecotoxicological studies of the impacts of major toxicants
- Identify effective and efficient techniques for monitoring the dispersion patterns
- Conduct further research on wastewater reuse option
- Provide the scientific basis for water quality standards for marine and estuary
- Evaluate the cost-effectiveness of the various rapprochements used to reduce land-based inputs to the marine environment through biophysical, social and legal research.

### Strategy V to Provide the Scientific Basis for the Planning and Implementation of Sustainable Multiple Use Management Practices in Marine Environment

**Recommendations**

- Survey and define the main regional ecosystems in India's oceans
- Assess the economic, environmental, social and cultural values of ocean resources
- Establish a series of demonstration studies, in selected regional ecosystems
- Provide the infrastructure required responding to the research needs
- Develop a scientific methodology for visualising and evaluating the biophysical consequences
- Define and apply a series of ecosystem and industry sustainability indicators;
- Use Marine protected Areas reference regions for biodiversity in developing and implementing sustainable multiple use

regimes in the marine environment;
- Develop coupled biological-oceanographic models to assess the effect on regional ecosystem

### Strategy VI Reducing Offshore Petroleum Pollution and Periodic Environmental Monitoring and Improvisation and Understanding of the Relationship Between Fished Stocks and the Ecosystems that Support Them

**Recommendations**
- Identify key fishery habitats and key ecosystems
- Evaluate natural fluctuations within fish stocks
- Assess the potential for, and environmental impacts of, stock enhancement of wild capture fisheries;
- Evaluate effect of fishing on the environment
- Evaluate the effectiveness of Marine Protected Areas
- Minimise the environmental impact of fishing practice
- Examine the commercial potential of some current marine by catch species
- Develop new method of post-harvest handling and storage
- Support improved fisheries management
- Identifying causes of variability in fish stock size and recruitment
- Identifying appropriate sustainability indicators and developing new methodologies for risk assessment
- Recognizing the importance of uncertainly in stock assessments
- Evaluating various enforcement, surveillance and education strategies
- Evaluating management strategy potion for resource
- Continue research to minimise the impacts of waste disposal
- Continue research to counter the presence or further introduction of introduced marine organisms in Indian coastal wild harvest fisheries;
- Identify regional (international) presence on shared straddling or highly migratory fish stocks and mechanisms to deal with them;
- Assess the relative impacts of commercial and recreational fishing on fish stocks and biodiversity;
- Support research new identify new fisheries and to establish sustainable management regimes;
- Develop recognised environmental standards for incorporation into fishery certification processes;
- Improve understanding of marine wildlife disease, parasites, pathogens and vectors Develop technique for diagnosis, identification and treatment of aquatic diseases.

### Strategy VII to Ensure that Shipping and Allied Transport Operations are Carried Out Efficiently, Safely and with Minimum Adverse Effect on the Marine Environment

**Recommendations**

- Work within relevant international and regional Organizations to improve compliance with, and implementation of, international treaty
- Monitor the effect of oil pollution, ships' wastes and anti-fouling
- Monitor India's ports to determine the presence or absence of introduced marine organisms
- Facilitate international cooperation in research and development on preventing the introduction of exotic species by ships' ballast water and other vectors
- Develop a ready response capability to identify and combat new incursions of harmful aquatic organisms
- Assist the shipping industry to deal with wastes and contamination
- Improve port waste reception facilities and waste disposal facilities for recreational craft;
- Develop treatment processes for contaminated shipyard wastes

### Strategy VIII to Promote the Potential of New and Emerging Industries, Services and Technologies

**Recommendations**
- Establish a new marine biotechnology centre
- Continue and expand collaborative public and private sector research

- Improve management of collection of marine biological specimens
- Support the discovery and utilization of novel bioactive molecules and other natural products from marine biota;
- Promote the provision marine scientific consulting services

### Strategy IX to Support Ecologically Sustainable Costal and Marine Tourisim and Recreation

**Recommendations**

- Develop partnerships with the tourism industry to identify more clearly the marine and coastal tourism sector
- Initiate research into impediments to the sustainable growth and diversification of the marine tourism industry
- Develop partnerships with the tourism industry to collect more accurate data on the value of the marine tourism industry, particularly in regional economies;
- Develop cost-effective, low-impact technologies and engineering techniques for construction, energy and water supplies, waste management, and provision of services to marine tourist sites
- Measure the environmental effect of known tourist activities on ecosystems
- Develop and evaluated planning tools to promote the ecologically sustainable development of tourism
- Utilize Marine Protected Areas in tourism strategies
- Develop the research base of present and future patterns of recreation
- Facilitate the participation of local communities in the monitoring and management of marine tourism and recreation areas;
- Investigate the potential contribution by the tourism industry to the introduction and spread of introduced marine organisms
- Model the ecological, economic and experiential interaction between tourist and marine habitats
- Work with tourism operators to enhance the quality of their product through the development of educational and cultural experiences
- Encourage the expansion of tourism training programs to include information about environmental monitoring data collection
- Design and implement informed management and education strategies for different regional and encourage local government, in particular, to be involved in management.

### Strategy X to Understand and Document the Implications of Marine Laws and Policies for Effective Management of Marine Resources

**Recommendations**

- Improve understanding of international laws and conventions and their impact on management of the ocean
- Investigate the enforcement of regulatory controls of the marine environment
- Investigate the efficacy of existing national law
- Conduct research to assist the more effective management of Strategies, Marine Protected Areas, Biosphere Reserves and World Heritage Areas.
- Improve understanding of the relationship between law and science; and
- Improve understanding of ethical in marine science.

### Strategy XI to Achieve Better Coordination of Marine Data Management

**Recommendations**

- Establish a National Marine Data
- Consider including data management deliverable in funding contracts issued by government and incorporate funding agencies
- Implement a process to develop a national policy for marine data exchange
- Support the development of distributed data and metadata management software
- Marine relevant satellite reception facilities and access to domestic and international satellite data sets;
- Develop mechanisms to include private sector data in the national data archives

### Strategy XII to Build Professional Exprertise and Knowledge Through Increased Involvement in Regional and Global Marine Science and Technology Programs

**Recommendations**

- Develop expertise in various fields of marine biology
- Capacity building
- Training the trainers
- Working and networking with other countries in the areas of conservation

## Overall Strategies for Natural Aquatic Ecosystems

The following are the general strategies for the conservation and restoration of natural aquatic ecosystems.

- Institutional improvement in the Government sector, to facilitate coordination and perhaps ultimately to consolidate administrative responsibility for biodiversity management within one competent agency.
- Application of incentives to rural communities and to the private sector, to clarity and strengthen ownership and usage rights so as to encourage long-term investment in sustainable management of biodiversity.
- Commercialization of biodiversity assets, to encourage the sustainable capture of wealth from genetic resources (e.g. through biotechnology and ecotourism) so as to rationalize their long-term protection.
- Research, training and monitoring programmes, to provide a comprehensive technical ability to understand complex biological systems and to intervene where needed to preserve, protect, manage and develop them in the interest of our nation and of the world.

# Natural Terrestrial Ecosystems Thematic Strategy and Action Plan

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The report provides an overview of the extant biodiversity of Indian landmass and perceived threats. The report also identifies areas/ecosystems needing special conservation efforts, and outlines potential strategies and action points for biodiversity conservation.

India is a megadiversity country, and is one of the twelve centres of origin and diversification of plant and animal species. The extreme diversity of the habitats due to varied topography, altitude, soil types, temperature and precipitation patterns, has led to marked luxuriance and variety of flora and fauna. Almost all types of forests, from scrub to tropical evergreen rain forest, and from coastal mangroves and sand dune vegetation to the temperate and alpine vegetation formations, occur in this region. As many as 16 major forest types comprising 221 minor types, and five major grass cover types with hundreds of communities are recorded.

The officially recorded forest area in the country is 75.18 million ha, although the Satellite imagery puts the figure at 64.2 million ha. Of the total forest cover, about 86% in tropical forest. The need for conservation of natural habitats and ecosystems, particularly those in the tropics is stressed, as the tropics are the house of millions of plant and animal species. Unfortunately, the same region also has the highest human population density and faces the related problems of human interventions in natural ecosystems.

The grassland vegetation of India is largely secondary but has been of immense importance in supporting wildlife and domestic cattle populations. Desert is another unique and complex habitat harbouring biological communities of high conservation value. The arid and semi arid zones in India are spread over eight states but 90 percent of the hot desert is located in the north western part of the country. The mangrove habitat is of high conservation value. Mangroves also function as feeding sites and nursery areas for a wide range of aquatic species, including fishes and prawns which are important source of food and income of artisan fisherman.

The Indian sub-continent is a confluence point of three major terrestrial biogeographical realms (viz., the Indo-Malayan, the Eurasian and the Afro-tropical). India contains a great wealth of biological diversity. There are 350 species of mammals. 1224 species of birds, 408 species of reptiles, 197 species of amphibians and 2546 species of fishes. It is estimated that over 48,000 species of plants are accounted for in this region which represent 11% of the known plant species of the world. The richness and diversity of flora of India can be further appreciated by the fact that as many as 10 biogeographic regions representing 3 basic biomes and 2 natural realms are recognised within the territory of the Indian Republic. Because of the multiplicity of biogeographical zones, India is rich in endemic flora and fauna. About 30% plant species are endemic to India. Areas rich in endemism are North Eastern India, the Western Ghats and the North Western Himalaya. A small pocket of local endemism is also reported from Eastern Ghats. The presence of a large number of primitive flowering plants in India renders the region 'a cradle of flowering plants'. As many as 131 species are stated to be primitive.

The 'hot spots' are exceptionally species-rich areas with a high rate of endemism and at the same time facing exceptionally high anthropogenic disturbances. Two regions from India namely, the Eastern Himalaya and the Western Ghats are included in the global 'hot spots' list. In India, broadly, the botanical 'hot spots' lie in the (i) Western Ghats, (ii) Northeast India, (iii) Himalaya, and (iv) Andaman and Nicobar Islands. A large number of alien species have come to India from the surrounding regions viz., Myanmar, Malasia, South-West China, Eastern China, Japan, West Asia, Sri Lanka and Africa. These are now naturalized in India and seem to be the permanent denizens.

Some of the natural terrestrial biogeographical realms in the western, northern and eastern India are contiguous. About two-third of India's terrestrial boundary is internationally shared with adjoining countries such as Pakistan, Afghanistan, China, Nepal, Bhutan, Myanmar and Bangladesh.

Biodiversity is declining throughout in response to anthropogenic stresses such as habitat modification, species overexploitation,

competition with exotic species, grazing, burning, lopping, logging, landslide, erosion reduced regeneration, shifting cultivation, recurring drought, plantation, developmental projects, excessive tourism, etc. and chemicals into air, water, or soil. Habitat fragmentation and destruction are currently viewed as the leading threats to biodiversity. These threats are ultimately driven by the growth of human population and their per capita amount of impact. Impacts of threats result in a change of ecological function and/or a loss of ecological integrity.

The introduction of the weedy species was facilitated by shifting agriculture, faulty pasturage, establishment of townships and colonies, mass shifting of labourers from one region to other for construction or for plantation work and so on. The neotropical weedy species, in general, have proved to be adventive in nature endangering the native flora.

The Botanical Survey of India has brought out several assessments of rare and threatened species in the country. It is estimated that about 3000 species of flowering plants out of 17000 species fall in one or the other category of threatened plants which also include several medicinal plants. Red Data Books of India include 623 threatened and endangered plants, of which 550 are endemic.

India has been concerned with the protection of habitats having natural vegetation. Setting up of Protected Areas (PAs), germplasm and gene sanctuaries are major efforts of the Government towards conservation. The protected areas (PAs) serve as the ultimate repositories of biological diversity in a `developing' and densely populated country like ours where land is a scarce resource and most of the natural ecosystems have been highly modified by man. Currently there are 581 PAs in India covering ca. 154619.8 km2 area i.e. 4.70 % of the country's land surface. These include 89 National Parks (NPs), and 492 wildlife sanctuaries (WSs). The NPs and WSs cover approximately 1.14 % and 3.56 % of the land area respectively. Some of these PAs, along with the adjacent buffer and multiple use zones have been designated as Biosphere Reserves (13 in number). There are 5 PAs which have been declared as Natural World Heritage sites. Although the present coverage of PA network seems to be `good enough', most of the PAs are too small to safeguard the ecological values and biological diversity given the fragility of several ecosystems. The WII has proposed 292 (75 NPs and 218 WLS) additional areas to brought under protected area network. This proposal needs immediate attention. A network of 306 forest preservation plots (PPs) have also been set aside for the preservation of the forest. The PPs also serve as examples of rare vegetation types and relict patches.

Another category of traditional protected areas, the sacred forests, serve today as refugia for a number of rare, endangered, endemic or interesting biota of the country. With drastic change in the outlook of tribals and ever increasing population pressure, the survival of these centuries old sacred forests is a matter of serious concern, however. It is important to revitalize the beliefs of tribals towards these sacred forests which are also the hyperdiversity areas. There are a variety of community conserved areas (CCAs), such as forests, tanks, grasslands, coastal areas, and river stretches, protected by communities for a variety of reasons. There is a need to encourage and strengthen such CCAs throughout the country to have a secure stake of the local community in the conservation of area.

There is a shift from the totally state controlled forest management to one that involves people's participatory role. In JFM the emphasis is on meeting the basic needs of the people from the forest as well as on conserving the forest land. Supported by outside funding, JFM is already operational in 27 states of India (in 10 years period). By the end of 1998, over 10.24 M ha of degraded forest area in the country was being managed and protected by about 36,000 Forest Protection Communities (FPCs).

Not much is known on floristic affinities of different biogeographic provinces with neighboring regions. The basic quantitative details from Trans/Northwest Himalaya are altogether lacking. Assessment of representativeness (native, non-native elements), uniqueness (endemic elements), sensitivity (rarity manifestations), and biological integrity (extent of native elements and their natural interactions) in forest ecosystems, have not received due attention. Considering the indicator value of Timberline zone (sub alpine forests) strengthening of monitoring systems for detecting the changes in ecosystem properties need due attention. A general ignorance towards: (i) taxonomic details (e.g. nomenclature, nativity, endemism etc.), (ii) uncommon taxa (e.g. rare, less frequent); and (iii) lower groups (e.g. pteridophytes, bryophytes, lichen etc.), in most ecological studies has resulted in incomplete conclusions about ecosystem properties. Systematic qualitative/quantitative details on extent and process of fragmentation of natural habitats under different ecosystems are lacking. Faunal components have not been duly integrated in ecosystem studies for their role in maintaining the functional attributes. Most of the PAs in the country, have extensive peripheral and internal human populations. Their dependence on resources from the PAs has severely fragmented the natural habitats. As such, the fragmentation details of PAs are not available. The coastal terrestrial ecosystems are largely neglected, because of their low stature and their potentials are grossly underestimated.

The following strategies and action plans are proposed for the conservation and sustainable use of terrestrial biodiversity.

### Strategy I: Update the knowledge on existing ecosystems and the extent of their biological diversity

- Define, identify, delineate broad boundaries and map various ecosystems/ecobiomes of Indian land mass. Identify economically and ecologically important ecosystems and mark/map representative sites in each biogeographical zone.
- Ecosystem/biome/biogeographical province- specific lists of endemic, rare and threatened taxa, needs to be expanded and updated frequently to prioritise conservation efforts. Identify indicator species for further monitoring.
- Consolidate information on taxonomic details such as nomenclature, nativity and endemism for the biological wealth.
- Faunal components need attention as biological resource due to their role in maintaining the functional attributes of ecosystems.
- Maintain a biome/biogeographic province- level biodiversity register as baseline information to periodically assess the changes in ecosystem structure. Proper linkages need to be developed among BSI, ZSI as well as NBPGR, NBAGR and NBFGR.

### Strategy II. Generate information on uses and value of biological diversity

- Information on microbial diversity needs to be generated for identified representative ecosystems.
- Identify species of ecological and economic value and assess their status in representative ecosystems.
- Identify the services extended by resident species of a representative ecosystem.
- A multi-stakeholder analysis of the impact of consumption and production patterns on the forest and grassland resources need to be performed.
- Encourage ethnobotanical and ethnozoological studies with partnership approach among scientists, indigenous people and practitioners of traditional and tribal medicines.
- Gender initiatives should be given due importance for the role of women in pre/post harvesting part of sustainable utilization and biodiversity conservation.

### Strategy III. Generate information on ecosystem services and valuation and enhance understanding of relationship between biodiversity and ecosystem services

- Identify, monitor and establish at least first approximation and management of services in economic terms.
- Integrate ecological, economic and social systems at all levels, and treat the supersystem (human-use system) as the unit of development and management.
- The cultural and spiritual values of the biological resources in an ecosystem should be collected and considered for the valuation. Consider alternate cultural practices that are efficient from both ecological and economical view points.
- Expand the scope of analysis for ecosystem services by considering how ecosystems vary in regard to services they provide and how to manage them to maximize their combined outputs at various spatial and temporal scales.
- Modify systems of national and state accounting to reflect the value of ecosystem services.

### Strategy IV: Establish a framework for sustainable use of biodiversity resources and the equitable sharing of benefits

- Develop research programmes at selected sites of importance for biodiversity conservation as testing sites and develop them as a model to show balanced existence of the biodiversity and local people.
- Quantify the use of biological resources, and prepare a regulatory mechanism to minimise this use for continued supply in a sustainable manner. An understanding of marketing and economics of bio-diversity trade has to be developed in order to link these aspects with IPR and patent issues.
- Workout mechanisms for providing socially acceptable economic incentives to the local population for biodiversity management.
- Based on some local experience, develop mechanisms for optimisation of biodiversity use and equitable sharing of benefits. Develop indicators of sustainable use.

### Strategy V: Develop an understanding on habitat fragmentation and its impact on biodiversity

- Investigate the causes and processes of fragmentation in different ecosystems, especially the identified important ecosystems.
- Develop a metapopulation approach to understand the dynamics of populations in natural and fragmented landscapes. Identify and map regions which are more vulnerable to fragmentation.
- Establish crucial role of forest remnants in reforestation efforts by knowing their ability to provide key sources of plant propagules.
- Develop approaches for intensive management of fragments to conserve biodiversity at fragment level. Examine utility and feasibility of corridors to connect major fragments.
- Generate basic information on the natural history of important species, and characteristics of vulnerable species and taxa.

### Strategy VI: Develop understanding and awareness about alien invasive specie

- Assess vulnerability of ecosystems towards alien invasion and identify potential areas/zones prone to invasion.
- Target importers and exporters of goods, as well as of living organisms as key groups for information/education efforts.

Develop a training package for quarantine, border control, or other relevant facilities to make people aware of the threats to biological diversity posed by alien invasive species.

- Initiate research on problems posed by invasive species in specific ecosystems and modes of control of the same. Develop 'black lists' of alien invasive species at national level.
- Encourage eco-tourism operators to raise awareness on the problems caused by alien invasive species.
- Give priority to the eradication of alien invasive species on islands and other isolated areas that have highly distinctive biodiversity or contain threatened endemics.
- Develop legal penalties to deter release and escape of invasive species where costly economic or damaging ecological consequences are likely to follow.

### Strategy VII. Strengthen and maintain the existing biodiversity conservation efforts

- Review the current status and the biophysical values of the existing protected areas. Also, evaluate their contribution towards enhancing survival of biodiversity elements, reducing threats, and for their ecosystem services. Catalogue sacred groves, analyse their extant biodiversity, and develop plans for their maintenance in collaboration with local people.
- Catalogue community conserved areas (CCAs) and project these as lessons for biological conservation and livelihood security of traditional communities. Further studies are required on these practices so that their full biodiversity and social value can be gauged.
- Review the adequacy of staff and funding for protected area management and reorganize in view of the emerging requirements and priorities. Arrange training programmes and refresher courses for protected area staff.
- Review the representativeness of ecosystems under PA network and identify potential representative non- PA sites for inclusion in PA network.
- Catalogue of most ecologically sensitive areas/fragile ecosystems should be prepared to plan for specific conservational approach. Identify ecosystems which are tightly linked to the sustenance of tribal populations, and develop exacting management plans in partnership of the resident tribal people.
- Three tier system (national committee, state-level committee and protected area - level committee) should be developed for the management and monitoring of the protected areas under a National Authority. Local inhabitants (particularly women folk) and NGOs should be represented at all levels.
- Studies on village ecosystem in a triangular approach of agrobiodiversity, domesticated animal biodiversity and agroforestry need to be undertaken.
- Integrate use of grazing resources particularly in dry areas with the prevalent social system of maintaining 'Orans', Gochars', Beeds' and 'Agors'.

### Strategy VIII: Minimise PA-People conflicts and enhance the effectiveness of the PAs

- The State Forest Departments need to ensure preparation of management plan for each protected area following the guidelines prepared by the Wildlife Institute of India. Involve local academic institutions and stakeholders in the preparation of management plans. The PAs with high human dependency and PA-people conflicts need to be attended on priority basis.
- The revenue generated through the tourism/eco-tourism from the park and its surroundings need to be ploughed back for the development of local communities so that they become partners in conservation.

### Strategy IX: Develop a focussed policy for the restoration of degraded ecosystems

- Identify degraded terrestrial ecosystems, assess the intensity and causes of disturbance, and develop mechanism for their recovery on priority basis. Restoration of degraded forest lands should be co-managed involving local communities during planning as well as during execution of the plan.
- Make it mandatory to include an Environmental Management Plan emphasizing on biodiversity conservation and restoration in all developmental works of either small or large scale. Companies undertaking the development work should develop in-house training programme for restoration of the areas affected by their activities.
- Taking into account the precautionary approach, all activities leading to large-scale deforestation and forest degradation should be halted, until effective policies and measures have been put in place to address the underlying causes of forest biodiversity loss.

### Strategy X: Initiate steps for the formulation and implementation of policies on transboundary biological diversity conservation

- Institute participatory management of biodiversity in the protected areas of candidate priority complexes (Khangchendzonga complex, Jaldapara-Buxa-Phibsoo, Jigme Dorji-Manas-Bumdaling, Tawang-Khulong Chu, Nemcha-Barwa-Dibang Walong, and Namdapha-Hkakaborazi) and their surroundings that will enhance conservation of the globally significant unique biodiversity of the Eastern Himalaya, which otherwise are under risk because of transboundary problems.

- Restore and increase the connectivity between the protected areas within the candidate priority complex and between the complexes. Allocate more conservation attention and efforts to focal species. Identify keystone plant species and their restoration and conservation in each of the candidate priority complexes.
- Solve transboundary issues such as grazing, poaching, unsustainable harvest of NTFPs, control of forest fires and creating new connectivity for overall conservation by regional and country-to-country cooperation basis. Undertake collaborative periodic monitoring of the resources, with the emaphasis on the critical areas from the conservation and richness point of view.
- Establish mechanisms for conservation and management of the Biorich areas. Establish MoU for these types of activities with the consent of neighbouring countries.
- Involve communities that straddle both sides of the border, including nomadic populations that migrate back and forth, in the conservation of the areas.

### Strategy XI: Review the existing legislative framework and Acts for the conservation of biological diversity

- Review the adequacy of the existing legal provisions for biodiversity conservation.
- Introduce annual independent Auditing and Appraisal reports mandatory for protected areas, forests and development areas to monitor the policies, legislative actions and impact on biodiversity. Based on reports, policy/legislative interventions may be taken for biodiversity conservation.
- Approach of ecosystem management should be a priority of policy and legislation for management.
- Resolve the conflicts in different Acts. Review the linkages between biodiversity bill and forest act.
- Improve the law enforcement practices such as revision of the fines and penalties for infringement of laws, involving NGOs and representatives of local community in enforcement efforts.
- Establish an Environment Commission for early settlement of biodiversity related crimes.

### Strategy XII. Promote public awareness and Education programmes on biodiversity conservation

- Adequate understanding and appreciation of the value of biodiversity to sustainable development have to be developed at all levels from local communities (focus on women), farmers, professional organizations, industries, decision makers to law enforcement agencies.
- Conduct attitude surveys (at local community level) and incorporate their perceptions to develop strategies to gain public support for major *in situ* conservation programmes.
- Use religious organizations and NGOs to educate the people about the relevant traditional practices and cultural values for biodiversity conservation.
- Industry/business sectors should collaborate in awareness programme to demonstrate their efforts in site specific biodiversity conservation.
- Biodiversity education should be a part of compulsory national education system at all the levels.
- Introduce courses on Conservation Biology at the graduate level in the universities which have proven expertise in the field of Ecology and Environmental Sciences.

### Strategy XIII. Encourage public participation in biodiversity conservation programme

- Management of forests and all natural areas should gradually be made participatory for the local people and other stake-holders. This needs to be stated as a management policy by all the state Governments.
- Socio-economically critical sites need to be identified and strategies for their conservation and use be developed and implemented through participation of all stakeholders in model sites.
- Arrange appropriate training programmes for the frontline staff of the forest department, workers at village panchayat, block and Tahsil levels for conservation and sustainable use of biodiversity.
- Integrate the biodiversity conservation plan with livelihood of local people.
- Highlight judgements associated with cases of biodiversity loss to encourage public participation.

### Strategy XIV: Establish sacred groves of the 21st century

- Develop activism for the sake of conservation by strengthening the integration of awareness of the natural world, field ecology and religious texts and prayers. Let religious leaders lead and tell people of their faith what God asks of his children to do in response to ecological needs of the time. Environmentalists in turn should provide necessary inputs on environmental issues to the religious leaders. Government and NGOs are required to play facilitator's role in such endeavour.
- Take bare mountain tops, and other such community and public places and declare them sacred.

### Strategy XV: Protecting forests from recurring and excessive fires

- Develop fire database, giving details of areas running risks. Establish forest fire organisation during fire season, involving authorities ranging from province to village level.

- Set-up fire prevention education programmes at the levels of community, schools and colleges. Promote active participation of concession holders, contractors, local communities, on the basis of their capabilities. Give rewards and incentives to village communities playing effective roles in preventive measures.

### Strategy XVI: Institutionalize biodiversity conservation and management.

- Establish interdisciplinary Research Centres, one in each biogeographical region in Universities/Research Institutes, connected to a National Biodiversity Data Bank. These Centres will not only assess and monitor regional biodiversity but will also perform fundamental studies on mechanistic and biotechnological aspects of biodiversity. Physiological, ecological and genetical studies on endangered taxa, and studies on inter-ecosystem linkages shall also be performed.
- Induce schools, colleges, universities, panchayats and Nagar Nigams to develop biodiversity parks for sensitizing people across age-groups and professions to biodiversity concerns.
- Make provision for a critical mass of multidisciplinary permanent research staff including ecologists and taxonomists for each biosphere reserve.
- Establish coordination between *in situ* and *ex situ* conservation efforts under a National Authority, and develop entrepreneurship for cultivation of medicinal plants in order to reduce anthropogenic pressure on natural populations.
- Establish clear links with industries for funding research in the areas of concern to industries.

# Wild Animals Thematic Strategy and Action Plan

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The conservation of wild animal diversity is an important component of NBSAP. The concern for a few animal species is what has driven conservation effort in India for the last many decades. A qualitative change in this effort is now in the making among the officials, forest managers and researchers following a better appreciation of wild animal diversity per se, especially following the Rio Convention. This also follows a better understanding and appreciation of the importance of species diversity in ecosystem functioning. The mandate given to the Thematic Working Group (TWG) on Wild Animal Diversity reflects this change of perception to a large extent.

The conservation of a few species such as the tiger and elephant, and the protected area network has been a subject of considerable attention for the last several decades, including focal species projects, special committees, reports and action plans. It was felt that the effort of the TWG was better spent on major issues that have not been addressed adequately till now, while accepting the various common recommendations and actions plans that already exist. This report is based on a review of these recommendations and action plans, mandates of ongoing major projects which address the conservation of Indian fauna, review of scientific literature and working papers, one workshop which addressed conservation issues of rainforest fauna, and discussions with individuals and at meetings.

## Key Issues and Strategies

**Issue 1.** Non-implementation of recent recommendations and action plans: During the last decade or more, several focal animal projects (Project Tiger, Project Elephant), special committees (e.g. Subramanian Committee on Prevention of Illegal Trade in Wildlife), and recently the National Wildlife Action Plan have made several recommendations for the conservation of wild animal diversity. The most important ones are common to all and pertain to providing adequate manpower, timely funding and other resources, control of poaching, extension of protected area network etc. The non-implementation of these recommendations and action plans would undermine all other efforts for conservation, including those that follow from NBSAP.

**Strategy 1.** Implement the important recommendations that have been suggested by several committees and action plans, some appointed specifically to address critical issues.

**Issue 2.** The lack of a legal framework for conservation of species: Although existing legislation protect individual animals of threatened species and their habitats, these are not sufficient to ensure the survival of species. As a result no worthwhile effort is being made to ensure the survival of several critically endangered species. It should be, therefore, mandatory for conservation actions to be based on a scientific assessment of the threat processes operating on the species.

**Strategy1.** Enact legislation making it mandatory to develop and implement threat reduction and recovery plans that are based on a scientific assessment of the threat processes operating on the species. It would be also necessary to have mechanisms to reassess periodically and scientifically the threat status of species and for such assessments to have legal validity.

**Issue 3.** Lack of species information and accessibility to information: There is at present a serious paucity of the most basic spatial and ecological information on a vast majority of species including several mammalian taxa. Such information is required for protected area design, preparation of management plans etc. Moreover, whatever information is available is not readily accessible in a way that facilitates decision making by various agencies involved in conservation. National institutions entrusted with the task of collecting and disseminating this information has seen a drastic reduction in manpower, expertise and funding in recent years.

**Strategy 1.** A systematic compilation of species data into national fauna database in a format that allows decision making transparent, and facilitates protected area design and management, environment impact assessment, conservation education, and scientific analysis etc. Existing data holders should be identified and strengthened so as to contribute towards this national effort. Several international databases could serve as models in this effort.

**Strategy 2.** Promote the collection of spatially referenced inventory data on small mammals, birds, lower vertebrates, and invertebrates. This would involve capacity building both in quality and quantity, increased funding, and mandating data collection in a format that allows easy compilation into a database.

**Issue 4.** Gaps in protected area coverage of species and populations: A protected area network that covers only about 5% of the country, and nearly 20% of the forested area, can hardly be expected to adequately cover all the wild species in the country. Preliminary analysis shows that even mammals and lower vertebrates may be poorly covered. Moreover, large populations of several threatened species occur outside the protected area network. It is necessary, therefore, that an effort is made to include as many wild species and as much populations of threatened species as possible within the protected area network. It is also necessary that each protected area be seen as a part of the network, each of them therefore with a unique role in the network.

**Strategy 1.** Make a systematic assessment of species occurrence in protected area network and outside so as to expand the protected area network wherever possible. A similar assessment of the populations of threatened species is also needed. Data that have accumulated in the last several decades on several taxa allow a meaningful gap analysis.

**Strategy 2**. The relative importance of each or a set of protected areas should be clearly stated with reference to the target taxa that they are expected to conserve. Management measures should then attempt to ensure persistence of these taxa.

**Strategy 3.** Evolve innovative measures to involve local communities (which might be locality specific) in protection and management in order to overcome shortages in manpower and funding, poor accessibility, and also to elicit local support.

**Issue 5.** Management of protected areas to ensure persistence of species: The management of protected areas to enhance the survival of target species is now mostly limited to protection of animals from poaching and habitat from loss and degradation. However, many species require management actions beyond this. Protected area management in the context of climate change is an issue that need to be addressed.

**Strategy 1.** Designate target taxa for each or a group protected areas so that management measures can be focussed on these taxa.

**Strategy 2.** Integrate climate change impacts into biodiversity conservation, especially the designation and management of protected areas for species conservation.

**Issue 6.** Conservation of species in community and other lands: Even if all the remaining forest land is enclosed within protected area network, major gaps would remain in terms of species and population coverage, and other aspects such as corridors. The major examples are the semi-arid grasslands that are privately or community owned, inland wetlands with highly complex ownership, and privately or corporate owned lands in the Western Ghats and northeast. All of these contain substantial or the only populations of several hundred wild species. They also form critical corridors in the seasonal movements of several species either within or between protected areas. There is thus an urgent need to devise ways and means of managing large, sometimes the only, populations of many species that are confined to these lands. The drastic decline in several species of common birds in rural and urban landscape is also a matter of concern.

**Strategy 1.** Promote conservation in corporate and private lands in the Western Ghats and northeast India through a combination of legal measures and economic incentives that would prevent rapid land use changes, for example from coffee to tea in the Western Ghats. There is sufficient scope for promotion of eco-friendly products such as natural shade grown coffee and ecotourism in such lands.

**Strategy 2.** Strengthen community conservation in semi-arid grassland and inland wetland areas. Recent studies show that community knowledge on biodiversity and conservation efforts are rapidly declining and that governmental interventions in recent years have often served to accelerate the decline. These studies have also revealed the need for devising new contexts and framework (especially mechanisms for conflict resolution, and need for economic benefits) for community conservation to be effective. Any governmental intervention such as designating new 'community reserves' or 'conservation areas' (as proposed in the amendment to the Wildlife Protection Act (1998) should take into account the above findings.

**Strategy 3.** Inclusion of sites in the new categories of conservation areas has to be based on a set of clearly laid out criteria, including those on wild animal diversity. There are several hundreds of candidates for inclusion in the new conservation areas (currently proposed) or those eligible for other kinds of public support. However, resources available for this purpose are limited. Therefore, the occurrence of species not represented in the protected area network and substantial populations of threatened species should

be important criteria in the selection of sites for inclusion in the new categories of conservation areas.

**Strategy 4.** Monitoring of indicator species in the rural and urban landscape. Long term monitoring and research are required to measure the extent of decline in several species (e.g.. birds such as vulture, house sparrow) and to identify the major reasons. This would also have major implications for human health.

**Issue 7.** The need for agreements, legislation, policies and action plans for the conservation of migratory species: India has for long been a signatory to several international conventions and treaties on the conservation of migratory species. All these conventions and treaties mandate bilateral or multilateral agreements among range countries on collaborative management, research and monitoring of migratory species and their habitats. The range countries are also called upon to have domestic legislation, policies and action plans for the conservation of migratory species and their habitats. However, India is yet to take any major measures in any of these, except for a recently signed MoU with Russia on migratory birds, and a belated MoU on the Siberian Crane. Although migratory birds and marine turtles have received some attention, some others like the marine mammals and the Gangetic dolphin have received no attention.

**Strategy 1.** Enter into bilateral or multilateral agreements with range countries so as to promote the conservation of migratory species including marine mammals, Gangetic dolphin and gharial, through collaborative research and monitoring.

**Strategy 2.** Develop action plans for species-groups and globally threatened species of waterbirds, including measures to effectively manage networks of sites that are internationally important for migratory birds, as recommended by the Asia-Pacific Migratory Waterbird Conservation Strategy: 2001-2005 (AMWCC 2001). Substantial progress in this regard is expected by two ongoing projects.

**Strategy 3.** Promote studies of distribution, population, and threat assessment of marine mammals, the least studied among the migratory species in India.

**Issue 8.** Biodiversity assessment in relatively unknown areas: While a considerable part of India has never been surveyed (e.g.. in northeast and trans Himalaya), vast stretches of potentially species rich areas, including marine areas, have never been surveyed for invertebrates and lower vertebrates. The number of new species being recorded every year is an indication of this. It is therefore necessary to have mechanisms to rapidly identify areas of high species richness and endemism, especially among lower vertebrates and invertebrates, while we await systematic surveys. Most of the indicators that are currently identified, besides being inconsistent, are useful only at scales larger than at which our protected areas are designed. It is therefore necessary that we identify indicators that suit our purpose.

**Strategy 1.** Promote scientific studies in order to identify biotic and abiotic indicators of high taxic diversity in India.

# Wild Plants Thematic Strategy and Action Plan

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## Introduction

India possesses richness of biodiversity elements at all organizational level and this feature is attributed to heterogeneity of geographic, climatic and evolutionary factors. Wild plants constitute a major part of this diversity. The significance of diversity in this group is more as the group contributes in diverse ways for human sustenance. However, wild plants are among most severely affected by the human onslaught in the country. As a result, fast depletion of these resources has been noticed across the nation. The TWG on Wild Plant Biodiversity attempted to review the overall status of information pertaining to this group, identify the major gaps and frame strategies for bridging the gaps. Review of information on status of wild plants in the country reveals the following:

- The reported number of flowering plants in the country varies between 16,500-19,400 taxa (including intraspecific categories) under 247-315 families, which represent roughly 7% of the described species in the world. The present analysis (review of available information) suggests presence of 17,672 plant species in the country. Of these, approximately 107 species are aquatic representing nearly 50 % of world total.
- Across biogeographic zones in the country richness of floristic diversity varies between approx. 8000 spp. (Himalaya) to 500 spp (Coasts). Among states, Tamil Nadu (5640), Sikkim (4500), Jammu and Kashmir (4252), U.P. (4250) and Arunachal Pradesh (4007) are the rich plant diversity states. However, Sikkim, Himachal and Goa score high in species richness per sq. km.
- The diversity of non-flowering plants is as follows: Gymnosperms (48); Pteridophytes (1135); Bryophytes (2850); Lichens (2021); Algae (6500) and Fungi (14500 spp.).
- The diversity of wild plants contributes significantly towards fulfilling livelihood needs of the inhabitants. Nearly 1000 species have food value, 525 - fiber yielding, 400 - fodder value, 300 - yield gums and dyes, 100 - different types of scent and essential oil, 300 - poisonous and 700 - traditionally used in social and various religious ceremonies. More importantly, over 3000 species are used as medicine in the country.

## Issues

As elsewhere in the world, wild plant diversity in the country is severely threatened/damaged. Unfortunately the dimensions of damage are not well understood. Some of the facts highlighting the severity of threats associated with Wild Plant Biodiversity can be summarized as:

- Nearly 10% (>1700 species) of flowering plants in India fall under various threats categories. As per the IUCN RED list of threatened plants, 19 species are now extinct in the country. Among other 1236 threatened species, 41 are possibly extinct in the wild, 152 - endangered, 102 - vulnerable, 251 - rare and 690 - indeterminate. Yet other 1080 species under various degree of threats require enlisting and categorization in view of new IUCN Red List. Maintenance of all such taxa is a major concern in the country.
- Maintenance of 550 (88.7% of total RDB taxa) endemic Red Data Book species is most critical issue. Limited information about their availability in wild and population biology makes the task difficult.
- Among reported 5725 endemic plants, nearly 2500 (43.66%) fall under threatened category. Of these 1950 (34.0%) species are narrow endemics and subject to high risk.

## Initiatives

Responding to the need for addressing issues associated with Wild Plants, various initiatives have been taken to maintain the diversity. Some major initiatives include:

- Among Government sponsored *in situ* initiatives for conservation, establishment of protected areas network (PAN) is worth mentioning. Total 573 PAs (89 NPs; 484 WLS) cover 1,54040 sq. km area (nearly 4.69%) of the country. In addition there are 11 Biosphere Reserves (BRs).
- A large proportion of plant species finds protection in PAN. Most of the plant diversity rich biogeographic zones, Himalaya (500: 62.5%); Western Ghats (3000:75%); North East (2500:62.5%); Deccan Peninsula (2000: 66.6%), find good representation of diversity in the PAs.

- Sacred Groves (SGs), age old community initiative, are another effective means of *in situ* conservation. About 13,720 SGs (covering 33,000 ha area) have been reported from different states of India.
- Among *ex situ* conservation initiatives, Botanic Gardens and Seed Banks have been set up. Presently there are over 150 Botanic Gardens are maintained in the country. They comprise about 0.2% of the total floristic diversity. About 19 BGs are engaged in conserving rare, endangered, endemic and interesting species of the Indian flora.
- Research on various components of plant diversity is yet another initiative being executed through various agencies. Attempts are underway to put all the information in a database for better accessibility. Also dissemination of information through publication and involvement of community at different levels is a continuous process in the country.
- Specific policy provisions for participatory mechanisms (for example National Forest Policy, 1988, envisages peoples movement in the development and protection of degraded forests as an essential component) are among major initiatives.
- A number of legislation have been enacted for the species protection and habitat protection. Progress made towards formulation and enactment of Biodiversity Bill-2000 is one among most recent legal initiatives.

## Gaps

In spite of a long history of initiatives pertaining to wild plant diversity in the country, a thorough review of available information highlights following gaps:

- Complete and authentic baseline data on the floral diversity, nativity, endemism, rarity, and value of species is lacking, which makes prioritization of species difficult and unrealistic.
- The base line information on ecological attributes of species, e.g. habitat relationships, population size etc., is inadequate.
- Complete floristic inventories are not available for various geo-political units (i.e., biogeographic provinces, state, district) and groups.
- In spite of rich indigenous knowledge on the use and conservation of plants, limited efforts for proper documentation and scientific evaluation of this knowledge have been made.
- Among hierarchical groups, exhaustive inventories on lower plants, such as algae, fungi and bryophytes are not available. There is no effort to improve expertise in these groups.
- Coordination among resource managers, planners, scientist and local communities for initiating any activity related to conservation of wild plant diversity is altogether lacking.
- Mechanisms of benefit sharing among community groups are not defined, therefore, participatory approach in wild plant diversity information sharing and conservation is still in infancy.
- Lack of emphasis on location specific maintenance concerns of wild plant diversity in policy documents is a major lacuna.

## Strategies and Action Plan

Considering the vastness of the area, richness of elements, diversity of issues and intensity of major gaps pertaining to Wild Plants in the country, sufficient time and adequate manpower would be required to successfully compile, collate and analyze the available information on subject. However, within the given resources and time, TWG on Wild Plant Diversity attempted to address all major issues within the gamut of this theme and following SAP has been proposed:

### Strategy 1: Establishing complete authentic national database on WPD

- Consider biogeographic regions as base unit and prepare full inventories for identified units. Possibilities of establishing grid systems in each unit for information collection and collation should be explored. For instance, grid system approach followed in west Himalayan timberline zone by GBPIHED can be expanded for entire Himalaya.
- Give equal emphasis for data generation on status of plants from seminatural areas. This will help in assessing the impact of anthropogenic disturbance on natural areas. The grid system approach will be useful in this context, which may help in identifying priority grid units for immediate conservation attention. The number of such sensitive grids will determine the importance of a particular biogeographic region for priority action.
- Consider usefulness of remote sensing techniques for characterization of priority biodiversity elements at higher organizational levels. For example, occurrence of patches of endangered plant species could be depicted through remote sensing tools and presented to policy makers for facilitating decision-making processes.
- Comprehensive mapping using Geographic Information System (GIS) of endemic species indicating their habitat, threat perceptions, rarity and rate of decline of populations and the degree of protection need to be developed. This will help to identify the endemic rich areas and habitats.
- Establish a sampling strategy to collect minimum plant samples from the wild
- Study and document information on species/population/community performance and distribution. Initially, this can be initiated on plants with restricted geographic range, high economic value, and small population size and habitat specificity.
- Make arrangements for covering most of the above information in District floras. They should not be a repeat of what is included in State floras.

- Involve educational institutes and make these exercises (collection, collation and analysis of existing status of the plant biodiversity) a part of study schedule and training programmes of managers and decision-makers. Encourage taxonomic researches in university education and recognize at national level the taxonomic database/museum specimens available with university departments.
- Emphasize on information collection/compilation on lower group of plants. Encourage researchers to work on these groups.
- Conduct studies on folk taxonomy, palaeo-ethnobotany, folk medicine, veterinary medicine and household remedies etc., and integrate results with main streams of plant diversity studies. Develop approach of prioritization of high value groups (e.g. Medicinal Plants) based on use and conservation value (i.e. status, population dynamics, and intensity of use).
- Establish a comprehensive electronic database on the status of existing information of wild plants. Create a network of natural/regional database, which makes specimen-based knowledge accessible. Involve taxonomic specialists to ensure taxonomic authenticity.
- Ensure availability of competitive research funds to support comprehensive comparative revision and monographs that focus on taxa at all levels from individual genera to phyla.

### Strategy 2: Strengthen *in situ* conservation mechanisms

- Bring type localities, areas of special conservation significance and botanical hot-spots ( both inside and out side PAs) under the umbrella of wildlife protection.
- Review and make necessary changes in guidelines for selection, establishment and management of protected areas, so that it covers maximum representativeness.
- Establish a link between field managers, ecologist and systematic botanist so as to gear up the plant conservation activity in PAs. Make it mandatory for forest managers to consult scientists/academics/experts before finalizing Working Plans, Management Plans and other action-oriented plans.
- Include separate section on wild plants while preparing management/conservation plans of any area. PA managers should draw a collaborative plan for the conservation of rare/threatened plants of their area.
- Identify research needs on the impact of deforestation, habitat fragmentation and anthropogenic disturbance on natural communities. Prioritize species, based on the threats, for protection and rehabilitation.
- Ensure regulatory mechanisms for illegal encroachments in pristine areas and prevent introduction of alien species.
- Conduct a thorough survey of sacred groves and document plant biodiversity status in such sites. Popularize the value of such initiatives.

### Strategy 3: Strengthening *ex situ* conservation initiatives

- Develop standard methods for mass multiplication (conventional/biotechnological) of RDB species.
- Establish area specific botanical gardens, live field gene banks.
- Promote *ex situ* conservation techniques for high value plants (for example MPs). Establish herbal gardens and impart training to local people (particularly women) about methods of propagation, preservation and monitoring
- Initiate efforts to involve students in conservation. Initially through awareness generation and then by involving them in restoration projects.
- Initiate rehabilitation of threatened species in sacred forests through voluntary participation of school/college students. Make this programme mission oriented by a strong back up mechanism.

### Strategy 4: Strengthening participatory mechanisms

- Develop effective benefit sharing mechanisms, which gives due consideration to rural biodiversity knowledge.
- Encourage direct participation of traditional community level institutions in planning and implementation of conservation and resource use programmes.
- Promote establishment of demonstration plots for technology transfer rural areas for community welfare.
- Review the existing agrotechnology on cultivation of income generating plants, like medicinal plants, and accordingly disseminate information among rural people
- Conduct training programmes for local inhabitants for authentic identification and scientific collection of medicinal plants. A blend of traditional knowledge and scientific technique would be required for this purpose.
- Based on the knowledge of specific quantities of secondary metabolites (phytochemicals) in specific climatic zones, soil and temperature, agrotechnological measures and subsequent domestication should be undertaken in identified areas.
- Give a high research priority to develop appropriate technology for propagation, cultivation, processing, chemical characterization and marketing of medicinal plants.
- Educate rural communities with regard to adequate time of harvesting of resources. Also, they must be imparted education on potential value of lesser-known resources.

### Strategy 5: Review and strengthen policy interventions

- Declare high conservation value areas as National Heritage Sites. Develop separate conservation and resource use policies for high, medium and low conservation areas.
- Make special provisions under revised Wildlife Protection Act for protection of threatened type localities and botanical hot-spots.
- Make it mandatory that status of indigenous knowledge on wild plant diversity forms one of the major components of any type of policy document related to plant biodiversity conservation.
- Make efforts to effectively cover traditional knowledge under Intellectual Property Rights.
- Ensure economic incentives to the local people for promoting participatory mechanisms.
- Establish policies on sustainable harvest of non-timber forest resources for economic enterprises.
- Frame policies for minimizing the affects of imbalance and non-integrated fertilizers use on natural plant diversity.
- Grazing policies in forest needs to be defined more appropriately and regulated accordingly.
- Policies on forest surveys and resource extraction should incorporate silvicultural attributes.
- Develop specific policies on ecotourism to explain the importance of local plant diversity and measures needed for conservation.
- Define policies on effective benefit sharing mechanisms for information dissemination.
- Methodology need to be developed for mass culture of threatened Red Data Book species, through conventional and biotechnological approaches.