Ensuring Biological Security

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The sketch on the cover is by Pratibha Pande.

The term "security" in this paper means the prospect of the continuation (or permanence) of a desirable state of affairs. Biological security would be the prospect of a continuing or permanent state of affairs where our biological resources are safe.

When talking about biological resources, this paper focuses on biological diversity, that being among the most fundamental of our biological resources.

What is biological diversity or biodiversity?

Biodiversity is defined as the variability of ecosystems, species and genes. There are many types of ecosystems on earth. There are the seas and oceans, rivers and lakes, forests, deserts, grasslands, islands, and mountains. Within these categories, there are sub-categories. In India, for example, there are sixteen major types of forests and hundreds of subtypes. Similarly there are tropical oceans and temperate oceans; there are cold and hot deserts and various types of mountain ranges and grasslands. Biodiversity at the ecosystem level means the variability of these ecosystems.

Within each ecosystem, there are various species. Human beings are one such species, but there are others like tigers, lions, elephants, *peepal* trees, *deodar* trees, *gulmohar* and ***neem*** trees, peacocks, crows, bees, flies, etc. etc. Biodiversity at the species level means the variability of species.

Within each species, each individual is different. Among human beings, for example, though we are all of one species, each one of us is physically and mentally different from the other: genetically variable. There are similar variations among individual members of all species. Biodiversity at the genetic level means the variability of individuals of the same species.

Conservation of biodiversity implies ensuring that the variability among ecosystems, species and genes does not become less than what is natural and that, in any case, no ecosystem or species becomes extinct.

Why worry about biodivesrsity?

There are many reasons why it is important to conserve biodiversity. Some of the major ones are described below.

Medicine: a large proportion of the medicines that are used in the world, especially the non-allopathic ones, are derived from plants and animals. Yet, we have only investigated about one percent of the known species for their medicinal and other values. And of the species likely to exist on earth, perhaps only twenty percent have so far been discovered and identified. If a species that has either not yet even been identified, or whose medicinal and other uses have not yet been investigated, becomes extinct, then the cure to some of the diseases that are currently plaguing the world, like AIDS and cancer, might be lost for ever.

According to E.O.Wilson "The humble and ignored are in fact often the real star species. An example of a species lifted from obscurity to fame by its biochemistry is the rosy periwinkle (*Catharanthus roseus*) of Madagascar. An inconspicuous plant with a pink five-

petaled flower, it produces two alkaloids, vinblastine and vincristine, that cure most victims of two of the deadliest of cancers, Hodgkin's disease, mostly afflicting young adults, and acute lymphocytic leukemia, which used to be a virtual death sentence for children.

"It can be safely assumed that a vast array of other beneficent but still unknown species exist. A rare beetle sitting on an orchid in a remote valley of the Andes might secrete a substance that cures pancreatic cancer. A grass down to twenty plants in Somalia could provide green cover and forage for the saline deserts of the world. No way exists to assess this treasure house of the wild except to grant that it is immense and that it faces an uncertain future." E.O.Wilson

"Few are aware of how much we already depend on wild organisms for medicine. Aspirin, the most widely used pharmaceutical in the world, was derived from salicylic acid discovered in meadowsweet *(Filipendula ulmaria)* and later combined with acetic acid to create acetylsalicylic acid, the more effective painkiller. In the United States a quarter of all prescriptions dispensed by pharmacies are substances extracted from plants. Another 13 percent come from microorganisms and 3 percent more from animals, for a total of over 40 percent that are organism derived. Yet, these materials are only a tiny fraction of the multitude available. Fewer that 3 percent of the flowering plants of the world, about 5000 of the 220000 species, have been examined for alkaloids, and then in limited and haphazard fashion.

"The scientific and folkloric record is strewn with additional examples of plants and animals valued in folk medicine but still unadaressed in biomedical research. The neem tree (*Azadirachta indica*), a relative of mahogany, is a native of tropical Asia virtually unknown in the developed world. The people of India, according to a recent report of the U.S. National Research Council, treasure the species. "For centuries, millions have cleaned their teeth with neem twigs, smeared skin disorders with neem-leaf juice, taken neem tea as a tonic, and placed neem leaves in their beds, books, grain bins, cup boards, and closets to keep away troublesome bugs. The tree has relieved so may different pains, fevers, infections, and other complaints that it has been called the 'village pharmacy.' To those millions in India neem has miraculous powers, and now scientists around the world are beginning to think they may be right.

"The leech, which is a vampire annelid worm, must keep the blood of its victims flowing once it has bitten through the skin. From its saliva comes the anticoagulant called hirudin, which medical researchers have isolated and used to treat hemorrhoids, rheumatism, thrombosis, and contusions, conditions where clotting blood is sometimes painful or dangerous. Hirudin readily dissolves blood clots that threaten skin transplants. A second substance obtained from the saliva of the vampire bat of Central and South America is being developed to prevent heart attacks. It opens clogged arteries twice as fast as standard pharmaceutical remedies, while restricting its activity to the area of the clot. A third substance called kistrin has been isolated from the venom of the Malayan pit viper." (Wilson 1992, 2001)

Even if a species that we have already investigated, and found to be of no use, becomes extinct, there are grave dangers. For, though this species might be of no use in curing the ailments we know about today, what is the guarantee that some new diseases might not appear in the future, just as AIDS did some years back. And then we might discover that its cure died with the extinction of the species that we thought was valueless. Also, our ability to identify and isolate those active ingredients in plants and species that have medicinal value are also increasing day by day. Therefore, even if we are not able to detect any medicinal value in a species today, it is quite possible that as our science and technology increase, we might be able to discover medicinal properties that were hidden from us earlier. Therefore, in

order to ensure that our options are not foreclosed, we need to ensure that each and every species is conserved. This is the *option value* of biodiversity in terms of medicine.

Agriculture: All the plants we cultivate or the animals we domesticate, are derived from wild species. In order to keep open the option of developing new strains for cultivation and domestication, we have to ensure that wild species are conserved. Also, if cultivated or domestic strains have to be immunised against pests or diseases, then most often wild species have to be used to create such immune strains.

Origins of Some of the Food Crops

- Mango-India
- Tea-China (Tibet)
- Papaya-Central America
- Mustard seed-Himalayas
- Melon/Water melon-Eastern Africa
- Cucumber-India
- Rice-Asia/Africa
- Sugar Cane-New Guinea
- Wheat-Mediterranean/Near East
- Maize-Mexico/Central America
- Groundnut-S. America
- Soyabean-China
- Lentil-Near East
- Pea-Ethiopia/Mediterranean/C. Asia
- Onion-Central Asia
- Banana-SE Asia and the Pacific
- Coconut-Africa/India/SE Asia/Pacific
- Pepper-W. Ghats-India
- Apple-C. Asia/Himalayas
- Coffee-Ethiopia
- Orange-China
- Tomato-S. America/Mexico
- Eggplant-India
- Potato-Bolivia/Peru
- Grape-Middle Asia
- Cardamom-India

Access to wild biodiversity is needed for developing new varieties of plants and breeds of animals, for food. Such a need is critical because of the current very narrow base (mainly between 10 to 20 species) of human food. This puts the human race at great risk, for any change in the macro environment or widespread disease can seriously undermine global food security.

In addition, hybrid varieties need regular infusion of fresh genetic stock- from the wild. Even the varieties that we are using for our food have to be genetically "rejuvenated" from time to time in order to ensure that their genetic vigour remains in tact.

Also, wild varieties are required to immunise cultivated varieties from disease. It is cheaper and very often the only option, to seek cures for plant and animal diseases from the wild. For example, in the early 1970's much of the rice in south east Asia was affected by a grassy stunt epidemic. This epidemic destroyed over 100,000 ha. of rice in countries of SE Asia. A frantic search of 6723 varieties of cultivated & wild rice, kept in the International Rice Institute in Manila, showed only one (*oryza nivara*) resistant to this virus. This species was collected from eastern UP in 1963, and had been preserved in the gene bank at the Institute.

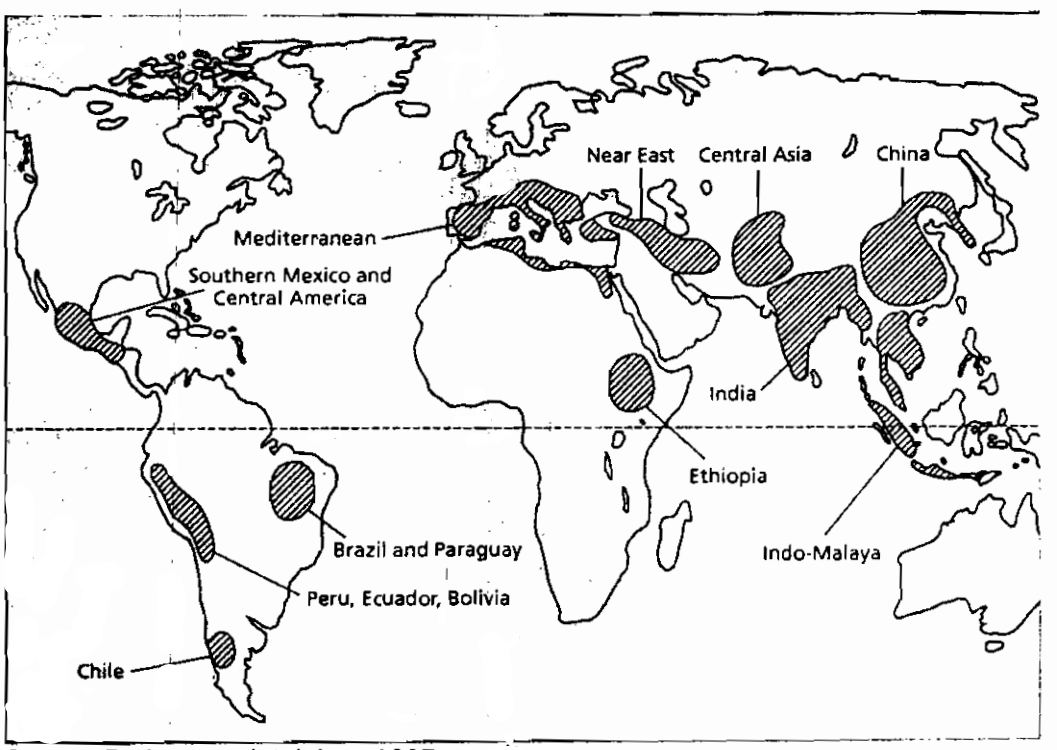
Using the genes from this specimen, rice strain resistant to this grassy stunt was developed and is today grown in 30 m ha in India, Nepal, Bangladesh, China & SE Asia.

Another example is illustrated by the maize species *Zea diploperennis*, a wild relative of corn discovered in the 1970s by a college student in Mexico. This species is resistant to diseases and its genes, if transferred into domestic corn, can significantly boost domestic production around the world. This maize species was, however, nearly lost for all times. It occurred only in a 10 hectares plot of land, the whole of which was being cleared and, if a week more had passed, all of it would have been cleared and burnt.

Biotechnology: This is a new area, which perhaps offers the greatest promise, among all technologies, to provide answers to some of the major problems facing the world: those of poverty, hunger and disease. However, the 'raw materials' of biotechnology are wild plants and animals. It is from the various plants and animals that genes can be found which, through genetic engineering, give new hope of solving many of the old problems. For example, the

green revolution in India was a result of genetic engineering and, whatever might be the problems with it, has certainly raised the productivity of food grains in India. However, if species in the wild became extinct, then this 'raw material' of genetic engineering would no longer be available. Ironically, most of the regions that are rich in biodiversity (see map below) are in the so called "third world". We, therefore, have a unique advantage over the other parts of the worls a far as bioltechnology goes. But we must preserve this advantage and keep our options open.

Vavilov Centres of High Biodiversity

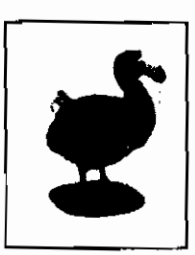


Source: Perlman and Adelson 1997

Web of life: All life is interconnected like the web of a spider. Each species is directly or indirectly dependent on all others. Therefore, if one species becomes extinct, then this affects all the species. The effect might not be felt immediately, but eventually the chain reaction starts.

There are numerous examples recorded from across the world where the extinction (or removal) of one seemingly innocuous, some times even pestilent, species can set off a chain reaction that threatens the stability of the whole ecosystem. A famous example is from China where, in order to save precious rice, which was being eaten by sparrows, all the sparrows in Beijing were reportedly killed one year. There was great rejoicing, but this was short lived, for a greater quantity of rice was ruined next year by insects that were also eaten by the sparrows, in whose absence their population grew alarmingly. The lesson being learnt, sparrows were immediately reintroduced - for fortunately that option was still available.

There is also the tale of the poor dodo (see inset), a flightless and somewhat affable bird found in Madagascar. Sailors bludgeoned the last Dodo to death some three hundred and fifty years ago. However, it is only now being realised that some of the key stone species of trees in the forests of Madagascar were



dependent on the Dodo for their regeneration, and with the extinction of the Dodo the forests of Madagascar also face a bleak future.

Ethical Imperatives: The earth is not created for human's alone. In fact, we share it with millions of other creatures, many of who have arrived on the earth much before we did. They have as much a right to live, and live happily, as we do and their existence cannot be dependent on our utility for them.

Major Threats to Biological Security

There are multiple threats to the biological security of India. The most significant threat comes from the destruction of habitats. This is followed by the depletion or extinction of populations of specific species either because of their use and/or commercial value or because of their perceived nuisance value. Equally important is the advent of exotic invasive species that push out less aggressive species from their traditional niches, sometimes to extinction. Some of the major threats are listed below.

1. ***External Direct Threats***
   a. Destruction of habitat caused by war or military action (including responsive military action and preparation by Indian forces).

      Military action and tension has resulted in huge destruction of biodiversity on the borders of India. Many of the sensitive areas, especially along the China border and the northern border with Pakistan, are also areas with high biodiversity value. Apart from the actual conflict, the build up of the armed forces, the roads and infrastructure required by them and the maintenance of a large number of personnel in these areas also takes a heavy toll of biodiversity. Members of the armed forces posted in these biodiversity rich areas have also been known to indulge in poaching activities, leading to further depletion of species.

   b. Destruction of species due to cross-border poaching.

      In some of the border area (notably in the Bhutanese border in Assam and the Nepalese border in UP) there is extensive cross border poaching , where the poachers come from across the border and escape back, making it difficult to apprehend them.

   c. Destruction of habitats and species due to cross-border introduction of invasive species.

      The introduction of exotics from other countries has taken a heavy toll of the biodiversity of India. Mostly these species were introduced either for commercial purposes (like American apples) or for "sport" (like the rainbow trout). However, some of them were also introduced as pets (which later escaped) or inadvertently.

   d. Destruction of habitats and species due to cross border pollution and movement of hazardous wastes (including oil spills and ship breaking).

      In some countries, the movement of air pollutants across borders has created havoc with biodiversity. In recent years, forest fires in Indonesia and the resultant movement of smog to neighbouring countries, has been an example of this. In Europe, the cross-border movement of oxides of sulphur and the resultant acid rains have also been an example of this. In India, there has been little record of air pollutants from across borders, but like many other countries it has been affected by oil spills and pollution (especially in the Andaman and Nicobar Islands – another biodiversity hot spot). India is the largest "ship breaker" in the world and pollutant and hazardous substances have been entering the coastal waters of India through the ships that are broken here. Also, there have been widespread reports of

hazardous wastes being dumped in India by various countries through the services of unscrupulous agents.

e. Theft of genetic material for external commercial utilisation.

Genetic material from biodiversity rich countries like India are being constantly smuggled out for commercial research and use in laboratories outside India. The ease with which genetic material can be transported without detection, and the general lack of awareness about the nature and value of genetic material among Indian enforcement agencies, makes this type of activity difficult to prevent. The use of these materials for medicines, cosmetics, agricultural products and other forms of products is also difficult to detect as partly there is inadequate transparency among corporations and their laboratories and partly because we do not know what we have and, as such, do not know what has been stolen.

f. Theft of genetic formulations for external commercial utilisation.

Though life forms cannot be patented, the processes and products relating to these life forms, that have commercial value, can be patented. Perhaps the most effective way for a country to ensure that their traditional processes and products are not stolen is to either have them recorded in a manner that their country of origin is adequately explicit, or to patent them before others can. We, unfortunately (unlike China), have a very poor track record in protecting our processes and products.

2. ***External Indirect Threats***

a. Destruction of habitats and species for meeting external commercial demands for animals and plants, and their parts.

Tigers, rhinos, ornamental fish, birds and flowers, sea horses, sea cucumbers, and musk, are some among the many species and specie parts that have great demand in other countries. The demand for tiger skins and trophies, which contributed to the near decimation of the species has now been replaced by a demand for tiger bones – reportedly used in traditional Chinese medicines and as an aphrodisiac – in much of south-east Asia. Similarly, the rhino horn has been used both as an aphrodisiac and for detecting poison in many parts of Asia (allegedly, if a poisonous drink is poured in a cup made of rhino horn, there is an immediate indication that it is poisonous!). The sea cucumber is a delicacy in many parts of south-east Asia, as is the edible swiftlet nest – resulting in both these species being extensively harvested and driven to near extinction. The demand for ornamental fish, birds, butterflies, orchids, flowers and insects has also exacerbated the situation. The trade in wild edible and medicinal plants is another major threat to biodiversity.

b. Destruction of habitats and species in order to accommodate demands of multi national commercial houses.

One of the disturbing (and perhaps peculiarly Indian) response to the imperatives of globalisation and attracting foreign investment has been the lowering of environmental standards within the country – standards that were already intolerably low. Therefore, in the name of development and of attracting foreign investors, our regulatory mechanisms are bending over backwards to clear projects that are destructive to biodiversity. It would be interesting to note that in the "developed" world, growth in industrialisation comes with growth in environmental regulations and the stringency of standards.

c. Destruction of habitats and species in order to meet the aspirations and lifestyles inspired by external influences.

We are a poor country trying to live the lifestyle of the rich. Western influence, through the media and through their marketing mechanisms, is catching the imagination of Indians, especially urban Indians, across economic classes. We are aspiring for greater consumerism and expressing this increasingly through both the ballot and the market (the recent national election results notwithstanding).

d. Erosion of conservation cultures due to external influences.

India has a long and strong tradition of protecting the environment and of safeguarding its biodiversity. Historically, there have been sacred sites and species that have been protected to various degrees by communities. Nature has been revered, respected and even worshipped and the right of other living creatures to coexist with human beings has been a part of the tradition. Unfortunately, this "conservation culture" is being eroded and all nature is increasingly being seen as a resources, as a potential source of income or, at the very least, as subservient to human needs and wants.

e. Global warming and ozone depletion.

Macro global climatic changes and the depletion of the ozone layer are also becoming a major threat to the biodiversity of each country. Unfortunately, countries other than those responsible for the problem often face the major adverse impacts.

3. Internal Direct Threats

a. Destruction of habitats and species for commercial purposes.

Internal demand for animals and plants, and their parts and derivatives, has been responsible for the degradation of many habitats and for the decline and disappearance of various species. Though in recent years there is legal protection offered to most endangered and threatened species (except perhaps micro-organisms), the enforcement of these laws is very weak and the commercial pressures very strong.

b. Destruction of habitats and species for development projects and activities.

Though Indian laws have laid down the necessity of an environmental impact assessment and obtaining environmental clearance (under the Environment (Protection) Act of 1986), over the years the process of ensuring that such assessments and clearances are based on good science and are independent and objective, has corroded. Today, a large number of critical parameters, especially concerning the environment, are never looked at, while projects are given clearances even before the EIAs are completed, or even when the EIAs show them to be environmentally non- viable. There is huge political, administrative and commercial pressure for the clearance of projects, but few who speak out against "destructive development".

c. Destruction of habitats and species in order to meet the basic needs of the people.

The growing human population, poverty, cornering of most resources by a few and the colonising of nature by the rich and the powerful has led to a larger and larger number of people being dependent on a shrinking stock of wilderness areas. Whether it is grazing lands, or fuel wood supply, or fisheries, or access to agricultural land or building and raw materials, the remaining forests, grasslands, rivers, lakes, coasts and other wilderness areas are facing the brunt. A battle that is between two classes of human beings is being projected as one between human beings and nature or, even more unfairly, between human beings and animals.

d. Destruction of habitats and species because of the spread of exotics and invasives, and because of forest fires.

The spread of weeds, mainly because of the over use and degradation of ecosystems, is posing one of the major threats to biodiversity. Along with this, the periodic occurrence of forest fires, especially in the dryer forests and in the mountains, is taking a very heavy toll of biodiversity.

e. Destruction of habitats and species because of pollution.

Air and water pollution, and the use of chemical fertilisers and pesticides are also taking a heavy toll of many species and ecosystems. Agro biodiversity is especially being threatened by the use of a large amount of chemicals and the use of polluted water.

f. Destruction of agro-biodiversity because of the exclusive promotion of modern agricultural practices.

Though the green revolution might have contributed significantly to the short and medium term food security of the country, the overwhelming focus on hybrid varieties and the use of uniform strains of crops across the country has resulted in the loss of a large amount of agro-biodiversity. Many traditional strains of wheat, rice, and other grains are no longer being cultivated, along with other species, and in many cases they have been permanently lost. In other cases, though the genetic material has been preserved, the traditional practices associated with their cultivation have been lost, perhaps for ever.

4. Internal Indirect Threats

a. Ignorance about the nature and value of biodiversity.

Not just the common public, but even politicians, administrators and even the scientists often do not know anything about biodiversity – not even what it means and why we should conserve it. This universal ignorance poses a great threat to the conservation of biodiversity.

b. Inadequate or inappropriate regulatory mechanisms.

As already mentioned in various specific contexts, though India has an impressive array of laws relating to the environment, its record, ability and commitment to enforce these laws is very weak. Barring some exceptions, most regulatory agencies are engaged in trying to facilitate rather than regulate commercial and development projects, and in trying to find ways of getting around environmental laws, rather than ensuring their enforcement. The political will to take hard decisions necessitated by the conflict of interests around environmental issues is also lacking.

c. Adopting unsustainable lifestyles and models of development.

Many of the problems of regulating environmental damage arise from the lifestyles and model of development that we have adopted. Just as an indicator of our mind set, we have adopted consumption indexes to measure our levels of economic development. Our economic and fiscal policies encourage consumption and waste rather than frugality, as is required in a country with a billion plus population, many of who are desperately poor. Our water policy, energy policy, transport policy, housing policy and even our agricultural policy promote practices that are not ecologically caring and sustainable. There is no interface between the various policies and the environment policy, therefore, every issue becomes a conflict with the more powerful lobby invariably winning.

d. Abject poverty or excessive consumerism and opulence.

Ironically, both excessive poverty and affluence pose a threat to the environment and to the inherent biodiversity. The desperately poor are forced to commit ecological suicide because they have no real choice. The desperately rich often become so at the cost of the environment and also inordinately tax the environment, to support their opulent lifestyles.

Possible Future Directions

What, then, needs to be done to safeguard the biological security of India? Just more of the same, or do we need a different approach? Perhaps the three principles that need to be built upon are:

a. Strong, objective and transparent regulatory mechanism.
b. Economic and financial disincentives for environmental destruction, and incentives for conservation.
c. Greater community participation in biodiversity conservation.

Regulatory Mechanism: The major regulatory mechanism in India is through the system of granting environmental clearances. However, as the system works, there are many weaknesses. Some of these are listed below.

a. Appropriateness of Environmental Impact Assessments

There is a general paucity of data, especially credible independent data, on environmental aspects relevant to the assessment of development and commercial projects and activities. There are Botanical and Zoological Surveys in India, and a Ministry of Environment and Forests along with state departments of environment and forests. However, despite this, detailed information on terrestrial and aquatic ecosystems are not available in advance of the projects and activities being proposed. Therefore, much of the data required are collected after the project has been proposed and the environmental impact assessment initiated. This results in at least the following problems:

- As the environmental studies are usually initiated very late in the day, there is a tendency to hurry them along so that the environmental clearance and the consequent completion of the project are not delayed. Considering that data have often to be collected from scratch, this results in the use of unscientific methodologies and a resultant inadequate assessment. An example of this is the Tehri dam where the fauna and flora studies were not even initiated by the time the dam was cleared, and were finally taken up only after the passing of the deadline prescribed for completion in the clearance letter. The fact that they were taken up at all was probably due to public pressure, in the form of a public interest litigation in the Supreme Court of India.

  As a result, the study on fauna was completed within six months of initiation, though scientifically at least two annual cycles must be studied before any assessment of the fauna can be made. The botanical studies were done with similar haste and carelessness [Tehri 1997].

  Similar experiences are recorded from most of the other few projects where such studies have at all been undertaken.

  Unfortunately, there is no system by which basic environmental parameters are studied much before a project is posed for clearance or as soon as potential sites for projects have been identified.
- These studies are done at the cost of the project proponents and are a part of the project cost in the calculations regarding the economic viability of the project. This results in a tendency to try and do them as cheaply as possible, thereby cutting corners and compromising on quality.

- The project proponents are interested in getting their project cleared as soon as possible and with the least costs. Consequently, there is pressure on project consultants to produce a report that either shows no adverse environmental impacts or suggests very cheap (and, usually ineffective) methods of mitigating these impacts. The problem is exacerbated by the fact that the Ministry of Environment and Forests (MoEF) and its environmental appraisal committees (EAC) have little ability to independently verify these reports and the data they contain. They can, at best, check up superficially on a few aspects or refer the matter back to the same consultants to review the data provided. This also results in delays in the assessment process that, in turn, makes the MoEF susceptible to criticism and to pressure for early clearances.

  Unfortunately, there is no system by which the financing of environmental studies can be done by an independent institution like the Planning Commission and debited on a fixed percentage basis to project cost, thereby freeing the project consultants from pressures by the project authorities.
- The guidelines of the MoEF are woefully inadequate. As the project authorities follow these guidelines, many of the critical aspects, especially impacts on biodiversity, are not covered at all.

b. Lack of Retrospective Assessments

Apart from the fact that for all the projects designed and initiated before 1978, none of the environmental impacts were assessed, there is no retrospective assessment of projects once they are completed. This is despite the fact that the need to conduct retrospective assessments has often been highlighted by various agencies and experts. The lack of such assessments makes the task of assessing the overall impacts of projects on the environment very difficult. It is also a wasted opportunity to learn from past experience. Consequently, even today, many of the impacts assumed and the mitigative measures planned have little experiential basis.

c. Political and Administrative Pressures

The process of environmental impact assessment has been subjected to political and administrative pressures almost from the start. Pressure is brought upon the professional project consultants to prepare environmental impact statements (EIS) in a manner such that the project is cleared. Pressure is brought upon the EAC to recommend the clearance or rejection of projects. Also, the MoEF or the Government of India rejects recommendations of the EAC, without assigning any reasons.

A well-known case is that of the Tehri Project, in Uttar Pradesh. The EAC that considered the project was unanimous in recommending that the project should not be accorded environmental clearance (1990). However, despite that, the government decided to give environmental clearance without assigning any reasons for rejecting the advice of their own expert committee. In his submission before the Expert Committee set up by the Power Ministry of the Government of India to assess the rehabilitation and environmental aspects of the Tehri dam (1996-97), the then Secretary of the MoEF said:

"..that records indicate that the decision for conditional clearance of the Tehri project was taken not by the MoEF, which did not favour clearance, but at a higher level" [Tehri 1997, p -104]

The minutes of the said Expert Committee go on to record that:

"The Secretary was also asked to comment on how the MoEF could have determined that the Tehri Project was environmentally viable, and consequently given environmental clearance, when the various studies which were to assess the environmental impact of the project had not been completed. The Secretary agreed that the MoEF could not determine the environmental viability of the project prior to the studies being completed and reiterated that environmental clearance had not been given at the behest of the MoEF but at the behest of a higher level" [Tehri 1997, p -105].

In other cases, projects were initiated much before clearances were received. This served to pressurise the Government of India to clear the project as so much expenditure of public funds had already been incurred.

d. The ability to Enforce and Monitor Conditions

Projects that are cleared are basically of three types.

- First, there are those which are unconditionally cleared, which means that the project proposal, in terms of the anticipated environmental impacts and the proposed preventive and mitigative measures, is found acceptable.
- The second (a large majority) are those where certain conditions are specified while clearance is being granted and, in that sense, the clearance is conditional.
- The third are those where the required environmental assessments have not been carried out but clearance is given with the understanding that the required environmental studies would be completed within a specified period and that the preventative and mitigative measures would be carried out *pari passu* with the construction work.

For each of these types, it is essential to monitor that their environmental impacts are within the anticipated limits, that the preventive and mitigative measures proposed by them or stipulated by the MoEF are being carried out properly and in time, and that they are having the anticipated affects. For the third type (with *pari passu* clearances), it is also necessary to ensure that the studies are carried out within the stipulated period and that the viability of the project is assessed as soon as possible and certainly before it has reached a stage where it cannot be abandoned. Where the project is found viable, it then has to be ensured that appropriate action plans are formulated and implemented in time to prevent and mitigate all that is preventable and mitigable.

The MoEF must also have the willingness and capability, as is implied by the law, to withdraw environmental clearance from, and thereby stop construction of, projects where the prescribed environmental conditions are not being complied. It must also have the willingness and ability to scrap projects, even after their initiation, if they prove to be environmentally non-viable.

The ability of the MoEF to monitor compliance to the stipulated conditions is limited. It is expected to monitor this through its regional offices which, in turn, rely mainly on the returns submitted by the project authorities themselves. And even this system of monitoring has come up only in the last five years or so.

e. Lessons to be learnt

Perhaps the major lesson that should be learnt is that projects should not be initiated before a comprehensive environmental impact assessment has been carried out and the project has been determined to be environmentally, socially and economically viable. If projects are initiated without such an assessment, there should be a legal provision to prosecute the concerned individual who has allowed the construction to start. A similar provision exists in the Forest (Conservation) Act of 1980 where the concerned forest officer can be imprisoned if he allows the diversion of forestland without the clearance of the Government of India.

Another lesson that should be learnt is that there need to be clear and transparent standards prescribed for the assessment of projects. In the absence of such standards, even where environmental impact assessments are carried out the determination of the viability of the project becomes a matter of arbitrary opinion. Also, all assessments must be done transparently and, wherever feasible, with the involvement of non-government institutions and individuals who are independent of the project.

Whereas for air and water pollution, standards have been fixed and one can assess whether an activity or project is viable from the point of view of pollution, the same is not true for most other aspects of the environment.

It is not that standards cannot be fixed. For example, one can list the ecosystem types and the species that are threatened in regions, nationally and globally, and prohibit any activity that further degrades them. One can also develop a land use plan where, region by region, areas are demarcated for various uses and dams can only be made if they keep within the limits set by the regional land use plan. This would also reward those regions that have maintained their ecosystems well.

Economic and Financial Mechanism: There are various methodologies available for putting an economic and financial value on the environment and natural resources. Most of these are market based, and thereby have various problems, especially in countries like India. However, when such methodologies are used to ascribe economic value to elements of biodiversity, and not just to natural resources, then the problem becomes even more acute. Some of the major problems with trying to apply the existing methodologies to biodiversity are described below.

Classification of Nature: The first problem relates to classification of nature into that which has economic value or, as economists sometimes describe it, has alternate uses, and that which has no economic value for it has no alternate use. The belief that some elements of nature have no alternate use and therefore no economic or financial value seems misplaced. Perhaps, if one takes a very narrow definition of "value" and "use", then one could argue this. However, it is well established that each individual living organism represents a unique element of biodiversity. Therefore, it is difficult to imagine even a single plant or creature that has no use.

Attaching Value: Even more difficult is the method by which economic and financial value is attached to elements of nature. Unfortunately, economics as a science can only put a replacement value to those goods and services, which are inputs into, or outputs of, an economic process. Much of nature, critical as it is to human survival, is not an input or an output of an economic process. Therefore, for economists, it is either invaluable or valueless. As economics cannot handle the notion of invaluable, it tends to consider much of nature as valueless.

As an example, how can economics ascribe a realistic financial or economic value to the last surviving pair of a species of a bird, which currently might have no known economic function? Given the present methodology, such a pair would ordinarily be considered without economic value. Yet, this very species might, if it survives, become of very great economic value in the future. Nevertheless, as there is no way of predicting with any certainty whether this would happen or not, ascribing value becomes an impossible task.

The North-South Divide: Though the difficulties in ascribing economic value to elements of nature are common all over the world, their implications are far greater for countries of the South. Whereas in countries of the North most people have enough surpluses after meeting their immediate basic needs, to be willing to pay for recreation and long term needs like environmental conservation, this is not so in countries of the South. Therefore, if the economic value of the environment was to be determined through market forces, as is envisaged in many of the prevailing methodologies, it is unlikely that in countries like India the poor people would be in a position to choose long term needs over their immediate ones. Market forces would, consequently, make it difficult to conserve and protect anything.

Also, given the vast differences in the buying power of different segments of society in countries of the South, and between the North and the South, it is difficult to ensure socially just utilisation of natural resources. This is especially so if decisions were to be made solely or primarily on an economic basis.

Undervaluing Nature: There is also a tendency of governments, dominated by imperatives for economic growth, to systematically undervalue the contributions of natural ecosystems to the economy and to human welfare in general. For example, a forest can be contrasted with a

human made industry. Whereas the human made industry requires inputs of capital, energy, raw materials, maintenance, replacement, and a labour force to make it productive, the forest, as an industry, produces goods and services critical to humanity without requiring any of these. It generates its own energy, produces its own raw materials, maintains and replaces itself, and goes on for eternity without needing any human input. However, the economic value attributed to forests never reflects this miracle of productivity and renewability.

Alternate Methodologies: An Overview

The task, therefore, is to develop a methodology which is appropriate for India, which is workable given the socio-economic conditions in India and which is in consonance with the principles of sustainable development.

The term sustainable development is mostly used in the context of natural resources and is understood to imply that the extraction of such resources must be sustainable in the sense of renewability. In other words, sustainability or renewability has come to mean that if a particular resources is being used or extracted, the rate of use or extraction must not exceed the rate at which the resource can renew or regenerate itself. However, such an understanding does not adequately take into consideration concerns about biodiversity conservation.

For one, many species that are not being specifically used or extracted can get adversely affected by the use or extraction of other species. Whereas the renewability of the primary (target) species may be safeguarded under 'sustainable use patterns', mostly the secondary (non target) species are not even considered. For example, the sustainable use of timber usually means that the amount of timber extracted from a forest does not exceed, in that time frame, the capacity of the forest to grow timber. Therefore, only the increment and not the capital is extracted. However, there would be many species of plants, insects, birds, reptiles and mammals that are dependent on the species of trees being extracted. There is rarely, if ever, an assessment to see whether the extraction is at a rate where their populations do not get depleted or adversely affected. Similarly with the sustainable use of grasslands, or rivers and oceans.

Of course, it can be argued that if other species in the ecosystem are being adversely affected then, sooner or later, this will have an adverse impact on the target species and their renewability will be threatened. Therefore, in so far as their renewability is being safeguarded, all the species linked to hem are also being safeguarded. However, the adverse impacts of the depletion of a particular species on another can take many years, sometimes even centuries, to manifest itself and, in any case, is not always obvious and is even now poorly understood. Therefore, if biodiversity has to be protected, just ensuring the sustainable use of the target species is not enough.

Even where the populations of other (non target) species are not depleted, there can still be a change in the populations and in the ecological processes. Such a change might itself be undesirable, especially as adequate representative populations and areas need to be maintained as genetic reference points. Therefore, there must be some areas which are entirely or substantially free from human use and disturbance. Proper sustainability must, then, include these concerns and considerations.

Keeping all this in mind and keeping in mind the earlier discussion on the contemporary meaning of 'development', any methodology for natural resource accounting which is to be in consonance with the notion of development must:

- Promote economic growth that is
- environmentally sustainable and
- equitable.

Judging from this standpoint, the current (market based) methodologies fail miserably.

For one, 'development' as defined above accepts sustainability as an absolute value, as it does equity. In fact, it constraints economic growth by prescribing sustainability and

equity. However, current natural resource accounting (NRA) methodologies do not accept any absolute values. Therefore, if the unsustainable use of a resource has greater market value than its sustainable use, then current NRA methodologies will prescribe unsustainable use as rational. By not accepting sustainability as an absolute value and, in fact, by discounting future value, current NRA methodologies actually militate against development in the real sense.

Similarly, current NRA methodologies have no absolute value for equity. In fact, market valuation will ordinarily militate against equity, for the capacity of the poor to pay for resources would ordinarily be much less than that of the rich. Therefore, the current methodologies would invariably favour the rich, and where there was competition between the poor and the rich for a resource, invariably prescribe that the rational thing is to give it to those who can pay more. An interesting example of this was a World Bank internal note that was leaked some years back. In this, a World bank economist had recommended that as the income levels of people in third world countries was very low it made economic sense to shift all polluting and hazardous industrial units to the third world. In the 'third world' it would be cheaper to pollute than to control pollution and certainly much cheaper to compensate injuries and deaths caused by hazardous effluents.

Artificial measures to introduce sustainability values in terms of option values and equity values in terms of government controls also do not work for, as these values are arbitrarily ascribed, they reflect the political power of the environment and the poor, which is usually not very much. What, then, is the solution.

The best way out seems to be to adopt a dual approach of both budgeting and accounting. This means that natural resources (and nature) are accounted for and decided upon on the basis of a system which first budgets, in physical terms, and then allocates the surplus on the basis of economic value. The elements of this approach are described below.

First, a natural resource, say water, needs to be budgeted in physical terms and allocations made to meet the basic ecological and social requirements. This means that, in a river, the minimum flows required for maintaining the ecological balance of the river and consequently its ability to cleanse itself and support life, must be assured. It must be assured that the river is not only able to perform all its ecological functions and renewably supply clean and wholesome water for human uses, but also that its biodiversity profile is not adversely affected. This would meet the absolute value of sustainability in the larger sense of including biodiversity conservation.

Once this is done, then the surplus water must next be allocated for meeting the basic needs of the human populations dependent on the river. This includes their drinking water requirements and other basic needs. Therefore, once sustainability is assured, then the next absolute value, that of equity, must be met. After water has been physically budgeted for these two requirements, the surplus, If any, can then be subjected to market forces and its use determined based on the paying capacity of the various contenders and the economic benefits of the various uses. In such a model, where there is industrial demand for water over and above the surpluses available, there the industrial sector must pay for enhancing lean season flows by, for example, regenerating catchments, in order to produce larger surpluses. There is also, then, an economic incentive to invest in water saving technology, as the real cost of water is being charged.

A similar approach can be applied to other types of ecosystems and resources. Take, for example, forests. Here, also, the area required for maintaining the biodiversity and ecological functions of forests must first be physically demarcated and budgeted. Once this is done then the areas required to meet the basic social needs, like firewood, must be physically demarcated. Once this is done, the surplus can again be ascribed economic value and made available to the highest bidder.

It must, however, be remembered that environmental resources are location sensitive in the sense that apart from ensuring overall availability it must also be ensured that they are available at the right place. So, for example, the ecological functions of forests would not be served if the total area of forests required all occurred in one part of the country while the rest of the country became devoid of forests. Similarly, for a river it is not enough that the total water flow required occurred in one part of the river while other parts became bone dry. Therefore, apart from calculating the area and resources needed totally, there also has to be an assessment of the distribution of these areas and resources. This is also important from the equity angle.

In short, apart from determining the carrying capacity of ecosystems there also has to be prioritisation of sites where conservation and utilisation needs to be regulated and where resources need to be earmarked for ecological and social functions.

One interesting attempt at economic valuation of resources was made in the mid 1980s by the Ministry of Environment and Forests, Government of India, with regards to the Narmada (Indira) Sagar Project in Madhya Pradesh. Using FAO norms, the Forest Research Institute and Colleges (FRI as it was then known) estimated that the cost of the forests to be submerged by the Narmada Sagar Project were Rs 30, 923 crores for a 50 year period. Considering the total cost of the project at that time, excluding these forest costs, was Rs. 6000 crores, if one added the forest costs, the project clearly became uneconomical. For obvious reasons, this estimate was not acceptable to the Government of India and the whole approach was shelved. [DoEF 1987]

Community Participation

Community participation in biodiversity conservation is not a recent phenomenon. Historical evidence indicates communities all over the world were getting together to protect sites and species hundreds of years ago. Even in pre-historical times some areas were demarcated for conservation and certainly many species were protected. However, much of the documented evidence that survives details conservation initiatives by communities in the last few hundred years.

One of the major difficulties with community participation in biodiversity conservation, especially relating to areas that are being protected with the objective of conserving biodiversity, is the high levels of protection that are usually postulated. Unlike conservation efforts aimed at the sustainable utilisation of natural resources, where varying amounts of use and manipulation of the ecosystem are permitted, in most cases biodiversity conservation requires human use to be severely restricted or all together curtailed. The total protection of an entire area, without any human use, usually conflicts with the needs of the local community to extract resources from the area.

The level of protection required determines to a large extent the level of inclination and ability of local communities to protect the area. Whereas, sustainable use is an objective that is widely accepted, it does not by itself imply biodiversity conservation. The average villager or forest dweller knows and values those species of plants and animals that are of some direct use. Some animals are good food, others control common pests, and others can be domesticated. Plants serve as food, medicines, ornaments and help build houses, boats and other implements. There is little problem in motivating the local communities to conserve such species. In fact, often they require no external motivation at all. However, the problem arises when they are asked to expend time and effort conserving those species that they perceive as being of no direct use or benefit to them. The problem becomes worse when they are also expected to conserve those species that raid their crops, attack them and their livestock or otherwise adversely affect them. But, if biodiversity is to be conserved, all these

must also be conserved. Therefore, whereas sustainable use would focus on ensuring that the plants and animals that are of use do not degrade or become extinct, biodiversity conservation implies the protection of all plants and animals. The types of conflicts that emerge, given different conservation objectives, different levels of protection and varying field realities, are summarised below.

Efficacy of Community Based Conservation Strategies

Objective: To Conserve Biodiversity; Level of Protection: High. Very limited or no human use or activity allowed		
Situation	*Nature of conflicts*	*Efficacy*
1. None or very limited human use with no alternatives.	Between conservation needs and community needs	Low
2. Same as above, but with adequate alternatives or incentives provided.	Between the community's interest to conserve and individual inclinations to exploit	High
3. Limited use but with commercial benefits flowing to the whole community	Between conservation needs and the temptation for financial returns.	Low
4. Same as above, but with benefits flowing to only some within the community.	Within the community.	Medium
5. The same as above, but with benefits not flowing to the community.	Conflicts between conservation needs and the dangers in opposing commercial interests	Medium
6. Area, conserved as a sacred site, with complete control of the community.	Conflicts between the religious beliefs and the local needs; and financial gains from exploitation.	High

Therefore, systems must be evolved where the local communities do not have to pay the cost of conserving biodiversity, whose conservation benefits all of humankind. In fact, incentives need to be developed to ensure that local communities have a real choice of conserving. Issues of tenure and control, but most important issues of livelihood must be addressed before community based biodiversity conservation can become a reality. We have to ensure that the people not only have an understanding of the need to conserve, and a will to conserve, but also a real social and economic option to conserve.

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