

Ecology is for the People: A Methodology Manual for People's Biodiversity Register

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Yah kriyavan, sa panditah: True learning entails action.

Ganatantra Din, 26th January 2006

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1 Preface

Conserving, using sustainably and sharing equitably in the benefits flowing from biodiversity resources have emerged as vital concerns in recent decades. This has prompted a number of international as well as national initiatives. The Convention on Biological Diversity (CBD), in force since 1993, is the most significant of the pertinent international agreements. India is one of the 170-odd nations that are a party to the CBD. As a follow-up to this Convention, India enacted the Biological Diversity Act, 2002, which received the assent of the President on the 5th February 2003. The rules promulgated under this Act, in force as of 15th April 2004, include the following provisions:

22. Constitution of Biodiversity Management Committees

(1) Every local body (i.e. Panchayat, Municipality etc.) shall constitute a Biodiversity Management Committee (BMC) within its area of jurisdiction.

(6) The main function of the BMC is to prepare People's Biodiversity Register in consultation with local people. The Register shall contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them.

(7) The other functions of the BMC are to advise on any matter referred to it by the State Biodiversity Board or Authority for granting approval, to maintain data about the local vaid and practitioners using the biological resources.

(8) The National Biodiversity Authority shall take steps to specify the form of the People's Biodiversity Registers, and the particulars it shall contain and the format for electronic database.

(9) The Authority and the State Biodiversity Boards shall provide guidance and technical support to the Biodiversity Management Committees for preparing People's Biodiversity Registers.

(10) The People's Biodiversity Registers shall be maintained and validated by the Biodiversity Management Committees.

The Committee shall also maintain a Register giving information about the details of the access to biological resources and traditional knowledge granted, details of the collection fee imposed and details of the benefits derived and the mode of their sharing.

Thus, all local bodies in the country, Gram, Taluk, and Zilla Panchayats, Town Municipalities and City Corporations would have the responsibility of documenting:

- ❖ Comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them;
- ❖ Data about the local vaid and practitioners using the biological resources;
- ❖ Details of the access to biological resources and traditional knowledge granted, details of the collection fee imposed and details of the benefits derived and the mode of their sharing.

The rules further stipulate that the National Biodiversity Authority shall take steps to specify the form of the People's Biodiversity Registers, and the particulars it shall contain and the format for electronic database; and that the National Biodiversity Authority and the State Biodiversity Boards shall provide guidance and technical support to the Biodiversity Management Committees for preparing People's Biodiversity Registers. Preparation of the People's Biodiversity Registers (PBR) is a novel activity that will involve people at the grass-roots in a scientific enterprise. The Centre for Ecological Sciences (CES) at the Indian Institute of Science, a Center of Excellence of the Union Ministry of Environment and Forests, has had the privilege of being extensively involved in the formulation of this programme. At the instance of the Ministry, CES has conducted pilot exercises of preparation of PBRs in a number of Gram Panchayats in the states of Karnataka and Maharashtra. Furthermore, CES was asked to conduct five Regional Workshops at Bangalore, Pune, Delhi, Bhuvaneshwar and Guwahati during 2003 to discuss the methodology of PBR preparation with a range of stake-holders including technical experts from Universities, research institutions, Botanical and Zoological Surveys, Forest and other Government Departments, school and college teachers, workers from NGOs, and members and office-bearers from Panchayat bodies. These five Workshops, each lasting 3 days, and involving a total of around 500 people, provided an excellent opportunity to discuss all pertinent issues in depth and obtain very substantive feedback. Assimilating all this experience, CES has attempted to formulate an appropriate methodology and design a database. This Manual presents the relevant material. It is hoped that this will serve as a useful input to the National Biodiversity Authority and the State Biodiversity Boards in their task to provide guidance and technical support to the Biodiversity Management Committees for preparing People's Biodiversity Registers.

2 Introduction

The "*People's Biodiversity Registers (PBR)*", a programme now mandated by the Biological Diversity Act 2002, was initiated in 1995 as an attempt by the Foundation for Revitalization of Local Health Traditions, Bangalore to record the rapidly eroding folk knowledge of medicinal uses of plants (Gadgil, 1996). Two other NGOs, Navadhanya of New Delhi and Deccan Development Society of Hyderabad continued the activity, focusing on recording the occurrence and management practices of land races of cultivated crops to support their on-farm conservation, as well as promotion of farmers' rights. Kerala Sastra Sahitya Parishat, the leading People's Science Movement of the country went on to prepare PBRs covering all 85 gram

panchayats of the district Ernakulam over 1998-99 as an element of the people's planning movement in the Kerala state (Ernakulam District Biodiversity Committee, 1999). The M.S. Swaminathan Research Foundation of Chennai has prepared PBRs in Wynaad district of Kerala and Paschim Banga Vigyan Manch and Society for Environment and Development of Kolkata at several sites in West Bengal with a similar motivation. Following the passage of the Biological Diversity Act, the Madhya Pradesh Biodiversity Board has vigorously propagated the preparation of PBRs in representative localities in all of the state's eco-regions over 2004-05. However, the most systematic attempt of preparation of PBRs, covering 52 sites in 7 states and UTs, was undertaken by a network coordinated through the Indian Institute of Science, Bangalore, initiated as a part of the Biodiversity Conservation Prioritization Programme sponsored by WWF (India) over 1996-98, (Gadgil et al, 2000).

We would like to begin this Manual by recounting a happy experience from one of these 52 sites, in the state of Himachal Pradesh. Situated on the bank of river Sutlej, village Nanj came up with a novel community initiative during the course of the PBR work. The village had been an active participant in the literacy movement during 1992-93 and the people had been exposed to a variety of issues related to natural resource management. As a consequence, a heavily degraded patch of forest had been protected by consensus with promising regeneration. During the literacy campaign, a blackboard had been painted on a wall at a public place in the village for open classes and dissemination of information. Over 94-95, the blackboard had fallen into disuse. It was revived again during the PBR documentation to display the gist of the information collected. It resulted in public debates on the issues raised by the information and in turn to conservation actions.

One such debate centered on kambal (*Rhus wallichii*), a multipurpose tree species of the mid-Himalaya. It is a good fuel wood and its leaves are used as green manure in ginger cultivation. It was pointed out on the blackboard that due to excessive lopping kambal has been reduced to a bush in the forest, leading to declining availability of both fuel wood and manure. After many days of discussion in front of the blackboard, it was decided that leaf manure for ginger was a higher priority. Since other fuel wood species were available in the forest, the extraction of kambal would be restricted to leaves for green leaf manure and the bushes would be pruned in such a way that one or two shoots would be permitted to grow. At the same time, a few progressive farmers decided to experiment with agricultural crop residues as a substitute for kambal leaves for manure. Over a year, it was demonstrated that there was no difference in the yields from the two kinds of manure and subsequently more farmers turned to crop residues, as it saved on

labour. As a consequence, kambal is now flourishing in the forest, and thanks to careful pruning and good rootstock, is now growing back to trees.

3 Biological Diversity Act

The PBR exercise in Nanj thus provided a platform for the community members to initiate positive steps to manage their biodiversity resources better. India's Biological Diversity Act provides for just such a forum in every local body in the form of Biodiversity Management Committees (BMC). This act aims to promote conservation, sustainable use and equitable sharing of benefits of India's biodiversity resources. With this in view it calls for the establishment of a National Biodiversity Authority (NBA), State Biodiversity Boards (SBB) and Biodiversity Management Committees (BMC) at the level of Panchayats, Municipalities and City Corporations. It stipulates that *"Every local body shall constitute a BMC within its area for the purpose of promoting conservation, sustainable use and documentation of biological diversity including preservation of habitats, conservation of land races, folk varieties and cultivars, domesticated stocks and breeds of animals and micro-organisms and chronicling of knowledge relating to biological diversity"*. The BMCs are authorized to regulate harvests of biodiversity resources within their jurisdiction, and to charge collection fees for this purpose. They will have at their disposal "Local Biodiversity Funds" into which such income, as well as other grants will be deposited. The NBA is authorized to scrutinize all Intellectual Property Rights related applications and ensure that they properly acknowledge the contributions of providers of indigenous knowledge. NBA is expected to consult all local BMCs in this respect and to ensure appropriate arrangements for equitable sharing of benefits. NBA is now working out a system of management of confidential information for this purpose.

While there are many significant initiatives such as Joint Forest Management and Watershed Development towards decentralization of ecosystem management, none of the institutions set up for the purpose have a statutory backing. The BMCs have the required legislative support and should therefore be in a position to strike roots more effectively. Most significantly, BMCs would serve to take science right down to the grass-roots, since, the rules lay down that *"The main function of the BMC is to prepare People's Biodiversity Register in consultation with local people. The Register shall contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them."*

4 Functions of People's Biodiversity Registers

One may begin by asking: what would people gain by compiling such a Biodiversity Register, or, do they, in fact stand to lose by making their knowledge readily available for biopiracy by multinationals? There are several ways in which people could gain by compiling such Registers in view of the provisions of the Biological Diversity Act.

4.1 Community regulation of access to biodiversity resources leading to sustainable harvests

The wooded tracts of Seoni district in Madhya Pradesh, dotted with Gond villages, constitute the famed "Moogli land" of Kipling's *Junglebook*. The fruit of achar (*Buchnanian lanzan*), gathered from the natural forest is an important source of income for the people. In any forest patch, people coming in from many surrounding villages may pluck the fruit. When there is no understanding amongst the harvesters, everybody rushes in to pick as soon as the nuts reach a minimal marketable size. But that size tends to be well below the mature size which can fetch much better price. So everybody loses, because nobody can trust others to wait patiently and share the well-matured fruit on some agreed basis. This continues to be the case over much of the region, but things changed when a cluster of 13 villages of the Chhapara block became involved in the preparation of the "Jal, Jungle, Jameen Dastavej", a prelude to the People's Biodiversity Registers. Coming together, the people recalled that the traditional convention was for everybody to wait till Akshayya (*Baisakh Shukla*) Trutiya, around 10th May, before plucking achar fruit, which is fully ripe by this time. As a part of the Joint Forest Management initiative, they were given exclusive rights to collect achar from this tract, and then agreed amongst themselves to wait till Akshayya Trutiya before touching it. The result was that their total collection went up by 33% in terms of weight, and much more in terms of value because the properly matured fruit commanded a higher price per kilogram.

4.2 Promoting knowledge-based sustainable management of agriculture, livestock, fish, forests and public health so as to enhance the quality of life of the community members

Ms Mukta Rai, the chairperson of the Teligram gram panchayat in Hoogly district of West Bengal led the vigorous involvement of the local community members in the preparation of the People's Biodiversity Register coordinated by the

Paschim Baga Vigyan Manch. She pointed out that a major issue in terms of natural resource management for their locality was the adverse impacts of excessive use of chemical pesticides in paddy fields on the fish cultured in the ponds and on the domesticated ducks. She therefore suggested that the scientific exercise should focus on introduction of integrated pest management techniques that would lower the use of chemical pesticides.

While it has not been possible to follow up on this important suggestion in Teligram, it has been implemented as a part of the PBR exercise spearheaded by School teachers and students in several villages of Tumkur and Bangalore districts in Karnataka. In this exercise, scientists of the Centre for Ecological Sciences at the Indian Institute of Science, the University of Agricultural Sciences, and ICAR's Project Directorate of Biological Control, all from Bangalore have worked with farmers and students to identify potential biological control agents for significant pests of major crops being locally cultivated. This was done through a series of interactions and training programmes, leading to the selection of the following agents:

4.2.1 Table: Bio-agents proposed for suppressing insect pests of different crops

	Crop	Pest species	Bioagents
1.	Groundnut	RHC, <i>Amsacta albistriga</i>	AaNPV
2.	Groundnut	Groundnut rot	Trichoderma/Pseudomonas
3.	Redgram	<i>Helicoverpa armigera</i>	HaNPV
4.	Tomato/Bhendi	<i>Helicoverpa armigera</i> and <i>Erias</i> spp	HaNPV/EaNpv
5.	Cabbage	<i>Plutella xylostella</i>	Bt

The selected agents were successfully multiplied locally in the schools and released on farmers' fields. The efficacy of the control agents was then systematically monitored as a part of the People's Biodiversity Register exercise. It turned out that AaNPV, Trichoderma, Pseudomonas, HaNPV, and EaNpv were all successful in controlling the target species.

4.3 *Opportunities to generate funds through imposition of collection fees for access to biodiversity resources*

The Biological Diversity Act authorizes local Biodiversity Management Committees to charge collection fees while permitting outsiders: (1) to access local biodiversity resources, or (2) to record local knowledge. That this has considerable potential was evident in many of the PBR exercises undertaken in 1996-98. Thus in village Kigga in Chikmagalur district of Karnataka state, the process of

documentation drew people's attention to the fact that large quantities of mosses were being collected and exported to urban centers. As a consequence, they became motivated to find out the prices prevailing in the urban markets and to organize themselves to regulate the harvests and ensure better returns for themselves. In village Mala of Udupi district in Karnataka, the villagers had not realized that the total value of non-timber forest produce being collected annually from their village was around 5 lakh rupees. Realization of this large volume during the course of the PBR exercise triggered an interest in sustainable use, as well as in the possibilities of charging collection fees, since even a 10% charge would add substantially to the income of the gram panchayat.

The range of diversity of life forms of economic value is now exploding as modern scientific discoveries permit ever more rapid screening of biodiversity resources, isolation of chemicals of potential use, and moving around of genes - units of heredity - from one species to another. But we have little record of what is going on in the field. For instance, a tiny insectivorous plant, *Drosera* grows, amongst many other places, in rainy season puddles on the lateritic hard pans of Masur-Lukkeri in Uttara Kannda district of coastal Karnataka. Residents of Masur-Lukkeri report that this plant is collected for export to Japan. Perhaps some special chemical is derived from the rather unusual animal digesting enzymes of *Drosera*. Proper recording of such information through the medium of PBRs and its follow up by the Government officials and the scientific community would clearly be of value to local people as well as in the national interest.

4.4 *Conserving valued resources*

A significant outcome of the preparation of People's Biodiversity Registers by the Society for Environment and Development in West Bengal has been a reawakening of farmers' interest in the traditional paddy varieties. This is in part prompted by the escalating costs of cultivation of HYVs and the emergence of a market for produce of organic agriculture. As a result the farmers in many villages engaged in PBR activities have set up "*seed banks*" of traditional varieties and taken to their multiplication. These farmers may also be rewarded in future under the *Protection of Plant varieties and Farmers' Rights Act* as farmer conservators.

The People's Biodiversity Registers programme is not only relevant to rural and forested tracts, but also to urban localities such as Pune in Maharashtra. Pune, aptly named the 'Queen of Deccan' after its elevated position atop the Deccan Plateau, lies just to the east of the crestline of Western Ghats. Initially confined to the Mutha river valley surrounded by hills on all sides, the city has now grown around many of

the hillocks, known as *tekdis* in Marathi. These fairly extensive hillocks serve as lungs for the city, and in a reversal of the trend in decline in wildlife over much of India, have come in recent years to harbour good numbers of the lovely peafowl. The current urban development rules strictly prohibit "cutting of hills" under any circumstance and have served to keep these hillocks free of construction and open to public as valued sites of exercise and recreation. But enormous profits are to be made if these rules are changed, and there have been repeated attempts to push through laws that will allow construction on hills against popular sentiment. Since the law requires that the public have an opportunity to offer suggestions and objections, a people's movement called "Tekdi" has worked hard to mobilize public opinion, register objections and ensure that there is no change in the law. To this end, they have published much relevant data on their website, www.tekdi.org/prot.htm, which also housed an online protest form. A discussion was also organized through the Eco-Portal www.tekdi.com to garner broader national and international support. As a result of some 80,000 submissions that this initiative generated, the plans to permit construction on hills by amending the rules were shelved.

We thus see in Pune a conflict of interest amongst citizens wishing to retain the hillocks as sites of aesthetic, recreational, and scientific interest and those wishing to use these as sites for housing development. Those who wish to retain the hillocks as sites of aesthetic interest particularly value the peafowl. They are therefore engaged in a conflict of interest with another group of people, the animal rights activists. Because of the measures instituted under pressure from the animal rights activists, the numbers of stray dogs have been on the increase throughout the country, including on the hillocks of Pune. Much to the agony of lovers of peafowl, these stray dogs hunt the peafowl, especially eggs and chicks since peafowl nests are constructed on the ground.

It is notable that much of the information used to support the objections to construction on hillocks of Pune was collected through an initiative called "Pune alive" www.ranwa.org/punealive by an NGO called RANWA. RANWA began its biodiversity documentation activities in rural Maharashtra as a part of the Peoples' Biodiversity Registers programme in the network coordinated by the Indian Institute of Science during 1996-98 and then extended it to Pune city.

4.5 Value addition to biodiversity resources

PBR activities may help organize local level value addition to biodiversity. An excellent example of the potential in this context, catalyzed by NGO initiatives and

scientific documentation by research groups, is provided by the enterprise-based approach to conservation in the BRT WLS. The Biligiri Rangaswamy Temple wildlife sanctuary, located at the confluence of Eastern and Western Ghats in the Mysore district of Karnataka state, harbours rich biota. The earliest inhabitants of the sanctuary are a tribal community called Soligas of whom about 4500 still live in 25 settlements scattered in and along the fringes of the sanctuary. The Soligas traditionally engaged in hunting, shifting cultivation, and collection of NTFP. Initially, they collected the wild products for subsistence, but later did so on a commercial scale. Earlier they used to sell their produce to traveling-traders and contractors, but later continued their collection under the aegis of a co-operative known as LAMPS (large-scale *Adivasi* multi-purpose cooperative societies). Preliminary studies in the sanctuary indicated that the Soligas derive about 50% of their cash income from the sale of NTFPs (non-timber forest products); and these earnings are quite inadequate (Hegde et al. 1996, Uma Shankar et al. 1996). It was also found that many NTFP-yielding species are not adequately regenerating, possibly due to over-harvesting (Murali et al. 1996). This situation was suitable for an intervention that combined both the economic interests of the forest-users and their active involvement in conservation.

In 1994, VGKK (Vivekananda Girijana Kalyana Kendra), a non-governmental community organization based in the BR Hills devoted to social, economic and health welfare of the Soligas, conceived a project in collaboration with The Energy and Resources Institute and Ashoka Trust for Research in Ecology and Environment. The 3-year project was designed to increase the economic stake of Soligas in conserving their biotic resources and to increase their capacity to ensure the ecological sustainability of these resources and the larger ecosystem. The central aim of the project was to create enterprises based on NTFPs, to be operated by the Soligas. The enterprises were to process some of the NTFPs, including herbal medicines, collected through the LAMPS and to market the items to generate profits for the community, while simultaneously ensuring sustainable NTFP extraction and broad-based development. The long-term goal of sustainability in extraction of NTFPs was to be achieved by a biological monitoring system to be undertaken by the enterprises with full participation of Soligas. The responsibility of socio-economic component of the project was to ensure full participation of the community in the project and equity in the flow of benefits. Monitoring was to be initiated to ascertain the degree to which Soligas rely on NTFPs, the prices they obtain for the products, the impact of the enterprises, and feedback from Soligas on issues related to extraction, management and conservation of forest resources.

As a result, a group of enterprises comprising a honey-processing unit, a food-processing unit, and an herbal-medicine-processing unit. The HPU is designed to process honey collected predominantly from wild rock bees (*Apis dorsata*). The unit has the capacity to process 30 tonnes of honey annually. It processed about 6 tonnes of honey in 1996 and about 15 tonnes in 1997, and made a net profit of Rs 340,000 in 1998. The FPU is intended to make pickles, jams, and other products. It became operational in 1996, processing 500 kg of pickle on a trial basis. Setting a target of 2000 kg of pickle in 1997, the unit aimed to generate a profit of about Rs 50,000. The HMPU, located at Yelandur, about 24 km from the BR Hills, was originally conceived by the local NGO, VGKK to process ayurvedic drugs generated a profit of Rs. 200,000 in 1998. At the end of the project, most of the activities of the enterprises have been handed over to the Soligas, who are presently managing the enterprises with inputs from VGKK. People's Biodiversity Register exercises could obviously play a positive role in promoting such activities in many parts of the country.

4.6 Recording of biodiversity related knowledge, pertaining to management

People possess extensive knowledge of the local biodiversity resources, their status, and dynamics as well as techniques of use. It is appropriate to consider this knowledge in two contexts:

- ❖ Knowledge of uses that might find commercial application, and that therefore might need to be guarded from the perspective of Intellectual Property Rights, and
- ❖ Knowledge pertinent to prudent management of natural resources, that might be widely shared with benefit to all concerned, without any unfair commercial profits accruing to any party.

While sections 4.7 and 4.8 consider knowledge with possible commercial applications, this section focuses on people's knowledge related to management issues. There is now abundant evidence that given the nature of complex ecological systems, scientists too have a limited understanding of their functioning (Hilborn and Ludwig 1993, Ludwig, Hilborn and Walters 1993). The history of the wetland of Keoladev Ghana at Bharatpur in Rajasthan, home to numerous species of resident and migratory water birds provides an excellent example. The eminent ornithologist, Dr Salim Ali and his co-workers have spent decades studying this ecosystem. As a result of this work, Dr Salim Ali was convinced that the ecosystem would benefit as a water bird habitat by the exclusion of buffalo grazing. The government accepted this recommendation, and, with the constitution of a National Park in 1982, all grazing was banned. The result was a complete surprise. In the absence of

buffaloes, a grass, *Paspalum* grew unchecked and choked the wetland, rendering it a far poorer habitat for the water birds (Vijayan 1987).

Scientists therefore advocate that ecosystem management must be flexible and at all times ready to make adjustments on the basis of continual monitoring of on-going changes. In contrast, the Government authorities made a rigid decision to permanently ban all grazing and minor forest produce collection from Keoladev Ghana, and having once committed themselves have felt obliged to continue the ban, even though it has become clear that buffalo grazing, in fact, helps enhance habitat quality for the water birds. The emerging scientific philosophy therefore is to shift to a regime embodying systematic experimentation with more fine tuned prescriptions. Under such a regime, stoppage of grazing would have been tried out in one portion of the wetland, the effects monitored and the ban on grazing either extended or withdrawn depending on the consequences observed. This would be a flexible, knowledge based approach, a system of **"adaptive management"** appropriate to the new information age, and in complete harmony with our strengthening democratic institutions (Walters 1986).

The practice of adaptive management calls for detailed, locality specific understanding of the ecological systems. Much of the pertinent information on the status and dynamics of the local ecosystems, as well as uses of their components, resides with people who still depend on it for their day-to-day sustenance. The Keoladev Ghana story offers an excellent example of the relevance of people's practical ecological knowledge. Siberian crane is one of the flagship species for which this wetland is being managed. Yet numbers of these migrant birds have dwindled in years following the constitution of the National Park in 1982. The residents of a village called Aghapur adjoining Keoladev Ghana participated in the preparation of a **"People's Biodiversity Register"** in collaboration with students and teachers of Biology from a college at nearby Bharatpur during 1996-97 (Gadgil et al 2000). They suggested that the National Park regulations which prevent people from digging for roots of *khas* grass have resulted in compacting of soil, making it harder for the Siberian Cranes to get at underground tubers and corms which are an important ingredient of their diet. Whether this is the primary cause for a decline in the visits by Siberian Cranes must, of course, be assessed carefully; nevertheless, this certainly is a plausible hypothesis that needs to be considered in developing a management plan for this wetland.

4.7 Recording of biodiversity related knowledge, coupled to opportunities to generate funds through imposition of collection fees for access to local knowledge

The village Mala, adjoining the great forest of Kudremukh National Park in Dakshina Kannada district of Karnataka is notable for continuing extensive use of herbal medicine. The most knowledgeable of the dispensers of herbal medicines is Shri Kunjeera Moolya, who does not charge for his services, but makes a living as a farm labourer. In recognition of his talents, the Indian Institute of Science joined in felicitating him, along with Shri Kadare Srinivas Prabhu, a knowledgeable healer of livestock in a special function during the wild life week of October 1996. This felicitation brought to fore many others from the village who were encouraged to talk of their knowledge. Moreover, this helped Kunjeera Moolya to become better known and receive other awards including one by the National Innovation Foundation in 2005.

But in March 1995, prior to his contacts with the Indian Institute of Science, Shri Kunjeera Moolya was approached by an agent of some pharmaceutical firm to disclose his knowledge of local medicinal plants. He went around the forest for two days and shared this information, for which he was paid a sum of Rs.200/-, equivalent to his normal earnings over 4-5 days. This agent possibly worked for Hoechst Marion Roussel India, a subsidiary of a multinational company of German origin. Hoechst runs in Mumbai a research unit established in 1972 and described as a "target oriented lead discovery centre from natural origin". It employs some 70 Ph.D. holding scientists; all but the Director being Indian citizens. Indigenous information, obtained from people like Shri Kunjeera Moolya, as well as from published literature including that of Ayurveda and ethnobotany which has no tradition of giving credit to folk healers and other knowledgeable individuals, and electronic data bases is used to provide clues to rationalize the search for plants with interesting biological activities. Only 3 of the scientists employed by the research centre are engaged in collecting samples of plants, fungi and microorganisms, others are busy with screening, toxicology and investigations of chemical mode of action.

Obviously Hoechst would pay very many people like Shri Kunjeera Moolya small sums like two hundred rupees, and then pool together all the information generated with other public knowledge such as of Ayurveda, and inputs from many scientific disciplines to eventually develop a small number of products. The process may take many years, perhaps decades, and of course particular pieces of information

provided by a specific individual may or may not yield any product; and in any case every product will use many other inputs in its development. In this context, a system of documentation of local knowledge through PBRs, along with a well designed system of organizing all such local information; along with relevant information from scientific/ technical/ commercial institutions is the only possible way forward.

4.8 Sharing in the benefits of commercial application of local knowledge

The prevalent patent laws only recognize claims made in specified manner and based upon non-obvious, novel and useful applications. These laws therefore do not permit any sharing of benefits with respect to oral knowledge, or knowledge contained in already published literature. India's classical as well as folk traditional health practices have been subject to centuries of documentation beginning with van Rheede's *Hotrus Malabaricus* published from 1678 to 1703. India or its people cannot therefore benefit from the commercial application of such knowledge. This is what happened in case of use of reserpine derived from *Rouwolfia serpentina* in treatment of high blood pressure, for which a German pharmaceutical company obtained a patent.

However, the Convention on Biological Diversity calls for benefit sharing with indigenous people holding such traditional knowledge. This was implemented by the Tropical Botanical Garden and Research Institute (TBGRI) in Thiruvananthapuram in Kerala in case of a tonic called *jeevani* that they developed based upon information derived from members of Kani tribe about properties of a forest herb, *Trichopus zeylanicus*. Aryavaidyashala, a pharmaceutical company, paid a royalty of Rs 10 lakh for this product to TBGRI. In turn, TBGRI shared 50% of this amount with a Trust established for the benefit of Kani community. Since these transactions occurred before the passage of India's Biological Diversity Act, they had no legal backing and have run into difficulties. Yet, they represent a pioneering attempt at benefit sharing with respect to community knowledge. Proper recording of such knowledge through the medium of PBRs, coupled to implementation of benefit sharing provisions of the Act by the National Biodiversity Authority could in future bring benefits from community, or individual, oral knowledge of such use to the people at the grassroots.

These are then some examples of the possible advantages to the local community members from the preparation of People's Biodiversity Registers. [Appendix 1](#) attempts an inventory of such potential advantages.

5 Biodiversity Information System

5.1 Broad mandate

As these examples make clear, a "People's Biodiversity Register" should not be a simple list of plant and animal species and of varieties of cultivated crops and domesticated animals. It should not even be just such a list along with a record of folk knowledge of medicinal and other uses of living organisms. PBR is much more than this, for it should serve as a component of the societal knowledge base for conservation, sustainable use and equitable sharing of benefits of biodiversity. Biodiversity, as defined in the CBD and the Biological Diversity Act, is the variability at the genetic, species as well as ecosystem levels. Hence, a PBR would not only focus on species and varieties, but also be concerned with maintenance and prudent management of ecosystems such as forests and grasslands, ponds and coral reefs. It would, for instance, be concerned with habitats or ecosystems such as the hillocks of Pune. Furthermore, a "People's Biodiversity Register" would concentrate on engaging people in these endeavors. This is very much in tune with the "Ecosystem Approach" adopted by the Convention on Biological Diversity, which emphasizes that humans are an integral component of ecosystems ([Appendix 2](#)). The Ecosystem Approach advocates decentralization of the management of ecosystems to the lowest possible level of governance, and taking on board all streams of knowledge. India's Biological Diversity Act adopts this approach; hence, PBRs must be concerned with documentation of the many facets of people-ecosystem interactions as well. These would range over harvests of biomass (e.g. collection of NTFP such as achar nuts by residents of Chhapara block or commercial fishing), and processing (e.g. of honey by Soligas of BRT), to technologies (e.g. preparation of food products like pickles, or of herbal medicinal plants by Soligas of BRT, or sustainable methods of tapping resin from pine trees or of treatment of paper mill effluents), and patents (e.g. over rice crop varieties of West Bengal or products such as stabilized alkaloids for pest control from neem leaves). PBRs would also serve to give due credit to knowledgeable individuals like Shri Kunjeera Moolya (section 4.7), and facilitate value addition to such knowledge accompanied by an equitable sharing of benefits. The totality of information in PBRs would thus include many different kinds of building blocks; species, their habitats, biological produce, prices of biological produce, harvesting and transport of biological produce, regulations governing harvests, technologies of processing biological produce,

people and their ways of using and managing biodiversity resources, local knowledge of uses and management of biodiversity resources, and so on.

5.2 Information flows

The preparation of PBRs throughout the country, in the 2.5 lakh or so local bodies, would be a stupendous exercise that would generate an enormous amount of information from the grass roots. To motivate their involvement, this information should, of course, be of some immediate local use to the communities, as discussed in section 4 and appendix 1. But it would also help facilitate many activities at national, and even international levels. Thus, this information is pertinent to the National Biodiversity Authority fulfilling its mandate of:

1. Examining, and deciding on requests for accessing biological resources or knowledge associated thereto for research, or for commercial utilization, or for bio-survey in consultation with the concerned Biodiversity Management Committees.
2. Ensuring equitable sharing of benefits arising out of the use of accessed biological resources, their by-products, innovations and practices associated with their use and applications and knowledge relating thereto in accordance with mutually agreed terms and conditions between the persons applying for such approval, local bodies concerned and the benefit claimers.
3. Examining, and deciding on requests for Intellectual Property Rights based on any research or information on biological resource of Indian origin, prescribing, as appropriate, benefit sharing fees or royalty or conditions for agreeing to intellectual property rights claims.

To fulfill this mandate, the NBA would not only require access to PBR information, such as on local knowledge of medicinal uses of plants, but also much other information such as on commercial products manufactured from such plant species, any patents claimed on such products, and so on. This information would be available with scientific bodies such as Botanical Survey of India or the Central Drug Research Institute, or commercial organizations like Dabur Pharmaceuticals, or in international databases like NAPRALERT (Natural Products Alert). Some of this scientific, technological and commercial information would be of interest to the Biodiversity Management Committees of the local bodies as well, since it would help them decide on appropriate levels of collection charges to be imposed, promote local level value addition activities, or devise effective marketing strategies. The

overall Indian Biodiversity Information System (IBIS) should therefore be designed to ensure flows of information, not only from bottom up, but top down and horizontally as well.

5.3 *Twofold Functions*

IBIS would serve two broad functions:

- ❖ Promote conservation and more sustainable management of biodiversity resources,
- ❖ Promote value addition to biodiversity resources, and associated knowledge, including knowledge in folk and classical streams.

Intellectual Property Rights (IPR) would be an important consideration in the context of value addition, and may call for access being restricted for some of the information. In the context of conservation and sustainable use this would be less important, though it may be necessary to restrict access to information on some issues such as the exact localities of occurrence of certain endangered species. To place the PBR exercises in their broader contexts it is appropriate to consider the institutional arrangements appropriate to the discharge of these two functions (diagrams [1](#) and [2](#)).

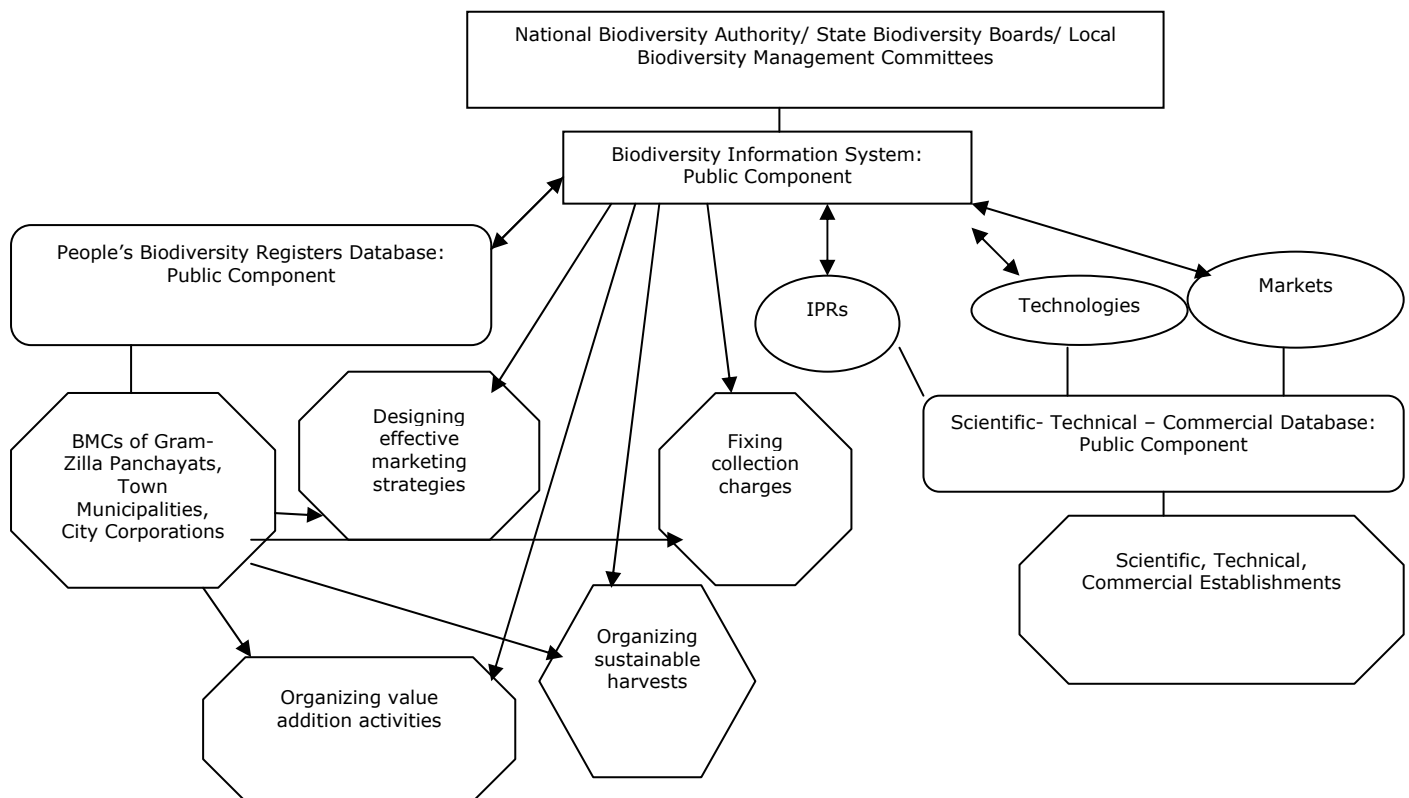
5.4 *Resource management*

The BMCs would be involved in five kinds of activities in the context of management of local biodiversity resources:

- ❖ Promoting conservation measures
- ❖ Organizing sustainable harvests
- ❖ Fixing collection charges
- ❖ Organizing value addition activities
- ❖ Designing effective marketing strategies

In each of these contexts they would collect locality specific, quite detailed information that would be of value in planning countrywide activities as well. For instance, an exercise by the Karnataka Planning Board showed that of the 300 species of medicinal plants used commercially in Karnataka, some limited information on status was available for only 27 of the most common species such as *amla* (*Phyllanthus emblica*) and *shikekai* (*Acacia concina*). This led to an experiment of involving high school students at looking at medicinal plant resources in their own localities as a part of the Karnataka Biodiversity Strategy and Action Plan exercise. The outcome was that students from 42 high schools collected data on the levels and recent trends in local abundance for 172 out of these 300 medicinal plant species. Such information, collected through PBR exercises would be of value at the state and national level in deciding on conservation and sustainable use strategies.

At the same time, information on countrywide status, various products derived, pertinent technologies and prevalent market prices, would help local BMCs decide on total protection to certain species, devise sustainable harvest regimes for others, fix appropriate collection charges, organize value addition activities and work out good marketing strategies. As diagram 1 shows the public component of IBIS could facilitate the desired information flows.

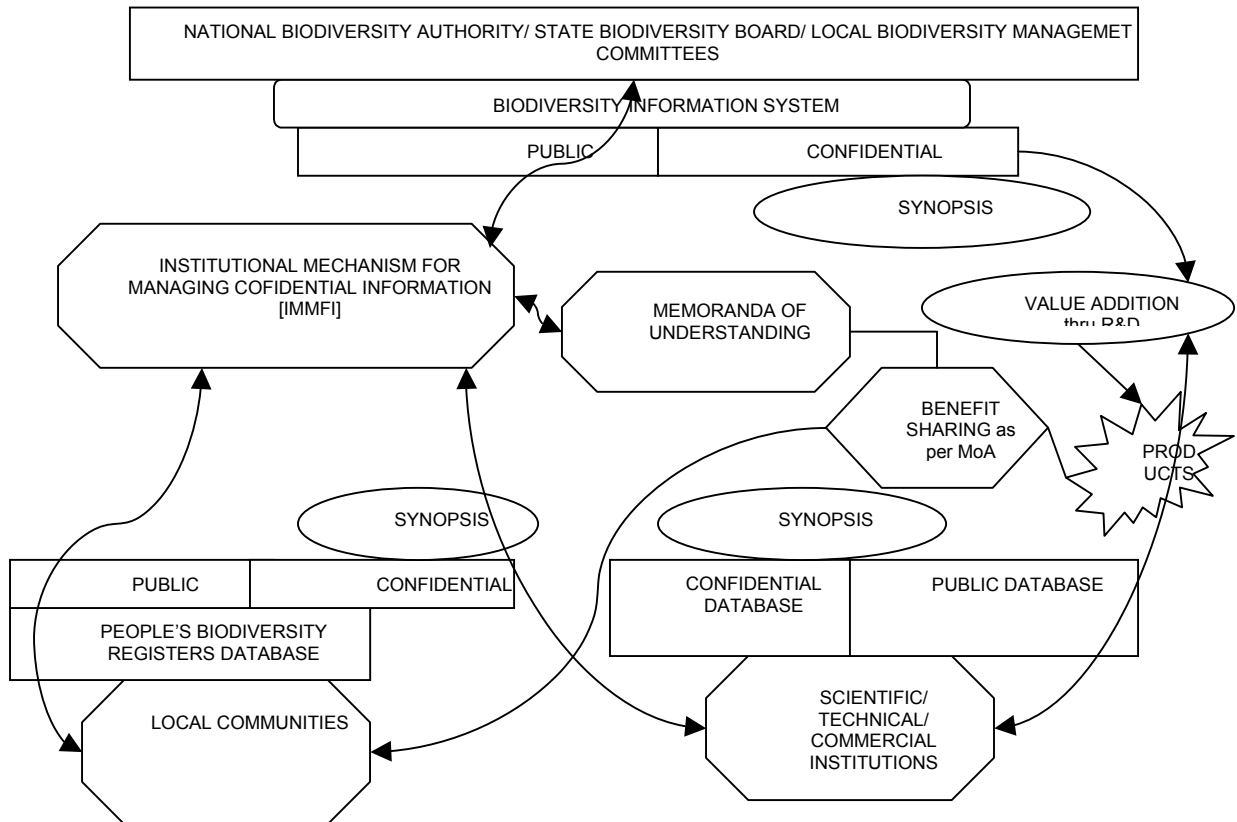


A possible system for the management of information pertinent to conservation and sustainable use of biodiversity resources, in particular the information recorded through the People's Biodiversity Register exercises.

5.5 Value addition

The PBR documents would also record people's knowledge of potential commercial application, and it is essential that measures be instituted to appropriately protect their intellectual property rights. If all the PBR information is open to the public, there is no way to ensure flow of benefits to people, especially in cases where the products are developed and sold in markets outside India. There is no international agreement in place today to permit India's National Biodiversity Authority to persuade foreign enterprises operating outside of India to share benefits in such a contingency. Neither is such an international agreement likely in the near future, especially since the USA has refused to ratify the CBD.

It is therefore vital that details of such knowledge are kept confidential. One possible agency to do so is the National Innovation Foundation (NIF), established by the Government of India in March 2000. NIF has grown out of the Honeybee Network activity as an agency to promote green grassroots innovations and traditional knowledge, and is presided over by the head of India's Council for Scientific and Industrial Research. It maintains an information base called National Register that is a repository of all socially and environmentally acceptable information flowing to it from a number of channels including village level exploratory trips. There is a provision to maintain the confidentiality of some of the information lodged with the National Register. The Governing Body of NIF has decided that NIF would set up an additional database to be named as *People's Knowledge Database (PKD)* to supplement the existing National Register (NR). The PKD will serve as an electronically searchable, multi-lingual, and multi-media, repository of all of people's knowledge recorded through PBRs and other means. This will be maintained either as publicly accessible or as confidential knowledge as specified by knowledge providers, giving full credit to individuals or communities concerned. All entries in the PKD will be scrutinized and those components that meet the criteria evolved by NIF pertaining to environmental and social sustainability will be transferred to the National Register, again maintaining specified restrictions on access and providing an indication of the content to the public in a synoptic form. The entries not accepted for inclusion in the National Register, will continue to be maintained in the PKD. The PKD and National Register would, of course, form part of IBIS that would also incorporate other relevant scientific, technical, IPR and market related information and serve as the knowledge base for the NBA, SBBs and the BMCs.



A possible system for the management of information pertinent to value addition to biodiversity resources and associated knowledge, in particular knowledge recorded through the People's Biodiversity Register exercises.

5.5.1 Memorandum of Agreement

The Indian Institute of Science has maintained an active dialogue with the National Innovation Foundation to explore the use of National Register as a repository of confidential information pertaining to uses of biodiversity provided by communities or individual knowledge providers in the course of PBR preparation. It has employed the information on medicinal uses of plants collected from Shri Kunjeera Moolya and other knowledge providers of Mala Village as a test case. A model of information management for this purpose was evolved during a brainstorming session at the Governing Body of NIF on March 9, 2004 ([diagram2](#)).

This model proposes that NIF execute a Memorandum of Agreement with the knowledge providers, in place of a simple Prior Informed Consent. The Memorandum would acknowledge NIF's acceptance of certain conditions laid down by knowledge providers under which their knowledge may be shared with third agencies. These third agencies would primarily be research and commercial organizations interested in developing products on the basis of the knowledge. The knowledge providers may specify the kind of agencies that may be allowed access to their knowledge, how these agencies may further manage this knowledge, and the expected benefits from these agencies. NIF may make available their knowledge only after these conditions are met.

Of course, outside agencies need to have an indication of the nature of the knowledge being held as confidential knowledge in the National Register to enter into an agreement with NIF for access to any particular item of knowledge. For this purpose, the National Register would provide a synopsis of the nature of the confidential knowledge. Such a synopsis may, for instance, mention the symptoms of a disease that can be treated with an herbal remedy, while withholding the name of species and other details. If such an arrangement works, it would be an excellent way to bridge the gap between the local and national scales and folk and modern scientific knowledge.

Following the elaboration of this model at the Governing Body meeting of NIF, a series of discussions were held with the knowledge providers of Mala Village as a part of Indian Institute of Science's PBR activities sponsored by the Ministry of Environment and Forests, GoI. These discussions focused on the form of a Memorandum of Agreement acceptable to them, and to NIF, and led to the drafting of a mutually agreeable Memorandum of Agreement. [Appendix 3](#) lists the main

clauses of this Memorandum, which was signed by the knowledge providers and NIF on 14th June 2004 with full concurrence of the village council.

However, a number of issues still need to be addressed. NIF has to develop a good system of links with government, academic and commercial research and development agencies to facilitate value addition to such knowledge. It has to ensure that the confidentiality of the knowledge in its repository is not violated during the process of collection and storage of the knowledge elements. Moreover, the National Biodiversity Authority has to decide upon the way it will organize a countrywide Indian Biodiversity Information System (IBIS), including the mechanisms for maintaining the confidentiality, while at the same time promoting value addition to the knowledge flowing from village councils through State Biodiversity Boards to the national level. NBA has to decide on the possible role of NIF in this process. These and many other challenges will have to be addressed in the days ahead.

5.6 A co-operative enterprise

While PBRs need to be placed in this broad context of the Indian Biodiversity Information System, they must still be documents of the people, by the people and for the people. Given the diversity of life and ecosystems, of people and economy, over our vast country in which hunting-gathering and shifting cultivation co-exist with intensive agriculture and modern industry, PBR exercises have to be fine tuned to the local conditions. In fact, to do this effectively, it may be appropriate to go down below the level of a Panchayat/ Municipality, and, as in the case of Village Forest Committees, organize sub-committees of BMCs at the level of individual villages/ hamlets/ town wards and to prepare PBRs at this level. Hence, PBR exercises cannot be set tasks with all details specified, but must allow for sufficient freedom to take on board local concerns and priorities. The exercises must also permit use of a whole spectrum of media from paintings and songs to seed banks.

Manifestly, local people, the barefoot ecologists must be at the center-stage of the PBR exercises to do justice to the task at hand. In any event, we simply do not have enough technical experts to man such an endeavor on their own. Therefore, the experts will have to work hand-in-hand with actors from many different segments of the society, from every village and town, from every fishing community, from every tribal hamlet, from every camp of herders. The network will have to include teachers and students from local schools and colleges, as well as local community leaders, government officials, researchers, and workers of voluntary agencies. Given their broad scope, the PBR exercises may be viewed as

comprising several, parallel, closely interwoven strands. The first of these strands will concern the more structured information with fuller participation in the networked Indian Biodiversity Information System; such structured information may be in the public domain, or may, in part, have restricted access. This may be complemented by a second strand focusing on the less structured information, such as relating to folk practices of conservation of biodiversity. These two strands of the PBR exercises would be complemented by a third strand of more global scientific, technological, law or market-related information to weave the fabric of IBIS, an Information System that should enable us to respond to the challenges of the modern times, while promoting biodiversity as a people's movement.

The local educational institutions, especially teachers and students in 8th, 9th, and 11th standards, and in undergraduate colleges might play a key role in generating the more structured information under the supervision of *Biodiversity Study Groups* that might be set up by the *Biodiversity Management Committees* of the Panchayats and Municipalities and City Corporations. These study groups may commission the local educational institutions to undertake specific studies that might generate a number of documents that may, for example, be designated as "Contribution # 1 of 2005-06 by Abhinava Vidyalaya towards the preparation of the People's Biodiversity Register for Yeradavane Ward of Pune Municipal Corporation". Putting together such contributions, along with the material generated by local community members, the study groups may compile the PBRs that should be ultimately put up to the gram sabha, or other equivalent assemblies of people for final approval. Special measures would have to be instituted to record and manage items of people's knowledge that they may wish to keep confidential. As mentioned above, more thinking needs to go into devising the appropriate systems for this purpose of managing information that has possible implications in terms of intellectual property rights, and the present manual would focus largely on information that people wish to share widely without any reservation.

To reiterate, at the Panchayat/ village level the implementing agencies for managing the more structured information could be a high school/ college/ a community based organization (CBO) like a youth club/ self-help group; at the city/ taluk/ district level a College / Krishi Vigyan Kendra, and at the state level some scientific or educational institutions such as G.B.Pant Institute of Himalayan Environment and Development or Kerala Forest Research Institute. These agencies may be supported by appropriately constituted technical and civil society support groups that would also contribute to the elaboration of the scientific, technical and other material needed to support the PBR exercises (see Table 5.6.1).

5.6.1 Table : Institutional framework for generating the structured information as a part of the PBR process

Scale Institution	Country	State	District	Taluk	Local body	Village / Ward
Supervisory Agency	NBA	SBB	ZP - BMC study group	TP - BMC study group	Panchayat/ Municipality BMC study group	Village or Ward BMC study group
Implementing agency	MoEF, GoI	Nodal Agency designated by SBB	Sci/edu institution designated by ZP-BMC	Sci/edu institution designated by TP-BMC	Sci/ edu institutions & CBOs selected by BMC	Sci/ edu institutions & CBOs selected by BMVC / BMWC
Technical Support agencies	Technical support group (TSG)	TSG	TSG	TSG	Local sci/ edu institutions	Local sci/ edu institutions

6 PBR process

Preparation of PBRs is an enormous challenge that will have to be addressed in phases, carefully building capacity of the many different actors that would have to join hands, as the activity progresses. We may visualize the overall nation-wide process, which would stretch over several years, as involving the following ten streams, not necessarily in a linear sequence:

1. A campaign of dissemination of information on biodiversity issues, including CBD, BDAct, BMCs and PBRs, and progress in development of PBRs.
2. Relatively simple PBR exercises, largely involving community members, CBOs and NGOs, and focusing on preparation of management plans pertaining to the most significant concerns of the people based on the already available understanding, and recording other information of interest to the community in a free-hand fashion. These exercises would serve to generate preliminary information that would create the awareness needed to undertake more structured exercises as suggested in step 4. We may term these exercises "basic" exercises. The "jal-jungle-jameen dastavej's" prepared for the Seoni district of Madhya Pradesh are examples of such basic documents.
3. School and college level individual and group projects, conducted as a part of environmental education activities that are mandated by a decision of the Supreme Court. These projects may be selected on the basis of exploratory discussions with community members on their most significant concerns. We provide a suggestive

list of such projects below in Appendix 4. These activities may, of course, run as a parallel stream throughout.

4. Exercises, that may be termed "mid-level" exercises, commissioned by the State Biodiversity Boards/ BMC Study Groups through educational institutions/CBOs involving (a) recognition of user groups, and, with their collaboration (b) identification of focal issues, associated species and habitats, and then (c) gathering information through interviews on well-known groups of organisms such as economic plants, fish and shellfish, birds, major wild life species, pending preparation of resource material on the other lesser known species and habitats [stream 8], while leaving out confidential information.
5. Exercises, that may be termed "advanced" exercises, commissioned by the State Biodiversity Boards/ BMC Study Groups through educational institutions/CBOs involving (a) recognition of user groups, and, with their collaboration (b) identification of focal issues, associated species and habitats, and then (c) gathering information through both interviews as well as field visits on well-known groups of organisms such as economic plants, fish and shellfish, birds, major wild life species, pending preparation of resource material on the other lesser known species and habitats [stream 8], while leaving out confidential information.
6. Technical groups, operating as appropriate at national, state and district levels, organizing a Biodiversity Information System by linking scientific biodiversity databases and PBRs.
7. Technical groups, operating as appropriate at national, state and district levels, possibly collaborating with the National Innovation Foundation, to organize a system of management of confidential information with an appropriate system of facilitating value addition and benefit sharing, and linked to the Indian Biodiversity Information System.
8. Technical groups, operating as appropriate at national, state and district levels, consolidating information flowing from grass-roots on focal issues, associated species and habitats [as per stream 4 and 5] and generating pertinent scientific information relating to identification, sustainable use practices, technologies of value addition, patents, marketing, and management.
9. Further exercises commissioned by the BMC Study Groups through educational institutions focusing on focal issues, associated species and habitats identified at

grass-roots through the first phase exercises (stream 4 and 5), and supported by resources generated through stream 8.

10. Further PBR exercises, largely involving community members and CBOs, focusing on (a) preparation of management plans building on the material generated through exercises commissioned in stream 8 and the work of the Technical groups, and (b) on recording of confidential information.
11. Continuation of the activities of the various streams, building on the foundation generated and moving towards a participatory, decentralized, system of adaptive management of biodiversity resources and associated knowledge.

7 Spreading awareness

Conserving, using sustainably, and sharing equitably in the benefits from biodiversity and associated knowledge is a complex process interlinked with a whole spectrum of other human endeavors. It is therefore important that all segments of the society are kept informed of the various pertinent issues and ongoing developments. It is especially important that these information dissemination activities reach out to people at the grass-roots. A well-established mechanism for doing this is a march or jatha, and this was the method employed in a campaign to develop the so-called "Jal- jungle- jameen dastavej's" in Seoni district of Madhya Pradesh. This jatha was organized by local NGOs with support from the State Forest Department and involved visits to a series of villages, informing them of PBR related issues, followed by compilation of preliminary information. The Deccan Development Society has similarly organized jathas through many villages, interacting with local community members to produce a matrix of information on many different attributes of local crop varieties depicted through use of a large chess-board drawn on ground using rangoli, seeds, stones and other objects so as to be accessible to all participants, irrespective of their formal education.

Such activities are important to prepare ground for and supplement the more organized activities in streams 2 to 11. They may use a variety of media ranging over songs and street theatre, posters, slide and film shows, to books and material on CDs and websites. They should deal with:

- ❖ India's as well as the concerned region's heritage of biodiversity and associated knowledge; India as a country of origin for endemic species and its sovereign rights over these biodiversity resources; the challenges of conservation and sustainable use.
- ❖ India's wealth of traditional knowledge, its on-going erosion and the challenge of preserving this knowledge and equitable sharing of benefits with knowledge-holders.
- ❖ Intellectual property rights, trade secrets, patents

- ❖ Implications of international agreements such as the Convention on Biological Diversity, GATT and TRIPS
- ❖ National laws like Biological Diversity Act, 2002 and rules 2004, Protection of Plant Varieties and Farmers' Rights Act 2001, Forest Act, Patents Act, Acts relating to local governance, and to rights to information.
- ❖ On-going national programmes of decentralized management of natural resources such as watershed and Joint Forest Management programmes.
- ❖ Scientific advances in our understanding of ecological processes and of biodiversity, and emerging concepts like adaptive management.
- ❖ Technological advances in fields such as biotechnology and information and communication technologies and their implications for conservation, sustainable use and equitable sharing of benefits flowing from biodiversity.
- ❖ IT tools, databases, sharing information, right to information, promise of new tools to aid decentralized planning processes
- ❖ Issues immediately involving people such as constitution of Biodiversity Management Committees in Panchayats and Municipalities, their authority to levy collection charges, techniques of sustainable harvests and possibilities of value addition to local biodiversity resources, use of internet to access pertinent information and so on.

Educational institutions should be an important focus of such awareness activities, since they would serve as key actors in the process of building up local level information on biodiversity. Our experience suggests that High School students in standards 8 and 9, Pre-university college students in standard 11 as well as first, second and third year undergraduates can do an excellent job in generating pertinent and reliable information if provided with good resource material and exposed to a few days of training in field situations. We may attempt to reach out to the educational institutions with the help of existing networks such as those associated with the National Council for Science and Technology Communication of DST, GoI or with the Center for Environmental Education, and the Green Corps and Eco-clubs programmes of the Ministry of Environment and Forests, GoI.

8 People's concerns

Biodiversity is an overwhelmingly complex phenomenon. Indeed, it is estimated that only about 20% of the total number of species of plants, animals and microorganisms living on the earth today have been described scientifically. Some groups such as flowering plants are relatively better known, but they constitute only about 2.5% of all species. Now, the Mala Panchayat in Karnataka Western Ghats, extending over an area of 50 km² harbours some 500 species of flowering plants. Hence this locality may shelter around 20,000 species of all living organisms put together, each with substantial levels of genetic variation. A large fraction of these species will be small insects, mites, threadworms and moulds as yet unknown to science. An attempt at preparing an inventory of all these forms is clearly not a practical proposition, and has not been successfully accomplished anywhere in the world.

Hence, in interest of practicality and efficacy, PBR efforts must focus on a manageable range of issues. In addition to national concerns such as conservation of endemic species, the issues selected must serve people's interests. The very first step in the PBR process should therefore be to communicate to local community members the significant challenges and the new opportunities arising from the provisions of the Biological Diversity Act. As discussed above in Section 4, these opportunities include:

- ❖ Community regulation of access to local biodiversity resources leading to sustainable harvests,
- ❖ Promoting knowledge-based sustainable management of agriculture, livestock, fish, forests and public health so as to enhance the quality of life of the community members,
- ❖ Opportunities to generate funds through imposition of collection fees for access to biodiversity resources,
- ❖ Conserving valued resources,
- ❖ Value addition to biodiversity resources,
- ❖ Recording of biodiversity related knowledge, pertaining to management issues,
- ❖ Recording of biodiversity related knowledge, coupled to opportunities to generate funds through imposition of collection fees for access to local knowledge,
- ❖ Sharing in the benefits of commercial application of local knowledge,

Thus the PBR process may begin by community members and teachers and students working with them exploring possible uses of information generated through a PBR exercise. Such a discussion may use as a starting point a checklist such as that provided in [Appendix 1](#). The PBR exercise should ideally proceed after both the community members and the teachers and students find at least some of the possibilities of sufficient interest to justify their involvement in the exercise.

9 Individual biodiversity projects

An excellent way to build capacity to develop PBRs would be to involve the students, from the primary school onwards, in projects dealing with various facet of local biodiversity. Such activities are now mandatory at all levels of education in accordance with the Supreme Court decisions of 22nd November 1991, 18th December 2003 and 13th July 2004. Ideally these projects should emphasize the possibilities such as those indicated in Appendix 1, and selected by local community members as of particular interest to them. Thus, if the impact of air pollutants from a local cement factory is a matter of interest, the projects could look at lichens as possible indicators. Such projects could provide useful activities for programmes like eco-clubs, green corps or science clubs. These could be encouraged on a very broad scale and in the long run would facilitate the coverage of PBRs over the length and breadth of the country. Appendix 4 provides more detailed suggestions for such projects.

10 Deploying student power

The PBR exercise will be an innovative enterprise bringing together knowledge of the local people with scientific knowledge. Local educational institutions will have to play a central role in these exercises, backed by technical support (see Box 10.1). The necessary technical inputs may be derived opportunistically from a variety of sources such as Regional Stations of Agricultural Universities, Krishi Vigyan Kendras, Farm Clinics, Universities and colleges, research institutes like Central Institute of Medicinal and Aromatic Plants, or G B Pant Institute of Himalayan Environment and Development, NGOs like the Foundation for Revitalization of Local Health Traditions and so on. Since, it will take some time to acquire such inputs, the PBR exercises should be initiated, albeit on a preliminary footing, on the basis of technical knowledge accessible to local High School teachers coupled to the knowledge of local community members. Simultaneously, efforts should be organized at the state and national levels to develop:

[a] Resource material,

[b] Training modules,

[c] Network of experts and technical institutions to support PBR activities everywhere, and

[d] Database designed to organize the locally collected PBR information and link it to a broader networked Biodiversity Information System.



10.1 Box: Steps involved in engaging educational institutions in the PBR process

1. Familiarizing community members with provisions of Biological Diversity Act, the concept of People's Biodiversity Register and possible advantages of engaging in the PBR process
↓
2. Confirming people's interest in engaging in the PBR process
↓
3. Informing educational institutions of a locality that has evinced interest in taking up a PBR exercise, of provisions of Biological Diversity Act, the concept of People's Biodiversity Register and possible educational value of engaging in a PBR process
↓
4. Identifying educational institutions committed to engaging in a PBR exercise
↓

5. Developing a rapport between the teacher-student team and local community members
↓
6. Building capacity of teachers, students and local community members to participate in a PBR exercise
↓
7. Delineation of user groups and identification of knowledgeable individuals
↓
8. Constitution of a broad based study team involving teachers, students, and local community members representing different user groups
↓
9. Participatory mapping of the landscape of the study area
↓
10. Preparing an inventory of locally known life forms
↓
11. Documentation of local geographic, social and economic setting
↓
12. Identification of focal issues
↓
13. Identification of species and habitats pertinent to focal issues, and communication of this information to a national technical support group to initiate development of resource material on the emergent set of habitats and species
↓
14. Documentation of ecological setting in terms of habitats of interest, trends of change and patterns of management of these habitats
↓
15. Documentation of occurrence of focal species, trends of change in populations, uses and patterns of management of these species
↓
16. Simultaneous compilation of scientific/ technical information available on focal issues and habitats and focal species to feed into plans of management and value addition
↓
17. Documentation of local knowledge of habitats and of focal species that people are happy to share with general public
↓
18. Preparation of a database
↓
19. Documentation of current and desired patterns of management of habitats and focal species
↓
20. Preparation of a biodiversity management plan



11 Managing the information

11.1 Contents of a PBR

As noted above, the totality of information in PBRs would include many different kinds of building blocks; species, their habitats, biological produce, prices of biological produce, harvesting and transport of biological produce, regulations governing harvests, people and their ways of using and managing biodiversity resources, local knowledge of uses and management of biodiversity resources, and so on. These different building blocks or entities would be related to each other in a variety of ways, and a well-designed information system should properly specify the relationships. A Relational Database Management System plays this role by efficiently organizing information in this fashion.

11.2 Inter-linked entities

As an illustration of the manifold, inter-linked information that might go into a People's Biodiversity Register, consider a biological produce, honey. Honey may be produced by a domesticated honey-bee, such as *Apis serrana*, or a wild honey-bee, such as *Apis dorsata*. A variety of names depict these species in different languages in different parts of the country. These honey-bees are influenced by a number of other plant, animal and microbial species in many different, positive as well as negative, ways. Giant *Tetrameles nudiflora* trees serve *Apis dorsata* bees as support trees, while *Xeromphis spinosa* trees serve as a nectar source. Sloth bears are major predators on bee-hives, while drongos and bee-eaters hunt bees on wings. A variety of different ecosystems, ranging over evergreen and deciduous forests to suburban habitation harbour wild *Apis dorsata* colonies. The bees need a good source of water, such as a stream or tank and *Apis dorsata* thrive on suitable trees close to water sources. Boxes sheltering domesticated *Apis serrana* colonies may be maintained in house gardens or orchards.

Different groups of people relate to different honey-bee species and their produce in manifold ways. Some people deriving a livelihood as landless agricultural labourers may harvest wild *Apis dorsata* hives. Orchard owners may maintain domesticated *Apis serrana* colonies. A few individuals from both these groups may be especially knowledgeable about the bees, or techniques of harvesting or rearing them. Some others, such as scientists working with Khadi and Village Industries Commission or with Dabur Pharmaceuticals may also be highly knowledgeable about bees, bee-keeping, and processing and marketing of bees-wax and honey. A variety of institutions may deal with honeybees and their products. Forest Departments

may regulate collection of wild honey from Reserve Forest areas. Forest Labourers' Co-operative Societies may undertake contracts for collection of wild honey from forest areas. Bee-keepers' Co-operative Societies may help members in production, processing and marketing of honey. Companies like Dabur Pharmaceuticals may also undertake purchase, processing and marketing of honey. Grocery shops may sell honey along with many other products.

A variety of technologies relate to honeybees, honey and bees-wax. Honey may be harvested from wild honeybee hives by lighting a fire underneath. Alternatively, a person wearing protective clothing may harvest only a part of the hive allowing survival and continued production of honey in the same hive. There are a number of technologies of processing honey and bees-wax, some of them protected by patents. Rights over patents relating to processing of honey may be held by pharmaceutical companies or individual scientists.

One can see from this quite limited example, the variety of entities that are relevant to a PBR exercise and the diverse inter-connections amongst them. A Relational Database Management System ensures that while the information may be recorded bit by bit, and organized in a number of independent tables, the inter-connections are kept in view. Thus, one table (form 5.1) may record *Apis dorsata*, *Apis serrana*, *Tetrameles nudiflora*, and *Xeromphis spinosa*, along with their local names, as some of the species recorded from one locality. A second table (form 4.1) may record patches of deciduous forest, rivers and paddy fields as three of types of ecosystems occurring in that locality. A third table (form 2.1) may record landless labourers, Forest Guards, and farmers as amongst three groups of people, and Forest Department, Forest Labourers' Co-operative Society and a Paper Mill as some of the agencies concerned with biodiversity resources (form 2.2). Another set of tables may record the management perspectives of the different stakeholders (e.g. forms 9.1b, 11.1b, 13. 4b). Yet another table (form 7.2) may record various songs, sayings and literary works relating to different species.

The Relational Database Management System allows one to trace and follow through the various links, not only for any given locality, but, across localities as well. Thus, *Apis dorsata* is known as *Agya Mashi* in Marathi. A user from tribal district of Gadchiroli in Eastern Maharashtra only familiar with this Marathi name can learn from the PBR database of Haldipur village in Honnavar taluk in Karnataka that this locality has a very active and well-managed Forest Labourers' Co-operative engaged in wild honey collection, processing and marketing that may serve as a model for their own activities. Similarly, an investigator looking into the impact of

forest based industry could readily retrieve the information in the PBR of Kargod village in Sirsi taluk in Karnataka that wild honey production in this locality has sharply declined following the harvests of *Tetrameles nudiflora* trees for plywood industry.

11.3 Recording and sharing information

People's knowledge and perceptions, the basis of much of the PBR information, has many facets expected to differ greatly over the length and breadth of India with its diverse cultures and plural society. People's ways of expression and methods of preservation of traditional knowledge also vary. A whole range of these, including folk songs, folklores, wall paintings, carvings, collection of materials and artifacts are apt to be involved. While documenting the knowledge in the PBR process, it is important to take note of these various forms through which the knowledge is being expressed and preserved. It is also essential that data collection should not become a stereotyped 'form filling' activity lest the interest of the people in the process and the location specific flavors of the expression be lost. We therefore do not propose to 'impose' any uniformity on the PBR data gathering activity, which should be shaped by the ingenuity and imagination of the agents collecting the data. These agents should ideally be themselves members of the local community, and give full scope to the creativity of local community members. Of course, the local people should also have the final say on who will access the data made available by them and on what terms. Therefore, all data elements will have attached to them information on access to the particular item of information:

- **Open to all**
- **Open to members of specific localities**
- **Restricted – with pertinent details of restrictions**

However, it is also essential that many components of the information contained in the PBR are:

- **Corroborated,**
- **Expressible in scientific terminology,**
- **Capable of being exchanged with other locations using modern technologies like the web,**
- **Amenable to being analyzed statistically.**

This would permit exchange of local data with others for:

- 1. Cross-checking, and where appropriate, validation**
- 2. To compile an overall picture**
- 3. For NBA to decide on benefit sharing claims**
- 4. For research purposes etc.**

This would also facilitate local people accessing global data as well as data from other localities:

- 1. To implement sustainable resource use practices**
- 2. To decide on levels of collection fees to be levied**
- 3. To organize local level value addition**
- 4. To decide on marketing strategies**
- 5. To stake claims related to benefit sharing etc.**

Indeed, local people stand to gain much from networking with other Panchayats, NGOs, scientific institutions, cooperative marketing societies and so on. It is therefore of great advantage to record some of the data in a structured fashion.

11.4 Relational Database Management System

The more structured, shared information, generated through extensive involvement of local educational institutions would constitute a significant component of the PBR information. This structured information will feed into a networked *Indian Biodiversity Information System* that would also incorporate information generated through more formal; scientific, technological, legal, and market institutions. Information in this *IBIS* should be properly shared, with Panchayat/ Municipality level BMCs and educational institutions not only providing information to other levels, but having access to information from other sources such as scientific names of local species, technologies of value addition, patented processes and market prices of various products derived from them. This would be greatly facilitated by starting with a shared understanding of entities about which information will be recorded, their various attributes, and the relationships amongst these entities. A *Relational Database Management System (RDBMS)* does just this,

systematically organizing information in terms of defined *entities*, their *attributes*, and the *relationships* amongst the different entities. Such a system would not only permit sharing of information in all directions, both vertically and horizontally; but also facilitate corroboration, analysis and interpretation.

With this in view the Centre for Ecological Sciences at the Indian Institute of Science has designed an RDBMS tailored for the PBR exercises called *PEBINFO*. The current version of PEBINFO employs Access 98/2000 as the database with Visual Basic 6 as the front-end. We are also developing a version employing free software, as well as a web-based version. Using PEBINFO calls for access to a PC with Pentium IV 2 GHz or above with other standard configuration; it would be an added advantage if a Multimedia Kit and a Modem are also available. PEBINFO will not only be available in English, but in all major Indian languages as well. PEBINFO is copyrighted by the Indian Institute of Science, but is being made fully available, including the source code, to all users as Free Software under the GNU General Public License. This License stipulates that any user is welcome to copy and distribute the software, and is welcome to further improve on the available versions, but is obliged to make the improved versions available to public as free software. As more and more people use PEBINFO, we hope that they will contribute newer features and enhance its quality and capabilities.

11.5 Entities, attributes and relationships

The entities recognized under PEBINFO will be characterized by certain attributes. Biological species is one such entity. Its attributes include scientific name, local names, and value to local people. Rock bee is one specific example of the entity, biological species. One of its attributes, scientific name, will be assigned a value defined globally, with a one-to-one relationship. Thus, there is only one scientific name, *Apis dorsata* for the rock bee. On the other hand, the attribute local names will be assigned values locally, with a one-to-many relationship. Thus the rock bee will be assigned the local name *agya mashi* in Velhe Panchayat in Maharashtra, *bhamvara* in Jabalpur Municipal Corporation in Madhya Pradesh and *hechjenu* in Mala Panchayat in Karnataka. Panchayats and languages are two other entities. Pin-codes of main post offices are attributes of Panchayats that are assigned a value defined globally, with a one-to-one relationship. Thus the pin code of village Mala in Karnataka has a globally defined value: 560123. Names are attributes of languages that are assigned a value defined globally, also with a one-to-one relationship. Thus Hindi, Kannada, Urdu, Tulu, Konkani are standard names of some of the languages in use in the state of Karnataka. In particular, in Mala

Panchayat in Karnataka, the languages spoken locally, take the values Kannada, Tulu and Konkani, thus exhibiting a one-to-many relationship. The values of language and scientific name will be accepted in the database as text, while that of pin code as a six-digit number. The attribute, *locally defined significance* of a species, is linked to particular localities. At any given locality this attribute is permitted to assume one of five globally defined values, namely, 1. *Of great value*, 2. *Of some Value*, 3. *Of no significance*, 4. *A nuisance*, and 5. *A great nuisance*. Thus, in Mala, the species rock bee is deemed to be: *Of great value*. Relationships amongst different entities are also defined as a part of the database design. Thus, local names are attributes of species that are linked to particular localities and languages. When local names are entered, the database will ensure that the locality and language are simultaneously specified. Such structuring facilitates corroboration, sharing and further analysis of the data.

To reiterate, PEBINFO brings in consistency in the way certain pieces of information are recorded to facilitate networking. For instance, the habitat types (or, Landscape/ Waterscape Element Types) may be assigned to one of the 25 categories that are explained below in the section on the "Landscape", and that are part of the master data of the PEBINFO Database Management System. Similarly, substrates of water-bodies may be assigned to one of the following 5 categories: 1. Bed rock, 2. Boulders, 3. Cobble, 4. Sand, 5. Mud. The trends in abundance of various species may be assigned to one of the following 5 categories: 1. Substantial increase, 2. Moderate increase, 3. Little / No change, 4. Moderate decrease, 5. Substantial decrease. The standardization in case of identity of biological species would involve equating a particular local name with an appropriate scientific name with the help of technical experts, and the database provides a list of scientific names of common Indian species for ready reference, and selection in case appropriate. In other contexts, such as recording the preferred regime of management of the population of a species like the weed *Parthenium*, or of a particular pond the information may be recorded as a free-flowing text. Even more free-flowing recording will be appropriate in contexts like local history, festivals, and songs associated with biodiversity. PEBINFO permits storing of such data in the form of images, audio and video clips as well.

11.6 Local and central coordinators

As mentioned above, PEBINFO specifies as master data 25 categories of habitat types (or, Landscape/ Waterscape Element Types). It also specifies as master data a number of sub-types under each habitat type. Thus, Landscape/ Waterscape

Element Types include: **No. 5. Forests**, with sub-types Evergreen, Disturbed Evergreen, Semi-evergreen, Disturbed Semi-evergreen and so on. These categories are, of course, not inscribed in stone and immutable for all times. A "Central Coordinating Group" would have the privilege of examining and changing these categories. However, no such central group would have adequate understanding of the sub-types of habitats relevant to any given locality in our diverse country. Thus, the evergreen forests of Western Ghats has a special, important and threatened formation called "*Myristica swamps*". A small patch of this formation occurred in our PBR study site of Mala village in Karnataka; it was appropriate to recognize this as a sub-type. Similarly, Landscape/ Waterscape Element Types include: **No. 7. Tree crops**. In the same study site of Mala mixed orchards of coconut and arecanut dominate the valley landscape, and it is appropriate to recognize this as a sub-type. Hence, while we suggest that, for the present at least, all local PBR exercises agree to the 25 habitat type categories of 14.2.1.1, they are free to create appropriate habitat sub-type categories to reflect the local context. The "Local Study Coordinator" in each PBR locality would have the authority to add habitat sub-types to the master list in case none of the existing sub-types seems appropriate. However, this means that essentially identical sub-types may be given slightly different names by two Local Study Coordinators. Thus, one coordinator may term the subtype coconut-arecanut orchard, while another may term it mixed coconut-arecanut orchard, and a third arecanut- coconut orchard, all referring to the same formation. It would be the responsibility of the Central Coordinating Group to examine the names of additional sub-types thus proposed by various Local Study Coordinators, decide on some appropriate name for a sub-type in case of duplications and add this name to the master list of standard sub-types. In a similar fashion, the master data specifies 17 "User Groups" to which people and institutions may be assigned in terms of their relationship to biodiversity resources. These can also be modified, but only by the Central Coordinating Group. The master data also specifies certain user group sub-types. These may be added to by Local Study Coordinators. Again, these additions will be incorporated in the master data only after scrutiny by the Central Coordinating Group.

There are three other categories of entities for which the master data is open to additions by Local Study Coordinators, namely, languages, human communities and scientific names of species.

11.7 Indian language applications

The PBRs will of course be in the local languages of the people. This implies the use of at least 15 official languages of states and 10 scripts, and more realistically, many more languages such as Gondi, Santhali, Kuki, Kinauri and so on. Ideally, all the publicly available data from any one locality should be accessible to a user in another locality employing a different language and script. This can in part be accomplished by giving centrally defined numeric IDs to data which is common at all locations e.g. ecological habitat or landscape element types, or locally assigned significance of species. Transliteration would serve the purpose in other contexts such as local names of species. In addition, some translation will be required wherever locally defined textual information is concerned. However, given that many Indian languages share much of their vocabulary, transliteration would facilitate a fair amount of understanding across languages. The current version of PEBINFO uses *Baraha*, a software that permits transliteration using Hindi, Marathi, Kannada, Tamil, Telugu and Malayalam scripts.

11.8 Data entry, queries, reports

Database software has now evolved to be very user-friendly, so that all users, including school students in rural areas would be able to enter data in PEBINFO, using simple data entry forms in the local languages. The users should also be able to summarize the data in many standard ways with the help of pre-defined queries and generate reports. With some additional effort they would be in a position to come up with queries on their own and produce reports in new forms. Indeed, we are confident that the PBR exercise will not only promote biodiversity literacy, but computer literacy as well.

11.9 Data validation

The remaining sections of this Manual use PEBINFO as the basis in discussing collection and handling of data. In PEBINFO all data elements would carry an indication of the persons responsible for providing and recording the data. The basic information on the location along with the composition of the Study Team responsible for the overall process would be specified in the initial table (Form 0). PEBINFO also provides for several levels of checking of the data. The agents scrutinizing the database may include:

- **Members of the local study team**

- **Other community members from the locality**
- **Members of other study teams from neighbouring localities**
- **Knowledgeable individuals from neighbouring localities**
- **Technical experts from various relevant disciplines**
- **Database managers working with State Biodiversity Boards or National Biodiversity Authority**

These fields pertaining to data providers and validators, are common to all data entry tables. Additionally, the field locality will be common for all data elements in a given locality. These are mentioned in the very first table in Annexure 1 listing the PEBINFO tables, and then dropped from all further tables to avoid repetition

11.10 Documentation process

This Manual focuses on the collection of the more structured information as a part of the PBR process. It is suggested that this may be accomplished most effectively on the basis of activities to be undertaken by educational institutions as contributions to the PBR process under the overall supervision of a Study Group established by the Biodiversity Management Committee. At the level of the educational institution the relevant activities would be undertaken by a team constituted as appropriate of students from 8th standard upwards, working under the guidance of one or more teachers, preferably with a science background. This team leader would serve as the "Local Study Coordinator". It is not essential, though, that the teachers have a science degree, as a whole range of social, administrative and other issues are also involved in compilation of the PBR, and non-science teachers too would find it of much interest. The teacher- student team should then try to induct a number of knowledgeable community members relating in many different ways to the living resources of the locality to work with them (see discussion below in Section 13 on "Peoplescape"). This composite study team should be exposed to the whole methodology as outlined in the manual through a series of appropriately designed training programmes. The capacity of the team also needs to be built up in terms of proper identification of living organisms and of elements of the landscape.

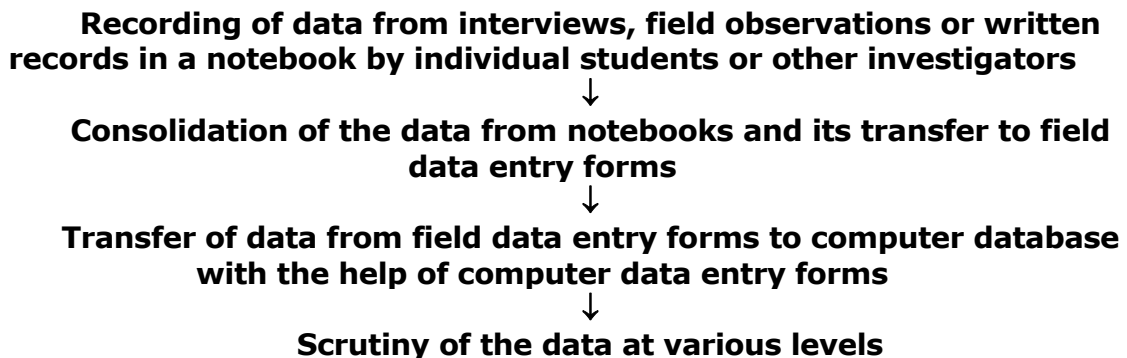
The study team would collect the information from the following sources:

- **Interviews of knowledgeable individuals, for instance, of changes in the availability of a medicinal plant species in the locality;**

- **Group interviews, for instance, as to who the gainers and losers are of a particular regime of management, such as, joint forest management of a forest patch;**
- **Field observations, for instance, of occurrence of a certain species of medicinal plant in a specific patch of forest, or the depth of water at a particular sampling location in a stream;**
- **Official documents, for instance, as to the amount realized by auctioning the rights to catch fish in a pond.**

In the first instance, the data may be recorded by hand, by the students, or others involved in the data collection process, as entries in a notebook. Several students may collect data in parallel on a given theme such as preparing a list of the life forms known to local community members. The many students who have done so may then work in a group to consolidate and transfer this data onto the appropriate field data entry form under the guidance of a teacher or some other coordinator. The next step would be to transfer this consolidated data from field data entry forms to the computer database with the help of the appropriate computer data entry form. The data thus entered in the database should then be scrutinized at several levels to ensure that it is complete and free of errors. Such scrutiny would be facilitated by printing out the data in the form of reports employing the tools provided in the database.

To summarize, the data generation and quality control process would involve:



11.10.1 An illustration

Consider, as an illustration, the process of collection and management of data relating to the diversity of cultivated plants and domesticated animals. The relevant table in the database, in this case, Form 13.2, would hold the data as a matrix of a number of rows, primarily corresponding to different crop varieties/ land races of domesticated animals, and a number of columns corresponding to various attributes of these varieties/ land races. Such a table with three illustrative rows is shown below as 11.10.2 Database table. This table is, of course, linked to other tables. Thus the second column in this table specifies the lca name of the species as "akki". Table 5.1 would specify that the scientific name of akki is *Oryza sativa* (paddy).

11.10.2 Database table: Domesticated biodiversity

Form 13.2: Domesticated biodiversity

(Group discussions)

Sr. No.	Local name of species	Local name of variety	Local name of other similar varieties	Time taken to reach maturity	Type of soil/cultivation/ animal husbandry practice most suitable for the variety	Size at maturity - specify measure and unit	Susceptibility to: Pests, Diseases, Low M-moisture stress, WL-Water logging	Yield – annual: Product, Measure, Unit	Value assigned by local community members	Part used	Uses, including symptoms treated in case of medicinal uses	Change in uses over the last ten years	Significant harvests; nature of material harvested	pin code of the destination of the harvests
1	Akki	Gandhasale	Jeersale	150 days	Sandy soil	Height: 5 ft	D-Low M-Low WL-Moderate	20 mura/acre	Great	Grain, straw	Good for Pulav	Substantial decrease	Grain, straw	Local
2	Akki	Dudri	Annapura	100 days	Sandy soil	4 ft	D-Low M-Low WL-Low	10 mura/acre	Great	Grain, straw	Good for Boiled rice	Substantial decrease	Grain, straw	Local
3	Akki	Atikarya	Not Known	120 days	Sandy soil	7 ft	D-Moderate M-Moderate WL-Moderate	20 mura/acre	Great	Grain, straw	Boiled rice & Medicinal property	Substantial decrease	Grain, straw	Local

Evidently, it is quite awkward to enter or view information in such a complex table. Instead, the data may be noted in simpler Field Data Entry Forms, such as shown below in 11.10.3. In this form, each variety/ land race would have its own separate page, with the columns in the database table converted into rows. Students, teachers, or others involved in data collection may use these field data entry forms as a checklist to note data during interviews or field work; then transfer the data onto the field data entry forms. The teachers or other team leaders may pool together the field data entry forms filled in by the different field workers and organize the computerization of the data. The computer data entry operators would also not have to work with the complex Database table (11.10.2), but would operate with user friendly computer data entry forms, that would be as convenient as the Field Data Entry Forms.

11.10.3 Field Data Entry Form: Domesticated biodiversity

a. Name of the data collector:		
b. Date of data collection:		
Source of information: Name of the knowledgeable individual/User groups(s):		
Local name of the cultivated plant/domesticated animal species		
Local name of variety:		
Local names of other similar varieties :		
Time taken to reach maturity :		
Type of soil/cultivation/ animal husbandry practice most suitable for the variety:		
Size at maturity - specify measure and unit:		
Susceptibility to:	Pests -	
	Diseases -	

	Low Moisture-	
	Water Logging-	
Yield – annual: Product, Measure, Unit :		
Values assigned by local community members:		
1. Of great value		
2. Of Some Value		
3. Nuisance		
4. A great nuisance		
Part used :		
Uses, including symptoms treated in case of medicinal uses :		
Change in uses over the last ten years :		
Significant harvests; nature of material harvested :		
Pin code of the destination of the harvests:		

12 Themes and methods

12.1 Activity flow

It is useful to organize data collection in a sequence that would facilitate a smooth flow of activities. Thus it is useful to map the ecological habitats and make a species list, before selecting particular habitat patches to record the abundance of different species of plants. We therefore propose collection of data in a series of 16 steps. These have been assigned to two levels of investigation: mid-level (M), or advanced (A). The extensive PBR preparation initiated by the Madhya Pradesh Biodiversity Board in 2005 follows the mid-level approach. The ongoing pilot studies through the Indian Institute of Science follow the advanced approach. The main difference is that the advanced approach calls for some field observations to complement the primarily interview based mid-level approach. The data being

collected in each step may be recorded systematically using one or more field data entry forms, and we indicate M = mid-level or A = advanced, against each form. Box 12.1.1 provides an overview of the proposed steps, sources of information, and the relevant forms.



Box: 12.1.1 Activities stream and proposed data entry forms



Form 7.1b: Background information - 2 {M}
Form 7.1c: Background information - 3 {M}
Form 7.1d: Background information - 4 {M}
Form 7.2: Historical and cultural information {M}



8. Documentation of issues that local community members would like to serve as the focus of the PBR exercise, and the associated taxa, functional species groups and landscape/ waterscape elements
(group discussions)

Form 8.1: Key concerns {M}



9. Documentation of status, dynamics, and management issues relating to various landscape/ waterscape element types/ sub-types considered as a whole
(group discussions)

Form 9.1a: Landscape status and dynamics {M}

Form 9.1b: Landscape management {M}

Form 9.2a: Waterscape status and dynamics {M}

Form 9.2b: Waterscape management {M}



10. Documentation of status, dynamics, and management issues relating to various focal landscape/ waterscape elements selected for further documentation
(field observations)

Form 10.1: Focal landscape elements field survey {A}

Form 10.2: Focal landscape elements vegetation cover {A}

Form 10.3: Focal waterscape elements field survey {A}

Form 10.4: Focal waterscape elements sampling studies {A}



11. Documentation of status, dynamics, and management issues relating to various focal landscape/ waterscape elements selected for further documentation
(group discussions)

Form 11.1a: Focal landscape elements history {M}

Form 11.1b: Focal landscape elements management {M}

Form 11.2a: Focal waterscape elements history {M}

Form 11.2b: Focal waterscape elements management {M}



12. Documentation of status of various focal taxa and species groups in focal landscape/ waterscape elements
(field observations)

Form 12.1: Focal taxa abundance field survey {A}



13. Documentation of status, dynamics, and management issues relating to various focal taxa and species groups selected for further documentation
(group discussions)

Form 13.1: Focal taxa status & trends in abundance {M}

Form 13.2: Domesticated biodiversity {M}

Form 13.3: Focal taxa status & trends in value/ uses {M}

Form 13.4a: Focal taxa status & trends in management {M}

Form 13.4b: Focal taxa management user group perspectives {M}



14. Documentation of people’s knowledge relating to various ecological habitats and focal taxa and species groups selected for further documentation
(group discussions)

Form 14.1: Folk knowledge of population ecology, life history and behaviour {A}
↓

15. Designing components of management plan
(group discussions, discussions involving the entire village/ ward assembly)
Form 15.1 Components of management plan {M}



Of course, these are only broad guidelines; the steps should not be thought of as a strict linear sequence, wherein one step must be completed before activity on any further steps can be initiated. Several of the activities can indeed proceed in parallel. Thus, one may list the known life forms side by side with preparing an inventory of the landscape element types and sub-types, and recording historical and cultural information about the study site, and so on. The total amount of effort put in can also be adjusted by deciding to focus on fewer or more species, fewer or more habitat patches, i.e. landscape/ waterscape elements, and so on.

12.2 Study methods

The PBR documentation would focus on the following elements:

- **People- natural resource links,**
- **Landscape/ waterscape of the study area,**
- **Local biodiversity elements,**
- **People’s knowledge associated with biodiversity,**
- **People’s perspectives on management issues,**

Culminating in the formulation of a:

- **Management plan to support the functioning of the local Biodiversity Management Committee.**

As noted in sec. 11.10, this documentation would be based on the following sources of information:

- **Interviews of knowledgeable individuals, for instance, of changes in the availability of a medicinal plant species in the locality;**
- **Group interviews, for instance, as to who are the gainers and losers of a particular regime of management, for example, joint forest management of a forest patch;**
- **Discussions involving the entire village/ ward assembly**
- **Field observations, for instance, of occurrence of a certain species of medicinal plant in a specific patch of forest, or the depth of water at a particular sampling location in a stream;**
- **Official documents, for instance, as to the amount realized by auctioning the rights to catch fish in a pond.**

12.2.1 People- natural resource links

India still remains a biomass based civilization and the quality of life of a significant fraction of our people directly depends on access to products and services of surrounding ecosystems, many of them grounded in biodiversity. These may be both positive and negative, goods and bads, services and disservices. A number of forms, therefore, record ecosystem goods and services, as also bads and disservices (forms 9.1a, 9.2a, 11.1a, 11.2a, 13.4a).

12.2.1.1 Ecosystem Goods and Services

What then are these goods, services, bads and disservices? Ecosystem goods and services may be visualized as "those goods and services which undergo relatively little change in the hands of people; in other words, conversion from the form in which it is provided by nature to the form in which it can be used by people involves relatively little capital investment." Ecosystem goods and services could be available as a result of human modifications of ecosystems, such as agriculture or plantations with chemical pesticides as an input, or could be more direct gifts of nature such as wild fruit or fishes. It may require significant and arduous human effort to access certain ecosystem goods such as wild honey or toddy but the form in which they are tapped from nature would usually be directly of use to humans without the need of any capital-intensive transformation. We may also include in

this category simple products that are results of local value-addition not involving any major external input, such as baskets and brooms, since these products involve strong links of local people with their ecosystem. Ecosystems bads and disservices are the converse of these, results of natural processes that are undesirable from the perspectives of some human groups.

We may illustrate these definitions with some concrete examples of ecosystem versus industrial goods/ bads and services/disservices:

	Ecosystem	Industrial
Goods	Locally available medicinal herb (Relatively little transformation, no well-defined market, labour-intensive collection process)	Commercially produced drug capsule (High degree of transformation, well-defined market, capital-intensive production process)

	Ecosystem	Industrial
Bads	Pests, disease vectors, pathogens	Persistent organic pollutants such as DDT
Disservices	Landslides, floods, tsunamis	Destruction of atmospheric ozone layer as a result of emission of CFCs from refrigeration processes

Goods/ bads and services/ disservices are defined with respect to their use-values to an individual, a group of individuals or a community. In almost every case, many of the ecosystem goods and services of an area are used by people living outside. They may access these through the market (e.g. a marketed NTFP such as *Garcinia* fruit), by virtue of locational advantages (e.g. watershed benefits in downstream areas) or by physically accessing the ecosystem (e.g. collecting firewood or enjoying scenic beauties). There would also be certain ecosystem goods and services, which yield benefits to a much larger community (beyond those with access through the above means). Forests, for example, provide benefits through fixing carbon to the global community at large with impacts potentially reaching a small island nation or a low lying delta facing threats of submergence thousands of miles away. These benefits will typically have no significance for the local people. We provide below an indicative list of ecosystem goods/bads and services/ disservices, as perceived by various groups of local people of Mala cluster study site.

12.2.1.2 Table. Examples of ecosystem goods as reported by people of Mala

Ecosystem goods	Use	Locally used	Mark-eted
Oryza sativa (Paddy)	Food	*	
Bamboo shoots	Food	*	
Crop waste	Fuel	*	
Screw pine	Mat-making	*	
Cane	Basket-making	*	
Amla	Pickles		*
Harada	Tanning	*	
Sikekai	Detergent	*	*
Betel nut (stem)	Irrigation pipe	*	
Casuarina equisetifolia	Timber		*
Teak	Timber		*
Ratsnake	Pest control	*	
Lizard	Control of insects	*	
Red ant	Pollination	*	
Honey bee	Honey	*	
Water	Irrigation, domestic uses, fishing	*	
Grass	Grazing	*	
Medicinal herbs	Medicine	*	*
Milk and milk products	Nutrition	*	

Locally value-added ecosystem goods include mats, baskets, large serving spoons made of coconut shells, rain-covers made of *Vateria indica*, milk products and betelnut leaf sheath plates.

12.2.1.3 Table: Ecosystem bads :

Ecosystem bads	Detriment
Wild boar	Nuisance species
Rat	Nuisance species
Porcupine	Nuisance species
Bonnet Macaque	Nuisance species
Ticks	Nuisance species
Leeches	Nuisance species
Mites	Crop pest
Caterpillar	Crop pest
Stem Borer	Crop pest
Terminal leaf eater	Crop pest
Tree borer	Crop pest
Peafowl	Crop pest

12.2.1.4 Table: Ecosystem services

- ❖ Evergreen forests are origin of streams
- ❖ Evergreen forests are repository of honeybees

- ❖ Evergreen forests are aesthetically and often, culturally important (for example, when certain spots are associated with sacred beliefs).
- ❖ Grasslands provide for grazing of livestock
- ❖ Flowering of rubber plantations increases availability of honey
- ❖ Plantations check soil erosion due to contour formations
- ❖ Water streams provide water for irrigation and domestic uses

12.2.1.5 Table: Ecosystem disservices

- ❖ Evergreen forests are repository of nuisance species, pests and vectors
- ❖ Contaminated water streams lead to health problems

To these lists based on discussions with local people may be added other goods/services, bads/disservices visualized from other, outside perspectives. Examples of these include (a) locally possibly relevant issues not visualized by any local people such as pollination as a service, or (b) more globally relevant issues like carbon sequestration by vegetation and maintenance of biodiversity.

Recording of the status and trends in goods and services, as well as bads and disservices through field observations, and through interviews would be an important component of PBR activities. Additionally, since one man's food can be another man's poison, it would be important to record who benefits and who loses from the various goods and services, and bads and disservices. Thus, wild pigs may be a bad for members of the user group whose livelihood depends crucially on cultivation, but for the user group comprising landless labourers, the pigs may represent a valued food resource.

12.2.1.6 Human activities

Humans are the most significant agents affecting the natural resource base and recording their on-going activities, as well as changes over the recent past would be a part of the documentation process (forms 10.1, 10.3). This documentation would have to be based on interviews, in particular in the context of trends over time, and supplemented by such field observations as are possible. The activities may be classified into three categories:

- **Harvests, removals: For example, of plant material, such as of fuelwood, or, grass through grazing by cattle, of stones through quarrying, or, of water by pumping from rivers for irrigation.**
- **Additions: For example, application of leaf manure or chemical fertilizers to orchards, or of sewage from towns to river waters.**
- **Modifications: For example, leveling of a hill slope by bulldozing, or damming of a stream by bunds.**

12.2.2 Landscape and biodiversity

12.2.2.1 Physical and biological parameters

In the context of landscape and biodiversity elements, the field observations as well as interviews would deal with a number of topics. These would include a whole set of (a) physical parameters such as extent of area, topography, nature of bottom substrate and depth of water in water-bodies, or distance from habitation, and (b) biological parameters such as occurrence of particular species, level of abundance of a particular functional species group such as fodder species or identity of neighbouring landscape/ waterscape element types. The data on current status would be largely based on actual field observations (forms 10.1, 10.2, 10.3, 10.4, 12.1). However, the data on trends would have to be based on interviews of knowledgeable individuals in the absence any earlier records (forms 9.1a, 9.2a, 11.1a, 11.2a, 13.1a). People tend have a very good recollection of changes that have occurred over the last ten years. So trends would be recorded over this time-scale. Since this is subjective recall, it would be appropriate to interview at least a few persons, either individually, or, in a group, to arrive at a broad consensus. The investigator recording data should satisfy herself/ himself that the information appears reliable before recording it.

12.2.2.2 Selection of sample points: on land

Field observations of particular ecological habitats, or, elements of the landscape /waterscape selected for more detailed study, would require identification of certain sampling points (forms 10.2, 10.4). It is important that these be selected at random, without any bias. For instance, the extent of plant cover on any land habitat is an important attribute of that patch. The points at which the plant cover is sampled should therefore be selected in an unbiased fashion. Thus, in a patch with little tree cover, one should not deliberately select a clump of trees as a sampling point. While we need to avoid any such bias, the procedure also needs to be simple enough to be implemented by teachers, students and other volunteers. We, therefore suggest a procedure that does not call for any equipment or accessories such as tables of random numbers. Figures 12.2.2.3, 12.2.2.5, and 12.2.2.6 provide illustrations of the use of these procedures in case of a land habitat, a pond/ lake or a river/stream, respectively.

In case of a land habitat, the procedure would involve the following steps:

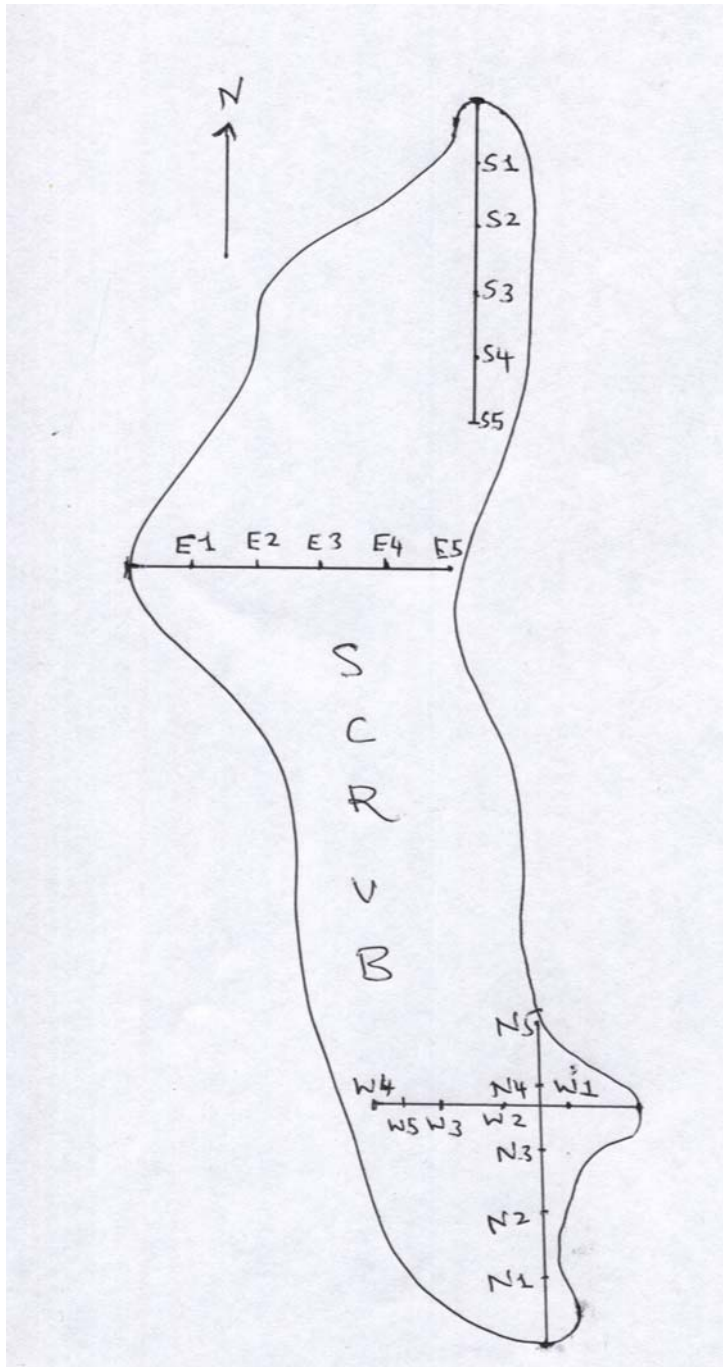
- ❖ Locate the northern-most point of the element. Using a compass, start pacing due south in a straight line, use the points at 20, 40, 60, 80 and 100 paces as

sampling points. If one comes out of the patch before completing the 5 sampling points, use as many as available. These points are labeled S1, S2, S3, S4, and S5 in figure 12.2.2.3.

- ❖ Locate the eastern-most point of the element. Using a compass, start pacing due west in a straight line, use the points at 20, 40, 60, 80 and 100 paces as sampling points. If one comes out of the patch before completing the 5 sampling points, use as many as available. These points are labeled W1, W2, W3, W4, and W5 in figure 12.2.2.3.
- ❖ Locate the southern-most point of the element. Using a compass, start pacing due north in a straight line, use the points at 20, 40, 60, 80 and 100 paces as sampling points. If one comes out of the patch before completing the 5 sampling points, use as many as available. These points are labeled N1, N2, N3, N4, and N5 in figure 12.2.2.3.
- ❖ Locate the western-most point of the element. Using a compass, start pacing due east in a straight line, use the points at 20, 40, 60, 80 and 100 paces as sampling points. If one comes out of the patch before completing the 5 sampling points, use as many as available. These points are labeled E1, E2, E3, E4, and E5 in figure 12.2.2.3.

If this exercise does not yield 20 sample points, use the midpoints between available sampling points as additional sample points. Thus, if the exercise has provided 19 sample points then use an additional point at 90 paces walking due west in a straight line from the eastern-most point of the landscape element being sampled.

In the process of locating these sampling points the walk may take one straight into a thick clump of thorny bushes, or if studying an area of human habitation, inside a building. In these cases, one may estimate where the sampling points are, without actually trying to reach them. The primary purpose of this procedure is to ensure that the 20 sampling points are selected in an unbiased fashion. So the procedure need not be followed rigidly. In case of a very large patch, for instance, it may not be easy to reach all four extremes. Some parts of the patch may be inaccessible. In such cases, one may make some small changes in the procedure.



12.2.2.3 A diagrammatic representation of sampling procedure in a habitat patch on land, in this case, a patch of scrub.

The sampling points have been selected to assess the level of plant cover. Therefore, at each sampling point, note whether that point is under a tree canopy, covered by a shrub, with herbaceous vegetation, on barren land, on paved land, or inside a building (Form 10.2). As mentioned below, this field sampling may be

combined with observations on the abundance of focal species, varieties, or species groups in the elements under survey.

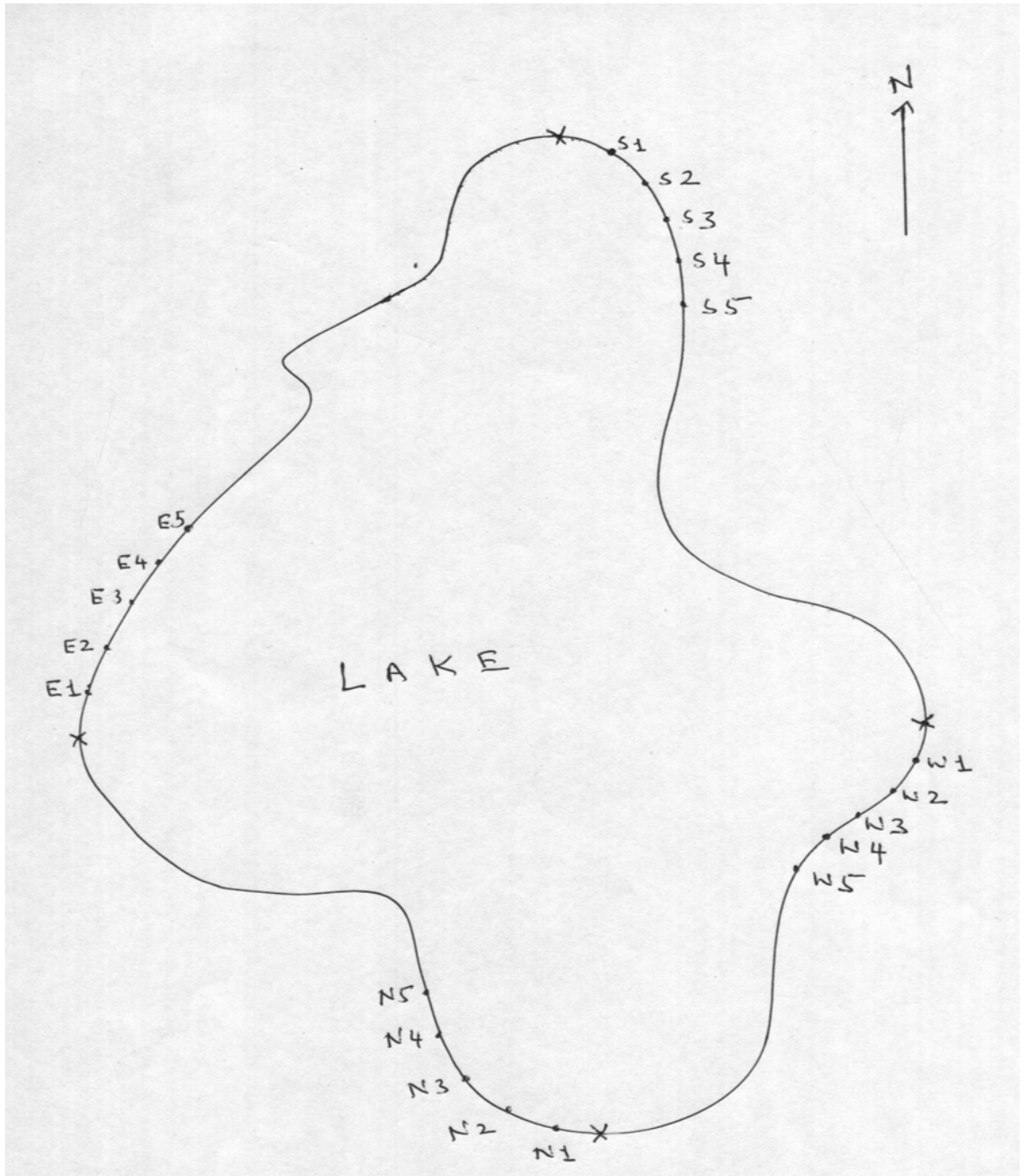
12.2.2.4 Selection of sample points: water-bodies

Sampling is a little more complex affair in case of water bodies. An important issue is the time of sampling. Ideally, one may sample twice a year; once when the availability of the water is at its peak, and the second, when it is at its lowest.

In the case of a lake or a pond, one may follow a procedure analogous to that suggested for land habitats (Figure 12.2.2.5). Thus:

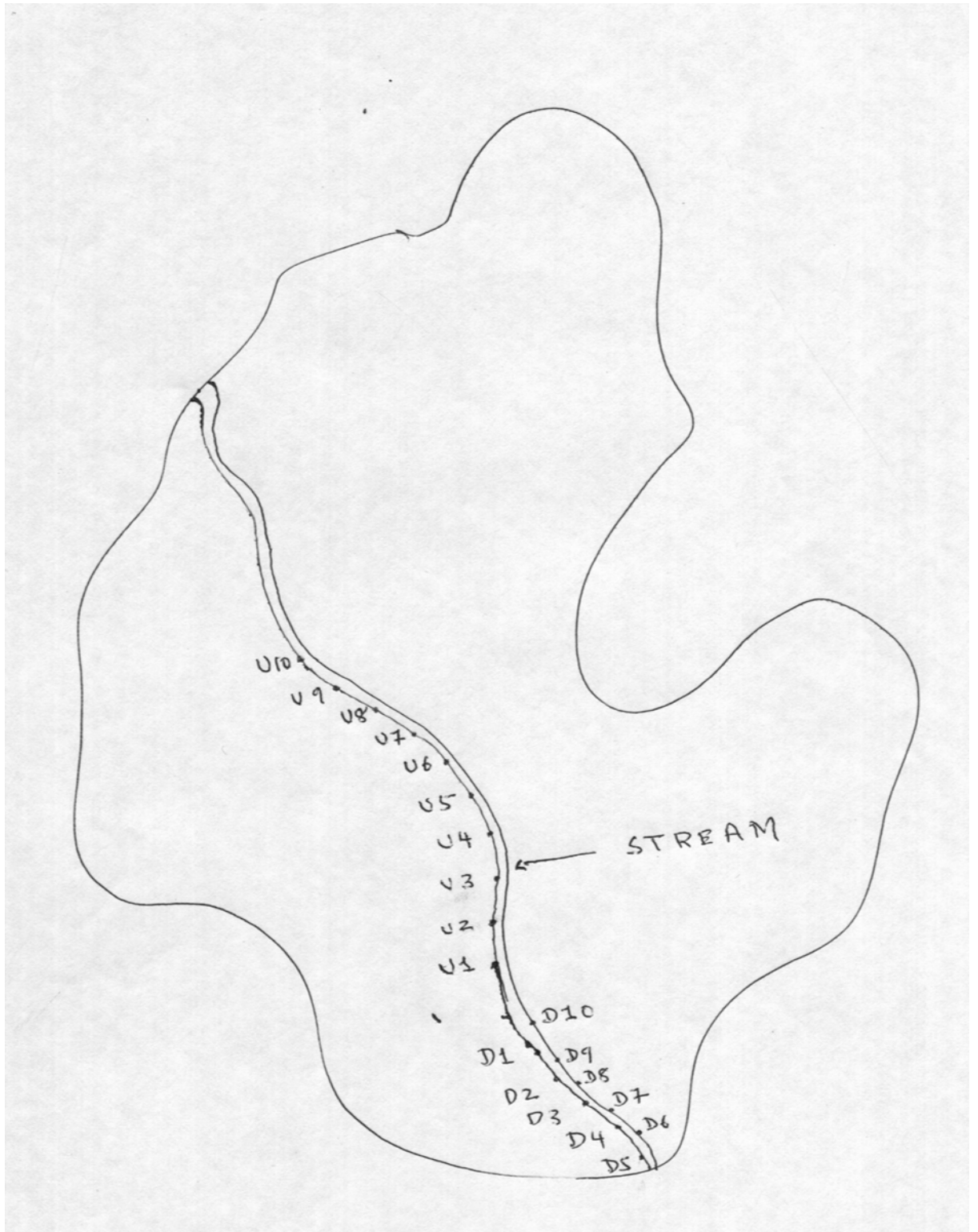
- ❖ Locate the northern-most point of the water-body. Walk along the edge of the water-body towards the south in an easterly direction, using the points at 20, 40, 60, 80 and 100 paces as sampling points. These points are labeled S1, S2, S3, S4, and S5 in figure 12.2.2.5.
- ❖ Locate the eastern-most point of the water-body, unless one has already overshot this point while selecting the earlier sampling points. In that case, use the last sampling point reached as the starting point. Walk along the edge of the water-body towards the west in a southerly direction, using the points at 20, 40, 60, 80 and 100 paces as sampling points. These points are labeled W1, W2, W3, W4, and W5 in figure 12.2.2.5.
- ❖ Locate the southern-most point of the element, unless one has already overshot this point while selecting the earlier sampling points. In that case, use the last sampling point reached as the starting point. Walk along the edge of the water-body towards the north in a westerly direction, using the points at 20, 40, 60, 80 and 100 paces as sampling points. These points are labeled N1, N2, N3, N4, and N5 in figure 12.2.2.5.
- ❖ Locate the western-most point of the element, unless one has already overshot this point while selecting the earlier sampling points. In that case, use the last sampling point reached as the starting point. Walk along the edge of the water-body towards the east in a northerly direction, using the points at 20, 40, 60, 80 and 100 paces as sampling points. These points are labeled E1, E2, E3, E4, and E5 in figure 12.2.2.5.

This procedure requires that the circumference of the water body should be at least 400 paces to yield 20 sampling points. If the water body is smaller than this, then midpoints between available sampling points may be used as additional sample points. Where practicable, one might use a row boat/ sail boat/ motor boat with the help of local fishermen, and imaginatively work out a sampling scheme.



12.2.2.5 A diagrammatic representation of sampling procedure in case of a lake

In case of a linear water-element such as a stream or a river, or sea coast, one may initiate sampling at a point where the stream, or the beach, is at its widest within the limits of the sampling locality (Fig.12.2.2.6). One may then walk along the edge of the water in either direction, using points at 20, 40, 60, 80, 100, 120, 140, 160, 180 and 200 paces as the sampling points. These have been labeled as U1, U2, U3, U4, U5, U6, U7, U8, U9, and U10 while moving upstream, and D1, D2, D3, D4, D5, D6, D7, D8, D9, and D10, while moving downstream. If this exercise does not yield 20 sample points, one may use the midpoints between available sampling points as additional sample points. This has been indicated in form of D6, D7, D8, D9, and D10 being situated as midpoints in Fig. 12.2.2.6.



12.2.2.6 A diagrammatic representation of sampling procedure in case of a river

Where practicable, on lakes, rivers or sea, one might use a row boat/ sail boat/ motor boat with the help of local fishermen, and imaginatively work out a sampling scheme.

12.2.3 Management

Preparation of a well-informed management plan with a broad support of all segments of the community to promote conservation, sustainable use and equitable sharing of benefits flowing from biodiversity is an important objective of the PBR exercise. Collection of pertinent information on management of habitats as well as species is therefore a significant element of the investigation. This information would be collected partly through field observations, but largely based on interviews. Since different segments of the population may have different perspectives on management issues, it would be appropriate to get their inputs through group discussions involving members of one user group at a time. Since these are matters of judgment, the investigator must be satisfied that there is a consensus within the group. Moreover, the investigator must ensure that she/he remains neutral and faithfully records the perceptions of the people being interviewed, rather than introduce her/his own biases.

Information on management would relate to (a) current management, as well as (b) experiences of management in recent past. Thus, a forest patch may have been managed earlier as a reserved forest, and may now be being managed under joint forest management regime. It would be useful to record the experiences of both the regimes. This should be followed by documentation of what members of any particular group want to see happen in future, and what changes they would like to see happen. They may then be requested to elaborate their own vision of a desirable management system. A number of different elements would be involved in this vision. These may relate to (a) rights of access to land, waters or biological resources, (b) roles of different governmental agencies, private industry, landowners or community institutions, (c) local versus outside actors, (d) technologies employed, and (e) access to capital or markets, and so on. It would be worthwhile to encourage the community members to give full scope to their imagination and come up with a variety of innovative solutions. But finally, it is important to examine ground realities, and the community members may be asked to shift from what they would ideally like to see happen to suggesting elements of a management plan that can be implemented under present circumstances and for

which a consensus of the gram sabha seems feasible. Different user groups may come up with a range of such plans. They may then be put before the gram sabha as reflections of the many different perspectives of the different user groups, local and external, to arrive at its own set of recommendations. Hopefully, there would be more and more space in the coming years for such a people-oriented mode of planning to play a significant role in the management of India's rich heritage of biological diversity.

12.2.4 Knowledge

The rules gazetted under the Biological Diversity Act state that PBR shall contain comprehensive information on availability and knowledge of local biological resources, their medicinal or any other use or any other traditional knowledge associated with them. This knowledge would be documented essentially on the basis of interviews, especially of knowledgeable individuals. At this stage, we do not have in place a proper framework for managing information that people might wish to keep confidential. So the documentation may, for the present, be limited to those aspects of knowledge that people are happy to share widely. This may include much of their practical ecological knowledge, but only a part of their knowledge of medicinal and other uses.

13 Peoplescape

13.1 User groups

The PBR process may ideally begin with the local Biodiversity Management Committee establishing a Study Group to organize the preparation of the PBR. This Study Group may initiate the work by bringing together community members and teachers and students to explore possible uses of information generated through a PBR exercise (appendix 1). In practice, this initiating group is likely to be relatively small, often dominated by the wealthier, more educated men. This would tend to exclude community members who are more closely tied to and more knowledgeable about biodiversity. This is because members from poorer households, often women, are perforce more dependent on activities such as basket-weaving, sale of fuel-wood, or fishing. Yet, it is very important that the PBR exercises bring on board people linked in many different ways to the resources of their environment.

To help create a broad-based team, the community members may be assigned to a number of User Groups. Each User Group may be viewed as comprising people with a similar relationship to their ecological resource base, differing, in some significant manner from that of members assigned to other user groups. Table 13.1.1 provides a framework for discriminating the various user groups living in a locality, as well as impinging on it from outside. Thus in village Masur-Lukkeri situated on an island in the estuary of Aghanashini river in Uttara Kannada district of Karnataka we may visualize four user groups:

[a] The first user group includes people who own no farm land with men primarily engaged in fishing, and women in sale of these fish and collection and sale of shellfish. These may be assigned to one of the following three standard categories: Freshwater fisher –Shellfish, Freshwater fisher –Shallow, or Freshwater fisher –Boatman. The exact assignment would depend on the relative contribution of these three ways of earning livelihoods, in this case, we assign them to: Freshwater fisher –Boatman.

[b] The second user group includes people who own a limited amount of hill slope land where they cultivate upland paddy, the women engage extensively in collection of shellfish and weaving mats, and both men and women engage in casual labour. These may be assigned to one of the following four standard categories: Freshwater fisher –Shellfish, Owner cultivator –Wetland, Bio-artisan and Unorganized worker –Indifferent. Based on dominant mode of earning livelihood, we assign them to: Unorganized worker –Indifferent.

[c] The third user group includes people who own estuarine farmland where they raise brackish water paddy or culture shrimp, the women weave mats and men engage in casual labour and work as masons. These may be assigned to one of the following four standard categories: Owner cultivator –Wetland, Fish farmer- Low input, Bio-artisan and Unorganized worker –Indifferent. Based on dominant mode of earning livelihood, we assign them to: Fish farmer- Low input.

[d] The fourth user group includes people who own bigger chunks of plain land where they grow coconut, arecanut and pepper. They may be easily assigned to: Owner cultivator –Orchards.

Members of different user groups may exhibit overlaps in their activities; thus women from groups [a] and [b] collect shellfish, and those from groups [b] and [c] weave mats. Members of any one group may also be linked to a variety of living resources. Thus members of group [b] are not only engaged in cultivation, shellfish

collection and mat weaving but also in collection of fuel wood and leaf mulch, occasional hunting of hare and wild pigs and a variety of other activities. Besides the women in a group may differ substantially from men in their relationship to natural resources. Nevertheless, the user groups have been so delineated that variation across groups is much greater than within groups. As a result, the concept of user groups represents a constructive way of assigning people to different categories to ensure that people with varying relationship to natural resources are represented in the PBR exercise. While there is some correspondence between ethnic communities and user groups, our concern is with the relationship of people with natural resources and not caste or other ethnic composition. Of course, it would be highly desirable to involve both men and women from each group in the PBR activities.

The area within the jurisdiction of the Panchayat (or Municipality) is, of course, not immune to outside influences. A factory or town upstream may be profoundly impacting the water and fish resources of a river passing through the locality (Adverse enterprise -Private). Similarly people from neighbouring villages may be drawing on its resources for fuel wood or fodder (Gatherer -fuelwood, Herder - Settled). Or nomadic herders may annually visit the area and penning their sheep in agricultural fields supply valuable manure (Herder -Nomadic). The activities and interests of all these concerned external parties must be taken into account in planning for prudent management of living resources within the jurisdiction of any local body. An important task of the study team should therefore be to delineate such *external user groups*. These too may be named using the framework of Table 13.1.1 as indicated in brackets above.

In an urban setting the way people relate to ecosystem resources may be substantially different. Thus in the city of Pune in Maharashtra, a small proportion of the people, for example, tribal Katkaris are still largely dependent on fishing and hunting of birds around the river courses for their livelihood (Gatherer-game, Freshwater fisher-shallow). Similarly, nomadic shepherds visit hills of Pune during monsoon months and graze their sheep and goats there for several weeks (Herder-nomadic). A somewhat larger number of poorer people depend on roadside and garden trees for their fuel energy (Gatherer-fuelwood). Others depend on shade of avenue trees to carry out businesses like cycle repairs. These may have a stake in the conservation of the avenue trees (Unorganized worker -Conservator). Another group depends on trading biodiversity resources such as fish or timber brought from outside (Biotrader -Organized, Biotrade worker -Small scale, Biotrade worker - Organized, Bioservice provider -Small scale). Yet others are involved in processing

of biodiversity resources such as medicinal plants (Bioprocessor –Industry, Bioprocessing worker -Industry). But a large fraction of urban population is not directly connected with biodiversity resources in terms of their livelihoods, earning their incomes from other trade, manufacture or service related activities (Organized worker –indifferent). A fraction of these people relates to biodiversity resources of hills of the city through recreational activities. They may significantly influence management of ecosystem resources, for instance, by lobbying to prohibit house construction on the hills (Organized worker -Conservator).

As was mentioned above, the standard categories of user sub-groups provided as master data in the database are necessarily limited, and local study coordinators may create additional user sub-group categories as appropriate.

13.1.1 Standard categories of User Groups and Sub-groups defined on basis of most significant source of livelihood in case of households, or revenue in case of institutions. Additional categories of User Sub-groups may be added as appropriate in any locality.

<i>Code #</i>	<i>Short title of user group</i>	<i>Most significant source of livelihood or revenue</i>	<i>Code #</i>	<i>Concatenated short title of user sub-groups</i>	<i>Most significant source of livelihood or revenue</i>	<i>Example of institution</i>
1	Gatherer	Gathering of naturally produced land-based living resources	1.1	Gatherer -fuelwood	Collection of fuel-wood	
			1.2	Gatherer -MFP	Collection of minor forest produce	
			1.3	Gatherer - medicinals	Collection of medicinal herbs	
			1.4	Gatherer -Game	Hunting of small birds and mammals like partridges and hare or snakes	
2	Freshwater fisher	Gathering of naturally produced freshwater living resources	2.1	Freshwater fisher - Shellfish	Collection of shellfish like mussels and snails	
			2.2	Freshwater fisher - Shallow	Fishing in shallow waters without a boat	
			2.3	Freshwater fisher - Boatman	Fishing in deeper waters using a boat	

3	Sea fisher	Gathering of naturally produced marine/ estuarine living resources	3.1	Sea fisher - Shellfish	Collection of shellfish like mussels and snails	
			3.2	Sea fisher -Country craft	Fishing in sea using country craft	
			3.3	Sea fisher -Motor boat	Owner of mechanized fishing craft/s	Trawling company
			3.4	Sea fisher -Worker	Working on mechanized fishing craft as employee	
4	Owner cultivator	Agricultural/ horticultural production as owner	4.1	Owner cultivator - Kumri	Shifting cultivation	
			4.2	Owner cultivator - Dryland	Settled cultivation of rain-fed crops	
			4.3	Owner cultivator - Wetland	Settled cultivation of irrigated field crops	
			4.4	Owner cultivator - Plantations	Raising plantations like tea, coffee, rubber	Tata Tea
			4.5	Owner cultivator - Orchards	Raising orchards like coconut, apple, mango	
			4.6	Owner cultivator - Woodlots	Raising wood plantations like <i>Casuarina</i>	
5	Herder/ fish farmer	Livestock/ aquaculture production as owner	5.1	Herder -Settled	Low input production based in one locality, e.g. goat rearing	
			5.2	Herder -Nomadic	Low input production based on nomadic movements, e.g. sheep rearing	
			5.3	Herder - Commercial	High input production like commercial poultry farms or dairies	Venkateshw hatcheries
			5.4	Fish farmer-Low input	Low input aquaculture, e.g. carps	
			5.5	Fish farmer-Intensive	High input aquaculture, e.g. shrimp	
6	Farm labour	Agricultural/ horticultural production as an employee	6.1	Farm labour - Dryland	Employed in cultivation of rain-fed crops	

			6.2	Farm labour - Wetland	Employed in cultivation of irrigated field crops	
			6.3	Farm labour - Plantations	Employed in plantations like tea, coffee, rubber	
			6.4	Farm labour - Orchards	Employed in orchards like coconut, apple, mango	
7	Herd/pond labour	Livestock/ aquaculture production as an employee	7.1	Herd labour - Nomadic	Employed in nomadic livestock production	
			7.2	Herd labour - Settled	Employed in settled livestock production	
			7.3	Pond labour	Employed in aquaculture	
8	Bioprocessor	Living resource based processing/manufacture as owner	8.1	Bioprocessor - Cottage	Processing/ manufacture in cottage industries sector, e.g. tapping toddy, or making leaf cups or pickles or khowa at home	
			8.2	Bioprocessor - Industry	Processing/ manufacture in industrial sector, pharmaceutical industry	Pravarana Co-operative Sugar Factory
9	Bioprocessing worker	Living resource based processing/manufacture as an employee	9.1	Bioprocessing worker -Cottage	Employed in cottage industries sector, e.g. rolling beedies	
			9.2	Bioprocessing worker -Industry	Employed in industrial sector, e.g. saw mill or an oil mill	
10	Biotrader	Living resource based trade as owner	10.1	Biotrader -Small scale	Trade in unorganized sector, e.g. retail sale of fish or vegetables	
			10.2	Biotrader - Organized	Trade in organized sector, e.g. wholesale trade in food grains or wooden furniture	ITC agro-business division

11	Biotrade worker	Living resource based trade as an employee	11.1	Biotrade worker - Small scale	Employed in trade in unorganized sector, e.g. as a coolie in retail fish market	
			11.2	Biotrade worker - Organized	Employed in trade in organized sector, e.g. sale of Ayurvedic medicines manufactured by companies like Dabur	
12	Bioservice provider	Living resource based services as owner	12.1	Bioservice provider -Small scale	Engaged in services in unorganized sector, e.g. as a village vaid or dispenser of herbal medicines, or a priest of a sacred grove, or a snake-charmer	
			12.2	Bioservice provider -Organized	Engaged in services in organized sector, e.g. as an owner of an ecotourism company	Jungle Lodg
13	Bioservice worker	Living resource based services as an employee	13.1	Bioservice worker - Small scale	Employed in services in unorganized sector, e.g. as an apprentice to a village vaid or dispenser of herbal medicines	
			13.2	Bioservice worker - Organized	Employed in services in organized sector, e.g. as an ecotourism guide in a hotel or as a gardener in a municipal park	
14	Bio-artisan	Living resource based crafts		Bio-artisan	Engaged in crafts like weaving baskets or mats	

15	Bioresource manager	Government employee engaged in controlling/ managing living resources	15.1	Bioresource manager - Regulation	Engaged in regulatory activities, e.g. as employees of Forest Department	Forest Development Corporation
			15.2	Bioresource manager - Extension	Engaged in extension activities, e.g. as employees of Agriculture Department	
16	Unorganized worker	Non-living resource based livelihoods in unorganized sector	16.1	Unorganized worker - Conservator	Engaged in living resource conservation activities, e.g. as a Bishnoi protecting Khejadi trees or blackbuck	
			16.2	Unorganized worker -Indifferent	Without any involvement in living resource conservation activities	
17	Organized worker	Non-living resource based livelihoods in organized sector	17.1	Organized worker - Conservator	Engaged in living resource conservation activities, e.g. lobbying for conservation of a city lake or opposing building activities on a city hill	Bombay Nat History Soci
			17.2	Organized worker - Indifferent	Without any involvement in living resource conservation activities	
			17.3	Organized worker-tourist	Visiting as a tourist	
18	Adverse enterprise	Institutions whose side effects impact living resources negatively	18.1	Adverse enterprise -State	Gouvernement	State enterprises such as hydroelectric projects or cities discharging untreated sewage into lakes
			18.2	Adverse enterprise -Private	Private	Private enterprises such as quarries or industries generating chemical effluents

13.2 Data collection

13.2.1 Inventory of activities

The user groups are defined in terms of the activities that link people and institutions to the natural resources of the study locality. Our concern is both with local people, such as farmers, and local institutions, such as a quarry or cashew processing factory, and outside people, such as villagers from neighbourhood grazing their cattle in the study area and outside institutions such as a distant paper mill that harvests bamboo from the study locality. The data collection may therefore appropriately begin with an inventory of activities of various members of the local community and of local institutions, with an emphasis on those that relate to the ecosystems goods (e.g. fuel-wood) and services (e.g. scenic natural spots) as also bads (e.g. weeds) and disservices (e.g. crop raiding by wild life), to be followed by a similar inventory of the activities of outside agents impinging on the study locality. However, we should also include broad categories of other activities, not directly linked to biodiversity, yet significant to the livelihoods of the various individuals and functioning of the various institutions.

For convenience, these activities may be classified under the following 14 categories:

- 1 Gathering of forest/shellfish produce**
- 2 Fishing / Hunting**
- 3 Agriculture**
- 4 Animal husbandry**
- 5 Labour in unorganized sector**
- 6 Craft in unorganized sector**
- 7 Service in unorganized sector**
- 8 Trade in unorganized sector**
- 9 Employment in organized sector**
- 10 Service in organized sector**

11 Manufacture in organized sector

12 Trade in organized sector

13 Seeking recreation / religious experience

14 Effluent generation.

Forms 1.1 and 1.2 in Annexure A provide an illustrative list of such activities for two of the study sites. Alongside the activities we also note if the activity is considered significant. This significance is to be attached, not from the perspective of a third party, such as teachers, but from the perspective of those engaging in that activity. For example, collection of mollusks from streams may be significant as an important protein source to landless labourers who engage in it, but not to others. Of course, this is a subjective judgment for the landless labourers as well. Nevertheless, the list should be prepared, to the extent possible, with their involvement. The overall list may be very exhaustive. The sub-set of significant activities from such a list would be relevant in two contexts: [a] delineation of user groups, [b] understanding of dynamics and management of ecological habitats.

13.2.2 Delineation of user groups

Our major interest lies in identifying a manageable number of local user groups/ sub-groups, up to 10 or at most 15 per locality, and a similar number of external user groups/ sub-groups, that represent varied ways in which people (and institutions) relate to the ecological resources. These would be named within the framework of Table 13.1.1, creating additional sub-groups as appropriate for the locality. Assignment of people to user groups/ sub-groups in this fashion would permit the constitution of a broad based team of people to provide inputs to the PBR process. Identification of such a set of user groups/ sub-groups, will be a matter of subjective judgment arrived at through broad based group discussions. We may then characterize the different internal and external user groups/ sub-groups on the basis of their involvement in clusters of activities with high levels of association with each other. Table 17.2.2.1 below provides an example for four user groups of Mala village.

13.2.2.1 User groups & associated activities

User group	Owner cultivator - Orchards	Farm labour -Orchards	Owner cultivator - Wetland
Associated activities	Rubber cultivation, Gardening,	Maintenance of chicken, Fishing, Service in unorganized sector, Sale of minor forest produce, Mining sand,	Priesthood, Collection of medicinal plants, Crop cultivation, Sale of medicinal plants

Forms 2.1 and 2.2 in the Annexure give examples of local, as well as external user groups identified for some of the study sites. These Forms refer to: (a) User Group Name: assigned on the basis of the most significant source of livelihood/ revenue of the group, (b) Associated Significant Activities: A list of the significant activities of the members of the concerned user group, (c) Approximate number of individuals involved including dependents, in case of households, or employees, in case of institutions, (d) Languages spoken by members of the concerned user group.

Since external as well as local user groups may act through intermediaries, Form 2.3 attempts to dissect their influence at three levels. Thus villagers from neighbouring localities grazing their own cattle are agents acting for themselves; as is a Paper Mill causing water pollution. In such a case, it is not necessary to enter information pertaining to them in Form 2.3. On the other hand labourers harvesting bamboo may be tertiary agents working for a primary agent, a paper mill, with a contractor engaged by the mill serving as the secondary agent, and these relationships should be documented through Form 2.3. This Form 2.3 refers to: (a) Local / External User Group name, (b) Primary agent - who is primarily responsible for the activity, (c) Secondary agent - who is responsible for execution of activity, (d) Tertiary agent - who actually works on ground (e) Significant activities, (f) Extent of Influence on ecosystem services, to be selected from high, moderate, low or nil, and (g) Effect, to be selected from positive or negative.

The final step in this set of activities is to note some details of the identified knowledgeable individuals from the different local and outsider user groups, as indicated in 13.2.4.

13.2.2.2 Nomadic populations

Nomadic shepherds, traders, entertainers are significant actors on the Indian ecological scene, often possessing special knowledge of ecological habitats and

biodiversity. Some like Gaddis of Himalayas or Narikuravans of Tamilnadu have been traditionally nomadic. Others like duck-keepers of South India are newly emergent nomadic groups derived from many different communities. For the PBR exercises nomads will constitute local user groups in localities where they are registered as voters. Elsewhere, in localities that they visit during their movements / migrations, nomads will constitute external user groups. It would be worthwhile to collect some additional information for such nomadic groups as indicated in Form 2.4. The data to be entered into this form should pertain only to the particular band of nomads visiting the study locality. There is no intention to record here information on other bands of the concerned nomadic community.

The Form 2.4 refers to:

- 1) **Nomad type** : (a) traditional nomadic / traditional semi-nomadic / newly emerged, (b) Pastoral /non-pastoral. Here, pastoral implies involvement in animal husbandry, as with nomadic shepherds, and non-pastoral, lack of such involvement apart from maintenance of some pack animals like donkeys, as in the case nomadic stone-workers.
- 2) **Place where registered as voters**: *Village/Panchayat *PIN *Taluk *Dist *State: Most nomadic populations have some base villages, where they may stay in some seasons such as monsoon.
- 3) **Community/ies** : Communities may preferably selected from those are those listed in the enumeration of the "People of India" project of the Anthropological Survey of India. Many, though not all, communities find a mention in this standard list. If so listed, much other information on these communities may be obtained from a series of books published through this project. In case a PoI Community is not applicable, the local name of the concerned community may be used.
- 4) **Composition** : *No of males and of females refers to the particular group visiting the study locality.

It is suggested that further information on overall movements of this particular group be collected. A time frame of ten years is appropriate, since people have a good recollection of events over such a time-span. Form 2.4 suggests recording the broad pattern of movement over this period, noting:

5) Movements in last ten years: It is suggested that the most significant localities used by the particular nomadic group for resource collection or camping be listed, giving the following details:

- PIN of the nearest Post Office,
- Name of the village & distance,
- Distance from habitation,
- Name of LSE of visit/stay as reported by members of nomadic population. Here LSE refers to a Landscape Element(e.g. a particular patch of grassland, or forest or other kind of ecological habitats) frequented by the nomadic group.
- Frequency of visits: Daily/weekly/fortnightly/monthly/bi-monthly/quarterly/half-yearly/yearly/not regular
- Duration of stay in hours/days: From month/nakshatra; *To month/nakshatra
- Significance of the locality for their sustenance

13.2.3 Special Nomadic Communities PBRs

Normally, PBRs will be focused on specific localities such as villages or Panchayats, and the different groups of people are viewed as User Groups. However, special PBRs may be developed with a focus on a particular nomadic population. These special PBRs may be designed as composite PBRs pertaining to all the localities significant to the livelihood of the different bands of a particular nomadic population. Their activities may then be documented as those of a Local User Group in the place where they are registered as voters, and as an External User Group in a sample of localities along their movement/ migration route.

13.2.4 Knowledgeable individuals

Not all people would be equally knowledgeable, nor would they be equally interested in participating in the PBR exercise. It is also likely that some of the most knowledgeable individuals would come from the poorest households and be

reluctant to speak out in a group. An important advantage of the user group approach is that these poor and socially disadvantaged people would tend to be assigned to some distinctive, relatively homogenous user group where they would be better able to contribute. Therefore the identification of user groups should be followed by separate discussions, if possible independently, with men and women from each user group to identify the most *knowledgeable individuals- men and women* from each group. This should be followed by identification of *knowledgeable individuals* from the external user groups as well. As many of the local knowledgeable individuals as possible should then be inducted as members of the PBR study panel along with interested teachers, students, members of Community Based Organizations such as Youth Clubs or women's Self Help Groups and concerned officials such as Panchayat Secretary, Agricultural Assistant or Forest Guard.

It would also be desirable to involve, to the extent possible, some of the knowledgeable individuals from external user groups in the PBR exercise, where feasible as participants in the study team. Forms 3.1 and 3.2 provide examples of the recording of information on knowledgeable individuals. These forms refer to:

- Name
- Age group: below 20, 20-40, 40-60, above 60
- Sex: M/F
- User Group (local/ external)
- Expertise - related to biodiversity
- Contact details

14 Mapping the landscape

14.1 Participatory mapping:

The first task of the PBR study team, once put together, is to get acquainted with the ecological setting of the study locality. A good way of getting to know the setting is to move around the entire study area and assess the occurrence of different types of ecosystems or ecological habitats of the area. Of course, all people have an intuitive mental picture of the landscape of their surroundings, including the

relative extent and interrelations of the various elements in the landscape. People also have locally prevalent terms for many individual elements as well as generic terms for ecosystem or landscape element types. Thus, Janaicha (=Janai's) rahat (=sacred grove), Saheb (=Sahib's) dongar (=hill), Chavdar (=Tasty) tale (=lake). The use of such local names of landscape elements can greatly facilitate communication. Therefore, it is best to begin by preparing an inventory of the different types and sub-types of ecosystems present and a sketch map showing their incidence as a participatory exercise. The sketch map would serve as a reference point to orient further investigations, and need not be to scale; it should, however, correctly depict the overall shape, relative extent, and position of the different elements of the landscape. These elements may be labeled in terms of scientific categories such as degraded deciduous forest as well as locally used name of that patch of land such as kattige kadiyada betta. These maps may also highlight elements that are considered particularly significant by some user group or the other and assign some code numbers to them to facilitate further data collection. These may be selected in relation to the most significant concerns of the people, or focal issues as discussed below in Section 17.

14.2 Landscape element types

Preparation of such a map calls for a way of delineating and naming the various ecosystems that constitute the basic elements of the landscape. What then is an ecosystem? It is an interacting system of all living organisms and their physico-chemical environment. This word is used in many different ways, to refer to systems on many different scales. This is because the choice of the boundary of an ecosystem is arbitrary; and one may even consider a human body harbouring a community of viruses, bacteria, and perhaps, hookworms and tapeworms, lice and ticks as an ecosystem. At the other end of the scale, the entire Western Ghats region may be referred to as a mountain ecosystem, or the entire Bay of Bengal sea coast as a coastal ecosystem. Reference may also be made to a region such as the Ludhiana district as an agricultural ecosystem, or the Lakshadweep islands as an island ecosystem and so on.

For our purpose, ecosystems are best visualized on the scale of ten to hundred hectares as constituting elements of landscapes defined on the scale of ten to hundred square kilometers. Such landscapes are a complex mosaic of elements of many different ecosystem or landscape element types. For example, in a Western Ghats tract the landscape may include elements of the following types: evergreen forest, semi-evergreen forest, humid scrub, bamboo brakes, paddy fields, rubber

plantations, mixed arecanut- coconut orchards, streams, ponds, roads, habitation. In an urban area like Bangalore the landscape elements may include habitation devoid of any vegetation, habitation interspersed with trees and other plants, gardens, lakes and roads. Scattered over the landscape – and waterscape- will be several elements, or patches, of each type, mixed with those of other types. In other words, any landscape is a mosaic of landscape or waterscape elements of many different landscape or waterscape element types. We do not as of today have a commonly shared, countrywide system of classification of landscape or waterscape element types. This is essential for organizing a proper Biodiversity Information System. Pending its elaboration, we suggest the use of the 25 types of Box 14.2.1.1 below.

14.2.1.1 Box: Landscape element types

- 1. Grassland:** A patch of land covered primarily by grass and other herbs with hardly any trees or shrubs
- 2. Scrub savanna:** A patch of land covered with scattered shrubs interspersed with grass and other herbs with hardly any trees
- 3. Tree savanna:** A patch of land covered with scattered trees interspersed with shrubs, grass and other herbs
- 4. Scrub-land:** A patch of land covered primarily by shrubs with little grass and hardly any trees
- 5. Forest:** A patch of land covered primarily by trees interspersed with some shrubs and grass
- 6. Annual crops:** A patch of land under cultivation for seasonal crops such as rice, jowar, cotton or vegetables
- 7. Tree crops:** Both orchards(coconut, mango, pomegranate etc) and forestry plantations(teak, acacia, babul etc)
- 8. Rocky outcrops:** A patch of rocky or otherwise barren land (e.g. mine dump) with hardly any vegetation
- 9. Largely paved and built with some vegetation:** Human settlement with many buildings and roads with very little vegetation
- 10. Sparsely paved and built with extensive vegetation:** A patch of land covered by gardens or orchards with some scattered houses or other buildings
- 11. Streams/ rivers:** Natural flowing water courses
- 12. Canals:** Man-made water channels
- 13. Natural pools, ponds, lakes:** Natural bodies of stagnant water
- 14. Tanks, reservoirs:** Man-made bodies of stagnant water
- 15. Estuaries:** Water bodies at river mouths with brackish water
- 16. Swamps, marshes:**
- 17. Open sea:**
- 18. Muddy beach:** Beaches covered by fine mud
- 19. Sandy beach:** Beaches covered by sand
- 20. Rocky beach:** Beaches covered by rocky outcrops
- 21. Markets:** Areas dominated by shops and other marketing facilities especially for biological products
- 22. Depots:** Areas dominated by godowns and other storage facilities especially for biological products

23. Industrial undertakings / processing units: Areas dominated by industrial facilities, especially for processing of biological materials

24. Repositories such as museums, zoos, herbaria dedicated to maintenance of dead or living biological materials

25. Animal farms: Dairies, stud farms, poultries and other facilities dedicated to breeding of domesticated animals

While these 25 types may serve as the basis of describing the landscape throughout the country, it would be necessary to distinguish further sub-types in any given locality. This elaboration of sub-types may be left open and taken up as appropriate in each state or district. Thus, for Lakshadweep, one may adopt the following sub-type of the Open Sea WSE type:

- Coral reef
- Lagoon
- Neritic waters (Continental shelf)
- Deep sea (Continental slope);

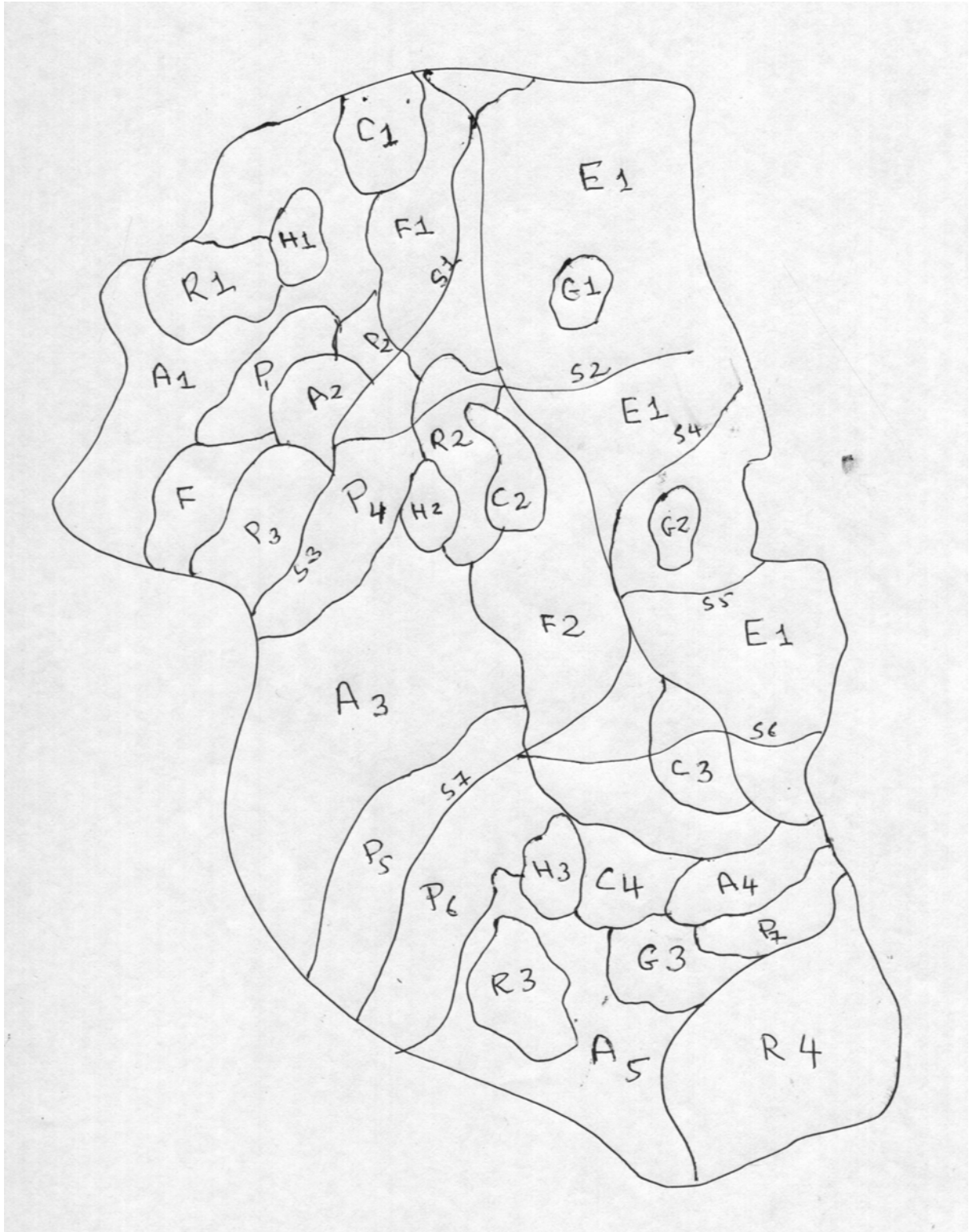
For Mala village the Forest LSE type may be distinguished into the following sub-types:

- Evergreen
- Semi-evergreen
- Degraded semi-evergreen

Not all of the twenty-five LSE types are likely to be present in any one study locality, but several will undoubtedly be present, and be represented by patches of various sizes. To reiterate, Landscape/ Waterscape Element Types and Sub-types refer to general classes, like grassland, or tanks/reservoirs, while the term Landscape/ Waterscape Element refers to a particular geographical entity such as a specific grassland that is the common grazing ground of village Khejadli in Jodhpur taluk, or the Sankey tank near the Indian Institute of Science in Bangalore.

Figure 14.2.1.2 portrays a rather simplified landscape map of one study locality, the Panchayat of Mala in Karkala taluk of Udupi district. This map depicts:

- a) One patch of evergreen forest labeled E1.
- b) Tree patches of grassland labeled G1, G2, G3.
- c) Four patches of cashew-nut orchard labeled C1, C2, C3, C4.
- d) Three patches of degraded evergreen forest labeled F, F1, F2.
- e) Four patches of rubber plantations labeled R1, R2, R3, R4.
- f) Five patches of areca-nut orchards labeled A1, A2, A3, A4, A5.
- g) Three patches of habitation labeled H1, H2, H3.
- h) Seven patches of paddy-fields labeled P1, P2, P3, P4, P5, P6, P7.
- i) Seven stretches of streams labeled S1, S2, S3, S4, S5, S6, S7.



14.2.1.2 A simplified landscape map of Mala village in Karnataka

Of these 37 total landscape and waterscape elements, a few, of particular interest to people may be selected for further study as focal landscape and waterscape elements. Thus of the paddy fields, the relatively large patch P6, and of

the streams, S3 may be selected as focal elements. It may also be noted that no subtypes are distinguished for the type grassland, while 3 sub-types, areca nut orchards, cashew nut orchards and rubber plantations have been distinguished for the type tree-crops.

14.2.2 Listing of LSE/ WSE types/ sub-types

As mentioned above, the participatory mapping exercise should be accompanied by a listing of the LSE/ WSE types occurring in the study site based on the standard list of 25 types mentioned in the Box 18.2.1.1 above, followed by listing of any sub-types that seem appropriate. These subtypes should be created only in case the type covers extensive area and each sub-type is distinctive and plays a characteristic role in the life of the people.

This listing may be undertaken using the framework of Form 4.1. Where sub-types have been distinguished, this Form should refer to each sub-type separately. If no sub-types of a type have been distinguished the Form will refer to each Type separately.

This Form 4.1 refers to:

LSE/WSE type (from the standard list of 25 types)

Local name of the type. Thus the type under consideration may be 7. Tree crops whose Kannada local name may be naduthopu.

LSE/WSE sub-type: Where locally distinguished as being appropriate. Thus mango orchard may be recognized as a sub-type of the type Tree crops.

Local name of the sub-type: Kannada local name of mango orchard may be mavin thota.

Number of LSE/ WSEs included: This refers to the total numbers of distinct elements or patches of the type/ sub-type under consideration. Thus, for the sub-type mango orchard, there may be 12 distinct patches. Our concern here is with contiguous areas of mango orchards; it is possible that one such distinct patch may be made up of mango orchards belonging to several distinct owners but situated next to each other.

Name of associated User group(s): This could be orchard owners, agricultural labourers, etc

Local names of the focal LSE/ WSEs selected for further study: We may select one or more particular patches of mango orchards for further study. Locally the patch so selected may be known as Raman thota, etc.

Code numbers of focal LSE/ WSEs selected for further study: Each patch selected for further study should be marked on the map and assigned a code number. Thus since Tree crops is type 7, mango orchard may be sub-type 7.1, Eucalyptus palantation sub-type 7.2, etc. The particular patch of mango orchard selected for further study, Raman thota may be given code number 7.1.1. These focal elements may reflect the habitats pertinent to key concerns as noted in Table 17.2.2.1, and Form 8.1.

15 Sketching the lifescape

15.1 Inventory of life forms

This documentation of the *landscape/ waterscape* may be followed by that of the *lifescape* or knowledge of diversity of life known to local people. The modern estimates of the diversity of life are remarkably close to the traditional Indian estimates, such as those mentioned in the Vishnupurana. We believe that every creature passes through 84 lakh yonis before attaining salvation. These 84 lakh yonis may reasonably be equated with the most natural category of biological classification, namely, species. A species is that set of plants or animals that is capable of reproducing with all members of the opposite sex. Thus all humans constitute a species, as do all tigers and Hoolock Gibbons, all coconut trees and all rice plants. Hoolock Gibbons and humans share a high proportion of their genes; they are grouped together along with all monkeys in a higher category, the order of Primates. All monkeys, deer, dogs, whales, and kangaroos are grouped together in a still higher category, the class of Mammals, and so on. Highly variable species, such as humans may be further differentiated into races or varieties. Thus many people from Punjab belong to the Caucasoid race, while many from Manipur belong to the Mongoloid race. However, the Punjabis and Manipuris belong to the same species and are perfectly capable of interbreeding with each other. Domesticated plant and animal species are similarly distinguished into a number of cultivars or varieties, such as Basamati or Kala Jeera varieties of rice, or Surati or Murra breeds of buffaloes.

Modern science has so far described a total of 16 lakh species of microbes, plants and animals. But our ignorance is profound, and the total number of species in existence on earth is believed to lie somewhere between 80 to 120 lakhs; which nicely brackets our ancient estimate of 84 lakh. Of the 16 lakh described so far from all over the world, 1.2 lakh, or 7.5% come from India, a respectable proportion, since our land area is around 2% of that of the earth. The majority of species occurring in India, as all over the world, belong to groups of small invertebrates such as soil mites and are as yet undescribed. Taking them into account the total number of species estimated to occur in India is 4 lakh; around 4 to 5% of the total existing in the world. Ecological thumb rules suggest that an area of the size of an average Panchayat, say 30 to 50 km² should harbour around 4% of the total number of species in the country as a whole. This implies that such an area will, on an average, harbour about 5000 of known, and 16000 of all, described and yet to be described species. Of course, this is only an average. A village council area in

Arunachal Pradesh is apt to be far richer, and a Ward of Chennai Municipal Corporation bound be much poorer than the average.

A majority of species is unknown, even to the scientific community today, and there has never been a complete inventory of all species of all groups of organisms in any locality in the world. So we expect local people to be familiar with only a fraction of the total diversity locally present. Still, they often know of 200-800 species and 50-150 of varieties of crops and domestic animals. They also recognize many categories above the species level, such as all of butterflies, assigned by science to order Lepidoptera. People's Biodiversity Register has necessarily to focus on the diversity of life familiar to people, and one of the initial steps would be to prepare an inventory of all life forms known to them. Some of these may then be selected for further more detailed investigations. These investigations may relate to one of four themes, namely:

- (1) Abundance,**
- (2) Uses,**
- (3) Management, and**
- (4) People's knowledge.**

The number of forms selected for these four purposes will depend on consideration of the time and resources available to the study team. Depending on its significance, a given species may be selected for further investigation in terms of one or more of these themes. Thus, an important non-timber forest produce species like Amla (*Phyllanthus emblica*) may be selected for study under all four themes; while a group of nuisance species like ticks may be considered under the themes of abundance and management and so on. Apart from such taxonomic groups, people may wish to investigate in some depth functional species groups such as fuelwood or mulch species. The exact number of such species/ species groups/ varieties / functional species groups selected for further studies would depend on the amount of time and human resources available. Depending on these constraints, one may select a set of those of most interest to people.

15.2 Scientific names

Discrimination amongst different forms of the great diversity of life requires that they carry distinctive names. These names have been standardized through the modern scientific system of binomial nomenclature introduced by Carl Linnaeus in

1750's. But the names in popular use are not standardized in this way, so that the same name may imply very different species to different people, and the same species may be called very differently in different localities. This is true of names employed in Ayurvedic pharmacopeias as well. Thus the name Shankhapushpi (= plant with a conch-shaped flower) is applied to at least four different species: *Canscora decussata* (family Gentianaceae), *Clitoria ternatea* (family Leguminosae), *Evolvulus alsinoides* (family Convolvulaceae) and *Xanthium strumarium* (family Asteraceae). At the same time *X. strumarium* is referred to by as many as 27 different names including Arishta, Kakubha, Medhya and Vanamalini.

The names in popular usage are, of course, still of considerable significance in involving the broader masses of people in the PBR exercise. Thus, one of Karnataka's more knowledgeable barefoot ecologists is Shri Kunjeera Moolya, by occupation a landless labourer, but a highly reputed dispenser of herbal medicines from the village Mala on the slopes of Western Ghats of Karnataka. He can name as many as 800 different species of organisms ranging over mushrooms and plants, to ants, snakes and mammals, and can offer good estimates of the local abundances of many of these species. But such folk knowledge must today be translated in terms of the more systematized, standardized scientific names. This needs to be done with great care, for in these days of commercialization of biodiversity and of patents relating to living organisms, the strength of claims critically depends on the use of scientifically valid names. For example, the Nobel prize-winning biochemist, Baruch Blumberg has patented a drug against hepatitis based on information on folk uses collected from India, and many other parts of Asia and Africa. He had offered rights over this patent, pertaining to molecules originally derived from *Phyllanthus niruri*, believed to occur in India. Further work has however revealed that there was an error and the species present in India is in actuality, not *Phyllanthus niruri*, but *Phyllanthus amarus*. An important component of technical support to be provided to local level PBR efforts will, therefore, have to relate to correct identification of at least the focal species in terms of scientific names. Similar support will have to be provided by organizations such as the National Bureau of Plant Genetic Resources and National Bureau of Animal Genetic Resources in terms of varieties of cultivated plants and land races of domesticated animals. Since this will take some time, it is proposed that the PBRs may initially focus on a limited set of common fish and shellfish, bird, wildlife and medicinal and food plant species.

15.3 Data collection

The initial phase of the PBR process would comprise: (a) preparing an inventory of activities, (b) delineation of user groups, (c) listing of landscape/ waterscape types and sub-types and (d) participatory mapping. In parallel with these one may initiate, through a series of group discussions, preparing a list of [1] species and higher groupings (e.g. grasses, dragonflies, frogs), [2] varieties of cultivated plants or land races of domesticated animals, and [3] functional groupings of species such as plants providing fuel-wood or green manure. Please note that our interest is in locally available species or other taxonomic entities known to people, rather than all species or entities known to them. Thus, they may be aware of chimpanzees or whales that are not present in the study area. These should be left out. This information may be recorded in the framework of Forms 5.1 and 6.1.

15.3.1 Species/ species group

Form 5.1 pertains to species and higher groupings, known to local people. It refers to the following items of information:

Type of organism: This is a checklist of major categories for discussions with people.

- | | |
|-----------------------|----------------|
| 1. Algae | 12. Crustacea |
| 2. Mosses | 13. Other |
| 3. Ferns | arthropods |
| 4. Gymnosperms | (Spiders, |
| | Centipedes) |
| 5. Flowering plants | 14. Mollusca |
| 6. Fungi | 15. Other |
| 7. Lichens | invertebrates |
| 8. Bacteria & Viruses | 16. Fish |
| 9. Nematodes | 17. Amphibians |
| 10. Annelids | 18. Reptiles |
| 11. Insects | 19. Birds |
| | 20. Mammals |

Local name of species/species group: If people do distinguish an entity at the level of the species, mention the local name of the species, e.g. pimpal for *Ficus religiosa* in Marathi; or note the name of species group, e.g. gavat for grass, Family Poaceae in Marathi.

Scientific name: In case of species, the appropriate scientific name, e.g. *Ficus religiosa* for pimpal

Person providing scientific information: It is important to keep track of sources of all information to aid in the process of validation. This information may pertain to the scientific name of a species, or scientific taxonomic category of a species group, such as family or order.

Taxonomic species group: For example, Family Poaceae for grasses

Language employed: Names would depend on the language employed, and in many parts of the country several languages are in vogue. So a separate entry should be made for each local name in case names in more than one language are being recorded.

Local value: This should be noted in terms of the following standard categories:

1. Of great value
2. Of Some Value
3. Of no significance
4. Nuisance
- 5.A great nuisance

Major uses: Note the major uses for useful species.

Major disuses: Note the major disuses for nuisance species

Additionally, it would be useful to decide on a subset of these that are of particularly high interest to people that may be chosen for further investigations. These may reflect the species/ species groups/varieties that are associated with the key concerns of the people. This is discussed further in Section 17 on Focal Issues. Hence, the selection mentioned below will reflect the information noted in Form 8.1, and in Table 17.2.1.1.

Selected as a focal sp group / sps (abundance) Y/N : Note whether selected for further investigation in terms of abundance. This would be documented further in Forms 12.1 and 13.1.

Selected as a focal sp group / sps (uses) Y/N: Note whether selected for further investigation in terms of its uses. This would be documented further in Form 13.3.

Selected as a focal sp group / sps (ecological knowledge) Y/N: Note whether selected for further investigation in terms of ecological knowledge of people. This would be documented further in Form 14.1.

Selected as a focal sp group / sps (management) Y/N: Note whether selected for further investigation in terms of management. This would be documented further in Forms 13.4a, 13.4b.

15.3.2 Functional species group

People may wish to collect good information on particular functional species groups such as fuelwood. Thus, people of Mendha (Lekha) are eligible to access fuelwood from the so-called "Nistar" forests as part of their subsistence requirements. They are therefore looking for reliable information on how much fuelwood they may extract from the surrounding forest on a sustainable basis. So, their interest is in fuelwood species as a group. This information may be recorded in the framework of Form 6.1. This Form refers to:

Functional species groups (e.g. fuelwood sps., leaf manure sps, thatching material, game birds): It would be useful to decide on a subset of these that are of particularly great interest to people that may be chosen for further investigations. These may reflect the functional species groups that are associated with the key concerns of the people. This is discussed further in Section 17 on Focal Issues. Hence, the selection mentioned below will reflect the information noted in Form 8.1, and in Table 17.2.1.

Local names of species involved if any: As many as are known to people.

Language employed: Names would depend on the language employed, and in many parts of the country several languages are in vogue. So a separate entry should be made for each local name in case names in more than one language are being recorded.

Local value: This should be noted in terms of the following standard categories:

1. Of great value
2. Of Some Value
3. Of no significance
4. Nuisance
- 5.A great nuisance

Major uses: Note the major uses for useful species groups.

Major disuses: Note the major disuses for nuisance species groups

Selected as a focal functional species group (abundance) Y/N: Note whether selected for further investigation in terms of abundance. This would be documented further in Forms 12.1 and 13.1.

Selected as a focal functional species group (uses) Y/N: Note whether selected for further investigation in terms of its uses. This would be documented further in Form 13.3.

Selected as a focal functional species group (ecological knowledge) Y/N: Note whether selected for further investigation in terms of ecological knowledge of people. This would be documented further in Form 14.1.

Selected as a focal functional species group (management) Y/N: Note whether selected for further investigation in terms of management. This would be documented further in Forms 13.4a, 13.4b.

16 Setting of the study site

16.1 Geographical coverage

The documentation of local geographic, social, and economic setting may be taken up in parallel with other activities such as delineation of the user groups, participatory mapping and inventorying of life forms known to people. This must begin with the demarcation of the boundary of the area under consideration. Since the PBR exercises are meant to support the activities of Biodiversity Management Committees in local bodies, the area under the jurisdiction of a Gram Panchayat or Municipality/ Corporation would be an appropriate unit for this purpose. However, such a unit would often be a little too large to handle, and a sub-unit such as an individual village or hamlet or a municipal ward in which the educational institutional is located may be appropriate. Since one of the purposes of the PBR is to help prepare a resource management plan, the area under consideration may also include adjacent areas under regular use, e.g. for grazing or fishing, even if they fall outside the jurisdiction of the concerned local body.

16.2 Background information

The details of the information to be collected on the geographic, social and economic setting would of course depend on the particular site. Forms 7.1a, 7.1b, 7.1c and 7.1d suggest some more structured information that might be usefully collected. Form 7.2 deals with some more qualitative, historical and cultural information that might be of much interest to the local community.

Some of this information may be recorded in the form of extended text, images, and audio- and video-clips. The database provides for storage of information in these forms as well.

17 Focal issues

The PBR exercise can only succeed if the local community members come to own it. This will not happen if its focus is remote from their own day-to-day concerns, for instance, if the exercise focuses exclusively on rare, endemic species that need to be strictly protected. So, while conservation of such species should remain an important concern; it is equally important that the exercise addresses more immediate concerns, especially of the weaker segments of the community. Hence, having laid the background, the study team should next concentrate on ascertaining local community's perceptions of what kind of information collection, to be followed by preparation and implementation of a management plan would best [a] facilitate knowledge-based, sustainable management of land and water use, agriculture, livestock, fish, forests and public health environment so as to enhance the quality of life of the community members and [b] help prevent loss of grass-roots knowledge associated with biodiversity, secure recognition for such knowledge and add value to it. This would involve the study team once again discussing with local people the entries in Appendix 1, list issues of interest and then arrange them in the order of priority.

This information may be organized in the framework of Form 8.1.

Issues: A representative list of issues of interest thus identified in a few localities during the pilot phase of PBR exercise is as follows:

17.1 Table: A representative list of significant issues

Locality	Setting	Significant issues
Bada-Yermal	A coastal fishing village in Karnataka	Impact of pollutants from petrochemical industry on marine fish stocks
Mala	A village on slopes of Western Ghats in Karnataka	Impact of dynamiting, especially by outsiders, on freshwater fish

		stocks
Channa-Keshavapura	A farming village in semi-arid tracts of Karnataka	Impact of pests and diseases on groundnut production
Mendha-Lekha	A tribal village in eastern Maharashtra	Impact of harvesting practices on tendu leaf and fruit production
Pardhiantanda	A village of semi-nomadic hunters-traders in eastern Maharashtra	Relative impacts of pesticide usage and hunting on quail and partridge populations
Teligram	A village dependent on paddy cultivation and aquaculture in Gangetic plains of West Bengal	Impact of pesticide usage on rearing of domestic ducks

17.2 Interested User groups:

It would be appropriate that these lists should represent significant interests of diverse user groups, rather than the concerns of only the most powerful segment of the population. Thus for the Channakeshvapura village mentioned in Table 17.1, a short list of priority issues that the local community members feel should be taken up in the initial phase of the full-fledged PBR exercise is as follows:

17.2.1 Table : A short list of Channakeshvapura focal issues

User Group	Issues
Coconut orchard owners	Control of coconut mites Development of a live fence
Owners of rain-fed farms	Control of various pests and diseases of groundnut Control of wild pigs
Shepherds	Control of various parasites and diseases of sheep Use of traditional herbal remedies to treat sheep diseases Management of grazing lands
Landless labourers	Production of fish in irrigation tanks

17.2.2 Associated LSEs/ WSEs/ species / species groups/ varieties / functional species groups

The next step is to devise a list of the various [a] ecological habitats, or Landscape/ waterscape element types, and [b] species, species groups, varieties, functional species groups that are linked to each of these themes. Table 17.2.2.1 provides an illustration of how such lists may be elaborated with reference to some of the focal issues mentioned in Table 17.2.1. The list of pertinent species/ species groups/ varieties should be reflected in those selected for further investigation in terms of abundance, uses, ecological knowledge, or management in Form 5.1. The list of pertinent functional species groups should be reflected in those selected for further investigation in terms of abundance, uses, ecological knowledge, or management in Form 6.1. Similarly, the list of pertinent habitats should be reflected in those selected for further investigation as focal landscape/ waterscape elements in Form 9.1b and 9.2b.

17.2.2.1 Table: Issues, habitats and species of interest

Issue	Pertinent species/ species groups/ functional species groups	Pertinent habitats
Control of leaf-miner (LF) pest of groundnut	Leaf-miner, alternative host plants for LF, microbial diseases and insect parasites of LF, bird predators of LF	Groundnut farms, farms where alternative hosts of LF such as soya beans are cultivated, farm bunds and scrub savannas harbouring wild plant hosts and bird predators of LF
Control of wild pigs	Wild food plants of wild pigs	Farms and orchards raided by wild pigs, scrub savannas, forests
Use of traditional herbal remedies to treat sheep diseases	Various plant species used as herbal remedies	Farms, grasslands, scrub savannas, forests, streams, lakes

18 Landscape types and sub-types

The next step in the PBR process is to document the current status and trends over time in various physical and biological parameters, ecosystem goods

and services as well as management concerns with respect to the LSE/WSE types and sub-types taken as a whole, e.g. all lakes and ponds, or all patches of degraded semi-evergreen forest, or all rubber plantations. This would be primarily based on group interviews. The collection of the pertinent information may be organized within the framework of Forms 9.1a, 9.2a, and 9.1b, 9.2b.

Forms 9.1a and 9.2a deal with the current status and on-going changes.

18.1.1 Form 9.1a:

Form 9.1a deals with documentation of status, and dynamics of various landscape element types/ sub-types considered as a whole.

- Name of LSE type as a whole: Forest or grassland
- Local Name/s (if any): e.g. grasslands are locally known as bugyals in Garhwal
- LSE sub-type : e.g. evergreen or semi-evergreen forest
- Local Name/s (if any):
- Topography: For sake of standardization, we suggest that selection be made from amongst the following categories:
 1. Plain, 2. Undulating, 3. Hilly, 4. Moderate slope, 5. Steep slope
- Total area (ha): For the type as a whole, counting together the area of different patches of the type. Thus, the total area of the forest may be 130 ha, fragmented into 3 patches of 65, 43 and 22 ha.
- Trend in change in area over past 10 years: For sake of standardization, we suggest that selection be made from amongst the following categories:

1.Substantial increase, 2. Moderate increase, 3. Little / No change, 4. Moderate decrease, 5.Substantial decrease

- Immediate reason & motivation: Thus, forests may be reduced in area due to fires. There may be manifold complex reasons, and these may be discussed at length.
- Long term reason & motivation: Fires may be being set to improve grazing resources. There may be manifold complex reasons, and these may be discussed at length.

Trend in change in vegetation strata (Big trees ;Shrubs; Ground cover) over past 10 years : These trends too will be recorded as:
1.Substantial increase, 2. Moderate increase, 3. Little / No change, 4. Moderate decrease, 5.Substantial decrease

- Immediate reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length
- Long term reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length
- Significant activities: Significant activities pertaining to the LSE type/ sub-type under consideration. These would be a sub-set of activities noted in Forms 1.1 and 1.2.
- Goods & Services: The ecosystem goods and services obtained from the pertinent LSE type/ sub-type. The concept of ecosystem goods and services was discussed above in Section 12.2.1.1. There may be many, and these may be described at length.
- User groups gaining most from goods & services: Important beneficiaries of ecosystem goods and services obtained from the pertinent LSE type/ sub-type. There may be many user groups,

gaining from different goods and services, and these may be described at length.

- Local groups:
- External groups:
- Change in goods & services: Changes taking place in recent past, especially last ten years.
- Immediate reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length.
- Long term reason & motivation: There may be manifold long term reasons and motivations for on-going changes, and these may be described at length.
- Bads & disservices: The ecosystem bads and disservices from the pertinent LSE type/ sub-type. The concept of ecosystem bads and disservices was discussed above in Section 12.2.1.1. There may be many, and these may be described at length.
- User groups affected most by bads & disservices: Important recipients of ecosystem bads and disservices obtained from the pertinent LSE type/ sub-type. There may be many user groups, suffering from different bads and disservices, and these may be described at length.
- Local groups:
- External groups:
- Change in bads & disservices: Changes taking place in recent past, especially last ten years.

- Immediate reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length.
- Long term reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length.

18.1.2 Form 9.2a:

Form 9.2a deals with documentation of status, and dynamics of various waterscape element types/ sub-types considered as a whole.

- Name of WSE type as a whole: For instance, tanks and reservoirs
- Local Name/s (if any): For instance, tanks, reservoirs are known as kere in Karnataka
- WSE sub-type: Streams, a subtype of streams and rivers
- Local Name/s (if any): Streams, a subtype of streams and rivers is known as jhara in Maharashtra
- Total length of stream / river (km): Within the study area
- Trend in change in length over past 10 years: These trends will be recorded as: 1.Substantial increase, 2. Moderate increase, 3. Little / No change, 4. Moderate decrease, 5.Substantial decrease
- Immediate reason & motivation: Certain streams may disappear due to house construction
- Long term reason & motivation: For example, migration of rural population into urban centers
- Water spread area of the tank/pond/lake (ha): Within the study area

- Trend in change in water spread area over past 10 years: These trends too will be recorded as: 1.Substantial increase, 2. Moderate increase, 3. Little / No change, 4. Moderate decrease, 5.Substantial decrease
- Immediate reason & motivation: Certain lakes may disappear due to house construction
- Long term reason & motivation: Rapid urbanization
- Availability of water (No. of days) for WSE: Within the study area
- Trend in change in availability of water over past 10 years: These trends too will be recorded as: 1.Substantial increase, 2. Moderate increase, 3. Little / No change, 4. Moderate decrease, 5.Substantial decrease
 - Immediate reason & motivation: May have increased due to development of new canals in a command area
 - Long term reason & motivation: Strong political support to irrigation projects
- Change in flora & fauna over past 10 years: For instance, rapid growth of water hyacinth
 - Immediate reason & motivation: For instance, nutrient enrichment of waters
 - Long term reason & motivation: For instance, failure to manage sewage treatment from urban centers
- Significant activities: Significant activities pertaining to the LSE type/ sub-type under consideration. These would be a sub-set of activities noted in Forms 1.1 and 1.2.

- Goods & Services: The ecosystem goods and services obtained from the pertinent WSE type/ sub-type. The concept of ecosystem goods and services was discussed above in Section 12.2.1.1. There may be many, and these may be described at length.
- User groups gaining most from goods & services: Important beneficiaries of ecosystem goods and services obtained from the pertinent LSE type/ sub-type. There may be many user groups, gaining from different goods and services, and these may be described at length.
- Change in goods & services: Changes taking place in recent past, especially last ten years.
- Immediate reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length.
- Long term reason & motivation: There may be manifold long term reasons and motivations for on-going changes, and these may be described at length.
- Bads & disservices: The ecosystem bads and disservices from the pertinent LSE type/ sub-type. The concept of ecosystem bads and disservices was discussed above in Section 12.2.1.1. There may be many, and these may be described at length.
- User groups affected most by bads & disservices: Important recipients of ecosystem bads and disservices obtained from the pertinent LSE type/ sub-type. There may be many user groups, suffering from different bads and disservices, and these may be described at length.
- Local groups:
- External groups:

- Change in bads & disservices: Changes taking place in recent past, especially last ten years.
- Immediate reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length.
- Long term reason & motivation: There may be manifold immediate reasons and motivations for on-going changes, and these may be described at length.

Forms 9.1b, 9.2b deal with management issues.

18.1.3 Form 9.1b

Form 9.1b deals with documentation of the different management issues relating to various landscape element types/ sub-types considered as a whole.

- Name of LSE type as a whole: Forest or grassland
- Local Name/s (if any): e.g. grasslands are locally known as bugyals in Garhwal
- LSE sub-type : e.g. evergreen or semi-evergreen forest
- Local Name/s (if any):
- Existing management authority: There may be a variety of formal as well as informal management authorities pertaining to a given LSE type such as forest. Thus one patch may be a reserved forest, another a protected forest, a third patch may be on private land. Local community members may have an understanding that a certain patch is to be used by people from a particular hamlet, and so on.

- Existing management system/ practices: There may be a variety of formal as well as informal management authorities pertaining to a given LSE type, such as grassland. For instance, some patches of grasslands may be being converted into fuelwood plantations; others encroached upon for cultivation, and so on. These should be described in detail.
- Gainer User groups: Certain user groups, local or external, may gain from the existing management system. For example, landless agricultural labourers may gain from encroachment on grasslands. These manifold interactions may be described in detail.
- Local groups:
- External groups:
- Loser user groups: Certain user groups, local or external, lose gain from the existing management system. For example, shepherds may stand to lose from encroachment on grasslands. These manifold interactions may be described in detail.
- Local groups:
- External groups:
- Other management patterns prevalent in recent past: Management systems/ practices have been undergoing rapid changes in recent times, and it would be useful to note these experiences, especially from the perspective of devising more effective systems for the future. These manifold experiences may be described in detail.
- User groups:
- Desired changes / desired future: This would entail documentation of what the various user groups would like to see happen in the coming days.

- Desired management system from the perspectives of different user groups: This refers to the vision of different user groups of a desirable management system. A number of different elements would be involved in this vision. These may relate to (a) rights of access to land, waters or biological resources, (b) roles of different governmental agencies, private industry, landowners or community institutions, (c) local versus outside actors, (d) technologies employed, and (e) access to capital or markets, and so on. It would be worthwhile to encourage the community members to give full scope to their imagination and come up with a variety of innovative solutions.
- Suggested components for a management plan that can be implemented under present circumstances as a consensus of the gram sabha: But finally, it is important to examine ground realities, and the community members may be asked to shift from what they would ideally like to see happen to suggesting elements of a management plan that can be implemented under present circumstances and for which a consensus of the gram sabha seems feasible. Different user groups may come up with a range of such plans; all of these may be recorded preserving their perspectives, and taking care not to introduce any bias on part of those involved in the documentation.
- Code numbers of focal elements selected for further study as marked on the map: Apart from documenting the condition of LSE/ WSE types/ sub-types as a whole, largely based on group discussions, it would be worthwhile to investigate some of the specific habitat patches or landscape/ waterscape elements that have been identified as of particular interest during the discussions on focal issues (section 21). These may, for instance, include a lake that serves as the principal source of drinking water, or the most fertile patch of farmland (which may include several separate individual holdings next to each other). In addition, it may be useful to select some representative examples of the various LSE/ WSE types/ sub-types as

focal elements for further investigations. These may be the largest and one of the average sized patches of each type/ sub-type.

However, the actual number of such focal elements selected will depend upon the practical constraints such as time of teachers and students available for these activities.

Form 9.2b

Form 9.2 b deals with documentation of the different management issues relating to various waterscape element types/ sub-types considered as a whole.

- Name of WSE type as a whole: For instance, tanks and reservoirs
- Local Name/s (if any): For instance, tanks, reservoirs are known as kere in Karnataka
- WSE sub-type: Streams, a subtype of streams and rivers
- Local Name/s (if any): Streams, a subtype of streams and rivers is known as jhara in Maharashtra
- Existing management authority: There may be a variety of formal as well as informal management authorities pertaining to a given WSE sub-type such as tanks. Thus one tank may be under the control of minor irrigation department, another may be on private land. Local community members may have an understanding that a certain tank is to be used by people from a particular hamlet, and so on.
- Existing management system/ practices: There may be a variety of formal as well as informal management authorities pertaining to a given WSE sub-type, such as tanks. For instance, some tanks may be being drained to create housing sites, others may be well-managed as recreational areas, and so on. These should be described in detail.

- Gainer User groups: Certain user groups, local or external, may gain from the existing management system. For example, builder may gain from encroachment on tanks. These manifold interactions may be described in detail.
- Local groups:
- External groups:
- Loser user groups: Certain user groups, local or external, may stand to lose from the existing management system. For example, farmers may stand to lose from encroachment on tanks. These manifold interactions may be described in detail.
- Local groups:
- External groups:
- Other management patterns prevalent in recent past: Management systems/ practices have been undergoing rapid changes in recent times, and it would be useful to note these experiences, especially from the perspective of devising more effective systems for the future. These manifold experiences may be described in detail.
- User groups:
- Desired changes / desired future: This would entail documentation of what the various user groups would like to see happen in the coming days.
- Desired management system from the perspectives of different user groups: This refers to the vision of different user groups of a desirable management system. A number of different elements would be involved in this vision. These may relate to (a) rights of access to land, waters or biological resources, (b) roles of different governmental agencies, private industry, landowners or community institutions, (c) local versus outside actors, (d) technologies

employed, and (e) access to capital or markets, and so on. It would be worthwhile to encourage the community members to give full scope to their imagination and come up with a variety of innovative solutions.

- Suggested components for a management plan that can be implemented under present circumstances as a consensus of the gram sabha: But finally, it is important to examine ground realities, and the community members may be asked to shift from what they would ideally like to see happen to suggesting elements of a management plan that can be implemented under present circumstances and for which a consensus of the gram sabha seems feasible. Different user groups may come up with a range of such plans; all of these may be recorded preserving their perspectives, and taking care not to introduce any bias on part of those involved in the documentation.
- Code numbers of focal elements selected for further study as marked on the map: Apart from documenting the condition of LSE/ WSE types/ sub-types as a whole, largely based on group discussions, it would be worthwhile to investigate some of the specific habitat patches or waterscape elements that have been identified as of particular interest during the discussions on focal issues (section 17). These may, for instance, include a lake that serves as the principal source of drinking water. In addition, it may be useful to select some representative examples of the various WSE types/ sub-types as focal elements for further investigations. These may be the largest and one of the average sized patches of each type/ sub-type. However, the actual number of such focal elements selected will depend upon the practical constraints such as time of teachers and students available for these activities.

19 Focal elements of landscape/ waterscape

19.1 Field observations

These focal elements, marked on the map, and recorded in Forms 9.1b and 9.2b, may be investigated further both through field visits, preferably in company of some knowledgeable members of the community, as well as through group discussions. The field observations may involve aspects such as identity of neighbouring LSEs or modifications such as construction of check dams on streams. They would also involve recording of observations such as vegetation cover (for landscape elements), or nature of bottom substrate (for waterscape elements) at specific sampling points. Forms 10.1 and 10.3 indicate the schedules for recording the overall observations, while Forms 10.2 and 10.4 indicate the schedules for recording observations at specific sampling points. These field visits may also be used to record observations on the abundance of focal species/ functional groups in these focal elements of landscape/ waterscape. The details of how to select the sampling points were discussed above in section 12.2.2.2 and 12.2.2.4. The information to be recorded in Forms 10.1 and 10.3 follows the pattern of Forms 9.1a and 9.2a discussed in Section 22 above. The only difference is that these observations noted in 10.1 and 10.3 pertain to a specific patch of forest or a specific pond, rather than all forests and ponds in the study site. In view of this focus on a specific element, the form calls for certain information such as: surrounding LSE/ WSE types, distance from a motorable road, duration (hours or days units should be mentioned) of inundation due to flood water during last one year, and so on.

19.1.1 Form 10.1 Focal landscape elements field survey

- Name of LSE type as a whole:
- LSE sub-type :
- LSE code:

- Local name of the landscape element (if any):
- Topography:
- Area (Ha)
- Surrounding LSE/WSE types:
- Distance from Habitation (Km)
- Distance from motorable Road (Km)
- Current management
- Activities:
- Significant harvests/ removals, e.g. fuel wood:
- Significant additions: e.g. pesticides
- Significant modifications: e.g. leveling by bull-dozer
- Goods & services:
- Bads & disservices:

19.1.2 Form 10.3 Focal waterscape elements field survey

- WSE type :
- WSE sub-type :
- WSE code- unique serial number in the study area
- Local name of WSE (if any)
- Area (Ha)
- Maximum depth of water within the study area during last one year (m)

- Estimated Length [for streams/ rivers] within study area (m)
- Average Breadth [for streams/ rivers] within study area (m)
- Water spread area [for tanks and lakes (Ha)]
- Duration (hours or days units should be mentioned) of inundation due to flood water during last one year
- No. of days / months (specify unit) water present
- Surrounding LSE/WSE types :
- Distance from Habitation (Km)
- Distance from motorable Road (Km)
- Current management
- Activities:
- Significant harvests/ removals: e.g. fish
- Significant additions: e.g. city sewage
- Significant modifications: e.g. dams
- Goods & services:
- Bads & disservices:

Forms 10.2 and 10.4 provide the framework for recording observations at specific sampling points for the selected landscape or waterscape element. The details of how to select the sampling points were discussed above in section 12.2.2.2 and 12.2.2.4.

19.1.3 Form 10.2 Focal landscape elements vegetation cover

- Sr. No.
- Name of LSE type:
- LSE sub-type :
- Local name of LSE (if any)
- LSE code- unique serial number in the study area
- Sampling point number:

- Vegetation cover: To be selected from amongst the following options: 1. Under a tree canopy, 2. Covered by a shrub, 3. With Herbaceous vegetation, 4. On Barren land, 5. Paved land, 6. Inside a building. Multiple options may be selected for any given sampling point.

19.1.4 Form 10.4 Focal waterscape elements sampling studies

- Name of WSE type:
- WSE sub-type:
- Local name (if any)
- WSE code- unique serial number in the study area
- Local name (if any)
- Sampling point number
- Observation about WSE*
- Nature of sampling site (water body) under survey:

In case of streams or rivers, this is to be selected from:

1 Run: Smooth, rapidly flowing section of a stream or river

2 Riffle: Shallow stream with rough substrate leading to ripples on surface

3 Cascade: Rapidly descending stream or river

4 Pool: An area of deeper, more quiet water in the course of a stream or river

5 Waterfall:

- Nature and extent of pollution
- Bottom substrate:
 - 1. Bed rock 2. Boulders
 - 3. Cobble 4. Sand 5. Mud

19.2 Interviews

Appropriately designed interviews would provide information on status, dynamics, and management issues relating to various focal landscape/ waterscape elements selected for further documentation. Forms 11.1a, 11.2a refer to the recent history of the focal elements. The information to be recorded in Forms 11.1a and 11.2a follows the pattern of Forms 9.1a and 9.2a discussed in Section 22 above. The only difference is that these observations noted in 11.1a and 11.2a pertain to a specific patch of forest or a specific pond, rather than all forests and ponds in the study site.

19.2.1 Form 11.1a Focal landscape elements history

- Name of LSE type:
- LSE sub-type :
- LSE code
- Local Name of the focal LSE
- Trend in area over the past ten years and reasons
- Trend in change in area
- Immediate reason & motivation
- Long term reason & motivation
- Trend in change in vegetation strata over the past ten years and reasons:

- Big trees
- Shrubs
- Ground cover

- Immediate reason & motivation
- Long term reason & motivation
- User groups (local & external) gaining most from goods and services:
 - Local groups
 - External groups
 - Change in goods & services and reasons.
 - Changes
 - Immediate reason & motivation
 - Long term reason & motivation
 - Change in Bads & Disservices and reasons
 - Changes
 - Immediate reason & motivation
 - Long term reason & motivation

19.2.2 Form 11.2a Focal waterscape elements history

- WSE type
- WSE sub-type

- WSE code
- Local Name of the focal WSE
- Trend in area over the past ten years and reasons
- Trend in change in area
- Immediate reason & motivation
- Long term reason & motivation
- Trend in change availability of water over past ten years and reasons:
 - Trend
 - Immediate reason & motivation
 - Long term reason & motivation
 - User groups (local & external) gaining most from goods and services
- Gainer UG Local
- Gainer UG External
- Change in goods & services and reasons.
- Changes
 - Immediate reason & motivation
 - Long term reason & motivation
- Change in Bads & Disservices and reasons
- Changes
 - Immediate reason & motivation

- Long term reason & motivation

Forms 11.1b and 11.2b refer to management issues pertaining to the focal landscape and waterscape elements under investigation. The information to be recorded in Forms 11.1b and 11.2b follows the pattern of Forms 9.1b and 9.2b discussed in Section 22 above. The only difference is that these observations noted in 10.1 and 10.3 pertain to a specific patch of forest or a specific pond, rather than all forests and ponds in the study site.

19.2.3 Form 11.1b Focal landscape elements management

- Name of LSE type:
- LSE sub-type :
- LSE code
- Local Name of the focal LSE
- Existing managing authority system and gainer / loser
- Existing managing authority
- Existing management system
- Gainer Local user group : Nobody
- Gainer External user group:
- Loser Local user group :
- Loser External user group:
- Other management patterns prevalent in recent past and gainer loser
- Other management patterns

- Gainer Local user group :
- Gainer External user group:
- Loser Local user group :
- Loser External user group:
- User group code
- Desired changes/ desired future
- Desired management system
- Suggested components for a management plan that can be implemented under present circumstances as a consensus of the gram sabha

19.2.4 Form 11.2b Focal waterscape elements management

- Name of WSE type:
- WSE sub-type:
- WSE code
- Local Name of the focal WSE
- Existing managing authority system and gainer looser
- Existing managing authority
- Existing management system
- Gainer user group Local:

- Gainer user group External:
- Loser user group Local:
- Loser user group External:
- Other management patterns prevalent in recent past and gainer loser
- Other management patterns
- Gainer user group Local:
- Gainer user group External:
- Loser user group Local:
- Loser user group External:

20 Focal life forms

During the earlier exercise of preparing an inventory of locally known life forms (section 19), a set of species/ functional species groups would have been identified as the focus of further investigations relating to [a] abundance, [b] value/uses, [c] management and [d] practical ecological knowledge. In addition, it is important to document domesticated biodiversity. This module would deal with collecting the required information on basis of field observations as well as interviews.

20.1 Field observations

As mentioned above in sections 12.2.2.1 and 19.1, field surveys of focal landscape/ waterscape elements may usefully include observations on the abundance of focal species, or functional species groups. Form 12.1 provides

details of the information to be collected. This recording of abundance will necessarily be qualitative and subjective.

- Name of LSE type:
- LSE sub-type :
- LSE/WSE code:
- Local Name of the Focal LSE / WSE:
- Local name of the focal species/variety/species group /functional species group: This would conform to the name recorded in Form 5.1.
- Level of abundance: This will have to be based on subjective judgment of the abundance in the particular habitat under observation compared to normally expected abundance of the species etc under consideration. Thus, to be judged as moderately common, a weed like *Parthenium* or a bird like the house crow would occur in far greater numbers than a herb like *Tridax procumbens* or a bird like Indian Roller. Abundance will be scored in terms of following categories:
 - 1 - Absent
 - 2 - Rare
 - 3 - Moderately common
 - 4 - Abundant

20.2 Domesticated biodiversity

India has an immense wealth of locally adapted varieties of cultivated plants and races of domesticated animals, a heritage that is rapidly eroding with the spread of modern higher yielding varieties and races. Government of India has passed an Act called *Protection of Plant Varieties and Farmers' Rights Act 2001* that attempts to protect on-farm continuance of the diversity of cultivated plants. The Act also provides for the establishment of a *National Gene Fund* for supporting the conservation and sustainable use of genetic resources including in-situ and ex-situ collections and for strengthening the capability of the Panchayat in carrying out such conservation and sustainable use. A similar Act dealing with domesticated animal diversity may also materialize in near future. The rules under the PPVFRA are yet to be finalized, and the Act is not yet being implemented. Nevertheless, it is clear that the PBR process could play a very effective role in documentation of domesticated biodiversity in connection with this act.

20.2.1 Form 13.2 indicates details of the points on which information on domesticated biodiversity may be recorded:

- Local name of species: This would conform to the name recorded in Form 5.1.
- Local names of varieties: All locally known varieties of cultivated plants/ domesticated animals may be listed.
- Local names of other similar varieties: This would provide an indication of the attributes of the variety under consideration.
- Time taken to reach maturity: Time taken for production of seed or young.
- Type of soil/cultivation/ animal husbandry practice most suitable for the variety: All pertinent local knowledge may be recorded under this head. This could be of an extensive textual write-up.

- Size at maturity - specify measure and unit. If local measures are used, their equivalence in standard CGS measures should be provided.
- Susceptibility to: Pests, D-diseases, Low M-moisture, WL-Water logging
- Yield – annual: Product, Measure, Unit. If local measures are used, their equivalence in standard CGS measures should be provided.
- Values assigned by local community members: These would be selected from: 1. Of great value, 2. Of moderate value, 3. Of little value.
- Part used: For instance, root in case of a tuber crop, or wool in case of sheep.
- Uses, including symptoms treated in case of medicinal uses
- Change in uses over the last ten years: Thus a rice variety may have been used earlier as medicinal; but, may be now being used only as food.
- Significant harvests; nature of material harvested: Thus harvests may be of seeds, or leaves or eggs or meat or dung etc.
- Pin code of the destination of the harvests: Pin-code of the nearest, significant market town or city to which a significant proportion of the harvests is exported.

20.3 Interviews

Appropriately designed interviews would provide information on status, dynamics, and management issues relating to various focal taxa and species

groups selected for further documentation. Forms 13.1, 13.4a, and 13.4b indicate details of the points on which information may be recorded.

20.3.1 Form 13.1: Focal taxa status & trends in abundance

- Local name of focal species/ species group/ / functional species group/ variety: From Form 5.1.
- LSE/WSE types/ sub-types favored by the species / species group: Habitats in which the concerned are relatively more abundant.
- Current level of abundance: To be selected from:
 - 1 - Absent
 - 2 - Rare
 - 3 - Moderately common
 - 4 - Abundant
- Trend and reasons behind trend
 - ✓ Trend in abundance in last 10 years: To be selected from:
 - 1. Substantial increase
 - 2. Moderate increase
 - 3. Little / No change
 - 4. Moderate decrease
 - 5. Substantial decrease
 - ✓ Immediate reason & motivation: Thus, the abundance of weedy *Eupatorium* may be increased due to fires. There may

be other manifold complex reasons also, and these may be discussed at length.

- ✓ Long term reason & motivation: Fires may be being set to improve grazing resources, or to facilitate collection of Mahua seeds etc. There may be manifold complex reasons, and these may be discussed at length.

20.3.2 Form 13.4a: Focal taxa status & trends in management

The information in this Form would follow the same pattern as suggested for Forms 9.1b and Form 9.2b in Sections 18.1.3 and 18.1.4 above.

- Local name of species/ species group/ functional species group
- Changes in goods and services and reasons
- Change in goods & services
 - ✓Immediate Reason
 - ✓Long term reason
- Existing managing authority, system and gainer - loser
- Existing managing authority
 - ✓Existing management system
 - ✓Gainer user group Local:
 - ✓Gainer user group External:

✓Loser user group Local:

✓Loser user group External:

- Managing authority, system and gainer - loser in recent past
- Other management patterns prevalent in recent past

✓Gainer user group Local:

✓Gainer user group External:

✓Loser user group Local:

✓Loser user group External:

20.3.3 Form 13.4b: Desired changes, management system from the perspectives of different user groups and suggested components for management regarding focal Species(management).

The information in this Form would follow the same pattern as suggested for Forms 9.1b and Form 9.2b in Sections 18.1.3 and 18.1.4 above.

- Local name of species/ species group/ functional species group/ variety
- User group code
- Desired changes/ desired future
- Desired management system from the perspectives of different user groups
- Suggested components for a management plan that can be implemented under present circumstances as a consensus of the gram sabha

21 Knowledge

21.1 Public versus confidential

In parallel with this documentation of habitats and species, may go on a process of documentation of people's knowledge regarding these entities. Consider the issue of control of leaf miner, a moth whose caterpillar is a major pest of groundnut as well as soyabean and some other crops. Farmers have a number of thumb rules as to the climatic conditions under which leaf miner populations either thrive or are suppressed. There is little good scientific data on this matter, and there may be much to be gained by combining farmers' knowledge with scientific knowledge. In this case the farmers may be very happy to make their knowledge publicly available and may not wish to insist on any intellectual property rights (IPR) and maintenance of confidentiality.

Consider, as a second case, use of traditional herbal remedies to treat sheep diseases. Such knowledge may be being lost rapidly as younger people become increasingly alienated from nature and it may be very worthwhile to record it. However, there may be definite possibilities of commercial exploitation of such knowledge and the knowledge holder/s may wish to assert their IPRs and make the knowledge available only to specific parties under specified conditions. As explained above in Section 5.5 (see diagram 2), documentation of such knowledge may be taken up after a proper system for the management of confidential information has been put into place.

21.2 Uses

At this stage, we will record a limited range of information on uses of the focal set of species, ensuring that people have no hesitation in making it public. Form 13.3 indicates details of the points on which information may be recorded.

- Local name of species/ species group/ functional species group: From Form 5.1.
- Values assigned by local community members: To be selected from:
 - 1 - of great value
 - 2 - of some value
 - 3 - Of no significance
 - 4 - Some what nuisance
 - 5 - A great nuisance
- Part used: For example, root or feather
- Uses, including symptoms treated in case of medicinal uses
- Change in uses over the last ten years: To be selected from:
 - 1) Substantial increase
 - 2) Moderate increase.
 - 3) Little \ No change
 - 4) Moderate decrease
 - 5) Substantially decrease
- Significant harvests; nature of material harvested: Thus harvests may be of seeds, or leaves or eggs or meat etc.
- Pin code of the destination of the harvests: Pin-code of the nearest, significant market town or city to which a significant proportion of the harvests is exported.

21.3 Ecological knowledge

In addition, an attempt should be made to document the extent of the ecological knowledge of the people in a free-hand fashion on the basis of the checklist provided in Form 14.1. For this purpose, a small number, 5 to 10 of species most significant from people's perspective, perhaps representing the most important fish and shellfish, bird, wildlife and medicinal and food plant species may be chosen as the focal species.

- Local name of the focal species/ species group/ functional species group (knowledge): From Form 5.1
- Abiotic conditions favouring the focal species/ species group
- Type of ecosystems favouring the focal species/ species group
- Food organisms of the focal species/ species group
- Foraging and feeding behavior
- Competitors of the focal species/ species group
- Competitive behavior
- Predators on the focal species/ species group
- Predator avoidance behaviour
- Parasites/ diseases of the focal species/ species group
- Parasite avoidance behaviour
- Organisms favouring focal species/ species group, e.g. pollinators, seed dispersers

- Life history stages
- Parental care
- Breeding behaviour
- Social habits
- Territorial behaviour
- Communication behaviour, displays, calls, scent markings
- Seasonal changes in the abundance of members of the focal species/ species group
- Consequences of ecological processes like fire or grazing
- Human influences on focal species/ species group

22 Management

An important outcome of the PBR exercises would be the preparation of a Management Plan to support the activities of the local Biodiversity Management Committee (BMC). The plan may provide inputs on specific follow up actions relevant to the implementation of the Biological Diversity Act. Thus, it may include suggestions, with special reference to the area under the jurisdiction of the BMC, on: [a] constitution of heritage sites, for instance, in Mala people would like the area around a scenic waterfall conserved as a heritage site; [b] declaration of threatened species, for instance, in Mala, and perhaps all over Karnataka Western Ghats it might be appropriate to declare a *Myristica* swamp species, *Myristica fatua* as a threatened species; [c] ban on harvest of some species, for instance, in Mala it might be prudent to temporarily ban all harvests of highly depleted fish species belonging to genus *Channa*; [d] regulation of

harvests of other species, for instance, in Mala, it might be prudent to strictly regulate harvests from the highly overexploited *Garcinia cambogea*; [d] levying of collection charges from outsiders harvesting certain species, for instance, in Mendh-Lekha the Panchayat could raise substantial funds by levying charges on collection of Tendu and Mahua; [e] regulation of outsiders engaging in recording of knowledge associated with biodiversity along with levying of some collection charges.

A variety of activities relating to decentralized planning for management of natural resources are already under way in different parts of the country. These include Watershed Development Plans as also Joint Forest Planning and Management. These activities are obviously complementary to PBR Management Plan preparation and should be properly coordinated. The main difference amongst them is that the Watershed Development and Joint Forest Management Plans pertain to one particular sector and are expected to be very detailed. The PBR Management Plans will have a broader scope and would provide a framework for more detailed plans. Such detailed plans may pertain to themes like: [a] Local breeding and release of biological control agents for control of the leaf miner pest of groundnut, [b] Implementation of total ban on dynamiting and poisoning of streams in course of fishing in streams and ponds, [c] Long term conservation of sacred groves, [d] Elimination of stagnant water pools providing habitats for mosquito breeding around habitations, and so on.

In the initial phase of PBR preparation, the management plan may focus on management of some better known groups of organisms such as medicinal and other economic plant resources, or on fish, and shellfish. We quote here two interesting examples of how such broad plans may be elaborated.



22.1 Box: A management plan for medicinal plant resources of Nagavalli

The first example is provided by a school level study conducted in support of the preparation of the Karnataka Biodiversity Strategy and Action Plan. As a part of this effort, a team of teachers and students, led by Shri B.V. Gundappa, a Biology teacher in the local Pre-University College, made an assessment of the medicinal plant resources of Nagavalli Village Panchayat (Tumkur taluk, Tumkur district, Karnataka) on the basis of individual and group interviews. During these discussions the local people came up with the following proposals:

A. Community members are afraid that the culture and tradition of which the use of medicinal plants is an integral component may come to an end with their generation. To forestall this, they suggest that a series of steps be taken urgently:

- Create awareness regarding medicinal plants among people.
- Prepare a checklist of locally accessible medicinal plants.
- List the endangered and threatened plants amongst these.
- Enumerate the uses of different plants and how to use the plants as a medicine
- Place name boards over the trees/ plants with uses.
- Prepare information material on plants that can be grown in the kitchen gardens.
- Arrange workshops on identification, uses, and conservation of medicinal plants for the local people.
- Develop projects for storage and preservation of the seeds and other parts of the plant at one center.

- Encourage work on cultivation and hybridization of these medicinal plants.
- Develop gene banks to protect endangered plants on the brink of extinction.
- Prepare an action plan regarding cultivation of endangered and threatened medicinal plants in restricted, protected lands.
- Create a park exclusively of medicinal plants close to the village and educate people who visit that park.
- Form a local body, to act like a watchdog, to prevent smuggling, excess cutting or collection of medicinal plants.

B. Measures for Protection of Habitat of Medicinal Plants:

- Not to disturb the existing landscape.
- Protect the medicinal plants occurring now in the agricultural lands.
- Reduce the use of chemical fertilizers and manure.
- Encourage biological control measures.

C. They suggested specific roles for the following agencies:

- Villagers: Try to acquire some knowledge of the medicinal plants available in their locality, and try to protect them, prevent smuggling, cutting, and destroying the medicinal plants.
- Forest Department: Prevent smuggling, theft of some of the trees like sandal, teak, neem etc. Establish nurseries, distribute seedlings and plants at a low cost and encourage farmers to grow economically valuable trees like sandal, teak, mango, silver oak by giving protection to them.

- Joint Village Forestry Committee: A committee involving both forest department, and village members should be formed, and it should identify empty lands near by village where nothing has been grown, and in those lands try to cultivate medicinal plants.
- Agricultural department: Establish research centers, nurseries, and medicinal plant gardens where information regarding cultivation of medicinal plants will be available, and medicinal plants will be supplied at nominal cost to the people. Establish a center where people can sell their products for a reasonable price.
- NGOs: Education and awareness creation regarding medicinal plants through posters, street plays, skills etc.
- Agencies preparing Ayurvedic medicines: Visit the locality on fixed days and purchase the medicinal plants. Encourage people who grow medicinal plants on an extensive scale by giving some incentives, such as loan, and subsidy.
- Gram Panchayat: Pass a resolution that people should take permission and clearance from Gram Panchayat when collecting medicinal plants and also when cutting trees like neem, mahua, Pongomia etc.
- Taluk Panchayat: Monitor the activities of Gram Panchayat and also help out interested people in maintaining and conserving medicinal plants.
- District Panchayat: Organize workshops for NGO's, Govt. officials, officers, teachers regarding the traditional uses and importance of medicinal plants and encourage them to continue those elements of the culture and tradition that are practical.
- A medicinal plants conservation agency should be formed, with sub-units in schools etc. This agency should monitor village level action plans prepared by the villagers.



22.2 Environmental problems of Chilika Lake and their solutions.

Another excellent example of a management plan, spontaneously arrived at by local citizens pertains to the Chilika Lake in Orissa. The Headmaster, Middle School, Kalupada Ghat submitted this plan to Dr. A.K.Patnaik, CEO, Chilika Development Authority on 31st December 2005 on behalf of the local community. This is quoted below, without any editing.

Problem 1: The Chilika Lake is gradually Slitting

Solution: The Chilika Lake is gradually silted with sedimentation and aquatic weeds and moss.

Hence the area and the water storage capacity is in down trend. Therefore living style condition of fishermen community and non fishermen community living in Chilika area put into trouble. The reasons for siltation are sedimentation by rivers flowing into Chilika, rioting of weeds and growth, of varieties weeds in neighborhood. More over we are throwing garbage daily to the lake which help for siltation.

The solution method of solution of above problems are:

- ❖ Management of sedimentation
- ❖ Protection of weeds
- ❖ Prohibition of throwing of garbage
- ❖ Opening of all new mouths
- ❖ Conservation of soil through mass plantation on adjoining and catchment area
- ❖ Better management of the lake involving local people
- ❖ Opening of new mouths where necessary
- ❖ Protection of flow of agriculture land
- ❖ Construction of ring embankment etc. is essentially required.

Problem 2 : Birds Problem in Chilika

Solution : Birds increase the scenery of the Chilika lake. For over clouded of birds, Chilika lake became active and resounded. Tourists coming to Chilika for enjoying birds but gradually birds population in Chilika is

decreasing. The reasons behind it are degradation of forests from adjoining land, dearth of food, action of hunters, use of chemical fertilizers and pesticides on agriculture land, plying of motor boat, lack of awareness among people for conservation of birds, inactiveness of Government to pronounce suitable policy for birds security.

Hence registration of forests with green vegetative coverage in south-East area and the Security of natural forests Nalabana is urgently required. Because, large number of birds are reside here by constructing their nest.

In case of necessity identification of security place of Birds in other sites and their development should be made use of zero net and siltation of Chilika mouth is another reason for food deficit of the lake water will be Chilika and will develop food production for birds and prohibition of veronct will solve the problem of food deficit of birds.

Appliance of chemical fertilizers and pesticides in adjoining agriculture land make pollution to the Chilika water and make harmful to the birds and few of them put into death. Few birds lost their breeding capacity. Hence use of the Chemical fertilizers on land may be prohibited, if it is not possible, arrangement may be made to draining of the alkine and polluted water of adjoining land direct to sea.

By plying of motor boat bird population also decreased . Due to engine sound of motor boat, collection food and breeding of birds hampering. The oil leakage from the engine soil on the lake water and stick to the wings of birds and they cannot fly. At long run the birds are die. Hence playing of motor boats in Chilika shall be prohibited or alternative measures taken to reduce the engine sound and leakage of oil. Alternative method may also be find out for providing income source for the bird hunters for their sustenance.

Birds population also decreased due to bird hunting. To protect bird hunting required legal provisions may also be made and for awareness generation among people workshops may also be organised,

Problem 3: Fishery resources

Solution: Fish production has been influenced to the economic condition of the local people of Chilika area. As such without destruction of fish production how fish production will be increased it is the responsibility of the local people. Catching of Juveniles should be completely prohibited to keep the mouths free. If the use of zero net be destroyed, traditional method shall be adopted during fishing operation, throwing of garbage to Chilika allowing the fellow of alkine polluted water catching of prawn juvenile will be prohibited then the fish production in Chilika will be improved.

Problem 4: Plying of Motor boat

Solution. Plying of motor boats in Chilika cause water pollution through leakage of oil contents

like petrol, diesel etc., for which fish eggs are destroyed. Fish production has been hampered. This also put an ii .: on economic condition of the local people. So playing of motor should be prohibited.

Problem 5: Prawn Culture Problem

Solution: The area of the lake is gradual!)' reduced due to prawn culture embankments (*gheri*).

This protects the growth of fish. Also the prawn culture increases the social disturbances by outsider non fishermen. Hence the prawn culture fields shall be completely evicted and the disturbances in this area may be protected.

Problem 6: Excessive use of Chemical fertilizers and pesticides

Solution: The Chemical *fertilizer and* pesticides are harmful to the culture. On the context of large scale use of chemical fertilizers and pesticides by the cultivators on their adjoining cultivated land alkine water flowing to Chilika and make water pollution and cause harmful to fish and juveniles and many fish suffered by disease. By taking these diseased fish as flood, human

kind are also suffered by various disease. Also by drinking of the polluted water and eating the disease fish birds are into death. Fish production in Chilika has been reduced and effecting the economic condition of local people. Hence without using chemical fertilizers and pesticides, if organic manure and scientific method shall be applied for protection of disease on agriculture fields.

Problem 7: Decrease of salinity in lake water

Solution: The salinity Quality of lake water help for development fish production in Chilika. The fishery resource of Chilika is the main resource for economic benefit for the Chilika area. The decrease in fish production hamper the economic growth of local people of Chilika area. *The* decrease in fish production hamper the economic growth of local people. To solve this problem steps may be taken to increase the salinity quality of lake water.

The main reason for decrease the salinity of water are soil erosion from adjoining land, stone crushing, destruction of forests, drainage of waste, for which the Jake has been silted and the salinity water n I. In past period, many channels were connected to the sea from the Jake. These channels were closed by siltation.

To solve the problem digging of Chilika is necessary steps may be taken to prohibit the entry of garbage, digging of all the channels including Palur to influx of safe water, in order to maintain the salinity of the water.

Problem 8 : Problem of over flooded and drainage of excess water and entry of saline water on adjoining agriculture land

Solution: India is basically an agrarian country moreover the people of Orissa are dependent on paddy cultivation. It is Primary occupation of the people. If paddy cultivation is disturbed for any reason, than the economical development of the people is not possible. The over flooded of Chilika and drainage of water, increase of salinity on agriculture land created major problem for the economic situation of local people. Hence the solution of these problems are necessary.

In rainy season Chilika lagoon has been over flooded and make waterlogged to the adjoining agriculture land and hence better crop could not been harvested. Besides the submersion of saline water continue for long period without driving away and deteriorate the,soil quality to the agricultural lands.

On the other hand the mouths of rivers and rivulets are silted.-The flood water creating waterlogged for long period and the crops destroyed.

To remove this difficulties digging of mouths, river mouths and canals from Kanas Block office up to Alibada Kharakhara via Balipada, Kholada etc.

Canal may be constructed from Gobardhanpur barrage up to Lunanadi from barrage to Talamala for irrigation purpose and in other places of Kanas Block. If these projects will be implemented, the problem of water logging will be removed and better crop can be harvested.

Problem 9: Communication Problem

Solution: Better communication facilities are the sign of a developed area. In absence of better communication facilities, the inhabitants of the area lagging behind socially, economically and in health status and enjoying a better communication facilities are required in Chilika area .

For non availability of better communication the people of rural villages of Chilika island facing many problems. Hence communication facilities from village may be developed. Construction of a pacca road from Bhusandpur to Sunamuhin in Chilika belt may be made. Repair of road where necessary may be done.

Problem 10: Problem of growth of aquatic weeds

Solution: To meet the requirement of food stuff of increased population of the country, cultivation of hybrid paddy is essentially necessary. For cultivation of hybrid paddy, farmers use chemical fertilizers and pesticides on adjoining land flow into Chilika water and helping-the growth of weeds and moss in the lake. The rots of the weeds and moss silting the lake. Hence steps may be

take to control the growth of weeds and moss awareness generation among the people as well as an alternative action plan.

Problem 11 : Degradation of forests and reduce of trees

Solution: Tree is the life. Plantation of tree around Chilika lake will increase the natural scenery and help in timely rain, soil conservation and living places for birds. Conservation of tree, forests and plantation of tree around Chilika lake is essentially required.

The Casuarina forests of costal belt has been destroyed by the domestic animals and local people and saline water submerged to the agriculture land and destroying crops. So casuarinas forests, and Government may also taken steps for conservation of it.

Problem 12: Education and health Problem

Solution: Education and health are fundamental right of humankind. Therefore emphasis should be given on these on these two issues of the people of Chilika area.

There are many villages in Chilika Island which has no communication facility and people of these villages depend on boat service. Moreover within 22km radius from Khajuria there is no health centre or dispensary. Hence for establishment of a upgraded hospital at Khajuria with improved equipment, staff, with high potentiality given priority.

The water resources are contain saline contents and became polluted. Steps may be taken to provide potable drinking water to every village. For every family sanitary latrines may be constructed. If the above programmes are implemented the health status of local people will be improved.

There is no infrastructure for vocational education and the unemployment problem increased. Arrangement for establishment also reduce the pressure over Chilika by the local people to some extent.

Problem 13: Prawn culture rings

Solution: The area of the lake is gradually reduced due to prawn culture embankments (*gheri*).

This protect the growth offish. Also the prawn culture increase the social disturbances by outsider non fishermen. Hence the prawn culture fields shall be completely evicted and the disturbances in this area may be protected.

Problem 14: Use of zero-net (*the mesh size of the net is very small*) and catch of juveniles

Solution: For catching of juveniles and use of zero-net the fish production in Chilika has been reduced and it is apprehended that the fishermen community will suffer. Due to decrease in fish production and catch fish quality, the dry fish business of women folk also reduced and economic condition of the fishermen community is badly affected. Therefore they could not give marriage to their daughters which creating instability in society.

Hence use of zero-net, catch of juveniles should be prohibited and steps taken to make planning's for their development of fish production otherwise the fishermen community will be turn into a neglected society. This will stand as a major problem for the country.

Problem 15: Role of outsider non-fishermen unsocial elements

Solution: Leasing out of the fishery resource on lease and sublease basis to the influenced persons and the outsiders should be discontinued. All the fishery sources shall be settled with the local fishermen. By this change the lake will be from social problems.

Problem 16: Entry of non-fishermen community

Solution: By the entry of non-fishermen community in Chilika, economic condition of fishermen community has been affected. Disturbances between fishermen and non-fishermen people is increased. Law and rules may be made to prevent entry of non-fishermen people. In case of poor person among the non-fishermen people alternative activities may be provided for their sustenance.

Problem 17: People of Chilika area are completely dependant on Chilika

Solution: The people of the adjoining villages of Chilika belt are completely dependant on this natural resource for sustenance, because their cultivated land damages the crops. Besides increasing of the pressure by the people many problems facing by the lake. Hence to reduce the pressure of local people, alternative income generation activities may be implemented. Such as repair of ring embankment construction of new embankment. The tourist places may also be developed, vocational education centre establishment to provide employment. Establish income generation cooperative societies.

Problem 18: Lack of awareness among the people

Solution: Lack of awareness among the people of Chilika area. People are illiterate and ignorant and do not understand the natural and man made problems. Hence they must be educated and made aware on this issue so that people can understand their role and responsibility and come forward to solve the problems.

Problem 19: Lack of unity among the people of Chilika area

Solution: Due to lack of unity among the people of Chilika area encroachments by the influenced outsiders and political persons are increased. Hence all persons of this area must be united in a common platform. They should be educated and made aware to get together which will help them to solve their problems themselves.

Problem 20: Indifference by Government

Solution : Due to indifference attitude of Government the influenced outsiders and political persons getting more benefit, moreover the wrong policy of Government the influenced outsiders and political persons are getting more benefit. If the Government will take appropriate step for security of the Chilika, then the influence of outsiders and political persons will be reduced. By better management of the lake, it will get it's previous glory.

Problem 21: Economic Problem

Solution: The fishermen community living in Chilika area are not having proper facility and economically storage due to non- availability of marketing. The market complex may be constructed and connected with outsiders market for better market offish production through scientific method, so that the economic condition of fishermen community will be improved.

Problem 22: Drinking water Problem

Solution: Water is life. The water resources like well, tanks, tubewells are contains saline contains and harmful to health. Hence portable drinking water may be supplied from different rivers or fresh water sources to the villages.

22.3 Follow-up of management planning

It is hoped that the management plan would lead to a number of useful follow up actions. These may include:

Strengthening of traditional conservation practices such as sacred groves.

Harvest regulation: For, instance, exclusion of grazing from certain grasslands during the monsoon months, followed by hand harvesting of fodder in the months of September- November.

Imposition of collection fees: For, instance, on collection of Sikekai *Acacia concina*, ponds for Panchayat lands.

Better access to markets: For, instance, for organically produced cereals.

Value addition: For, instance, local level processing of *Garcinia indica* fruits.

23 National level support

This programme will need to be provided broad technical support at the national level though a series of activities indicated in Box 23.1.



23.1 Box: An action plan for a National Technical Support Group

Establishment of an Indian Biodiversity Information System incorporating PEBINFO

Creating web-compatible, free software versions of PEBINFO

Preparing more user-friendly versions of methodology manual

Preparation of resource material, including interactive identification keys for an initial set of [a] medicinal and other economic plants, [b] birds and some

prominent wildlife species [c] landscape and waterscape element types; in English as well as major Indian languages

Preparation of:

A] Country-wide inventory of focal issues

B] Country-wide inventory of focal species of local interest, local and scientific names, significance

C] Country-wide system of classification of landscapes and waterscapes

D] Country-wide system of classification of User Groups

Preparation of resource material, including interactive identification keys for country wide set of focal species and landscape and waterscape element types

Finalizing a system of management of confidential information

Building Capacity for Resource Management:

Developing resource material for sustainable harvests, storage, preliminary processing, local value addition and efficient marketing of biodiversity resources

Disseminate resource material and organize training programmes and field trials



24 Acknowledgements

The development of the methodology and the database for preparing **People's Biodiversity Registers** has been a co-operative effort stretching over a twelve year period. It has therefore involved hundreds of people, from scientific and educational institutions, from Government agencies, from NGOs and from local communities, of all ages from young students to elderly

dispensers of herbal medicines, from all parts of the country. We apologize that we are not able to name them individually in this document. The endeavor has been consistently and generously supported by the Ministry of Environment and Forests, and the Department of Biotechnology of the Government of India. It has also received financial and technical support from the Department of School Education Research and Training of the Government of Karnataka, the World Wide Fund for Nature (India), and the Millennium Ecosystem Assessment.

25 Appendix 1: Possible applications of information collected through the PBR process from the perspective of the local community members

25.1 Crop Fields and Orchards:

- Good information on identity of pests and diseases of crop fields and orchards and on effective and environment friendly control measures could help reduce chemical input and increase both profitability and sustainability of agriculture.
- Such information could also be used to promote biological control measures including local production of biological control agents.
- Good information on nutrient/ micronutrient status of soils and on composting/ vermiculture could help reduce chemical input and increase both profitability and sustainability of agriculture.
- Good information could help maintain and locally add value to indigenous crops and varieties. Thus, grain Amaranths are an excellent protein source, Kokum (*Garcinia indica*) has much value in food and pharmaceutical industry, Koraput in Orissas grows Kala jeera and many other rice varieties with medicinal value. Several crop cultivars are resistant to specific pests and diseases, e.g. Pattambi rice against leaf hopper.
- Good information could help promote on-field conservation measures of crop varieties and claim rewards for farmer-conservators under the Protection of Plant Varieties and Farmers' Rights Act.
- Good information could help promote positive role of non-cultivated plants and animals associated with agro-ecosystem, e.g. weeds serving as leafy vegetables; fish, crabs, even edible rats from paddy fields.
- Good information could help press for protection of crops against pollution e.g. from Cement factories by generating good evidence. Thus

lichens serve as bio-indicators of air pollution and could be monitored locally.

- Good information could help in developing a database on pests and diseases to fulfill requirements of international conventions pertaining to export of agricultural commodities.
- Good information could help explore possibilities of introducing / reintroducing multiple cropping systems.

25.2 Animal husbandry:

- Promote on-field conservation measures for land races of domesticated animals, e.g. ducks, fowls, livestock, donkeys, pigs, camel, yak, mithun etc.; several of them are resistant to specific diseases and have special characteristics as well as cultural values attributed to them. It is likely that in near future there will be rewards for herder-conservators like those for crop cultivars under the Protection of Plant Varieties and Farmers' Rights Act.
- Conserve the knowledge of traditional remedies for livestock diseases and promote their continued application where appropriate.

25.3 Tree plantations by farmers:

- Information may be generated to suggest alternative sets of species of fuel, fodder, fencing, fruits, mulch, nectar source, bio-cosmetic, structural material or other values.
- Monitor market prices available at various major markets for future planning.
- Monitor and generate good information on pollution threats such as from spraying of Endosulfon on cashew plantations.

25.4 Trees associated with Farm bunds:

- Maintain, restore and add value to trees associated with Agriculture such as khejadi, neem, arjun, bamboo, *Acacia arabica*, *Thespesia populinea* (Ran Bhend) and honge.
- Plan Agro-forestry activities.

25.5 Government Forest Lands:

- Promote provision of goods and services from forest lands to rural economy; encourage maintenance of watershed services, grazing resources.
- Work out methods and schedules of sustainable harvests of minor forest produce.
- Promote value addition to minor forest produce.

- Record and check destructive harvests by community members as well as outsiders. Many little known species such as the insectivorous plant *Drosera* are being collected and exported to Japan without any official agency being in the know.
- Establish proper links to JFM.
- Maintain proper records of people- wild life conflict to devise ways of minimizing them and obtain due compensation.
- Promote traditional conservation practices like protection to sacred groves, trees and animals.
- Promote measures to control forest fires.

25.6 Community owned forest lands:

- Prepare detailed management plans for sustainable harvesting.
- Promote traditional conservation practices like protection to sacred groves, trees and animals.
- Promote measures to control forest fires.

25.7 Grasslands:

- Promote maintenance of grasslands.
- Devise methods and schedules of sustainable use of grazing resources.
- Promote planting of fodder trees, control of weeds on grassland.
- Promote traditional conservation practices with respect to systems like Orans of Rajasthan and bugyals in Himalayas.
- Record and appropriately regulate grazing pressure by outsiders and nomadic herders.
- Organize grazing regimes so as not to exceed the carrying capacity of grasslands
- Promote conservation measures for birds and other wildlife of grassland ecosystems.

25.8 Hilly Lands:

- Promote maintenance of natural biological communities on hill slopes.
- Promote agro-forestry models on lands under shifting cultivation.
- Promote soil conservation measures.
- Promote moisture conservation measures.
- Promote maintenance of hills supporting natural communities in urban areas for their recreational value.

25.9 Ponds, lakes, streams and rivers:

- Promote maintenance of natural biological communities in water-bodies.
- Promote maintenance of ponds, lakes, streams and rivers supporting natural communities in urban areas for their recreational value.

- Protect water-bodies from encroachments, reduction of water inflow from catchments.
- Promote eradication of alien invasive species like water hyacinth and African catfish from water-bodies.
- Organize effective pollution monitoring using more accessible bio-indicators such as Chironomids.
- Promote traditional conservation practices like protection to sacred ponds, fish and heronries.
- Promote sustainable fishing practices such as protection to fish migrating upstream for spawning.
- Promote traditional conservation practices like protection to sacred stretches of rivers, fish and dolphins.
- Document and regulate destructive fishing practices such as use of dynamite and pesticides.
- Forge proper links to Watershed programmes.

25.10 Seas:

- Promote sustainable fishing practices
- Organize effective pollution monitoring using, where possible, more accessible bio-indicators
- Document and lobby for regulation of over-fishing, especially by foreign vessels.
- Record and check destructive harvests by community members as well as outsiders. Many little known species of marine organisms such as sponges and sea pens are being collected and exported without any official agency being in the know.

25.11 Sea coast:

- Forge proper links with Coastal Regulatory Zone programmes.
- Promote maintenance of coastal areas supporting natural communities for their recreational value.

25.12 Roads:

- Promote planting of a variety of indigenous evergreen trees and other plant species along roads and highways.
- Organize pollution monitoring using bio-indicators such as lichens.

25.13 Habitation:

- Promote traditional conservation practices like protection to sacred trees and animals.
- Promote biodiversity rich natural communities in parks and open spaces around habitations.

- Promote cultivation of nutritious plants such as leafy vegetables and medicinal plants in kitchen / home gardens.
- Promote technique of roof-top gardening in urban areas.
- Monitor spread and impact of pollutions like air, water, vehicles etc in urban areas.

25.14 Institutional Lands:

- Promote biodiversity rich natural communities and plantation of medicinal/endangered, shade giving species in open spaces.
- Promote bio-fencing

25.15 Industrial Establishments:

- Promote biodiversity rich natural communities in open spaces.
- Organize effective monitoring of pollution using more accessible bio-indicators such as lichens and chironomids.
- Promote bio-fencing

25.16 Public health:

- Monitor populations of vectors of human diseases and devise newer methods of control as the older chemical methods are proving ineffective.
- Monitor microbial pollution of water sources and devise ways of provision of safer drinking water.

25.17 Human resources:

- Promote recording of traditional knowledge as well as grass-roots innovations associated with biodiversity such as medicinal uses, vegetable dyes, cosmetics, pest control agents. This should be accompanied by appropriate measures for regulation of access to this information, protection of intellectual property rights and equitable sharing of benefits.
- Promote recording of folk arts and crafts associated with biodiversity, accompanied by appropriate measures for regulation of access, protection of intellectual property rights and equitable sharing of benefits.
- Involvement of students and teachers in first hand collection of information in the PBR exercises would enhance the quality of their education.
- Use of modern Information and Communication Technologies in the PBR exercises would provide excellent opportunities for human resource development.

26 Appendix 2: Principles of the Ecosystem Approach adopted by CBD

3. The objectives of management of land, water and living resources are a matter of societal choice.
4. Management should be decentralised to the lowest appropriate level.
5. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
6. Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should: a) Reduce those market distortions that adversely affect biological diversity; b) Align incentives to promote biodiversity conservation and sustainable use; c) Internalize costs and benefits in the given ecosystem to the extent feasible.
7. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the ecosystem approach
8. Ecosystems must be managed within the limits of their functioning.
9. The ecosystem approach should be undertaken at the appropriate spatial and temporal scales.
10. Recognising the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
11. Management must recognise that change is inevitable.
12. The ecosystem approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.

13. The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
14. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.

27 Appendix 3: Salient features of Memorandum of Agreement between knowledge holders of Mala Gram Panchayat, Karkala taluk, Udupi district, Karnataka and the National Innovation Foundation

[1] MoA between individual knowledge holder / community with NIF to include information in PKD and also possibly in the National Register being prepared by NIF. This will help knowledge holder / community to retain the claim and confidentiality, if needed over the knowledge deposited with NIF without changing right of knowledge holder / community over it. This does not mean that this traditional knowledge or innovation or practice may not have been reported by some third party already or may not be reported directly later or may not already have been put in public domain.

[2] MoA highlights need of differentiating between information already in public domain / documented without the consent of the knowledge holder/s and the documentation with mutual agreements such as MoA / PIC.

[3] NIF is engaged in scouting, documenting, augmenting, and adding value to the innovations and traditional knowledge of the innovators at the grassroots level. NIF is mandated to develop a National Register of traditional knowledge and contemporary unaided grassroots innovations. NIF is also engaged in strengthening R&D linkages between the scientific institutions and grassroots innovators and traditional knowledge holders so as to promote commercial and non-commercial applications of grassroots innovations and traditional knowledge.

[4] NIF also wishes to enter into an agreement with the traditional knowledge holder/community so as to add value, wherever possible, to the people's knowledge, innovations and practices of both contemporary and

traditional origin and disseminate the same, protecting *inter-alia* the intellectual property rights of the knowledge holders as applicable in each case and ensuring equitable share of benefits wherever applicable.

[5] Now therefore both the parties hereto agree as follows:

a) That the traditional knowledge holder will provide the complete information/particulars to NIF in order to enter the traditional knowledge in its data base (PKD) and if possible in the National Register. NIF may also consider the traditional knowledge to be included in the list for the award in the next and subsequent biennial competitions.

b) That, the traditional knowledge holder/community has agreed for publishing indicative information of traditional knowledge along with contact address on the internet/Honey Bee magazine or any other media with the precaution so that their detailed traditional knowledge does not become public.

c) That, the traditional knowledge holder/community has agreed to share the traditional knowledge with the third party(s) on exclusive and /or non exclusive basis only if the written consent from traditional knowledge holder(s)/community for sufficient amount of money is received in return as per the milestones of value addition and/or commercialization where applicable. However the traditional knowledge holder(s)/community can share the traditional knowledge for individual use and/or for further R&D in order to add value to it.

d) That the traditional knowledge holder/community has agreed to allow NIF to use the information for product research and development purpose so long as the intellectual property rights are intact/protected and traditional knowledge holder(s) is/are going to receive the benefit out of it. NIF will take care that in any circumstances, the confidentiality of the knowledge is maintained by research team involved in the product research and development process.

e) That NIF will add the information/particulars, pertaining to a specific traditional knowledge to People's knowledge database and / or National Register if found suitable. The information can be made available to a third party only with informed written consent of the traditional knowledge holders(s) (or in case he/she has expired, his/her legal heirs) and on the terms and conditions including benefit sharing indicated by the traditional knowledge holder/community.

f) That the benefits, arising from the possible commercialization of the traditional knowledge being improved by NIF on the basis of the basic information provided by traditional knowledge holder/community, will be shared among various stakeholders (including other communities providing same or similar information, third party researchers/business plan developers) as per the terms and conditions agreed upon by the concerned innovator(s)/traditional knowledge holders in consultation with NIF.

g) NIF can facilitate IPR in cases where applicable.

h) That in case of substantial improvement being done by the scientist(s) contracted by NIF, the concerned scientist(s) may be named as the co-inventor and a part of the benefit may be shared with him/her as well as other stakeholders such as the institutions like GIAN, NIF or their sister institutions, for meeting institutional overheads or for conservation of nature or community development or innovation fund for helping other communities or innovators etc. as per the mutual consent of the traditional knowledge holder/community and the concerned person/s and NIF.

i) That in the case of the publication of the outcome of the research and development the prior informed consent will be taken from the traditional knowledge holder(s)/community and in the publications due credit will be shared with the traditional knowledge holder(s)/community.

[6] That both parties shall indemnify, defend, protect and hold harmless each other and its respective successors in case any of the party fails to discharge its obligations.

[7] This MoA shall remain in force for a period of TWO years, and can be renewed for two additional terms of two years each that is for six years after which it will be reviewed. Review can take place earlier also through mutual consent. It is however assured that the confidentiality of the knowledge deposited with NIF on conditions specified will be respected in perpetuity unless otherwise agreed upon in writing by the knowledge holder(s)/community regardless of this process of review. It is possible that knowledge provided by a particular individual / community may have been communicated by another individual(s) / community(ies) directly to NIF or may already exist in public domain due to prior documentation by third party. In such cases NIF may share such knowledge as per the existing conditions but without sourcing the community which has provided knowledge in PBR unless so authorized.

[8] That all disputes arising out of this agreement shall be settled through conciliation by a mutually agreed person, and shall be governed by the provisions of the Arbitration and Conciliation Act 1996. The place of conciliation shall be at Ahmedabad, Gujarat, India.

Signed by Traditional knowledge holder, NIF representative and BMC Chairperson / Panchayat Secretary.

28 Appendix 4 Biodiversity related topics for extra-curricular projects for Primary, High School and College students that will support PBR activities.

Students may undertake projects based on three kinds of activities: observations, experiments and computer based interactive learning, games and simulations. Any of these three kinds of projects may be designed for the various topics.

Diversity of living organisms

Diversity is a hallmark of life.

Observations:

Variety of grains, fruit, vegetables, fish used at home and in local market. Variety of plants in gardens and along roads. Variety of plants in farms, orchards, forest. Variety of fish, frogs in rivers, ponds. Variety of birds. Variety of size, body shape, colouration in dogs. Microscopic forms of life from pond water. Folk knowledge of diversity of life forms.

Range of variation in size and complexity.

Observations:

Size range: smallest plant in flower to largest tree. Soil organisms, smallest invertebrates to largest mammal. Microscopic forms of life to largest fish or turtle in aquatic habitats.

Degrees of similarity amongst living organisms. Hierarchy of taxonomic categories.

Observations:

Different life forms of plants: herbs, shrubs, non-woody climbers, woody climbers, trees, epiphytes. Different species of grasses, cereal crops, compared to Chrysanthemum, marigold, safflower, sunflower. Different species of pea family: wild and cultivated herbs, shrubs, climbers, trees. Compare leaves, flowers, fruit, seed. Variety of insects at a light trap. Compare insect wings and mouth parts. Moths and beetles. Snails and bivalves in aquatic habitats. Land snails. Use of taxonomic keys. Folk systems of classification of living organisms.

Computer based interactive learning, games and simulations:

Interactive identification keys for different taxonomic groups. Measures of similarity for the various attributes of specific taxonomic groups such as flowering plants or birds in the data base of the identification keys.

Levels of diversity within different taxonomic categories.

Observations:

Number of seemingly different kinds of species of plants observed around school. Number of seemingly different kinds of species of birds observed around school. Number of seemingly different kinds of species of moths and beetles in light trap collections. Number of seemingly different kinds of species of ants. Number of seemingly different kinds of species of soil invertebrates. Number of seemingly different kinds of species of snails. Number of seemingly different kinds of species of fish in a lake or stream. Preparing species inventories. Correlating local and scientific names.

Genes as the basis of heredity. Development of an organism as a result of gene-environment interaction.

Observations:

Different traditional and modern varieties of cultivated crops. Variation amongst plants of a given variety attributable to soil, water, nutrient, light availability. Different traditional and modern varieties of chicken, dogs and cattle.

Genetic diversity. Levels of genetic diversity within species.

Observations:

Human blood groups.

Evolutionary history. Tendencies towards increasing levels of complexity and diversity.

Computer based interactive learning, games and simulations:

Computer simulation of a process of evolutionary diversification. Advantage of size in escaping predation and in adding smaller organisms to diet.

Episodes of mega-extinctions.

Computer based interactive learning, games and simulations:

Computer simulation of a process of evolutionary diversification, with slightly higher rate of origin of new, as compared with extinction of extant taxa. Chance episodes of large scale extinctions.

Current upsurge in extinction rates. Local and global extinctions.

Observations:

Estimates of rates of local extinctions of species of medicinal plants, fish, larger wild mammals from interviews of knowledgeable individuals.

Current upsurge in rates of invasion of exotic species.

Observations:

History of invasion of exotic weeds, diseases of crops and insect pests from interviews of knowledgeable individuals.

Current upsurge in rates of introduction of new high yielding species and varieties.

Observations:

Which species and varieties of cultivated plants and domesticated animals have been newly introduced to the locality?

Threatened eco-regions.

Threatened habitats.

Observations:

History of transformation of the major types of habitats in and around the school from interviews of knowledgeable individuals. Which habitat types are disappearing from the locality?

Threatened species and varieties.

Observations:

History of change in the abundance of notable species of plants, birds, fish from habitats in and around the school from interviews of knowledgeable individuals. Which naturally occurring species seem to be disappearing from the locality? Which species of cultivated plants seem to be disappearing from the locality? Which varieties of cultivated plants and domesticated animals seem to be disappearing from the locality?

Diversity of ecosystems

**Life as a process of interaction of organisms and their environment.
Abiotic conditions governing life processes. Light.**

Observations:

Herbaceous plants growing in the open as compared to under deep shade of a tree or a building.

Abiotic conditions governing life processes. Temperature, water.

Observations:

Herbaceous plants growing in water, at the margin of a pond, on dry ground close by. Structure of aquatic, moisture loving and dry land plants. Crop species grown under irrigation and rain fed conditions. Response of crops to long periods of drought or heavy rainfall. Outbreak of certain pests and diseases in conjunction with certain weather conditions.

Abiotic conditions governing life processes. Fire.

Experiments.

Composition of plant community in relation to incidence or absence of fire.

Observations:

Composition of forest understory plant community in relation to incidence or absence of fire. Composition of insect community before and following a fire. Weather and vegetational conditions favouring fire.

Abiotic conditions governing life processes. Nutrients.

Observations:

Aquatic organisms living in clear, bluish water and nutrient rich greenish water. Crop species grown under conditions of extensive fertilizer application and without much fertilizer. Response of crops to manure/fertilizer application.

Abiotic conditions governing life processes. Pollutants.

Experiments:

Mortality of animals in response to addition of some pollutant such as an insecticide to a culture of flour beetles or *Corsera* larvae.

Observations:

Insect communities of crop fields prior to and following heavy application of pesticide. Herbaceous plant communities of crop fields prior to and following heavy application of weedicide.

Biotic interactions: Direct: mutualism:

Observations:

Lichens as a mutualistic association of algae and fungi. Role of insects in cross-pollination of crops. Role of sunbirds and flowerpeckers in pollination and seed dispersal of semi-parasitic mistle-toes. Role of animals and humans in dispersing grass and other fruit and seed that stick to the hair and fur. *Ficus* plants and fig wasps.

Biotic interactions: Direct: Herbivory.

Experiments:

Grazing exclusion *Experiments*.

Observations:

Grazing by cattle, sheep, goat- in forest, on gomal lands, on tank-beds. Insect pests of crops. Species identity, conditions favouring pest outbreaks, impact on host survival and yields. Crop damage by wild pigs, monkeys, peafowl. Feeding on fruit by barbets, koel, parakeets, fruit bats.

Biotic interactions: Direct: predation:

Observations:

Role of birds as insect predators in crop fields. Drongos and bee-eaters as predators on honey bees. Spiders as predators on insects. Egrets, herons, storks, cormorants as predators on fish.

Biotic interactions: Direct: parasitism:

Observations:

Parasitic diseases of crop plants and domestic livestock. Species identity, conditions favouring parasite outbreaks, impact on host survival and yields. Role of sunbirds and flowerpeckers in pollination and seed dispersal of semi-parasitic *Loranthaceae*.

Biotic interactions: Direct: competition.

Experiments:

Impact of plant density on survival, growth and seed production in herbaceous plants. Impact of density on survival, growth and reproduction in flour beetles, and aquarium fish.

Observations:

Weeds in crop fields. Species identity, conditions favouring weed abundance, impact on crop plant survival and yields. Impact of Parthenium on grass and herb production and of Eupatorium on regeneration of trees.

Biotic interactions: Indirect: habitat transformation.

Observations:

Impact of water hyacinth and other similar weeds on aquatic habitats. Water hyacinth and abundance of mosquito larvae.

Ecosystems as interactive systems of biological communities and their physical environment. Aquatic and terrestrial ecosystems. Biomes. Natural and managed or wholly artificial ecosystems. Ecosystem mosaics.

Computer based interactive learning, games and simulations:

CD based spatial data. French Institute vegetation maps, Wasteland maps, Survey of India toposheets, revenue maps. Satellite imagery. Raw data and supervised classification. Interpretation of local toposheets and revenue maps. Participatory mapping.

Landscape and waterscape element types.

Observations:

Field identification of landscape and waterscape element types. Preparation of landscape maps.

3.Organism-ecosystem relationships

Life forms and diversity levels in different biomes, landscape and waterscape element types.

Observations:

Characteristic life forms present in different landscape and waterscape element types.

Species richness levels in elements of different landscape and waterscape element types.

Species-area relationships.

Observations:

Species richness levels in patches of different sizes in the different landscape and waterscape element types.

Computer based interactive learning, games and simulations:

Species- area curves for flowering plants and birds for individual patches, whole study area, and larger areas such as districts, state and country from CD based data base.

Generalist and specialist species.

Observations:

Occurrence of species in only one, or several of the different landscape and waterscape element types.

Movements and migrations.

Observations:

Occurrence of migratory bird species only during the winter season. Other local migrations of birds such as storks and pelicans. Seasonal aggregations and movements of Crow and Blue Tiger butterfly species.

Significance of biodiversity for humans

Humans as a complex organism, a product of a long process of evolution giving rise to complex ecosystems. Manifold interactions with biodiversity.

Goods and services

Food: extremely broad range, wild as well as cultivated. Spices and condiments.

Observations:

Major taxonomic groups and species of plants and animals represented in the food, spices and condiments: in markets, in home gardens, on farms and collected from the wild by different sections of the local population.

Domestication of a range of microbes, plants and animals.

Observations:

Use of microbes in fermentation processes during food preparation. Major taxonomic groups and species of domesticated plants and animals maintained at home and on farms by different sections of the local population. Wild relatives of cultivated plants and domesticated animals. Exchange of pollen amongst cultivated plants and their wild relatives. Exchange of pollen amongst genetically modified strains of cultivated plants and their wild relatives.

Manure for cultivated plants.

Observations:

Major taxonomic groups and species used as manure for the field in home gardens and on farms. Their occurrence in different landscape and waterscape element types.

Fodder for domesticated animals.

Observations:

Major taxonomic groups and species used as feed and fodder for cultured fish, poultry and livestock. Landscape and waterscape elements utilized by cultured fish, poultry and livestock. Food sources for domesticated silkworms and honey bees. Their occurrence in different landscape and waterscape element types.

Biomass as a source of energy.

Observations:

Dung and plant species used as fuel by different sections of the local population. Their occurrence in different landscape and waterscape element types.

Structural material for artisanal uses, construction, paper and polyfiber.

Observations:

Dung and plant species used as structural material, in house construction, for making furniture, baskets, mats, agricultural implements etc by different sections of the local population. Plant species used by paper and polyfiber industry. Their occurrence in different landscape and waterscape element types.

Drugs. Dyes.

Observations:

Animal and plant species used for their medicinal properties and in preparation of dyes by different sections of the local population. Their occurrence in different landscape and waterscape element types. Animal and plant ingredients of various medicines available on local market. Animal and plant ingredients of various medicines prescribed by local medical practitioners.

Ornamentation.

Observations:

Animal and plant species used for ornamental purposes by different sections of the local population. Their occurrence in different landscape and waterscape element types. Animal and plant species used for ornamental purposes available on local market.

Cultural, religious, aesthetic services.

Observations:

Animal and plant species imbued with cultural, religious, and aesthetic significance for different sections of the local population. Their occurrence in different landscape and waterscape element types. Specific landscape and waterscape elements such as hills, streams and sacred groves imbued with cultural, religious, and aesthetic significance for different sections of the local population.

Biocontrol agents. Pollination services.

Observations:

Role of birds, predatory beetles as predators on insect pests in crop fields. Use of special biological control agents by farmers. Role of insects in cross-pollination of crops.

Watershed services.

Observations:

Flows of water in otherwise comparable streams with or without a vegetation cover in the catchments.

Bads and disservices

Human predators, parasites and pathogens.

Observations:

Locally recorded cases of: elephants, tigers, sloth bears, wild pigs who may attack humans, or cobras, vipers and others whose bite may kill people. Their occurrence in different landscape and waterscape element types. Major taxonomic groups and species represented amongst human parasites and pathogens. Polluted water or other sources of human parasites and pathogens. Their occurrence in different landscape and waterscape element types.

Vectors of diseases.

Observations:

Major taxonomic groups and species represented amongst vectors of human diseases. Their occurrence in different landscape and waterscape element types.

Pests, weeds, predators, parasites and pathogens affecting cultivated crops, stored grains and domesticated animals, as well as other desirable organisms.

Observations:

Major taxonomic groups and species represented amongst weeds, pests and diseases of cultivated crops, pests of stored grains and parasites and diseases of domesticated animals. Wild dogs were viewed as enemies of deer and systematically eliminated in the past, are there any equivalents of this in the study locality?

Poisonous animals, aesthetically, culturally displeasing animals.

Observations:

Major taxonomic groups and species represented amongst such organisms, e.g. snakes, centipedes, scorpions and others are viewed as poisonous, owls may be viewed as displeasing or as a bad omen, and so on, by different segments of the society. Their occurrence in different landscape and waterscape element types.

Organisms changing the habitat to an undesired state.

Observations:

Major taxonomic groups and species represented amongst those viewed as changing the habitat to an undesired state, e.g. thorny plants, by different segments of the society. Their occurrence in different landscape and waterscape element types.

Diversity of human-ecoresources relationships

Hunting

Observations:

Variety of species hunted by different human communities, or different households, for self consumption, or for market, for food, medicinal or other purposes from different landscape/ waterscape elements

Fishing

Observations:

Variety of species fished by different human communities, or different households, for self consumption, or for market, for food, medicinal or other purposes from different waterscape elements

Gathering

Observations:

Variety of plant or animal species gathered by different human communities, or different households, for self consumption, or for market, for fuel, fodder, medicinal or other purposes from different landscape/ waterscape elements

Cultivation

Observations:

Variety of plant species cultivated by different human communities, or different households, for self consumption, or for market, for food, spices, fiber, fodder, medicinal or other purposes

Animal husbandry/ aquaculture

Observations:

Variety of animal species husbanded by different human communities, or different households, for self consumption, or for market, for food, wool, medicinal or other purposes in different landscape/ waterscape elements

Artisanal activities

Observations:

Variety of plant or animal species gathered by different human communities, or different households, for fabrication of baskets, mats, domestic, agricultural or fishing implements etc, for self consumption, or for market, from different landscape/ waterscape elements

Trade

Observations:

Variety of plant or animal species used by different human communities, or different households, for trade purposes from different landscape/ waterscape elements

Transport

Observations:

Variety of plant or animal species being transported into or out of the study locality by different human communities, or different households

Manufacture

Observations:

Variety of plant or animal species being employed in industrial manufacture in the study locality. Involvement of different human communities, or different households, in such activities.

Services like tourism

Observations:

Variety of plant or animal species or landscape and waterscape elements of the study locality that support service activities like tourism by different human communities, or different households

Livelihood activities often represent a mix of activities relating to ecoresources. Ecoresources Ecoresource user groups

Observations:

Major categories of livelihood activities relating to ecological resource base in the study locality. Number of households of different human communities belonging to the various categories of "Ecoresources Ecoresource user groups"

State, community and private property rights over land and water and living resources

Observations:

Ownership rights and privileges of access to land, water and living resources in different landscape/ waterscape elements within the study locality. Relative proportion of subsistence and cash-earning needs of different households of different communities fulfilled by accessing ecological resources under different ownership and access privileges regimes.

Global commons.

Intellectual Property Rights over living organisms and their products.

Observations:

Number of plant varieties under cultivation in the study area that are registered either as breeders' varieties or farmers' varieties under the *Plant Varieties Protection and Farmers' Rights Act*. Number of locally present species of plants and animals which appear in the CD based data base on patents relating to living organisms. Various local uses of such plants and animals.

Human impacts on ecosystems

Transformation of habitats.

Observations:

On-going processes of transformation of the different landscape/ waterscape elements of the locality into other types of elements on the basis of interviews of knowledgeable individuals.

Impacts of habitat fragmentation.

Observations:

Increase in incidence of species favouring habitat edges over those favouring habitat interior as a result of habitat fragmentation.

Habitat modification through setting of fires and grazing by livestock.

Observations:

Increase in incidence of fire tolerant and non-palatable species.

Transformations of natural ecosystems into managed ecosystems or wholly artificial ecosystems.

Observations:

Rates of transformation of natural or semi-natural habitats into agriculture, habitation etc on the basis of interviews of knowledgeable individuals.

Deliberate tradition- based attempts at conservation on religious, aesthetic, economic, grounds.

Observations:

Traditional community or individual based practices of conservation or restrained utilization of habitats and living resources on the basis of interviews of knowledgeable individuals.

Deliberate attempts at conservation as a part of modern resource management practices of the Government.

Observations:

Experience of management on the basis of Forest Working Plans, wild life sanctuaries or National Parks and other modern resource management practices of the Government on the basis of official documents, interviews of officials and other local people

Human impacts on biodiversity

Harvests from and pollution of natural ecosystems.

Observations:

Changes in species composition of the natural habitats of the locality as a result of harvests and pollution on the basis of interviews of knowledgeable individuals.

Harvests and destruction as by-catch.

Observations:

Changes in species composition of the natural habitats of the locality as a result of incidental destruction accompanying harvests as when other plants are destroyed while cutting forest trees or when unwanted fish are caught and discarded on the basis of interviews of knowledgeable individuals.

Deliberate culturing of desired organisms.

Observations:

Occurrence of specific species/ varieties as a consequence of agriculture, animal husbandry, aquaculture activities.

Elimination of undesirable organisms

Observations:

Impact of deliberate removal of plants or killing of animals to eliminate competitors, herbivores, predators and parasites, and vectors of parasites of humans, cultivated plants and domesticated animals on the composition of biological communities on the basis of interviews of knowledgeable individuals.

Wider impacts of pesticides and weedicides

Observations:

Elimination of non-target organisms as a result of the application of pesticides and weedicides. Possible impacts on the composition of biological communities on the basis of interviews of knowledgeable individuals.

Deliberate attempts at conservation on religious, aesthetic, economic, scientific grounds

Observations:

Persistence of species of plants or animals that are likely to have been eliminated as a result of deliberate attempts at conservation on religious, aesthetic, economic, scientific grounds. Possible impacts on the composition of biological communities on the basis of interviews of knowledgeable individuals.

Environmental history

Large-scale extinctions because of human hunting and fishing beginning with Pleistocene to date. Large scale transformation of habitats in relation to farming, animal husbandry and human settlements. Harvests to meet industrial and subsistence demands. Pollution impacts. Global warming. Nature conservation efforts beginning with nature worship to modern scientific efforts. On-going ecological change

Observations:

Record of different facets of ecological history of the locality on the basis of official documents and interviews, especially of older knowledgeable individuals.

Management of biodiversity resources

Management of habitats as a key to management of biodiversity resources.

Observations:

On-going patterns of management of various habitats in the study locality on the basis of official documents and interviews, especially of older knowledgeable individuals.

Management of harvest levels of water, soil nutrients and living organisms.

Observations:

On-going patterns of management of harvest levels of water, soil nutrients and living organisms in the study locality on the basis of official documents and interviews, especially of older knowledgeable individuals.

Pollution issues.

Observations:

On-going patterns of management of pollution problems in the study locality on the basis of official documents and interviews, especially of older knowledgeable individuals.

Conflicts and convergence of interests of different segments of society as impacting management.

Observations:

Conflicts and convergence of interests of different segments of society as impacting patterns of management of habitats and living resources in the study locality on the basis of official documents and interviews, especially of older knowledgeable individuals.

Administrative and legal framework of management.

Observations:

Administrative and legal framework of management of habitats and living resources in the study locality on the basis of official documents and interviews, especially of older knowledgeable individuals.

Biodiversity Act and its implementation.