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POSITION PAPER

NATIONAL FOCUS GROUP

ON

HABITAT AND LEARNING



राष्ट्रीय शैक्षिक अनुसंधान और प्रशिक्षण परिषद्
NATIONAL COUNCIL OF EDUCATIONAL RESEARCH AND TRAINING

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EXECUTIVE SUMMARY

Taking good care of the human habitat, that is, of the environment that nurtures us, is emerging as one of the most significant concerns of the new millennium. As humanity endeavours to move onto a path of sustainable development, even as it enters the Information Age, it is evident that we need a new paradigm for education. Environmental education (EE) is ideally placed to serve as the lever for this paradigm shift that would focus, not on memorising what authoritative textbooks decree to be correct answers in order to reproduce them to get good grades, but instead on learning, on building capacity for critical thinking and problem solving. Since holistic thinking is at the heart of EE, the new paradigm would replace sectoral thinking by multidisciplinary thinking. The human habitat displays tremendous variability in space and time, and its understanding has to be locale specific, albeit in the context of a global vision. A great deal of the knowledge of the environment lies with India's barefoot ecologists, the people at the grass roots, and the new paradigm will be participatory, engaging members of local communities and will be sensitive to issues of diversity, gender and equity.

Given its intrinsic variability, each manifestation of the human habitat tends to be unique. Its understanding is, therefore, not amenable to the classical scientific approach of experimentation, usually based on replication. Instead, understanding of such complex systems requires extensive locality and time-specific observations, careful documentation, and an elucidation of the patterns and underlying processes based on comparisons of systems that differ from each other in some selected parameters. There is hardly any good quality documentation available today of the many facets of India's environment, such as the depth of the underground water table, and it is feasible to create such documentation on the basis of student projects. It would be possible to upload the results of such projects on a publicly accessible website, thereby creating a transparent and comprehensive database on India's environment. By inviting not only experts, but also all interested citizens to assess the quality of such projects and augment their results, a self-correcting system could be set up that would lead to an organic growth of our understanding of the Indian environmental scenario and concrete ways of undertaking positive action. Including such knowledge-generation activities as a part of the educational process would greatly enhance the quality of the educational experience as well.

Of course, working towards such a paradigm shift is a major challenge and the Group recommends that we do so through efforts in six major areas:

- Curricula revision;
- Materials development: conventional media;

- Taking advantage of Information and Communication Technology (ICT);
- Teacher preparation;
- Evaluation system;
- The school habitat;

The Group has also sketched a road map for organising this effort over a period of five years, beginning serious work from the first year onwards. The Group recognises that the Hon'ble Supreme Court's judgment emphasising the necessity of teaching EE as a compulsory subject at all stages underscores the significance of the concerns addressed by our Group, and is an important impetus towards the required changes. It suggests a model of systematic infusion of EE into the curricula of all disciplines, with clearly earmarked time periods for undertaking the pertinent activities. The Group sincerely believes that if our recommendations are accepted, the resulting actions would follow the Supreme Court judgment in letter as well as in spirit.

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1. INTRODUCTION

1.1 Exploring the Human Habitat

‘Habitat and Learning’ is the theme of a focus group set up as part of the National Curriculum Review process. Habitat is where any specie finds conditions that permit it to thrive. Learning is a vital faculty of all animal species. First and foremost, animals learn about the features of their own habitat, picking up clues as to where they may expect to find food, where they may expect to encounter enemies, and where they may expect to meet social companions. For our ancestors, knowledge thus began with the exploration of their habitat. In that sense, this focus group may be said to be at the centre stage of education, an enterprise dealing with knowledge.

Humankind's knowledge thus began with the exploration of its habitat and its features. This knowledge has great survival value, as was recently brought home to us by the ability of people living close to nature to more effectively escape the fury of the 26 December 2004 tsunami. But as human beings' control over the environment has increased, and as people have begun to mould the world more and more to suit their needs, this component of knowledge has diminished. So much so that today formal education has become largely alienated from the habitat of the students.

But as environmental degradation proceeds at an unprecedented pace, we are beginning to realise the importance of taking good care of our habitat. Humankind must, therefore, make an attempt to comprehend its roots, to re-establish links with its habitat, and to understand and take good care of it. In substance and spirit, then, the theme ‘Habitat and Learning’ is equivalent to EE. The formal curriculum of ‘Habitat and Learning’ needs, therefore, to be developed within the framework of EE.

Environmental contexts abound in diversity. EE cannot, therefore, be straitjacketed, but rather must

emphasise continual inquiry. An important challenge before us is to inject into the learning process a spirit of questioning, to rid it of rote learning and of unquestioning acceptance of authority. Rather, the process of EE must become a vehicle for engaging young minds in the excitement of first-hand observation of nature, of understanding patterns and processes in the natural and social worlds, indeed, of participating in the enterprise of generating knowledge about this world.

1.2 An Enormous Challenge

Thus, to reorient education—to get away from a system in which students are being encouraged to do no more than mechanically reproduce what the authoritative texts decree to be the right answers to get good grades, and instead to encourage them to observe, to figure out, to generate knowledge on their own—is an enormous challenge. India is a large, heterogeneous country, with crores of students being taught by lakhs of teachers, often operating under conditions of inadequate facilities. We must also reckon with a society that has scant respect for manual work, and therefore little sympathy with the idea of getting out of the classroom and dirtying one's hands in the course of studying the environment. Lastly, we must also contend with malpractices like students resorting to buying ready-made projects to get good grades instead of putting in honest work on their own.

1.3 A Continuing Effort

Fortunately, we have a long tradition of pertinent efforts to draw upon, beginning with Mahatma Gandhi's movement of basic education. Nearly forty years ago, the Education Commission (Kothari Commission) called for bringing EE into the formal stream. Following this, many agencies—ranging from NCERT to NGOs like the Bombay Natural History Society

(BNHS), Centre for Science and Environment (CSE), and Centre for Environmental Education (CEE)—have been active in this regard. Our group recommends a vigorous continuation of this effort, drawing on the strength of all these agencies. At the same time, new and exciting opportunities are opening up with the development of Information and Communication Technologies (ICT). These facilitate access to and sharing of information like never before. They also open up novel possibilities of the generation of new knowledge resources that may be scrutinised and augmented by all interested citizens. One can thus, for the first time, visualise the elaboration of a publicly accessible and transparent database on India's environment, a modern and most effective follow-up to the path-breaking publication *State of India's Environment: First Citizens' Report* (1982) by Anil Agarwal and his collaborators more than two decades ago.

2. STATUS OF ENVIRONMENTAL EDUCATION IN SCHOOL EDUCATION

2.1 Background

The movement of basic education launched by Mahatma Gandhi in 1937 was an early serious attempt at relating education in schools to local environmental needs. The essential elements of basic education were: productive activity in education; correlation of the curriculum with productive activity and the social environment; and an intimate contact between the school and the local community. The education system in India had incorporated some aspects of EE in school curricula as early as 1930. The roots of the present status of EE in formal education can be traced back to the Report of the Education Commission (1964–66) (Kothari Commission). This Report also incorporated the best that basic education had to offer so as to relate it to the life, needs and aspirations of

the nation. For the primary stage, the Report recommended that “the aim of teaching science in the primary school should be to develop proper understanding of the main facts, concepts, principles and processes in the physical and biological environment”.

This recommendation could be implemented only in 1977 when the curriculum for the 10+2+3 pattern of school education was evolved at the national level by NCERT, and presented in the document ‘The Curriculum for the Ten-year School: A Framework’ (1975). The National Policy on Education (NPE, 1988) and subsequent curriculum frameworks brought out by NCERT in 1988 and 2000 reiterated the importance of EE in school education. Thus, EE has been one of the priority areas of concern in all curriculum development programmes. The syllabi and instructional material for science and the social sciences, and, to some extent, those for languages and mathematics, included enough content related to the environment essential for the fulfilment of the desired objectives. The textbooks of biology, chemistry, physics, geography, sociology and mathematics at the senior secondary stage, too, provided enough content on the environment to further strengthen the knowledge, understanding and skills acquired up to the secondary stage.

To summarise, some major initiatives of NCERT include:

- Continuing the practice of teaching Environmental Studies (EE) as EVS (science) and EVS (social studies) at the primary stage.
- The curriculum of general education for the upper primary and secondary stages, developed following the directives and guidelines provided in the National Curriculum Framework (NCF), has been quite wide-ranging on all aspects of the environment

although EE was not perceived as a separate subject;

- Development of training modules for pre-service training by District Institutes of Education and Training (DIET) (one each for the northern, southern, eastern and western regions of the country);
- In-service training of key resource persons and teachers;
- Dissemination about EE through NCERT journals, e.g. School Science;
- Organisation of annual national- and state-level science exhibitions;
- Collaboration with international agencies (e.g. UNESCO, UNICEF, UNEP, World Bank, Commonwealth Secretariat) for various EE programmes. NCERT has also developed pre-service and in-service training materials on EE for some stages of school education under contract with UNESCO.

2.1.1 Initiatives at the State/UT levels

Along with their own initiatives, the States/UTs have either adopted or adapted the syllabi and instructional material of NCERT. An analysis of syllabi and textbooks prescribed in different States/UTs for the primary and upper primary stages in the mid 1990s revealed that there were many content areas pertaining to EE that were common to all of them.

2.1.2 Initiatives by other agencies

A number of other agencies, both governmental and non-governmental, have also been engaged in EE. These programmes pertain to both curricular and co-curricular interventions in school education. Notable among the governmental agencies are the Union Ministry of Human Resource Development (MHRD), Union Ministry of Environment and Forestry (MoEF),

Department of Science and Technology (DST), Government of India, and their counterparts in the States. Some of the major initiatives include:

- ‘Scheme of Environmental Orientation to School Education’ launched by MHRD in 1988;
- Establishment of institutes offering pre- and in-service courses at different levels by MoEF;
- Establishment of the National Museum of Natural History (NMNH) and its regional centres (MoEF);
- Environment Education in the School System (EESS), a sub-component of the India Environmental Management Capacity-Building Project undertaken by MoEF and supported by the World Bank, with the Centre for Environment Education (CEE) as the consultant;
- National Green Corps aims to establish 150 eco clubs in each district of the country (MoEF);
- Establishment of Centres of Excellence by MoEF;
- Organisation of Children’s Science Congress at the state and national levels every year by the National Council of Science and Technology Communication (NCSTC), Department of Science and Technology (DST).

A number of Non-Governmental Organisations (NGOs) in different parts of the country are also actively engaged in EE.

2.2 Present Status

The present status of EE in schools had its genesis in the National Policy of Education (NPE) 1986 (modified in 1992), in which ‘Protection of the Environment’ is stated as a common core around which a NCF would be woven. The National Curriculum

Framework for School Education (NCFSE), 2000 also lists EE as one of the concerns to be integrated into the curriculum.

2.2.1 Primary and upper primary stages

At the primary stage, in most States/UTs integrated textbooks on environmental studies have been prescribed. In some states environmental concepts have also been integrated into language and mathematics, while in some others EVS has been bifurcated as 'science' and 'society' for which separate textbooks-cum-workbooks have been prescribed. In the NCERT curriculum, the teaching of language and mathematics has been woven around the children's immediate environment in Classes I–II. In Classes III–V, separate textbooks for environmental studies have been provided. EE has been reinforced as a component of the Art of Healthy and Productive Living (AHPL). By and large, the textbooks of science and the social sciences in most States/UTs include environmental concepts. Environmental concepts have been included in the NCERT curricula for the upper primary stage mainly through science and technology.

2.2.2 Secondary stage

The concepts of EE have been prescribed in the textbooks of most States/UTs through science and the social sciences whether taught as integrated or separate subjects. NCERT textbooks of science and technology and integrated social science include various concepts of EE.

2.2.3 Higher secondary stage

The majority of the concepts related to EE are found in the textbooks of biology, chemistry, physics, geography, economics, sociology and political science. This is true for NCERT and State/UT curricula.

In conclusion, it can be said that EE is a compulsory part of the syllabus in schools throughout

the country. EE in schools invariably aims at providing children with knowledge, attitudes and skills so that they are equipped to contribute meaningfully towards the betterment of the environment and accomplish the goal of sustainable development. The review of environmental themes in textbooks at different stages of school education shows that textbooks, by and large, include environmental concepts.

2.3 Shortcomings

Despite these major initiatives, there is still very inadequate exposure of the students to their 'habitat'; there is little active learning from the natural and social worlds around them. The prescribed activities may simply be routinely taught as set material to be memorised through teaching in the classroom instead of being pursued by students on their own with an open mind. Activity-based projects may again be carried out in a routine fashion, sometimes with improper involvement of parents or even commercial agencies. It is clear that we need to recognise and address the challenges posed by these shortcomings as we attempt to forge ahead. This would be difficult to accomplish within the constraints posed by the current framework. Instead, we need to shift to a new paradigm.

3. NEED FOR A PARADIGM SHIFT

3.1 Objectives of Environmental Education

The main focus of EE should be to expose students to the real-life world, natural and social, in which they live; to enable them to analyse, evaluate, and draw inferences about problems and concerns related to the environment; to add, where possible, to our understanding of environmental issues; and to promote positive environmental actions in order to facilitate the move towards sustainable development. To achieve these goals, the curriculum may be based on:

- Learning about the environment;
- Learning through the environment;
- Learning for the environment;

These objectives assume great significance as humanity increasingly realises, after a long journey from Stockholm through Rio de Janeiro to Johannesburg, that a development paradigm that largely ignores the environment has disastrous consequences. In a world entering the new Information Age, education is becoming increasingly central to the development process. It has to help raise awareness, and build the capacity of communities to elaborate a vision and participate in the pursuit of environmentally and socially sustainable development. It must draw upon the new tools of ICT to do so. Truly meaningful EE is, then, a crucial activity that must lead the way for a paradigm shift in education to promote the pursuit of sustainable development.

3.2 New Paradigm

The new paradigm of education, embodying the spirit of science, of democracy, and of caring for the environment, would emphasise a number of key elements:

1. Learning rather than teaching;
2. Building capacity for critical thinking and problem solving;
3. Locale specificity in the context of a global vision;
4. Multidisciplinary approach;
5. Multi-sourced and accessed, rather than top-down, controlled and orchestrated in nature;
6. Participatory with broad involvement of peers and other community members;
7. Life long and continuous in character;
8. Sensitivity to diversity, equity and gender;
9. Knowledge generation;
10. Empowerment, rather than indoctrination.

This would be a paradigm appropriate to the pursuit of sustainable development in the emerging Information Age.

3.3 Method of Science

Human knowledge has progressed through a series of stages. In its early stages, knowledge grew very slowly through a process of trial and error. It was often viewed as being revealed from some divine source, and called for an unquestioning acceptance of such an authority.

Modern science has elaborated a far more effective way of growing knowledge. This involves rejection of all authority other than that of empirical facts. Science has thus firmly grounded itself on the hard rock of empirical facts. Simply put, the methodology of science entails: observing facts directly; discerning patterns; inferring processes that give rise to observed patterns; making models of the working of the system under consideration; formulating hypotheses about the system; making predictions; verifying predictions through fresh observations of facts; revising models of the working of the system; and then making new predictions in an ever-continuing process. In the march of science anybody is welcome to challenge any assertion, whether it be of facts supposedly observed, or of models of how the system works. Along with rejection of all authority, science has also given up claims of arriving at any absolute Truth. Science deals in knowledge that is always treated as provisional, that is, open to being supplanted by newer and more effective observations and theories. This open, democratic and participatory exercise of science has proved tremendously effective in rapidly increasing our knowledge of the natural world.

Science should, therefore, be learnt as a dynamic experience rather than as a mechanical accumulation of facts. Engaging in the process of science; of undertaking first-hand observation of facts; of looking

for patterns; of postulating models of processes that might be generating the observed patterns; of making predictions based on such hypotheses; of attempting to verify the predictions—this is by far the best way of imbibing the spirit of science. Of course, one must also endeavour to become acquainted with the great deal of knowledge that has been accumulated thus far—with the facts, patterns and processes ascertained by others and with the models of the working of the world developed by them. But reading all these accounts second hand in books and journals can never be a substitute for first-hand engagement with scientific activities, and there should be a proper balance between learning the facts of science and first-hand engagement in scientific activities. Many of these elements of the scientific method are equally pertinent to the exploration of other branches of knowledge as well. Science thus, very importantly, incorporates the first two elements of the new paradigm of education outlined above, namely, (1) learning rather than teaching, and (2) building capacity for critical thinking and problem solving.

3.4 Systems: Simple and Complex

There are significant differences in the nature of scientific activities focused on the simpler physical and chemical systems and the more complex ones of concern to the environment. Simpler physical and chemical systems may be described with the help of a small number of parameters; this permits the design of replicated experiments to test predictions. As a result, our understanding of simpler systems has progressed enormously. Observing new, hitherto unknown facts pertaining to such systems, therefore, calls for highly sophisticated equipment and chemicals, and this is out of the reach of most educational institutions. Hence, the laboratory exercises of physics and chemistry necessarily

tend to take students over well-trodden ground.

But with more complex systems, the situation is different. Complex systems characteristically require a large number of parameters for their specification. As a result, each manifestation of the system tends to be unique. Thus, every cyclone in the Bay of Bengal is different from every other recorded so far; each takes a slightly different course. Every patch of forest harbours a set of animal species slightly different from every other forest patch in the world. With these animals variously serving as grazers, pollinators or seed dispersers, and because of many other differences in the environmental regimes, the rates of regeneration of the different plant species in any given forest patch also differ greatly from patch to patch.

The experimental method of science depends on the experimenters' ability to control all relevant parameters and to replicate conditions at will. This poses serious difficulties in the case of complex systems. The experience of a group of Bangalore-based ecologists investigating the fate of wild amla populations on the nearby BRT Hills provides an interesting example of dealing with a complex system. Their hypothesis was that the regeneration of amla is governed by the amount of fruit collected for commercial use, and that the low levels of regeneration in recent years were related to excessive harvests of the fruit. So they laid out statistically well-designed randomised block experiments to test the influence of different levels of harvests of fruit. The local Solliga tribals told them that these experiments would yield no results of interest, because, according to their understanding of the ecosystem based on many years of first-hand observations, the levels of regeneration were primarily influenced by forest fires. Amla seeds require fire to germinate well, and the Solligas felt that the low levels of regeneration were related to the

suppression of forest fires in recent years. The scientists did not initially give credence to this view and continued with their experiments. Only later did they come to the conclusion that the Solligas had indeed been right. Thus, since it is so difficult to discern what the relevant parameters are in a complex system, it is difficult to design meaningful experiments. The study of the environment thus necessarily incorporates the third and fourth elements of the new paradigm of education outlined above, namely, (3) locale specificity, of course, in the broader context of our overall understanding providing a global vision, and (4) multidisciplinary.

3.5 Value of Observations

The first-hand observations of the BRT Hills forest ecosystem by the Solligas had evidently provided them with an understanding of much value. On the other hand, elaborately designed experiments yielded little understanding because the experimenters had failed to identify the key parameters. Actual observations of these complex systems are, therefore, of vital importance in becoming acquainted with the empirical facts. Disciplines such as geology, hydrology, meteorology and ecology as well as the social sciences are, therefore, not amenable to the use of laboratory experiments in the same way as is possible in the case of physics or chemistry to acquaint students with empirical facts. Laboratory exercises do have a value in these fields as well, but the experiments must be complemented with actual observations in the field. Fieldwork has to be a vital component of learning in the study of complex natural and social systems. Hence, the study of the environment has to incorporate the fifth element of the new paradigm of education outlined above, namely, being (5) multi-sourced and accessed, often with one's own initiative, rather than being a discipline with a top-down, controlled and orchestrated nature.

3.6 Comparative Method

Because of these difficulties, advancing knowledge through hypothesis testing in the sciences of complex systems has to take another route—that of the comparative method, taking advantage of natural experiments. The comparative method is based on compiling extensive information on a number of systems that differ from each other in a few features and generating hypotheses about the effects of such factors and testing them. For instance, lichens, symbiotic associations of algae and fungi that grow on rocks or tree trunks, are known to be sensitive to air quality in some parts of the world. India has several species that have not been studied in this fashion. So the best way for us to acquire an understanding of this phenomenon is to compare lichen floras on the trunks of the same species of trees growing on roads carrying heavy traffic and elsewhere where the air is cleaner. Similarly, one may use the comparative method to assess the impact of water pollution on fish and aquatic insect communities.

3.7 Recording New Facts

Because of these limitations, science has made far more limited advances in documenting and understanding the behaviour of complex systems. A corollary of this is that new facts are being continually added to the storehouse of human knowledge. Even non-scientists may participate in this adventure. Thus, amateur astronomers find new comets and asteroids from time to time, and amateur bird watchers routinely publish lists of birds from new localities. Indeed, the barefoot ecologists of the country, common people close to the natural world, such as the Solliga tribals of the BRT Hills, have with them an enormous store of facts well above and beyond those recorded in the scientific literature. This is why high school or college students

and teachers, too, can contribute their mite towards building a scientific understanding of the environment. Indeed, the systematic recording of such facts by students could help flesh out the picture of the state of human habitat; the students could engage not only in recording the basic facts, but also attempt to discern emergent patterns and understand underlying processes. This would be a most worthwhile learning experience as well. The study of the environment evidently incorporates the sixth and seventh elements of the new paradigm of education outlined above, namely, being (6) participatory with broad involvement of peers and other community members, and being (7) a life-long and continuous enterprise.

Of course, we cannot expect young children, right from the beginning of their school experience, to engage in careful observations that may contribute to a formally constituted database on India's environment. Rather, young children may begin with very simple activities that would gradually lead to more careful recording of observations, eventually helping to contribute to a formally constituted database

3.8 Publicly Accessible Database

Today we have a dearth of quality information on the state of the habitat of humans and other living organisms of India. Of course, a large amount of information is collected in the form of government statistics, for example on the depth of the underground water table. However, such information turns out to be quite incomplete, often faulty, outdated, and, regrettably, largely inaccessible to the public. Yet the depletion of groundwater is a truly vital issue. Locally, such information is readily available from observations of open wells and from the experiences of people digging bore wells. It is quite feasible to compile such information locally, through school projects. The projects could be so designed as to keep the information

updated and then make it available through an electronic database. From this point, we certainly have the technology to put together an all-India picture and make it available as a transparent and publicly accessible database through a website.

Such information may be collected on a great variety of themes ranging over physical, chemical and biological parameters to social, political and legal issues. These may pertain to soils, minerals, water, and natural, semi-natural and man-made habitats and biological communities. They may pertain to human activities such as hunting, fishing, agriculture, animal husbandry, mining, and the construction of roads, dams and buildings. They may relate to health and sanitation issues. They may relate to landownership and tenure issues. They may involve questions of social and economic status, gender and other equity issues. They may relate to customary and formal legal regimes. They may address themes relating to the management and development of natural resources.

Consider, as an example, the use of groundwater in the coastal tracts of the Uttara Kannada district of Karnataka. Traditionally, the crops of this region include rice (largely cultivated by smallholders) and betel nut, primarily cultivated by richer orchard owners. When, fifty years ago, there were no electrified pump sets, the water table was at a depth of about five metres, and the smallholders were able to hand irrigate and raise a second crop of rice in the winter. Following rural electrification, free power was made available to farmers along with subsidised pump sets. These facilities were primarily availed of by the orchard owners, who began to extensively irrigate betel nut in the dry season, substantially increasing its yields. But this drove the water table down. As a result, the smallholders could no longer raise a second rice crop. This has compelled their women to switch to the sale of fuelwood as a livelihood activity in the dry season,

resulting in extensive conflicts with forest authorities and the degradation of forests at a rapid pace.

This highlights the significance for the study of the environment of the eighth element of the new paradigm of education, namely, (8) sensitivity to issues of diversity, equity, and gender. At the same time, it stresses the relevance of the fourth element, namely, (4) multidisciplinary.

3.9 Scientific Exercises

Using the data available on such a transparent and publicly accessible website—developed, at least in part, on the basis of school exercises—it would be easily possible to undertake a number of scientific exercises based on the comparative method applicable to the study of complex systems. Thus, one may visualise on such a website countrywide spatial data on soil and rock types, rainfall and cropping patterns, and human population density, along with data on the depth of groundwater. Students could access such data and undertake statistical analyses of different levels of sophistication to assess the influence of various factors on the depth of the underground water table. They may then be introduced to the world of hydrological models and try to understand the underlying processes. Thus, educational experience could be most fruitfully combined with the ninth element of the new paradigm of education, namely, (9) knowledge generation. Of course, knowledge is power, and these exercises could promote the last of the elements of the new paradigm of education, namely, (10) empowerment, rather than indoctrination.

Of course, a number of individual projects that could generate useful inputs for such an endeavour, such as surveys of plant and animal species, have been and are being conducted in many schools in the country today. Some of these are being conducted on an all-India basis within a common framework as well, as is

the case with the Children's National Science Congress programme of DST. However, these are not geared towards compiling the information collected to create a broader picture. Once such a broad picture is available, a number of additional educational and environmental activities of great interest will become possible. These will lead to the emergence of answers to questions of much social relevance.

3.10 Karnataka Experience

The Centre for Ecological Sciences (CES) at the Indian Institute of Science (IISc), Bangalore has been engaged in experiments on such a model with a number of high schools and junior and degree colleges in Karnataka since 1993. These experiments have demonstrated that good quality data can be collected by deploying student power provided that sufficient efforts are devoted to developing a proper methodology, resource material and training programmes. As an example, students of 42 Karnataka high schools collected data on the various levels and recent trends in local abundance for 172 out of 300 medicinal plant species used commercially in the state. Only limited information on 27 of these species is available with government agencies or the pharmaceutical industry.

3.11 Relational Database Management System

The CES at the IISc, Bangalore has also developed a Relational Database Management System (RDBMS) that would support such a programme of creating a countrywide, open, transparent and publicly accessible information system on different facets of India's environment. The system, currently focusing on biodiversity, provides for simple, user-friendly data-entry forms that students can use to enter data on a variety of topics including:

- Relationship of people to their natural resource base;

- People's knowledge about their habitat;
- Ecological habitats and their distribution;
- Biological species, their current status, and changes in abundance and distribution;
- Uses of biological species;
- Current and desired management practices for management of biological resources.

The database is available not only in English, but also in major Indian languages. This RDBMS can easily be built upon to broaden its scope and include other areas of interest, such as issues relating to water management. Currently, it is a CD-based version using Access with a Visual Basic front-end. CES expects to soon make available a Web-based version using MYSQL database and PHP scripts.

In addition to the RDBMS, CES has also developed CD-based resource material to assist in the proper classification of ecological habitats and the identification of significant biological species. This takes advantage of the fact that a large number of colour images as well as animal calls can be made available at very affordable costs using CDs. This resource material, too, is being prepared not only in English, but also in major Indian languages. CES is in the process of developing freely accessible Web-based material as well.

3.12 A Worthy Challenge

With its long traditions of learning, its wealth of folk knowledge, its diverse ecologies and rich heritage of biodiversity, and its strengths in information technology, India can take the lead in involving its student body in exciting learning experiences that would, at the same time, create a publicly accessible database on environmental issues of great social relevance.

4. IMPLEMENTATION STRATEGY

4.1 A Step-by-Step Approach

The changes envisioned in this new paradigm involve

a major shift in our thinking of education as a process of 'learning' rather than 'teaching', and, going even further, of involvement in the active generation of knowledge. This cannot be done by merely changing the curriculum and the textbooks, but needs a more fundamental change in the way that teaching-learning happens and the way that knowledge is viewed in the school. Unfortunately, the current examination system is not just a way of measuring what the student has learnt but it also actually governs what is learnt. The final examinations, especially for Classes X and XII, determine a child's future in a way disproportionate to his or her achievements in other faculties. This is likely to continue to be the case for some time. Unless a change in the examination system happens simultaneously, one cannot expect to make a fundamental change in the system of school education.

The other major determinant of change is the teacher and his/her role. To move away from the traditional role of a teacher and to become a partner and facilitator in the process of the child's learning and knowledge-generation activities is not a small step. First of all, it calls for a major change in perspective. It also involves learning certain new skills, competencies and techniques. In pre-service training, such changes would eventually and very gradually lead to such a transformation. To hasten the change, a very effective and efficient in-service training programme needs to be implemented.

The changes in the curriculum and teaching-learning materials need to be seen in this context. A lot of good materials are available and one can draw on the experiences of numerous experiments and projects. However, a system that links learning and the process of knowledge generation to the environment cannot be one that can be wholly based on centralised materials. It needs to capture local flavours, to be adapted to the needs of a particular region, to become locale specific.

This will necessitate a change in the way that curricula are written and textbooks and teaching materials are prepared.

The education system in India is hampered by its huge inertia. Change in such a system cannot be brought about merely through a shift in policy. It will involve a total system change carefully executed in a step-by-step fashion, with the active involvement of both the Central Government and the governments of States/UTs. It needs to be stressed here that education being a subject on the Concurrent List, the involvement and commitment of the governments of States/UTs is vital.

4.2 Components

There are six major components that will need to be worked on simultaneously to successfully bring about these changes in the system of school education:

4.2.1 Curricula revision

The curriculum dictates what is taught and how it is taught. This is thus the crucial foundation of our effort. Considerable thought needs to be given to setting the objectives for EE at the school level, and in translating this into syllabi, textbooks and teaching-learning processes.

4.2.2 Development of material: conventional media

EE will require the development of locale-specific teacher, student and classroom material. ‘Greened’ textbooks, which are written from a holistic environmental perspective in terms of both their content and pedagogy, and which encourage flexibility to bring in locale specificities, are at the core of this endeavour. In order to arrive at such instructional material there needs to be a serious rethinking on the approach to writing textbooks. Teachers need handbooks that help them to teach the texts effectively.

For the hands-on part of EE, student workbooks and teacher manuals are required. Charts, reference material, etc. are also needed. This would involve not only the print medium, but also audio and audio-visual material as well as the new electronic media. The approach need not have all the material developed centrally, but should be designed to facilitate the development of quality material regionally and locally.

4.2.3 Taking advantage of ICT

EE could lead the way in effectively including the manifold capabilities of the new media in changing the paradigm for education. Already, many students, especially in the metropolitan schools, are using computers to access curricular material. They also surf the Web to access related information, especially to carry out project assignments. We are suggesting that we go beyond these activities, and use these media as tools to augment the knowledge base on India’s environment by getting students involved in generating knowledge. This calls for developing software to support EE project work of students through communicating proper methodologies of data collection, help validate identification of plant and animal species or of soil and rock types, and organise databases capable of accepting data from many sources. We need to design appropriate websites and put in place mechanisms for the moderation of the content. We need to organise experts’ and citizens’ discussion groups to comment on and add to the quality of the material on this website.

4.2.4 Teacher preparation

It is accepted that quality EE involves both change in content quality as well as change in how this content is transacted in the school. Teachers will be the key to the successful transition to EE. In order to do this, major initiatives in the area of teacher training—both

in-service training and pre-service teacher training—for teachers of all the different levels in the school system will be required. This training will need to help the teachers understand environmental concepts, concerns, issues and efforts; to enable them to work with students to communicate this information and knowledge; to create an awareness, attitude, and concern; and to facilitate their taking up environmental action. The teachers will need to be empowered to lead their students in undertaking locale-specific hands-on activities, projects, field studies, etc., and to integrate the results of these activities into the proposed public database on the state of India's environment.

4.2.5 Evaluation system

What is evaluated is what determines what is taught and how it is taught. In order that we may be able to bring about the changes that we desire, we need to change the method of evaluation: evaluation in terms of the examination system; evaluation of projects, field studies and activities; evaluation of teachers; and evaluation of schools. The evaluation system must be able to ensure that projects are actually done; that the projects are of high quality and are locale specific. Considerable research, development and testing are required for this. Some tools that are already available and can be a starting point are: open-book examination; alpha marking; examining in depth what the student says he/she knows; workbooks, etc. Similarly, how teachers and schools are assessed needs also to reflect the objectives of EE.

Currently, the evaluation is conducted by a small group of people, or is done in a mechanical fashion as through grading of responses to multiple-choice questions. If we could organise a system of posting the results of EE projects on a publicly accessible website with proper credit to the students and teachers involved, a novel and participatory system of evaluation

could be put in place. For then local experts as well as lay citizens familiar with the situation would have the opportunity of pointing out any mistakes, of adding to the information posted, and in the process pointing to the quality of the project. This may encourage students to strive to do well. It would also help check malpractices such as purchasing projects from commercial sources.

4.2.6 The school habitat

The school must be a demonstration of the environmental values that the education system tries to convey. Whether the context is that of drinking water and sanitation facilities, paper, energy use, garbage management, composting, or greening, the school needs to exemplify good practices and needs to communicate these, through demonstration, not only to the students but also to the community. These resources need to be built up with the involvement of the community and various other stakeholders. Locale-specific standards need to be set for this, but care needs to be taken to ensure that central models are not propagated. Classroom education needs to support the understanding, use and maintenance of this infrastructure.

4.3 The Methodology for Developing these Components

4.3.1 The curriculum framework

It is envisaged that the curriculum framework, to be evolved after reviewing the existing one, will define the:

- Overall aims and objectives of school education;
- Place of EE in the school curriculum;
- Place of EE vis-à-vis other subjects of study.

It is expected that the curriculum framework would also deliberate on the need for imparting EE, the form in which it is to be introduced at different stages of

school education, issues and problems concerning its implementation, and the weightage to be given to EE in terms of time and allocation of marks, besides other related issues.

4.3.2 Syllabi and instructional material

Development of syllabi and instructional material in a given subject of study, primarily textbooks, is the most logical step to be followed after the identification of specific objectives both stage-wise and class-wise. However, the scope and purpose of this exercise is likely to be quite different in the case of EE due to its inherent nature and specific needs to contextualise learning experiences extending from local to global environmental issues and concerns. It may be difficult to meet this requirement through centrally developed syllabi. The syllabi of EE and related instructional material are, therefore, expected to be as locale specific as possible. The syllabi and instructional material to be developed at the central level, say, at the national or state level, could at best provide the broad content outlines and themes around which the transaction of EE in schools needs to be done. There has to be sufficient scope and direction to translate these broad guidelines into teaching-learning situations in the context of locale-specific environmental problems and issues. The syllabi of EE at the central level are, therefore, not expected to be in the form of statements of specific topics but in a form that could be further interpreted and translated at the district/ region/block levels without compromising the overall aims and objectives of EE.

The development of the syllabi and model instructional material at the national/state level, therefore, will be one of the most crucial factors in shaping the courses on EE. The institutions that could be involved at this stage of development of EE materials may be NCERT, SCERTs, NGOs, and

experts from universities/colleges/research institutions. The possibility of preparing more than one variant and trying them out in schools may be explored in order to evolve the most suitable designs of syllabi and instructional material.

4.3.3 Projects and activities

Projects and activities will be the backbone of any scheme aimed at the effective implementation of EE in schools. In order to inculcate the desirable skills and competencies, it will be imperative to develop a basket of activities and projects that may vary in range in respect of their difficulty levels, coverage of skills and parameters of environment, as also the feasibility of carrying them out within the limitations of teacher competency, available resources and time. However, a certain number of activities need to be designed in a coordinated fashion to generate information that would feed into the public database on a variety of environmental issues such as the depth of the groundwater table, frequency of landslides, quality of surface water, density of vectors of diseases such as mosquitoes, availability of medicinal plants, abundance of wildlife species such as langurs and macaques, amount of open space surrounding buildings in urban localities, violation of traffic rules and so on. Some of these issues, such as the depth of the water table, might be covered by schools throughout the country. Others, such as the frequency of landslides, may be more region specific. It is envisaged that students of a given stage from almost all schools in the country, or in the pertinent region, will be involved simultaneously in such activities. As such data accumulate they will open up possibilities for other kinds of worthwhile projects. Students at secondary and senior secondary levels may undertake analysis and interpretation of such composite data, along with the modelling of phenomena such as water balance and energy flows in ecosystems.

The development of a basket of activities and projects with so many variations—and one that is at the same time feasible for the effective teaching-learning of EE and for the generation of knowledge on the state of India's environment—is a major undertaking and calls for the involvement of expertise at the highest level.

4.3.4 Assessment and examinations

All efforts aimed at reforming school education so far have failed to yield the desired results primarily due to lack of success in reforms in the examination system. This particularly holds true for assessing achievement in the affective and psychomotor domains. Indeed, an objective assessment of students' achievement in activities involving laboratory experiments and fieldwork has been one of the prime concerns of school education. Since the development of appropriate attitudes, skills and values is to be the most significant component of EE in schools, developing a scheme to assess students' achievement on these aspects will perhaps be the most crucial in determining the success of interventions through the EE curriculum. It may be worthwhile to evolve a variety of assessment strategies for a given type of activity, and refine them through trying them out on a pilot basis to arrive at practical and feasible modes of assessment. As mentioned above, this may involve radically new methods such as exposure of the project reports on websites accessible to the public, inviting comments of all interested citizens.

4.3.5 Teacher empowerment and orientation of other functionaries

4.3.5.1 Development of Training Modules

Teachers are the key agents for the success of any exercise for curriculum reform in school education. This is more so for EE as EE is a relatively new concept

that demands that teachers go beyond the boundaries of their traditional subject specialisation. The development of the desired attitudes and skills and the inculcation of EE-related values also require innovative planning and execution of teaching strategies, which demand special skills on the part of teachers. It is, therefore, essential to empower teachers with the desired skills and competencies, which could be accomplished through properly planned training programmes for both pre-service and in-service teachers. At the same time, orientation of other functionaries like headmasters, principals, education officers, and other administrators will also have to be planned to provide support to teachers for the effective transaction of EE. In addition to this, training material for key resource personnel will have to be prepared to conduct in-service training of teachers of different stages of school education and also with different subject backgrounds.

The identification of the content, skills and competencies to be imparted through training programmes, whether pre-service or in-service, at different levels would be one of the prerequisites for their planning and execution. The development of training modules, both in print and non-print modes, and using tools such as computers, databases and Web-based discussion groups, must proceed before initiating training programmes for teachers and functionaries at all levels.

The identification of training needs for different categories of personnel and the development of training modules may be entrusted to institutions like NCERT, SCERTs, teacher educators, teachers, NGOs, and experts from universities/ colleges/research institutions. The possibility of preparing more than one variant and trying them out in schools may be explored in order to evolve the most suitable designs of training modules and modes of training.

4.3.5.2 *Training*

Training of in-service teachers on a mass scale will have to be undertaken to implement an effective programme of EE in schools. Both contact and distance modes should be utilised for this purpose. The first step would be to create a large pool of key/resource personnel at the national, state and district levels. A detailed plan to evolve such a pool of key resource personnel will have to be worked out, which among other things should also include details about the financial implications and the number and duration of such programmes, and identify the institutions from which the experts could be drawn. The next step, before embarking on the actual training of teachers, would include working out the financial implications, number and duration, content, pedagogical and other academic inputs of the training programmes for different categories of teachers. At the same time, support/training material for the training of teachers through the distance mode will have to be prepared, which could be in print, audio-visual, and digital forms so as to extend the reach.

At the same time, it will also be important to modify the courses, content and methodology of pre-service training of teachers at all levels so that they may be equipped with the necessary knowledge, skills and competencies to effectively transact the EE curriculum in schools when they become a part of the teaching community at a later stage.

4.3.5.3 *Networking*

The free flow of information, ideas and experiences among all those concerned with the planning and implementation of EE could promote improvement in the quality of transaction of EE in schools to a great extent. A number of activities and projects concerning different aspects of EE could be facilitated if the teachers and students have easy access to the data and information necessary for conducting them. At the same time, the pooling of data on similar activities

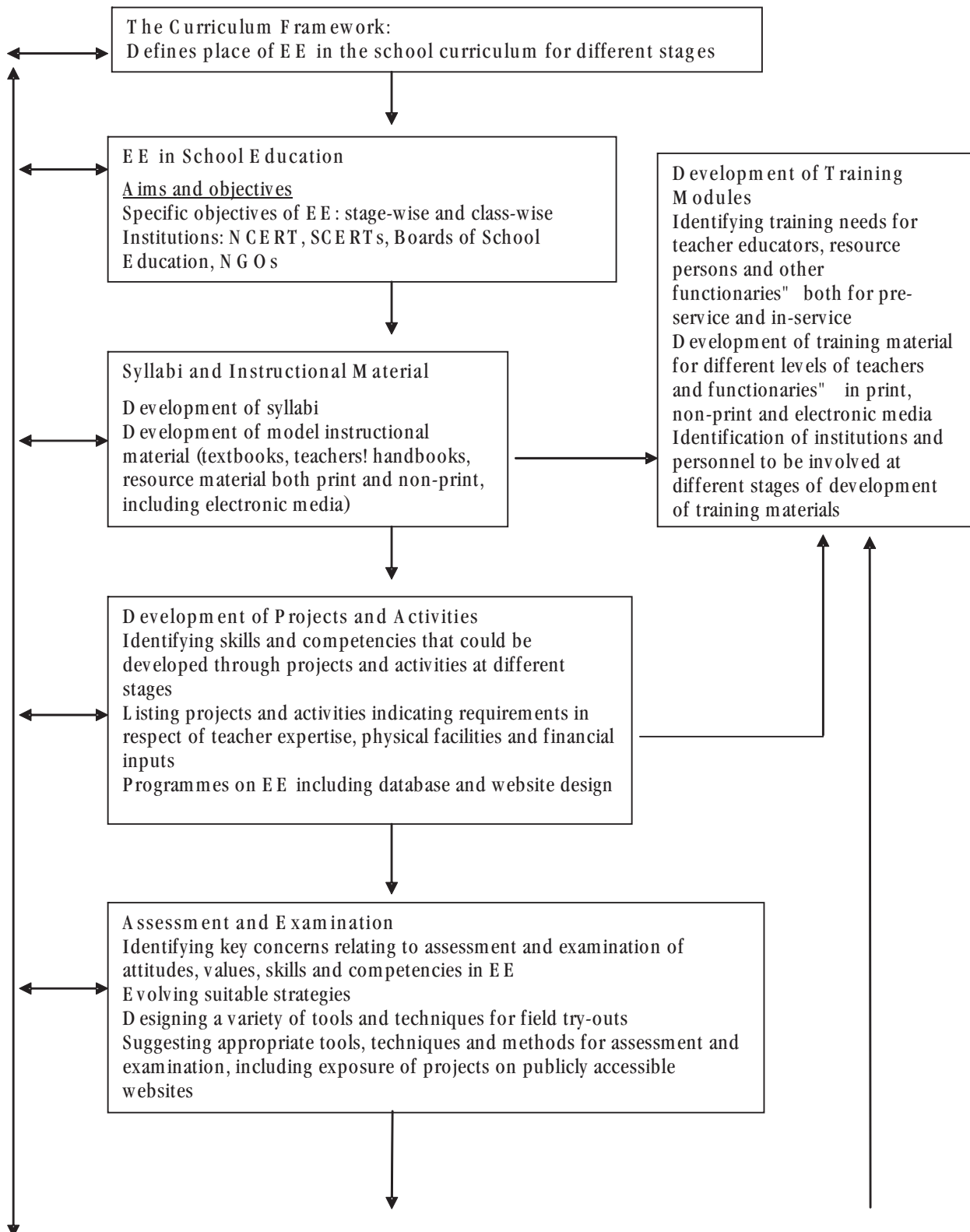
across a group of students/ schools and sharing information among them could go a long way in creating a database on a variety of issues concerning the environment. Networking among all individuals and agencies concerned with the implementation of EE in schools could facilitate this aspect. To begin with, both the direct contact mode and the Internet may be utilised for networking. For example, the Block Resource Centres (BRCs) and Cluster Resource Centres (CRCs) that have been set up in a large number of States could provide a forum for the exchange of ideas and experiences during the teachers' meetings, which are organised periodically. Similarly, District Institutes of Education and Training (DIETs) can also act as centres for the dissemination of ideas and experiences at the district level until all schools get access to the Internet.

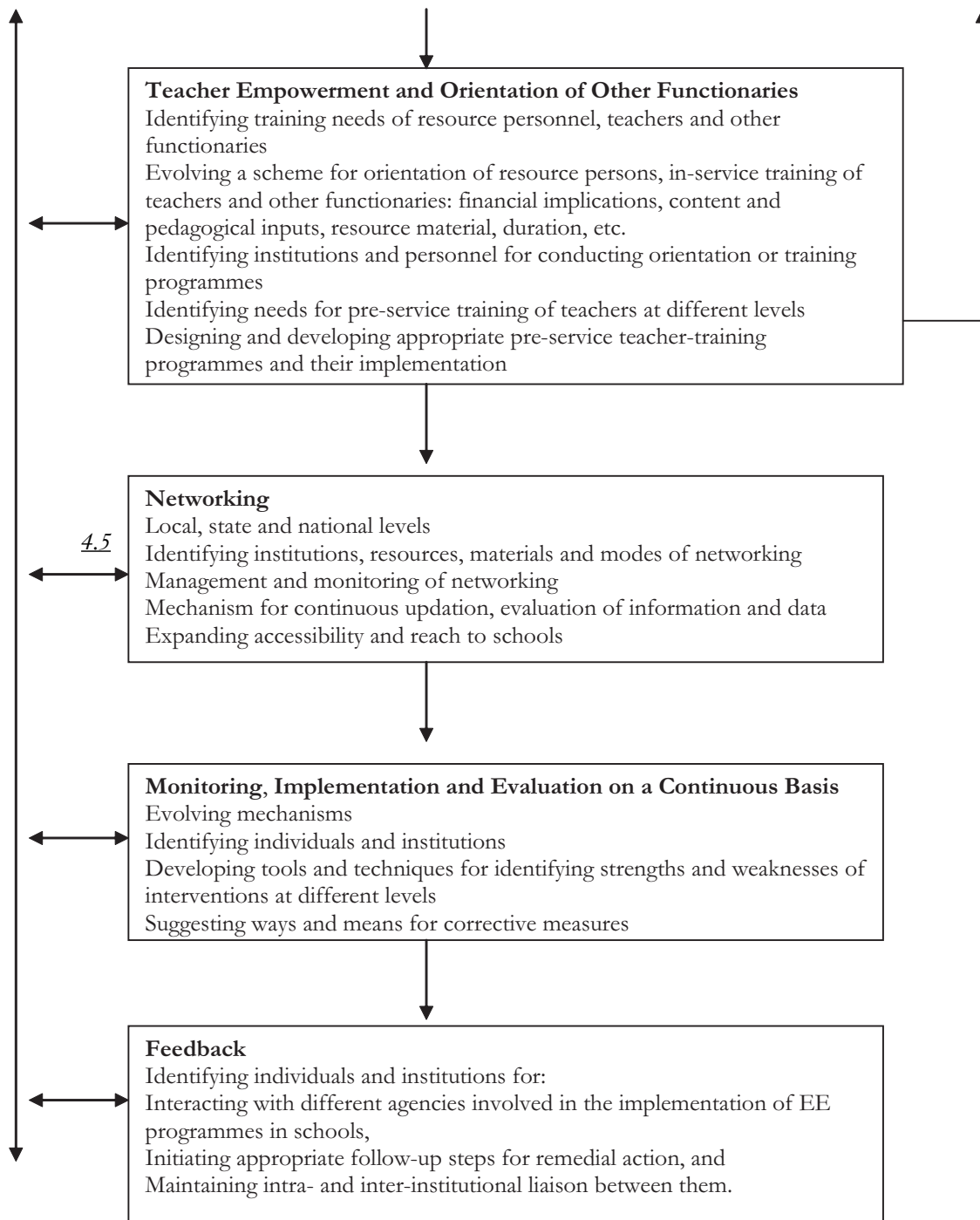
4.3.5.4 *Special Time*

EE has been a component of almost all subjects of study in schools although it is not listed as a discipline in the curriculum. The Focus Group, as has been mentioned in the preceding pages, strongly feels the need for making provision for a separate time for involving students in EE-related activities. Acceptance of this suggestion/recommendation of the Focus Group would have many implications for the development of the curriculum and curricular materials, their transaction in schools, and teacher preparation, besides making adequate provisions for academic as well as administrative support. It is in this context that a flow chart for the implementation of EE in schools may enable subsequent committees to discuss the implications of the recommendations of the Focus Group on Habitat and Learning in their entirety and evolve appropriate policy guidelines for EE in the curriculum framework for school education.

The flow chart depicts the chronological order and linkages among the different steps involved and the possible strategies with regard to various issues and problems concerning the implementation of EE in schools.

4.4 Flow Chart for Implementation of EE at a Glance





5. ROAD MAP FOR IMPLEMENTATION

An action plan to implement the proposals sketched above is outlined here. The changes will be such as to be significant in the first year itself but the entire action plan will take five years to implement fully. This action plan takes cognisance of the experiences of the recent few years. In particular, as a part of the 'Environmental Education in the School System' project under the World Bank-supported India Environment Management Capacity-Building Project, greening was done for science, social science and language textbooks of Classes VI, VII and VIII. This was done without changing the larger framework and approach of the existing textbooks. This has been done in 16 states.

The Focus Group suggests that the step-by-step plan should be actually implemented starting in 2005–06. If the implementation were to begin considerably later, then the plan would have to be suitably modified. Education being a subject on the Concurrent List, the Focus Group recommends that the States/UTs should play a major and crucial role in all developmental processes required for implementation as outlined below.

The overall plan for the States/UTs is to:

- Strengthen infusion of EE in all subjects, at all levels;
- Carve out separate time for projects and fieldwork from existing periods of SUPW, science and other subjects;
- Develop tools and techniques for evaluation of projects and fieldwork;
- Revise syllabi, textbooks and other instruction material;
- Merge the separate time, carved out earlier, with the introduction of revised syllabi and textbooks in a phased manner;
- Support these with orientation programmes for various stakeholders;

- Simultaneously, develop the school as a laboratory for EE transaction and, wherever possible, as a resource centre for the community.

5.1 Monitoring

It is suggested that a National Committee to oversee the task of monitoring this action plan may be set up by NCERT. Apart from NCERT representatives, the National Committee should consist of members drawn from other national bodies, representatives of State/UT administrations, NGOs, representatives from school boards and systems, academic institutions and other relevant institutions, and experts.

The action plan consists of five main elements, namely:

- Curriculum review and revision;
- Preparation of educational material;
- Teacher training;
- Examination reform;
- School habitat improvement.

Each of these will have suitable feedback and monitoring mechanisms in place. The feedback mechanisms would include:

- Quantitative data obtained from identified parameters from currently generated statistical data, and by adding new parameters to be obtained through the statistical information-and-gathering systems of the States/UTs.
- Qualitative and detailed information from pilot projects and benchmarked schools to get a better understanding of what is happening at the field level in terms of the overall goals of bringing EE into the school system.
- Specific studies, to be conducted by NCERT and other institutions and experts, to take up specific tasks and assignments to examine certain key assumptions implicit in the thinking of the new paradigm and the strategies adopted.

	<i>Year 1</i>	<i>Year 2</i>	<i>Year 3</i>	<i>Year 4</i>	<i>Year 5</i>
<i>Syllabus</i>	Revision of syllabus for primary stage	Revision of syllabus for upper primary stage	Revision of syllabus for secondary stage	Revision of syllabus for senior secondary stage	
<i>Textbooks</i>	Initiate revision of primary stage textbooks; Introduce activities and projects to strengthen EE at all stages	Implement revised textbooks for primary stage; Initiate revision of upper primary stage textbooks	Implement revised textbooks for upper primary stage; Initiate revision of secondary stage textbooks	Implement revised textbooks for secondary stage; Initiate revision of senior secondary stage textbooks	Implement revised textbooks for senior secondary stage
<i>Time and space</i>	Carve out a separate period for activities and projects from the existing schedule for SUPW, science and other subjects for all stages	Conduct activities and projects for primary stage as per revised textbooks	Merge back activity period at the primary level; Conduct activities and projects for upper primary stage as per revised textbooks	Merge back activity period at the upper primary stage; Conduct activities and projects for secondary stage as per revised textbooks	Merge back activity period at the secondary stage; Conduct activities and projects for senior secondary stage as per revised textbooks
<i>Teachers' Material</i>	Develop teachers' manuals for activities and projects to be done in separate period for primary stage; Develop teachers' manuals for revised textbooks for primary stage; Support material (print, AV); Initiate development of computer and Web-based material	Develop teachers' manuals for activities and projects to be done in separate period for upper primary stage; Develop teachers' manuals for revised textbooks for upper primary stage; Support material (print, AV); Continue development of computer and Web-based material	Develop teachers' manuals for activities and projects to be done in separate period for secondary stage; Develop teachers' manuals for revised textbooks for secondary stage; Support material (print, AV); Continue development of computer and Web-based material	Develop teachers' manuals for activities and projects to be done in separate period for senior secondary stage; Develop teachers' manuals for revised textbooks for senior secondary stage; Support material (print, AV); Continue development of computer and Web-based material	

<i>Orientation</i>	Orientation of education administrators, curriculum developers, textbook writers, master trainers, teachers and concerned NGOs and academics for understanding short- and long-term plans	Orientation of teachers for revised textbooks for primary stage	Orientation of teachers for revised textbooks for upper primary stage	Orientation of teachers for revised textbooks for secondary stage	Orientation of teachers for revised textbooks for senior secondary stage
<i>Evaluation system</i>	Formation of expert groups for developing new system of evaluation for primary stage	Implementation of new system of evaluation for primary stage; Formation of expert groups for developing new system of evaluation for upper primary stage	Implementation of new system of evaluation for upper primary stage; Formation of expert groups for developing new system of evaluation for secondary stage	Implementation of new system of evaluation for secondary stage; Formation of expert groups for developing new system of evaluation for senior secondary stage	Implementation of new system of evaluation for senior secondary stage
<i>School as habitat</i>	Expert groups at regional and national levels on compiling ideas for 'School as habitat' concept	Pilot implementation of 'School as habitat' concept at a few sites	Learning from 'School as habitat' concept: Pilot testing and planning for second phase of 'School as habitat' in some states	Learning from 'School as habitat' concept: Second phase and planning for state-level 'School as habitat' in all states	Implementation of 'School as habitat' concept

It is very important for the governments of States/UTs to take over the ownership of the entire process in their respective territories. A similar mechanism for state-level monitoring committees is recommended.

It is recommended that at the start of this process a workshop be organised with the National Committee and the representatives of the governments of States/UTs, at which all the objectives of the programme can be presented and a detailed plan of monitoring worked out in a participatory way, so that there is ownership of the process. NGO partners, universities and individuals that are likely to play an important part in the development of the materials and the task of monitoring should also be involved. The National Committee should meet with the state committees periodically to review the programme implementation.

6. CONCLUSION

Taking good care of the human habitat, of the environment that nurtures us, is emerging as one of the most significant concerns of the new millennium. As humanity endeavours to move onto a path of sustainable development, even as it enters the Information Age, it is evident that we need a new paradigm for education. EE is ideally placed to serve as the lever for this paradigm shift, which would emphasise:

- Learning rather than teaching;
- Building capacity for critical thinking and problem solving;

- Locale specificity in the context of a global vision;
- Multidisciplinary approach;
- Participatory efforts;
- Knowledge generation;
- Sensitivity to diversity, equity, gender;
- Empowerment, rather than indoctrination.

Of course, working towards such a paradigm shift is a major challenge and the Focus Group recommends that we do so through efforts in six major areas:

- Curricula revision;
- Materials development: conventional media;
- Taking advantage of ICT;
- Teacher preparation;
- Evaluation system;
- The school habitat.

The Group has also sketched a road map for organising this effort over a period of five years, beginning serious work from the first year onwards. We recognise that the judgement of the Hon'ble Supreme Court emphasising the necessity of teaching environmental studies as a compulsory subject at all stages underscores the significance of the concerns addressed by our Group, and is an important impetus towards achieving the required changes. The Group sincerely believe that if our recommendations are accepted, the resulting actions would follow the Hon'ble Supreme Court judgement in letter as well as in spirit.

7. APPENDICES

7.1 Basket of Activities

Activities dealing with the physical, biological as well as the social environment, both natural and modified by humans to varying degrees, would be at the heart of learning about the habitat. This is a theme that touches upon all aspects of life; hence EE can, and should, permeate every discipline being taught in the schools. This is why we strongly recommend that EE should infuse all disciplines as an activity-oriented endeavour. This would serve far better than teaching it as a separate subject in the conventional bookish fashion. We provide here some idea of the rich diversity of themes that may be addressed by such activities.

7.1.1 Physics

The Indian economy is said to be a gamble on the monsoon rains, which are a matter of perennial fascination to all Indians. This rainfall exhibits intricate variation over space and time. Excellent data on such variation are available and can be used to promote many interesting activities in physics and mathematics. Thus, the ascent of moisture-laden monsoon winds over the Western Ghats and the Khasi Hills results in some of the highest levels of rainfall anywhere in the world. Equally remarkably, there are areas of very low rainfall in the lee of the hills. Simple experiments may be devised to visualise patterns of flow of fluids over uneven topography, as well as to demonstrate how the ascent of air leads to cooling and precipitation, and descent to the opposite effects.

7.1.2 Mathematics

There is a widespread feeling that recent years have witnessed a decline in rainfall over India. However, the data collected over the last hundred odd years at several hundred stations across India do not seem to substantiate this belief. A careful analysis of this data set provides excellent possibilities for projects relating to data representation, visualisation and interpretation.

7.1.3 Computer Science

There is little good-quality data available today on many facets of India's environment, such as the depth of underground water tables, and it is feasible to create such documentation on the basis of student projects. It would be possible to upload the results of such projects on a publicly accessible website, thereby creating a transparent and comprehensive database on India's environment. By inviting not only experts but also all interested citizens to assess the quality of such projects and augment their results, a self-correcting system could be set up that would lead to an organic growth of our understanding of the Indian environmental scenario and concrete ways of undertaking positive action. Many interesting computer science projects may be designed around the endeavour of setting up such a database and a website.

7.1.4 Chemistry

Effluents from sewage-treatment plants are widely available throughout the country. They would provide excellent raw material for a variety of chemistry projects.

7.1.5 Biology

The recently passed Biological Diversity Act, 2002 aims to promote the conservation, sustainable use and equitable sharing of benefits of India's biodiversity resources, including habitats, cultivars, domesticated stocks and breeds of animals and micro-organisms. With these goals in view, the Act provides for the establishment of a National Biodiversity Authority (NBA), State Biodiversity Boards (SBBs), and Biodiversity Management Committees (BMCs) at the level of panchayats, municipalities and city corporations. 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 a 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." Throughout the country, then, schools could work with local panchayats or municipalities to document biodiversity resources and associated knowledge. This could be accomplished on the basis of a variety of school projects addressing specific issues of interest, such as the occurrence and utilisation of medicinal plants or the protection of rare and endangered fish in a water body.

7.1.6 Geography

Most people greatly enjoy being involved in an exercise of preparing a map of their immediate environment. 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 types. Thus, Janaicha (=Janai's) dongar (=hill), Chavdar (=Tasty) tale (=lake). The map need not be drawn on paper; it may begin as a model on the ground using pebbles, stones and rangoli to depict various features. The map does not have to 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 labelled in terms of scientific categories such as degraded deciduous forest as well as the locally used name for that patch. These maps may be overlaid with a number of themes such as depth of the underground water table, spread of flood water, frequency of landslides, frequency of traffic accidents, or incidence of cases of malaria. Additionally, the documentation of these local names of habitats could be an interesting exercise in the study of languages.

7.1.7 History

Several weeds today dominate India's landscape. These include eupatorium in humid forests, parthenium in drier tracts, ipomoea in waterlogged areas, and water hyacinth in rivers and lakes. Their history deserves to be carefully documented and related to other changes such as overexploitation of land and opening up of the forest canopy, or nutrient enrichment of freshwater bodies. Little documentary evidence of such changes exists, but they could be reconstructed from oral histories gathered through interviews conducted as student projects. When put together, these would constitute a very worthwhile contribution to documenting India's environmental history.

7.1.8 Political Science

Water is becoming an increasingly scarce resource all over India. Conflicts over water are seen at various levels. Such conflicts display many dimensions pertaining to issues of equity and gender. At the level of households, conflicts may occur over division of labour in terms of the effort expended in fetching water in households without access to piped water. At the level of local communities, they may be witnessed as queues at public water taps or water tankers, or as conflicts over use of groundwater resources. Consider as an example the use of groundwater in the coastal tracts of the Uttara Kannada district of Karnataka. Traditionally, the crops of this region include rice (largely cultivated by smallholders) and betel nut, primarily cultivated by richer orchard owners. When, fifty years ago, there were no electrified pump sets, the water table was at a depth of about five metres, and the smallholders were able to hand irrigate and raise a second crop of rice in the winter. Following rural electrification, free power was made available to farmers along with subsidised pump sets. These facilities were primarily availed of by the orchard owners, who began to extensively irrigate betel nut in the dry season, substantially increasing its yields. But this drove the water table down. As a result, the smallholders could no longer raise a second rice crop. This has compelled their women to switch to the sale of fuelwood as a livelihood activity in the dry season, resulting in extensive conflicts with forest authorities and the degradation of forests at a rapid pace. At the level of municipalities and panchayats, conflicts over water manifest themselves as protests against the pollution of river water sources used by villagers by sewage from cities. Then there are interstate disputes such as that over the Kaveri waters between Karnataka and Tamil Nadu, and international disputes such as that over the Indus water resources between India and Pakistan. A variety of activities and projects could address such political issues.

7.1.9 Languages

India's Biological Diversity Act mandates the establishment of Biodiversity Management Committees (BMCs) at the level of panchayats, municipalities and city corporations throughout

the country. The main function of the BMC is to prepare a People's Biodiversity Register in consultation with the local people. This Register is expected to contain comprehensive information on the availability and knowledge of local biological resources, their medicinal or any other use, or any other traditional knowledge associated with them. Much of this information lies with the people living close to the grass roots and is expressed in words that are often unknown in the literary tradition of the various Indian languages. Such information may also be expressed in tribal languages such as Gondi, Santhali, Kuki or Kinnauri. Students may be profitably involved in projects relating to material that would contribute to the local People's Biodiversity Register. While recording knowledge associated with biodiversity resources for this purpose, they may be encouraged to learn of many new facets of language.

7.1.10 Music

Much of people's understanding of biodiversity is expressed through songs and dances. Recording such knowledge is part of the mandate of preparation of People's Biodiversity Registers under the Biological Diversity Act, and students may fruitfully be involved in projects that would contribute to the preparation of these Registers. Consider an example from the Gond village of Mendha-Lekha in eastern Maharashtra. A traditional women's song of this village describes the swimming patterns of the different species of fish migrating upstream for spawning during the monsoon. This song is a component of folk music; it also contains information on fish behaviour not recorded so far in the scientific literature.

7.1.11 Art

Much of people's understanding of biodiversity is expressed through art forms. Recording such knowledge is part of the mandate of preparation of People's Biodiversity Registers under the Biological Diversity Act, and students may fruitfully be involved in projects that would contribute to the preparation of these Registers. Consider an example from the Gond village of Mendha-Lekha in eastern Maharashtra. The Gonds erect a wooden wedding pillar at the time of every wedding. Figures of many animals are carved on this pillar, not just large animals like deer, but even smaller animals like scorpions.

7.1.12 Craft

Much of people's use of the various resources offered by biodiversity is related to their crafts. Recording such uses is part of the mandate of preparation of People's Biodiversity Registers under the Biological Diversity Act, and students may fruitfully be involved in projects that would contribute to the preparation of these Registers. Consider an example from the Uttara Kannada district of Karnataka. Here one of the artisanal communities specialises in the fabrication of

headgear for brides and bridegrooms from ischioneme, a plant growing on the banks of ponds. The livelihood of this community is being threatened by the destruction of the ischioneme habitat by the encroachment of agriculture on the margins of irrigation ponds.

7.1.13 Scheduled Castes/Tribes Issues

Much of people's understanding of biodiversity lies with members of Scheduled Caste/Scheduled Tribe communities since these people often depend on natural biodiversity resources to sustain their livelihoods. Recording such knowledge is part of the mandate of preparation of People's Biodiversity Registers under the Biological Diversity Act, and students may fruitfully be involved in projects that would contribute to the preparation of these Registers. Consider as an example the knowledge of the Pharsepardhis, a semi-nomadic hunting-gathering community living in the dry tracts of Maharashtra. Since these people have been engaged in trapping birds for generations, they have a profound knowledge of the bird communities of their region. Such knowledge includes details of territorial behaviour not recorded so far in the scientific literature.

7.1.14 Health

Many landless agricultural labourer and tribal communities depend on wild plants to provide important nutritional supplements to their diet. These include several species of green leafy vegetables that are otherwise considered agricultural weeds. Projects assessing the nutritional role of such plants may be worthwhile components of health education.

7.1.15 Work Experience

Malaria remains a major scourge in many parts of India even as mosquito vectors evolve resistance to chemical methods of control. Environmental management must, therefore, become an increasingly significant component of efforts aimed at the eradication of this disease. Such environmental management activities, for example, the draining or covering up of stagnant water pools, could be very worthwhile components of work experience in the schools.

7.1.16 Physical Education

Active exploration of the local environment is an important component of EE and can, with profit, be linked to physical education. For example, tree-climbing skills could be made a part of physical education and used in projects exploring associates of trees such as lichens, orchids, strangling figs, or parasitic mistletoes.

7.1.17 Gender

All school learning is related in one way or the other to the environment. Learning about our environment is incomplete without the inclusion in the curriculum of references to the active role

played by women in its sustenance and nurturance. Historically, women have had a close relationship with the environment. For instance, in hunting-gathering societies, food gathering and foraging was the work of women. As a result, women are more likely to have made observations of plant behaviour, and through a process of trial and error made the momentous discovery of agriculture.

In India, rural women were at the forefront of the Chipko movement, an environmental and social movement in northern India in the 1970s that is often cited as an example of successful grass-roots activism. The movement involved satyagraha, or non-violent resistance, wherein the women hugged trees and stood between the trees and the contractors' axes. This movement led to changes in the natural resource policy of India.

Women play an important role as users and managers of forest resources (collecting fuel, fodder, forest products, and providing labour in forest industries ranging from nurseries to plantations). In the non-forest scenario, in rural India women are intimately connected with the five f's: food, fuel, fodder, fertiliser, and fibre (herbs). Women and girls everywhere are deeply involved in the use of natural resources for their livelihood and survival. They thus have empirical knowledge of natural resources that must find a legitimate place in school learning.

While environmental concerns have entered the school curriculum, they need to address the relationship of women to natural resources and not treat these concerns in a gender-neutral manner. EE also needs to address the fact that the impact of environmental change is different for men and women; it varies with the local social structure; it depends on gender divisions of labour, income and responsibilities; and it is affected by unequal access to and control of resources.

India's Biological Diversity Act mandates the establishment of Biodiversity Management Committees (BMCs) at the level of panchayats, municipalities and city corporations throughout the country. The main function of the BMC is to prepare a People's Biodiversity Register in consultation with the local people. This Register is expected to contain comprehensive information on the availability and knowledge of local biological resources, their medicinal or any other use, or any other traditional knowledge associated with them. Recording such knowledge is part of the mandate of preparation of People's Biodiversity Registers, and students may fruitfully be involved in projects that would contribute to the preparation of these Registers.

Consider an example from the Gond village of Mendha-Lekha in eastern Maharashtra. There are significant differences in the knowledge associated with biodiversity amongst the men and women of this village. For instance, women are far more knowledgeable about wild food plants, especially those producing tubers, and fish, while men know much more about birds and mammals.

7.2 The Supreme Court Order and Its Implications

In response to the writ petition No. 860/1991 by Shri M.C. Mehta, the Hon'ble Supreme Court said in its order dated 22 November 1991:

We accept on principle that through the medium of education, awareness of the environment and its problems related to pollution should be taught as a compulsory subject.

This recognises the significance of environmental concerns in humanity's pursuit of sustainable development the world over. This is, of course, of special concern in a country like India where a substantial proportion of people are dependent on environmental resources to sustain their livelihoods. The Group feels that this is best accomplished by infusing the teaching of EE as a part of different disciplines while ensuring that adequate time is earmarked for pertinent activities. We have attempted to sketch a road map to accomplish this goal, and believe that if our recommendations are accepted, the resulting actions would follow the Supreme Court judgment both in letter as well as in spirit.

On 18 December 2003, the Hon'ble Supreme Court further ordered, "We also direct the NCERT . . . to prepare a module (model) syllabus", and on 13 July 2004 it directed that "the syllabus prepared by the NCERT for Class I to XII shall be adopted by every state in their respective schools". It further directed that "the NCERT be appointed as a nodal agency to supervise the implementation of this Court's order". Our recommendations also include a plan of action for the implementation of EE, which has an inbuilt mechanism for monitoring at every stage as well as at the State/UT and national levels. The road map involves the following five elements:

- Curriculum review and revision;
- Preparation of educational material;
- Teacher training;
- Examination reform;
- School habitat improvement.

8. READING LIST

1. Agarwal, Anil et al. State of India's Environment: First Citizens' Report (1982) and State of India's Environment: Second Citizens' Report (1984–85). Centre for Science and Environment, New Delhi.
2. Gadgil, Madhav and Ram Guha. 1996. Ecology and Equity: The Use and Abuse of Nature in Contemporary India. Penguin Books India, New Delhi.
3. Gadgil, Madhav and Ram Guha. 1994. This Fissured Land: An Ecological History of India. Oxford University Press, New Delhi.

8.1 Publishers of Material for Young Readers

1. National Book Trust
A 5 Green Park
New Delhi 110 016
2. Children's Book Trust
Nehru House
4 Bahadur Shah Zafar Marg
New Delhi 110 002
3. Centre for Environment Education
Thaltej Tekra
Ahmedabad 380 054
4. Centre for Science and Environment
41 Tughlakabad Institutional Area
New Delhi 110 062
5. CPR Environmental Education Centre
1 Eldams Road
Chennai 600 018
6. Eklavya
E-1/25, Arera Colony
Bhopal 462 016
7. Publications Division
Ministry of Information and Broadcasting
Patiala House
New Delhi 110 001

8.2 Useful Reference Books and Other Material for Young Readers

NCERT, New Delhi (*mimeo*)

- M. Chandra. Greenhouse Effect and Global Warming.

- M. Chandra. Acid Rain.
- M. Chandra. Heavy Metal Pollution.
- M. Chandra. Inorganic Fibres.
- V.P. Srivastava, R. Joshi, and M. Chandra. Environmental Education: Issues and Concerns.

Bombay Natural History Society, Mumbai

- S. Ali. 1996. The Book of Indian Birds (12th and enlarged centenary edition). BNHS and Oxford University Press, New Delhi.
- J.C. Daniel. 2003. The Book of Indian Reptiles and Amphibians. BNHS and Oxford University Press, New Delhi.
- S.H. Prater. 1971. The Book of Indian Animals. 3rd edition. BNHS.
- R.E. Hawkins (ed.). 1986. Encyclopaedia of Indian Natural History: Centenary Publication of the Bombay Natural History 1883–1983. Oxford University Press, Bombay.
- Ethelbert Blatter and W.S. Millard. 1977. 2nd edition reprint. Some Beautiful Indian Trees. BNHS.
- Romulus Whitaker. 1978. Common Indian Snakes: A Field Guide. Macmillan Co. of India Ltd., Bombay.

Charles McCann. Trees of India: A Popular Handbook. Periodical Expert Book Agency, Delhi.

- P.V. Bole and Yogini Vaghani. 1986. Field Guide to the Common Trees of India. Oxford: Oxford University Press for World Wildlife Fund, New Delhi.

Pippa Mukherjee. 1983. Common Trees of India. Oxford University Press, New Delhi.

- Suresh Vaidyarajan and Arvind Gupta; Illustrations by Avinash Deshpande. Pumps from the Dump.

The whole world is a garbage pit; Collect some junk and make a kit.

- Bikram Grewal. 2000. Birds of the Indian Subcontinent. Local Colour, Hong Kong.
- Vivek Menon. 2003. A Field Guide to Indian Mammals. Dorling Kindersley for Penguin Books, New Delhi.

Books by Ruskin Bond have been published by Penguin Books India, New Delhi and Rupa & Co., New Delhi.

Books by Jim Corbett have been published by Oxford University Press, New Delhi.

Centre for Science and Environment, New Delhi

- *State of India's Environment: Citizens' Report series*

- Anil Agarwal and Sunita Narain. 1997. *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems*. This volume is one of the biggest efforts in recent decades to comprehensively document India's millennia-old wisdom in water management. This influential book, released in 11 regions across India, triggered a nationwide interest in community-based water-management systems.
- *State of India's Environment: Fifth Citizens' Report. 1999.*
- A comprehensive two-volume dossier on environmental issues, events, policies and practices in India, along with statistics on environment-related facts.
- *Gobar Times*
- Bimonthly magazine for children.

Bharati Vidyapeeth Institute for Environment Education and Research (BVTEER), Pune

- *Booklet on Forest Ecosystem*. English, Marathi.
- *Booklet on Grassland Ecosystem*. English, Marathi.
- *Booklet on Aquatic Ecosystem*. English, Marathi.
- *Activity Book: Explore Your Forest*. English.
- *Activity Book: Explore Your Grassland*. English.
- Flip charts on birds. English, Hindi.
- Flip charts on mammals. English, Hindi.
- Game on 'The Tree as an Ecosystem'. English, Hindi.

Books and Other Material for Children from CEE

- *Nature Scope Series: Amazing Mammals; Birds, Birds, Birds; Incredible Insects; Endangered Elephants.*
- *Turtles in Trouble* (five titles published so far). Richly illustrated manuals containing information and activity ideas.
- *Water Conservation Game*. A richly illustrated and colourful game in a poster form, which sensitises children to appropriate water use.
- *Ropes and Ladders*. A board game that gives practical tips on how every one of us can become more environmentally friendly by our actions in our daily lives. English, Marathi.
- *Where's Away?* On the waste trail using a story format involving two creatures, Worryworm and Litterbug, to explore what happens to the garbage we throw out. This colourfully illustrated book also offers information, games, activities, etc.
- *ABC Naturally!* Using verses, the book stresses the importance of various natural resources in a simple way, and also discusses the impact of human activities on these resources. It has been illustrated by child artists, and also suggests various activities.
- *Forest Tales*. The book uses folk tales from the South Asia region to highlight environmental ethics, especially in relation to forests and forest dwellers.

- *Puzzling Out Pollution.* This book combines information, stories, puzzles, games, and activities to make children aware of the various dimensions of the problems of pollution.
- *Oceans Omnibus.* This richly illustrated and colourful book for children and young people provides general information, specific facts, maps, etc. on the different dimensions of the subject with special reference to the seas around India. It includes four handy charts. Each chart discusses one theme: Our Coastal Heritage; Threats to Our Oceans; Fauna of Our Oceans; and Shells. Both sides of the chart are used to give detailed information about these issues.
- *Storm Over Silent Valley.* This is the story of the battle to save one of the last remaining pockets of pristine rainforest in Kerala. The book is written by the well-known environmentalist Darryl D'Monte. It includes colour plates and illustrations that bring alive the unique beauty of the forest. The book is suitable for young people and all those who would like to know more about this landmark case.
- *Exploring the River Front of My Town.* A central concern of educationists is how best they can equip the child with skills appropriate for a rapidly changing world. For the urban child, the 'environment' is an alien concept invoking mainly pretty trees and tigers. How the child is linked to the entire environment and is affected by the rapid changes in the macro environment is a concept that the student finds difficult to understand or experience. This publication deals with some interesting experiences of the changing urban environment, written in a lucid fashion with appropriate and imaginative illustrations.
- *Nature Observation series:* This series has been developed to guide children in the systematic observation of the plants and animals around them. The titles include:
 - *Pakshi Nirikshan Pustika* (original in Hindi and Marathi, Assamese, Khasi, Mizo editions)
 - *Standbary Parichay Pustika (Hindi)*
 - *Vanaspati Nirikshan Pustika (Hindi)*
 - *Aksheruki Prami Parichay Pustika (Hindi)*
 - *I am a Tree.* A touching poem about how much a tree gives, and how little humans care. Simple verses and imaginative illustrations combine to make it appealing to both young and old readers. Also suitable for dramatisation. English, Hindi and Gujarati.
- *Nature File series:* Ant, Ozone, Grasses. Booklets containing information and facts.
- *Walking the Wild Path.* This book describes what has inspired people to take up wildlife-related careers. Some of India's leading wildlife experts and some dedicated youngsters who made up their minds to work in the field of wildlife conservation have contributed to this exciting and adventure-filled volume for young people. English.
- *Elephantasy.* All about the Asian elephant. Using stories, articles, proverbs, etc. the book attempts to create a feeling of compassion and affection for the elephant. Each story is

followed by some interesting information about elephants that relates to the theme of the story as well as some ideas for doing, making, and sharing elephant-related things. English.

- *Wild Dreams, Green Screens*. The book consists of articles written by eminent wildlife filmmakers. It may inspire young readers to embark upon adventurous journeys of their own and also try their hand at wildlife photography. English.
- *Books on birds in Gujarati*: Aas Pas na Pankhi; Pani na Sangathi; Vid Vagada na Pankhi; Van Upavan na Pankhi.

Tulika Publishers

13, Prithvi Avenue (First Floor)
Abhiramapuram
Chennai 600 018
Phone (44) 24981639, 24671117
tulikabooks@vsnl.com

Many of Tulika's books can be used as supplementary texts in schools for various subjects:

- Priya Krishnan. Art Uma Krishnaswamy. 2002. The Story of Ganga.
- Priya Krishnan. Art Uma Krishnaswamy. 2002. The Story of Narmada.
- Priya Krishnan. Art Uma Krishnaswamy. 2002. The Story of Brahmaputra.
- Priya Krishnan. Art Ashok Rajagopalan. 2002. The Story of Kaveri.
- R. Rao and Sandhya Rao. 1998. Suresh and the Sea.
- Samina Mishra. 2000. Hina and the Old City.
- Mahashweta Devi. The Why-Why Girl.

Tara Publishing

35, 28th Cross Street
Indira Nagar
Adyar
Chennai 600 020
<http://www.tarabooks.com/>

Some books from Tara:

- Sirish Rao. 1998. Leaf Life.
- Anushka Ravishankar and Pulak Biswas. 2004. Tiger on a Tree.
- Gita Wolf and Anushka Ravishankar, Illustrated by Orijit Sen. 1999. Trash! On Ragpicker Children and Recycling.
- Trash! is a unique combination of fact and fiction. Based on the real-life experiences of ragpicker children, it tells the story of Velu, a runaway child from a village.
- Sudarshan Khanna, Gita Wolf and Anushka Ravishankar. 2000. Toys and Tales with

Everyday Materials. Tara Publishing and National Institute of Design, Ahmedabad.
This book deals with toy making at many levels. It addresses three age groups—children, teenagers and adults—at various levels of complexity.

8.3 Publishers of Teachers' Material on the Environment

1. Centre for Environment Education (CEE)
Thaltej Tekra
Ahmedabad 380 054
2. CPR Environment Education Centre
1 Eldams Road
Chennai 600 018
3. World Wildlife Fund, India
172 B Lodi Estate
New Delhi 110 003
4. National Museum of Natural History
Barakhamba Road
New Delhi 110 001
5. Centre for Cultural Resources and Training (CCRT)
Bhawalpur House
Bhagwandas Road
New Delhi 110 001
6. National Council of Educational Research and Training (NCERT)
Sri Aurobindo Marg
New Delhi 110 016
7. Central Institute of Educational Technology (CIET)
NCERT
Chacha Nehru Bhawan
Sri Aurobindo Marg
New Delhi 110 016
8. Bharati Vidyapeeth Institute of Environment Education and Research (BVIEER)
Pune Satara Road
Dhankawadi
Pune 411 043
9. Creative Learning for Change
S 268 Greater Kailash II
New Delhi 110 048

10. Uttarakhand Seva Hindi

Champa Nala

Manorath Sadan

Almora 263 601

11. Kalpavriksh

5 Shree Duttakrupa

908 Deccan Gymkhana

Pune 411 004

8.4 Books and Other Material for Teachers

- Cathy Spagnoli. 2003. The World of Indian Stories: A teaching resource of folktales from every state, with illustrations by N. Bindhu Malini. Tulika Publishers, 13 Prithvi Avenue (First Floor), Abhiramapuram, Chennai 600 018.

BVIEER, Pune

- Handbook on Environment Education for Teachers from Std. V to Std. IX: Maharashtra Syllabus. English, Marathi.
- Handbook for Teachers on Environment Education. Hindi.
- Handbook for Ecosystem Interpretation. English.

CEE, Ahmedabad

- Joy of Learning I, II, III. A set of three handbooks describing more than 150 activities to help children understand different facets of the environment, developed for NCERT. Each activity is presented in a user-friendly format with suggestions as to the subjects in which the activity can be introduced; variations/ extensions; ideas for evaluation, etc. English, Tamil, Telugu, Bengali, Marathi.
- Exploring a Tree. This manual for teachers of Classes V–VIII will help them carry out an outdoor activity-based programme with their students. The activities in the manual will help teachers create awareness about how a tree is important to a variety of living things on and around it. It explains how a tree is a microhabitat by itself while also being part of the larger environment. English, Gujarati.
- Water Quality Monitoring in Schools. This manual can be used as a guide to river water quality monitoring in a laboratory.
- Ozone Eleven. This book examines some of the key questions that may be asked by those who want an introduction to ozone depletion and answers some of these basic questions in a simple way.
- Design a Playground. India has a rich and varied play tradition. With rapid urbanisation, formal playgrounds have been pushed into the background. This little publication of 39

pages offers creative ideas for designing a playground, including designs for equipment. It shows how one can transform open spaces into exciting natural spaces for learning and playing. Useful for schools, colleges, and housing societies.

- Approaches to Environmental Education. This is a compilation of a set of working papers based on an instructional technologies workshop held for a nationwide teacher-training programme. It offers a variety of methods that may be effectively used at the school level. These methods include camping and excursions, neighbourhood field trips, observation of the world around us, observation and measurement, and a lot more. Hindi.
- Environmental Orientation to School Education. Environmental Orientation to School Education (EOSE) is a programme of the Ministry of Human Resource Development. This publication describes some of the experiences and learnings in working with this programme. It also gives details on developing proposals and includes some interesting case studies. It also deals with some technical aspects for developing EE material. English.
- The Green Teacher. The package includes a video demonstrating different EE approaches and a manual. The manual discusses experiences and case studies providing insights to help incorporate EE in school education. The video demonstrates some of the active approaches to teaching and learning about the environment. This package is useful for orienting pre-service and in-service teachers.
- The Green Club. A guide to setting up and running clubs dealing with the environment. Addressed to teachers, leaders and organisers of eco clubs, nature clubs and other action groups, this manual discusses ideas on forming and running green clubs, organising support for them, organising and planning activities and projects, etc.
- The Green Action Guide. A manual for planning and managing environmental improvement projects. It discusses the what, why and how of school action projects for environmental improvement. It presents some ideas for action projects that teachers can carry out with their students. The manual has been developed with support from the Ministry of Human Resource Development.
- Green Reader. The book is an introduction to environmental concerns and issues and forms part of the Green School Series. The 10 chapters—on ecology and biodiversity, agriculture, energy, climate change and ozone depletion, urbanisation, industry and environment, pollution, population, consumption and environment, and environment and development—have all been reviewed and commented upon by experts in their respective fields. English, Marathi.
- Wild at the Zoo. This information-and-activity manual on educational opportunities at the zoo offers ideas for making a visit to the zoo more exciting and educational. It comprises three sections, viz., Understanding a Zoo, Worksheets, and Activities. Each

- worksheet and activity is accompanied by a note that provides background information about the topic it covers. An educator can use these facilities to plan and create teaching-learning experiences. Prototype worksheets on different themes can be used to note guided observations while visiting a zoo. The activities described are those that can be carried out by the educator before, during, or after a visit to the zoo. The manual has been developed with support from the Ministry of Human Resource Development. English, Marathi.
- Energy Matters. This teacher's guide suggests activities designed to sensitise students about various aspects of environmental issues so that when they grow up they can take decisions while factoring in concerns about environmental sustainability. The book helps lay the foundation for a lifestyle that is environment friendly. English.
 - Garbage to Gardens. This activity booklet on solid-waste management for schools suggests various methods that may be employed to communicate concepts about waste management to children. It will help teachers to lead students in learning about and understanding the problem of garbage and then taking action to deal with it.
 - Water Package. This package, for use by teachers of Classes V–VII, consists of 16 information cards on various aspects of water; an activity booklet that suggests 12 interesting classroom activities on the theme; a colourful classroom poster; and two sheets and 36 colourful labels for students. The package has been used for nationwide teacher training programmes under the National Environmental Awareness Campaign (NEAC) of the Ministry of Environment and Forests.
 - Conserving our Water Resources (booklet). This handbook on EE activities for teachers of Classes V–VIII explains the need to conserve water resources. Developed along the lines of (a) importance of water; (b) uses of water; (c) water storage; (d) water quality; and (e) reuse of waste water (recycling of water), the publication attempts to integrate these five dimensions in an interesting and informative manner.
 - Green Games Manual. This book describes the games developed by CEE, and also popular games adapted by CEE, to suit the Indian context. These games can be used for different groups, ranging from school and college students to NGOs. English, Marathi.
 - Cleaner World: A Question of Civic Sense. This handbook on solid-waste management is addressed to the youth and provides useful ideas and experiences for individuals, youth organisations, and anybody who cares to make a difference. The first section deals with information on waste management and the second section offers ideas about activities and projects that young people can take up to participate in environmental conservation.
 - Essential Learnings in Environmental Education. This database of 635 statements provides the framework of what constitutes environmental literacy. Useful for educators, particularly those involved in developing EE programmes, materials, curricula, textbooks, etc.

Developed as part of an Indo-US collaborative project.

- Exploring the River Front of My Town. A central concern of educationists is how best they can equip the child with skills appropriate to deal with a rapidly changing world. For the urban child, the 'environment' is an alien concept invoking images mainly of pretty trees and tigers. How the child is linked to the entire environment, and how he or she is affected by rapid changes in the macro environment, is a concept that the student finds difficult to understand or experience. This publication deals with some interesting experiences of the changing urban environment. It is written in a lucid fashion with appropriate and imaginative illustrations.

8.5 Material for Undergraduates

BVIEER, Pune. 2004. Biodiversity of India. CD-ROM for the compulsory core module of environment studies for undergraduate courses. English.

BVIEER, Pune. 2004. Textbook on Environment Studies, for UGC, for all branches of higher education. English.

Kiran Chhokar, Mamata Pandya, Meena Raghunathan (eds.). 2004. Centre for Environment Education. Understanding Environment. Sage Publications Pvt. Ltd. New Delhi.

Display Material

CEE, Ahmedabad

- Act Now Package (Set of 9 Posters). This set of colour posters, aimed at an urban audience, discusses what a city gives us, the environmental impact of excessive use of electricity, water, etc., and, most importantly, what each individual can do to improve the environment. The accompanying booklet in English is a guide to using the posters as a framework to set up a full-fledged exhibition, which may include other models, exhibits, etc., as well as ideas to make the exhibition more effective. English. A textless version of the posters is also available. Local-language versions can be created by writing the text in the desired language in the spaces provided in the posters from an accompanying pamphlet that provides the text.

- Floods and Droughts

Package (Set of 11 Posters). This set of two-colour posters deals with the Indian monsoons, describes floods and droughts, discusses why they occur, and suggests what we can do to control soil erosion, conserve water, and take up greening activities. Suitable for school and community exhibitions. English, Hindi.