Parisara: A Free, Public Domain Knowledge Resource on Indian Environment Developed in a Collaborative Fashion *

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Abstract

To address the important challenge of taking good care of India's environment, we clearly need substantial, good quality information. Unfortunately, pertinent information is in very short supply. Most of it is collected through the state machinery, and is of poor quality and highly incomplete. This is because the official machinery violates the spirit of science by discouraging scrutiny. Modern science has abundantly demonstrated that good information flows from an open, transparent process that welcomes participation from all interested parties. We obviously need to put in place such a broad/based, open, participatory process to develop a sound, comprehensive base of information on India's environment. All over the world, citizens are a great repository of detailed information on many facets of their local environment. Our citizens, especially students and teachers, ought therefore to play an important role in this process of building up a good information resource on India's environment. The rapidly advancing tools of ICT hold much promise in facilitating such a participatory process of knowledge generation. An outstanding example of such an application is Wikipedia, the free encyclopedia that anyone can edit. Wikipedia articles are expected to be encyclopedic, i.e. based on published, authenticated information, and not on primary observations. Thus, a review of published information on birds of Ratnagiri/Sindhudurg district can, while a checklist of birds of a particular college campus based on personal observations cannot, qualify for an article in Wikipedia. However, the Wiki software is freely available for other users to create their own websites. Therefore, such a checklist could be-hosted on a wiki site set up on the website of a school/college, or some other appropriate

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agency. Taking advantage of the wiki facility, other students or interested citizens, observing additional species may then quickly add to the checklist. They may also add images of these bird species in Wikimedia Commons, their Marathi names in the Marathi Wiktionary, classification details in Wikispecies, and show the location of the college campus on Google Earth image. Another application of interest is a shared spreadsheet that is made available to all or selected users for concurrent data entry or modification, usually on a private or public network. One may visualise students from different colleges collecting information on BOD levels and other water quality parameters, in different water bodies, as a part of their Environmental Education projects. They may all be authorised to access a shared spreadsheet on which information from a number of different investigations can be uploaded, validated by a moderator, integrated, analysed and eventually shared with the public. We propose to begin this collaborative process of developing publicly accessible information on India's environment, with a pilot project in Ratnagiri/ Sindhudurg district. The programme may involve the many interested citizens of the district working with a consortium of junior and undergraduate colleges representing both urban and rural localities. It would take advantage of the fact that it is now mandatory for students of Class XI and XII standards as well as for the second year undergraduates in all branches to undertake a major project on environment. It could also build upon the provisions of the Biological Diversity Act 2002 that mandates all local bodies—Panchayats and Nagarpalikas—throughout the country to undertake documentation of local biodiversity resources and associated knowledge in the form of 'People's Biodiversity Registers.'To succeed, such an endeavour clearly needs vigorous scientific support. It is proposed to provide this with the help of a Technical Support Consortium (TCS), primarily of Ratnagiri/ Sindhudurg district/ based scientists. This group will have to develop manuals detailing study methodologies, formats in which quantitative data may be collected to support these studies, as also other resource material such as field guides for identification of bioindicators of water quality. Most importantly, the TCS may help through assessing the quality of the primary data posted by students or other interested citizens on various wiki sites that may be networked to constitute a non-peer-reviewed publication called 'Ratnagiri/ Sindhudurg Parisara Sthiti'. TCS may help in selecting material of good quality from this information resource, help in its interpretation in light of available scientific knowledge and in its publication in an appropriate peer-reviewed medium. Since much of such information, although of good quality, is likely to be of very locality-specific interest, it might be worthwhile organising a locality specific online publication called 'Ratnagiri/ Sindhudurg Parisara Prakashana' to host it. Once properly peer reviewed and published, this information may be used to write Wikipedia articles. This should set up a positive feedback system, because the more knowledge there is, the more readily can its quality be assessed,

and the more readily can it be added to. With students, and other interested citizens generating knowledge about environment, the quality of environmental education will improve. The built-in transparency of the process would promote honest submissions, as well as grading. It would be a self-correcting system with a built-in forum for all citizens, including experts to assess, point out possible deficiencies, and incorporate improvements. In the long run, this process should create a totally transparent, publicly accessible information resource on India's environment with proper accreditation to concerned students, teachers and other interested citizens for all items of information.

Introduction

Taking good care of the environment, a human concern that emerged in the second half of the last century, has become all the more pressing in the new millennium. The youth obviously must play a vital role in addressing this challenge. One of the ways to engage them is through the educational process, and this is being attempted in our country with the help of the Supreme Court order of 22/11/91: "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." Awareness has to be based on good understanding. For this, we clearly need substantial, good quality information on the manifold aspects of environmental problems as they manifest themselves in our country with its complex society and diverse environmental regimes.

Unfortunately, pertinent information is in very short supply. Most of it is collected through the state machinery, be it by recording of river flow by the Irrigation Department, of water pollution by Pollution Control Boards, or of the number of wild animals by the Forest Department. Regrettably most of the resulting information is of poor quality, often outdated and highly incomplete. A recent striking example of this comes from the census of tigers. Authorities of our Tiger Reserves have been attempting since 1973 to come up with exact tiger numbers based on the 'total pugmark count'. There are several possible sources of errors in such a census of tigers and in consequence, it is difficult to arrive at exact tiger numbers based on total pugmark count. Such difficulties are universal, especially in the study of complex environmental systems, where all signals are confounded by noise. The scientific skill lies in estimating and minimising the noise levels. Thus, it is imperative that one estimates the extent of various sources of error in arriving at tiger numbers. Based on these, one should come up with a range, rather than just one specific number, along with a statement of the likelihood that the actual numbers will fall within that range.

However, the official information stream has the serious weakness of claiming that there is no question of error in the official 'authoritative' information being handed out. But if a single number is provided as if that is a precise estimate, there is every danger

that any lower number arrived at subsequently would be taken to imply a decline tiger numbers. If further, there was a tendency to judge the performance of Tiger Reserve managers on the basis of the supposedly exact number of tigers in the area under their charge, then the managers would be inclined to manipulate the data and project a picture of continually increasing numbers of tigers. Such a tendency could be checked if there was in place a system of public scrutiny of the veracity of the numbers being declared. However, as with almost all government statistics, no such system has been in operation, so that tendencies to manipulate data have gone unchecked. This has, in all probability, been occurring in many Tiger Reserves; we have concrete evidence that it did happen in Sariska, where the publicly declared numbers have been decidedly inflated. An unfortunate consequence of dissemination of manipulated data has been a failure to recognise signs of decline in tiger numbers, till a public outcry forced the authorities to subject official statistics to independent scrutiny. This was done, firstly, through a CBI enquiry, and secondly, through the Prime Minister's Office setting up an independent Tiger Task Force. The Task Force had access to the information available with the field staff and put together the following picture:

Evidently, we must now reform such closed opaque systems of information collection prevalent throughout the country today.

Organising a collaborative process

Modern science advances knowledge by actively promoting questioning and enquiry. On the contrary, the official machinery, claiming to collect information by employing scientific methods, violates the spirit of science by discouraging scrutiny. Indeed, scepticism is at the very heart of scientific enquiry, whose main ingredients are:

- Open access to all facts and inferences,
- Rejection of all authority other than that of empirical facts, and
- Welcoming all interested parties to question all assertions as to facts as well as logic.

TABLE 2: Tiger population estimates in Sariska Tiger Reserve

Year	1998	1999	2000	2001	2002	2003	2004
Tiger population (official census)	24	26	26	26	27	26	17
Tiger sightings by staff*	17	6	5	3	0	1	0
*Number of distinct animals present as judged by field staff							

It is this openness that has ensured that in science the proportion of empirically sound to unsound information is very high, and any deliberate manipulation of information is quickly exposed and weeded out. On the other hand, by discouraging scrutiny, official knowledge permits itself to be manipulated by a variety of vested interests. As a result, it often

ends up with a substantial proportion of unsound information.

Modern science has abundantly demonstrated that good information flows from an open, transparent process that welcomes participation from all interested parties. We obviously need to put in place such a broad/ based, open, participatory process to develop a sound, comprehensive base of information on India's environment. This process would most appropriately be spearheaded by students and teachers, who are, after all, in the business of acquiring, growing and managing knowledge. Consider, for instance, the vital issue of depletion of groundwater. Little detailed, reliable, up-to-date information on this issue is available today in the public domain. Yet, such information is readily available from observations of open wells and from the experiences of people digging borewells, and may be compiled locally, through school projects. The projects could be so designed as to regularly update the information and make it available through an electronic database. Moving ahead, we certainly have the technology to pool together such data to create an all-India picture and make it publicly accessible in a transparent fashion on the web.

The Centre for Ecological Sciences (CES) at the Indian Institute of Science (IISc), Bangaluru has been engaged in experiments on such a model with a number of high schools and junior and degree colleges in Karnataka since 1989. These experiments have demonstrated that good quality data can be collected through the exercise of student power provided that sufficient efforts are devoted to develop proper methodology, resource material and training programmes. As an example, students of 42 Karnataka high schools collected good data on the status 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 pharmaceutical industry.

Information and communication technologies

The rapidly advancing tools of ICT hold much promise in facilitating a participatory process of knowledge generation. Already many students, especially in the metropolitan schools, are using computers to access curricular material as also information to carry out Environmental Education (EE) and other project assignments. However, these students are forced today to rely on largely irrelevant web based material, mostly pertaining to the very different environmental situation in the U.S.A. It is desirable that they use these media as tools, not only to acquire but to augment the knowledge base on India's environment. This calls for developing software to support EE student projects through communicating proper methodologies of data collection, help validate information such as 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 portals 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 thus brought into the public domain.

Wiki software

In fact, the Web 2.0 technologies that facilitate the community (for example, of students of Classes XI-XII and II year undergraduates, undertaking Environmental Education projects) creation of content on the websites are the rage today. An outstanding example of such an application is Wikipedia, the free encyclopedia that anyone can edit. Since its creation in 2001, Wikipedia has rapidly grown into the largest reference website on the Internet. The content of Wikipedia is free, written collaboratively by people from all around the world. This website is a wiki, which means that anyone with access to an Internet-connected computer can edit, correct or improve information throughout the encyclopedia, simply by clicking edit this page link. In every article, links guide the user to associated articles or images or information such as the full taxonomic classification of a species, often with additional information. Users are welcome to add further information, crossreferences or citations so long as they do so within Wikipedia's editing policies and to an appropriate standard. Because Wikipedia is an ongoing work to which in principle anybody can contribute, it differs significantly from a paper-based reference source. In particular, older articles tend to be more comprehensive and balanced, while newer articles may still contain significant misinformation, or vandalism. Users need to be aware of this in order to obtain valid information and avoid misinformation, which has been recently added and not yet removed. However, unlike paper reference sources Wikipedia is completely up to date, with articles on topical events, such as tsunami, being created or updated within minutes or hours, rather than months or years for printed encyclopedias.

Currently, Wikipedia has over 80,000 active contributors working on articles in 268 languages, including several Indian languages. There are over 3.6 million articles in English; and a recent count of the number of articles (in thousands) in various Indian languages shows: Hindi 88, Bengali 22, Punjabi 2, Telugu 48, Tamil 32, Urdu 17, Kannada 11, Gujarthi 20, Oriya 2, Nepali 14, Sanskrit 5. Every day hundreds of thousands of visitors from around the world make tens of thousands of edits and create thousands of new articles to enhance the amount of knowledge held by the Wikipedia encyclopedia. Visitors do not need any special qualification to contribute, and people of all ages help to write Wikipedia articles. The Wikimedia Foundation, a non-profit organisation also hosts a range of other projects:

1. Wiktionary, Dictionary and thesaurus
2. Wikibooks, Free textbooks and manuals
3. Wikisource, Free-content library
4. Wikispecies, Directory of species
5. Commons, Shared media (e.g. photographs, video clips) repository

Wikipedia articles are expected to be encyclopedic, i.e. based on published, authenticated information, and not on primary observations. Hence, a student project could involve a review of published information on birds of Ratnagiri/Sindhudurg district that may be uploaded as a Wikipedia article, in both English and Marathi versions. However, a checklist prepared by students of Gogte-Joglekar College on birds of College campus based on personal observations cannot qualify for an article in Wikipedia. However, the Wiki software is also freely available for other users to create their own websites. Therefore, the Gogte-Joglekar College itself can set up a wiki site on its own website (not just in English, but also in Marathi), and host such a checklist. Taking advantage of the wiki facility, other students or interested citizens, observing additional species may quickly add to that checklist. They may also add images of these bird species in Wikimedia Commons, their Marathi names in the Marathi Wiktionary, classification details in Wikispecies, and show the location of the college campus on Google Earth image. By adding an external link from the Wikipedia article on birds of Ratnagiri/Sindhudurg district to the Gogte-Joglekar College websites article on birds of college campus, all this information maybe made readily accessible.

Shared spreadsheets

Another application of interest is a shared spreadsheet that is made available to all or selected users of the spreadsheet for concurrent data entry or modification, usually on a private or public network. Each authorised user is able to make modifications to the spreadsheet, or simply view it, according to his/her own level of authority. One user may be able to modify any cell in the spreadsheet by changing its value, layout, position or formula whereas other users may be restricted to enter values into one or more cells.

One may visualise students from different colleges in Ratnagiri/ Sindhudurg district collecting information on BOD levels and other water quality parameters, in different water bodies, as a part of their Environmental Education projects. They may all be authorised to access a shared spreadsheet on which information from a number of different investigations can be uploaded, validated by a moderator, integrated, analysed and eventually shared with the public.

Multiple dimensions

At the heart of Environmental Education is its focus on the interconnected nature of the physical-biological-social-economic system pertinent to environmental issues, the manifold environmental impacts cascading through such an interconnected system, and the continual processes of environmental change. Student projects may, therefore, entail collection of information on a great diversity of themes ranging over physical, chemical, biological parameters to economic, social, political and legal issues. These may pertain to soils, minerals, waters, natural, semi-natural and man-made habitats, man-made artifacts and

biological communities. They may pertain to human activities such as hunting, fishing, agriculture, animal husbandry, mining, road, dams and building construction. They may relate to health and sanitation issues. They may relate to ownership and tenure issues. These 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 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 wealthier farmers). 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.

Scientific exercises

Using publicly accessible data developed, at least in part, on the basis of student projects, and augmented from other sources, it would be easily possible to undertake a number of scientific exercises. Thus, countrywide spatial data on soil and rock types, rainfall, cropping patterns, and human population density, along with that on the depth of the ground water, may eventually become widely available. 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 underground water table. They may then be introduced to the world of hydrological models and try to understand the underlying processes.

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 and colleges in the country today. Some of these are being conducted on an all-India basis with a common framework as well, as is the case with the National Children's Science Congress programme of DST. However, these are not geared towards compiling the information collected together to create a broader picture. Once such a broad picture is available, a number of additional educational and environmental activities of great interests will become possible. These would lead to answers to questions of much social relevance as well.

Konkan districts pilot project

We propose to begin such a collaborative process of developing publicly accessible information on India's environment, with a pilot project in Ratnagiri and Sidhudurg districts of Konkan region of Maharashtra. The programme will be spearheaded by a consortium of junior and undergraduate colleges representing both urban and rural localities, and will be coordinated through Gogte-Joglekar College. It will take advantage of the fact that it is now mandatory for students in Classes XI-XII to undertake a major project on environment over the first three terms, as well as for the second year undergraduates in all branches to do so during the first term. The programme will work closely with the National Council of Educational Research and Training, which has the responsibility of guiding and monitoring Environmental Education throughout the country at levels up to Class XII . In this undertaking, students will be the main actors in developing an information base on five different aspects of the district's environment, namely, water, biodiversity-bioresources, roads, energy, and noise; though initially we may concentrate on the first three themes. The project would include the following elements:

Specifying the geographical context through defining the spatial elements of the study area as villages and town/city wards. Articles may be developed on the geographical-social-economic-environmental setting of each of these localities on the English and Marathi Wikipedias. GPS readings of locations of schools and colleges, post offices and panchayat-municipal offices in these localities may be used to link these articles to Google Earth images through the use of Placeopedia.

Downloading satellite (http://geo.arc.nasa.gov/sge/landsat/ and http://glcf.unimcs.umd.edu/data/ for landsat and http://edcdaac.usgs.gov/main.asp for Modis) and Google Earth images, identifying study sites. These images may be uploaded into Wikimedia Commons and linked to pertinent articles in Wikipedia. Photographs or video clips of the localities may similarly be uploaded into Wikimedia Commons and linked to pertinent articles in Wikipedia.

Developing a system of assigning people to different Environmental Resources Stakeholder Groups. Such a system has been proposed by the Centre for Ecological Sciences, IISc in the context of biodiversity-bioresources and accepted by National Biodiversity Authority as the starting point for the People's Biodiversity Register exercises mandated to be carried out throughout the country as a follow/up of the Biological Diversity Act. Articles on the various stakeholders may be posted in Wikipedia with associated images uploaded in Wikimedia Commons.

Making an inventory of activities linking people to particular environmental resources such as water, biodiversity-bioresources, energy, roads and noise. Preparing activity-time budgets for different seasons, for people of different ages and gender, and belonging to different stakeholder groups. Students may write essays on stakeholder groups and their activities that will be uploaded on school/college websites

with wiki versions on the Gogte-Joglekar College website. Students may upload associated images in Wikimedia Commons. Students may enter quantitative information on time-budgets on a shared spreadsheet.

Mapping of study localities in terms of distribution of sources of and demands on environmental resources such as water, bioresources-biodiversity (using techniques of landscape ecology), roads etc, as participatory maps prepared by people or through visual interpretation of satellite imagery. Such maps may be uploaded on school/ college web sites. Students may also upload associated images in Wikimedia Commons.

Preparing an inventory of locally occurring biodiversity elements. These inventories may be based on scientific studies by students or based on interviews regarding life forms known to people. Such inventories may be entered onto shared spreadsheets, or uploaded on school/college websites with wiki versionson the Gogte-Joglekar College website. Students may upload associated images in Wikimedia Commons, information on classification in Wikispecies and local names in Wiktionary.

Preparing inventories of the most significant concerns of people (for people of different ages and gender, and belonging to different stakeholder groups) with respect to different environmental resources. Such inventories may be entered onto shared spreadsheets, and may be uploaded on school/ college websites with wiki versions on the Gogte-Joglekar College website.

Documentation of status of environment in terms of spatial elements of interest (e.g. habitats of biological communities, water resources, roads, etc), trends of changes over time in such elements and prevalent and desired patterns of management (for people of different ages and gender, and belonging to different stakeholder groups) for these elements. This documentation may be in the form of essays, for instance, on grazing lands, sewage disposal system or highways. It may also be quantitative documentation, for instance of abundance of weed species on grazing lands or of bioindicators of water quality in different water bodies, or levels of traffic congestion on roads, employing shared spreadsheets. Student essays may be uploaded on school/ college web sites with wiki versions on the Gogte-Joglekar College website. Students may upload associated images in Wikimedia Commons, information on classification in Wikispecies and local terms in Wiktionary.

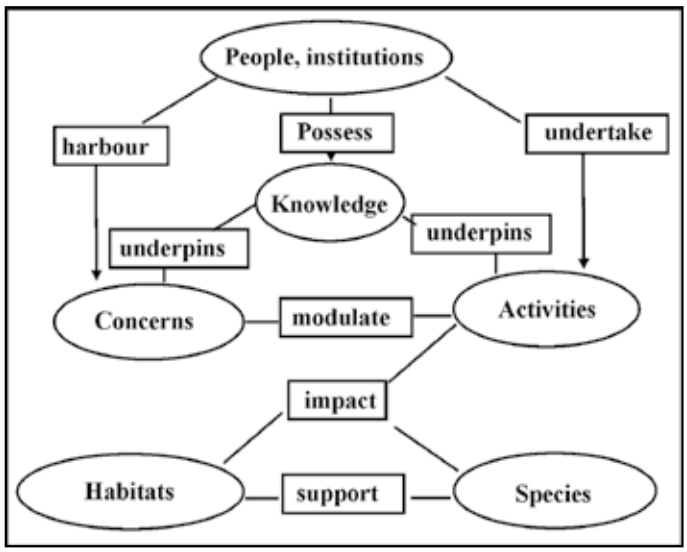
Documentation of people's knowledge of various aspects of the environmental resources, for example seasonal availability of grazing for sheep, use of herbal insecticides or preparation of vegetable dyes. This documentation may be in the form of essays, or quantitative, for example distribution of knowledge of uses of herbs amongst people of different age and gender, and belonging to different groups of stakeholders. Student essays on these topics may be uploaded on school/ college websites with wiki versions on the Gogte-Joglekar College website. Students may enter quantitative information on shared spreadsheets. Students

may upload associated images in Wikimedia Commons, and local terms in Wiktionary.

Relational Database Management System

As noted above, at the heart of Environmental Education is its focus on the interconnected nature of the physical-biological-social-economic system pertinent to environmental issues. Consequently, student projects in EE would generate information on many different kinds of entities, related to each other in a diversity of ways. Take as an example, one particular component, namely, bioresources-biodiversity. Projects focusing on this theme would involve studies on many different kinds of elements: species, their habitats, biological produce, prices of biological produce, harvesting and transport of biological produce, regulations governing harvests, people and their ways of using and managing biodiversity resources, local knowledge of uses and management of biodiversity resources, and so on. These different building blocks or entities would be related to each other in a variety of ways, and a well-designed information system should properly specify the relationships. A Relational Database Management System (RDBMS) helps to efficiently organise information in this fashion.

The Centre for Ecological Sciences at the Indian Institute of Science has designed such an RDBMS termed 'PeBInfo' to support People's Biodiversity Registers exercises being conducted as a follow-up of the Biological Diversity Act, and now formally accepted as a desirable starting point by the National Biodiversity Authority. This RDBMS is a possible model of the kinds of



Schematic Representation of the Main Classes of Entities and their Major Relationships

information systems that will have to be developed to effectively organise the wealth of data that would flow from EE projects. PeBInfo specifies six major classes of entities, namely: (1) People and institutions, (2) Knowledge, (3) Concerns, (4) Activities, (5) Species and other taxonomic categories, and (6) Habitats. Diagram 1 depicts the most significant relationships amongst these classes of entities; additionally there are many other relationships not depicted in this diagram. Thus knowledge not only underpins concerns and activities, but it also pertains to species and habitats, and so on.

Such RDBMSs would have to be organised to pool together the wealth of information that would be generated through the EE projects. In the context of the Ratnagiri/Sindhudurg Pilot Project mentioned above, the spreadsheets included in Annexure 2 have been so designed as to be compatible with the PeBInfo schema. This would facilitate the pooling together of this information by a Technical Support Group based at the Gogte-Joglekar College. The resultant database would be hosted on the website of the Gogte-Joglekar College. This would, however, be just a first step. EE projects would eventually generate wealth of data on many other themes besides bioresources-biodiversity such as water and energy, and from several hundred districts beyond Ratnagiri/Sindhudurg.

Web Portals

As the next step, then we would need to establish a series of web portals to manage the knowledge thus generated. Web portals are comprehensive (bundled) websites that allow for knowledge management, and integration of information and applications along some central theme. The purpose of a portal is to collect information from different sources and create a single point of access to the information. The portal has to perform a number of technical and organisational tasks like a single entry point giving access to a critical number of resources in a homogeneous way, and ability to handle resources of different kinds: databases, knowledge bases, and programmes, in an integrated way to enable various types of information and styles of presentation to be presented in a coherent form.

The key features of such portals would include the following:

Interactive, user friendly, dynamic/ adaptive (customisable) in natures; Comprehensive repository of essential knowledge, enabling efficient and effective retrieval of information through online query and analysis; Ability to update and add additional knowledge (expandable architecture); A platform for interaction and exchange of ideas backed by a consortium of organisations, experts and concerned individuals.

These portals would be based on a collaborative, web based, interoperable framework for providing internally connectedz user interface, feeding upon distributed databases (placed at different geographic locations) that are heterogeneous is size, content and thematic makeup. This is achieved by establishing resource inventory/ search and access/control mechanism by creating Universal Description, Discovery and Integration (UUDI)

registry that facilitates inter operability of data sources from multi disciplinary databases. This is implemented through 'Extensible Markup Language (XML) Schemas' currently in use by similar global initiatives (e.g. GBIF) that can be evolved into 'XML Schemas' specific to Indian datasets to facilitate robust data exchange and analysis across multiple data providers. A mechanism of this kind is essential to enable query formulation across distributed and heterogeneous databases to extract the desired information and present it in a suitable/customisable format to the user through single access interface. Such a framework can be used for integrating both legacy and emergent data and services. While this would aid in increased integrity, interoperability, scalability and extensibility amongst the data sources, it would not compromise on the autonomy of database developers and owners, allowing them full control and independence over the design and development. Most importantly it would achieve both flexible and optimal use of data sources, despite heterogeneity.

There are several ongoing attempts at development of such portals in India. The University of Agricultural Sciences in Bangalore hosts the Indian Biodiversity Information Network (IBIN) funded by the National Bioresources Development Board. An "India Water Portal" promoted by the Arghyam Foundation of Bangalore is being launched in October 2006. The National Biodiversity Authority has approved a proposal to establish an 'Indian Biodivesity Information System'. It would be necessary to work with such portals to fully develop the tremendous potential for knowledge generation of the student EE projects.

Technical support

To succeed, such an endeavour clearly needs vigorous scientific support. It is proposed to provide this with the help of a consortium of Ratnagiri/Sindhudurg district based scientists, convened through Gogte-Joglekar College. It will use as one of the starting points, the methodology outlined in 'Ecology is for the People: A Methodology Manual for People's Biodiversity Register' and the associated Relational Database Management System 'PeBInfo'. A series of spreadsheets, compatible with this methodology and RDBMS has been developed to support collection of data through individual student projects. This material focuses on biodiversity-bioresources. The conceptual schema developed so far will have to be further elaborated to deal with other themes such as water and energy. Thus we will have to work out a scheme of classification of stakeholder groups pertinent to various environmental resources.

We will have to develop further manuals detailing study methodologies or suggesting formats in which quantitative data may be collected to support these studies, as also other resource material such as field guides to identification of bioindicators of water quality. These may be published as Wikibooks, so that they will grow further in a collaborative fashion.

The Technical Support Consortium may also consider helping in a number

of ways, by building capacity and developing background material. This could include the following:

- Develop the conceptual framework for carrying out student projects.
- Work out appropriate methodologies.
- Design spreadsheets and databases.
- Help build capacity of teachers to guide and exercise quality control over student projects.
- Help validate and consolidate the data.
- Prepare a directory of people (academics, officials and others) knowledgeable in different aspects of the environment of Ratnagiri/ Sindhudurg district.
- Prepare a bibliography of published, as well as gray literature (e.g. Forest Working Plans) on various aspects of Ratnagiri/Sindhudurg district's environment. Post it on a wiki site on Gogte-Joglekar College website, so that people can continually augment it.
- Prepare reviews based on published information on various aspects of Ratnagiri/Sindhudurg district's environment, for example rainfall patterns, rivers and dams, list of flowering plants, sacred groves, and road network. Post these as Wikipedia articles.
- Write Wikipedia articles on different geographical localities within Ratnagiri/Sindhudurg district. Prepare a database of their GPS readings. Link them to Google Earth images.
- Download relevant satellite imagery.
- Post photographs and video clips pertinent to various aspects of Ratnagiri/Sindhudurg district's environment, for example forests, grasslands, crop fields and orchards, individual plants and animals, sewage outfalls in streams and rivers, stone quarries, state of roads, and so on. Post these on Wikimedia Commons.
- Add all species present in Ratnagiri/ Sindhudurg district to Wikispecies.
- Add Marathi words pertaining to various aspects of environment, such as different types of soils and rocks, names of plant animal species, ecological habitats to Marathi Wiktionary.

Validation and publication

Most importantly, the Technical Support Consortium may help through assessing the quality of the primary data posted by students or other interested citizens on the various wiki sites (e.g. on websites of schools/colleges, of RANWA or other institutions), that may be confederated in the form of a non-peer-reviewed publication called 'Ratnagiri/ Sindhudurg Parisara Sthiti'. TCS may help in selecting material of good quality from this non-peer-reviewed resource, help in its interpretation in light of available scientific knowledge and in its publication in an appropriate peer-reviewed medium. Since much of such information, although of good quality, is likely to be of very locality-specific interest, it might be worthwhile organising an online publication to host it. Such a publication may be hosted on any appropriate website

and be called 'Ratnagiri/Sindhudurg Parisara Prakashana'. Once properly peer reviewed and published in this form, the information so published may be used to write Wikipedia articles.

Virtuous Cycle

Knowledge is a remarkable positive feedback system; the more knowledge there is, the more rapidly does it grow. Hence, enhancing store of knowledge on Indian environment will lead to a positive feedback. Simultaneously, with students generating environmental knowledge, they will carry out projects of better and better quality. Concurrently, the system of public assessment for the proposed Information System 'Parisara' could create a totally transparent, publicly accessible information resource on India's environment with proper accreditation to concerned students, teachers and interested citizens for all items of information. Parisara would provide a forum for all citizens, including experts to assess, point out possible deficiencies and incorporate improvements. Its transparency would promote honest submissions, as well as grading.