

Biodiversity and India's Degraded Lands

"Ecosystem people" of the world subsist by producing or gathering a diversity of biological resources from their immediate vicinity. Their quality of life is intimately linked to the maintenance of modest levels of biodiversity in their own circumscribed resource catchments. Their resource base has been extensively degraded by pressures created by "biosphere people"; i.e. the Third World elite and citizens of industrial countries, who can draw resources from all over the world and are thus, indifferent to environmental degradation in the Third World. Because "ecosystem people" have a genuine stake in biodiversity maintenance in their immediate surrounding, it is important that conservation efforts include maintenance and restoration of at least modest levels of biodiversity throughout the Third World. In the case of India this may be achieved by (a) dedicating the bulk of reserve forests to production of nontimber forest produce (NTFP), to support rural economy; (b) organizing effective community-based management systems to fulfill subsistence biomass requirements of peasants and tribals; (c) encouraging a switchover from shifting cultivation to horticulture; (d) supporting traditional practices of growing a variety of plant species, including keystone resources like *Ficus* spp, in rural habitats and on roadsides, farm and canal bunds; and (e) promoting tree farming on private lands to fulfill commercial needs

INTRODUCTION

This paper attempts to explore an alternative perspective, that of "ecosystem people" of the world, on conservation of biodiversity. These are people subsisting largely on resources produced or gathered from their immediate vicinity. In contrast, the "biosphere people" enjoy access to resources from all over the world; e.g. food, drugs or petroleum, or wilderness to which they can transport themselves (1). Ecosystem people are perforce concerned with the availability of resources, including biodiversity, in their immediate vicinity; the biosphere people only with global levels of available resources. Biosphere people dominate the increasingly integrated global society, with ecosystem people being part of an underclass in Third World countries. Ecosystem people mostly inhabit regions rich in biodiversity and have a personal stake in, but little control over, the health of the natural resource base of these regions. Control is in the hands of biosphere people who are unaffected by, and tend to promote, non-sustainable patterns of resource use in the Third World (2). In consequence, these biodiversity rich regions are being progressively degraded. The response of biosphere people, be they citizens of developed countries, or Third World elite has been to set up islands of biodiversity-rich protected areas from which local ecosystem people are excluded. If successful, this could ensure maintenance of high overall levels of biodiversity, as well as access to resources of such areas for a global elite. For ecosystem people it would mean being compelled to live in increasingly degraded and biodiversity poor environments, while being denied access to the few remaining biodiversity-rich habitat islands in their own countries. This approach can have little appeal for ecosystem

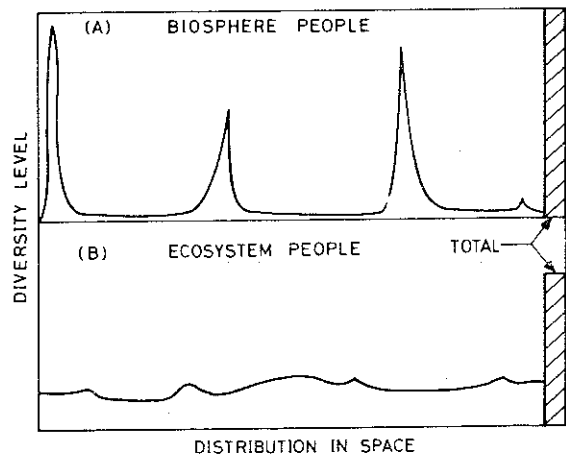
people. They stand to benefit only if their own limited resource catchments retain a healthy base of natural resources rich in biodiversity. For them what is relevant is not the global stock of biodiversity, but rather its spatial distribution and their access to local stock (3). From this perspective, it is desirable that levels of biodiversity are modest, well distributed, and accessible to everyone on an equitable basis (Fig. 1).

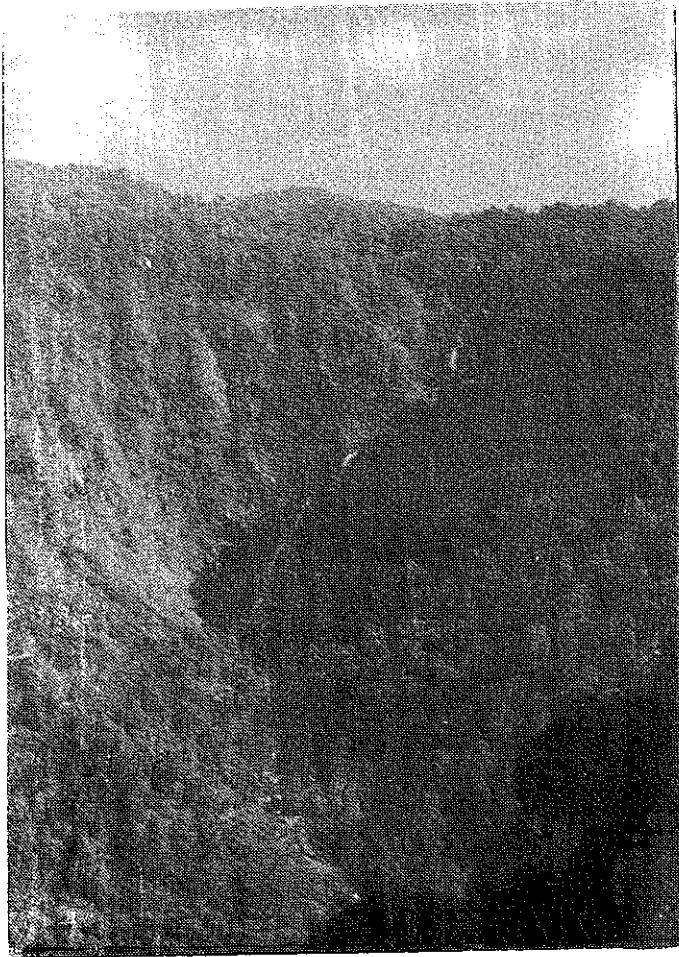
From this perspective degrading or degraded, but potentially rich, ecosystems in Third World tropics become a significant concern. Ecosystem people in these regions often have rich traditions of biodiversity conservation, but are today either helpless spectators of or active participants in the process of non-sustainable use of bioresources and depletion of biodiversity. With their own well-being linked to local biodiversity, they could relatively easily be motivated to sustain and restore it (4, 5). However, a whole range of barriers stand in the way of accomplishing this. It is important to understand what these barriers are and how they may be overcome.

INDIA: A BIOMASS-BASED CIVILIZATION

An analysis of what has been happening in India, one of the top 12 megadiversity countries of the world is presented here, in the hope that it may contribute to an understanding of the issues. Accounting for over 2% of the world's landmass, India spans a great diversity of environmental regimes. In the northeast, it boasts of areas with the highest levels of annual precipitation in the world. At the same time, parts of the Thar desert may have no rain for years; the annual average being below 300 mm. Its northern plains may experience summer temperatures of 50°C, while the higher reaches of Himalaya remain perpetually snowbound. India has some of the largest mountains in the world

Figure 1. "Biosphere people" with access to resources from all over the world are interested in maximizing the total global stock of biodiversity by concentrating on selected biodiversity-rich localities. On the other hand, "ecosystem people" with resource access largely restricted to their own localities would benefit from conservation of at least modest levels of biodiversity.





Tropical rainforest of Aghanashini valley on the Western Ghats in south India. While over 100 indigenous species from this tropical rainforest provide nontimber forest products valued by the local people, forestry practices have tended to focus on replacing these forests by a few species like teak and eucalyptus. Photo. M. Gadgil.

and also tiny coral islands in the Indian Ocean. Its river systems include the mighty Ganga and Brahmaputra with their huge flood plains and the short and swift west-flowing rivers discharging from the Western Ghats into the Arabian Sea. In consequence, India's natural vegetation ranges over tropical evergreen and mangroves to dry deciduous and desert scrub (6).

India's flora and fauna are reasonably well-documented, although some groups of insects and mites have hardly been studied. The total number of described species from the Indian subcontinent includes about 13 000 species of flowering plants, some 50 000 species of insects, 4000 species of mollusks, 6500 species of other invertebrates, 2000 fish species, 140 amphibian species, 420 reptile species, 1200 bird species and 340 mammal species. In all, there is a total of nearly 13 000 species of angiosperms and 65 000 of animals. This can be contrasted to known world species total of about 250 000 plants and 1.5 mill. animals. India then, harbors 5.2% and 14.3% of all known plant and animal species, respectively (7). This proportional representation may well hold if the, as yet, undescrbed 30 mill. or so species are documented by science.

Information available on land use and vegetation cover is not very reliable, reflecting legal ownership, rather than actual biophysical status. However, availability of satellite imagery has permitted some estimates of the actual status by the *National Remote Sensing Agency* and the *Forest Survey of India*. These estimates suggest that some 80 mill. ha out of 143 mill. ha under cultivation suffer from substantial degradation, while about 40 mill. ha out of 75 mill. ha controlled by Forest Department has a canopy cover of less than 40%. Another 12 mill. ha of pasture

lands are also substantially degraded. Thus, a total of 130 mill. ha, about 40% of the country's land mass, has a productivity well below its potential (8).

India is a biomass based civilization, therefore, this is a matter of considerable significance. Over two-thirds of its 850 mill. people depend on agriculture for their subsistence. They gather some 150 mill. tons (tons = metric tons) of fuelwood annually for domestic use, and free-range grazing by their livestock amounts to a fodder demand of over 500 mill. tons (9). The *Anthropological Survey of India* has recently completed an investigation of the 2600 ethnic communities making up the entire Indian population (10). This investigation revealed the very substantial dependence of the population on biomass, with at least some members in 5% of the communities being engaged in hunting-gathering; 7% in fishing; 2% in trapping birds; 2% in woodwork; 7% in basket and mat weaving; 3.5% in shifting cultivation; 20% in animal husbandry; and 50% in settled cultivation. Jodha's (11) investigations in 82 villages in semiarid districts of 7 Indian states suggest that biomass harvests from common lands furnish 14% to 23% of household income from all sources. Furthermore, poorer households derive a larger fraction of their income from such lands so that their use leads to a reduction in income inequalities. Two thirds of the communities report continued use of indigenous herbal medicines (10).

In this biomass based civilization a wide diversity of living organisms are put to a range of uses. Consider for instance the use of plant material to manufacture a variety of articles. Over an area of just 1000 km² in south India we found that 58 different plant species were used to make some 66 different kinds of articles including brooms, ropes, baskets, mats, various kinds of fishing and agricultural implements, furniture and decorative articles. There is a definite preference for specific plant species for the manufacture of certain articles. Thus, brooms are made from grasses, palms or weedy dicots; baskets from reed, bamboo or cane; bullock cartwheels from the hardwood of *Acacia nilotica* or *Azadirachta indica* while sandal or rosewood is preferred for the fabrication of decorative articles. Even exotic weeds are incorporated in the repertoire with *Lantana* used to make brooms. *Eupatorium glandulosum*, a pernicious composite weed is now routinely used as bedding for cattle and added to the manure pit next morning.

A significant proportion of India's large population depends on a diversity of products from living organisms. A majority of these people gather the plant and animal materials with their own labor from their immediate vicinity. Some 35—40% of the Indian population reportedly earns just enough to feed itself and has no purchasing power to meet other needs from the market place. Fully half of the ethnic communities making up the Indian population, report dependence on state-sponsored rural employment programs which provide wages that meet only basic nutritional requirements (10). Thus, a third or more Indian people behave as "ecosystem people", people whose quality of life is intimately linked to the productivity and diversity of living organisms in their own restricted resource catchments.

But under pressures of non-sustainable exploitation of biological resources the Indian environment today is rapidly losing both the productivity and diversity so critical to the ecosystem people. Official attempts to protect biodiversity are largely confined to the about 3% of India's land surface that make up the protected areas system (12, 13). These few species-rich areas are being increasingly surrounded by a matrix of biologically poor land- and water scape dominated by an increasingly smaller number of weedy species. Ecological theory tells us that such fragments are bound to lose a large proportion of their species in the long run. Such a loss would be all the more drastic in the event of the global warming that may occur over the next few decades. It is vital that protected areas are entrenched in a biologically diverse, ecologically friendly, matrix. But such a

matrix is viable only if it also contributes to the quality of life of the large numbers of ecosystem people who must derive their subsistence from these areas. The critical issue then is; how can 40% of India's landmass, currently under excessive pressure of extraction of biological resources and depleted of biodiversity, be restored to supporting productive and diverse biological communities in ways that would contribute to the quality of life of India's ecosystem people.

In a country as complex and heterogeneous as India, there are obviously, no simple solutions. I propose instead to explore solutions in four different ecological and socioeconomic contexts that may work or have been shown to have worked, namely, reserve forests, lands under shifting cultivation, village common lands and cultivated lands.

RESERVE FORESTS

The first case study pertains to reserved forests of the district of Uttara Kannada. Reserved forests encompass lands controlled by state forest departments which have been largely devoted to the supply of raw materials to forest-based industry. Local people are not expected to meet their subsistence biomass requirements from these lands. This is in contrast to another category, under control of the forest departments, the protected forests. Nevertheless, local people do have the privilege of grazing livestock as well as collecting dead and fallen wood and nontimber forest-products (NTFPs) from reserved forests. A variety of NTFPs are also commercially harvested from reserved forests through contracts awarded by auction. Timber is harvested by concessionaire industries, like plywood mills, by contractors or by government agencies. In theory, these timber harvests are organized so as to result in sustainable yields, but in practice they have led to rather rapid depletion of forest stocks. The 40 mill. ha of reserved forest lands with a canopy cover of less than 40% represent lands degraded primarily as a result of excessive timber harvests (14, 15).

The district of Uttara Kannada (13° 52' to 15° 30' N and 74° 05' to 75° 5' E) is located at the center of the hill chain of Western Ghats. Today, it harbors the most extensive contiguous tract of forest in south India and has over the years produced large quantities of teak and other hardwood for construction, fuelwood for the brick and tile industry and softwood for paper, polyfiber and plywood industries. The demands of forest-based industry have rapidly increased since the 1950s, as have the demands of

local population which began to increase after malaria was eradicated between 1948–1950. Over these years the area under forest cover has declined from 80% to 60%. In areas still retaining forest cover, the standing biomass has probably declined by a factor of two. While no plant species may have actually disappeared from the district the diversity of tree species has substantially decreased in evergreen forest tracts subject to substantial harvests. In particular, tree species in heavy demand by the plywood industry have suffered local extinctions. As standing stocks have declined forests have been clearcut for conversion to monocultures of eucalyptus and *Acacia auriculiformis* (16).

Ecosystem people of Uttara Kannada district have traditions of sustainable use of biological resources and conservation of biodiversity; traditions that have suffered much attrition over the last two centuries. These traditions include total protection of sacred ponds and groves; indeed the only surviving stand of *Dipterocarpus indicus* in the district is part of a sacred grove of the goddess Karikanamma. Some 20 species of the genus *Ficus*, now recognized as a keystone resource, dot the countryside and are protected as sacred trees. The village forest of Kallabbe, managed by the local people supports a larger standing biomass and a greater variety of trees when compared to reserved forests in the vicinity. However, traditions now have only a tenuous hold and are gradually giving way to pressures from the market and to increasing demands from the population. A number of sacred groves have been clearcut by the forest department and *Ficus nervosa* has been supplied to plywood industry at highly subsidized rates (17, 18).

Several measures are required to halt the pace of degradation of forest reserves. Extraction pressures need to be reduced by halting (a) halting all commercial timber extraction; and (b) collection of fuelwood and grazing. It is feasible to phase out commercial exploitation by raising the raw material on private tree farms. Between 3 to 5 mill. ha of the 143 mill. ha of cultivated land could meet the annual demands of 30 mill. tons of industrial wood, provided that farmers can be paid a fair price. The latter would require that the government halt all subsidized supplies of wood to industry, as well as appropriately taxing timber imported from countries like Malaysia (14, 17).

Halting fuelwood collection and excessive grazing pressure in the reserved forest depends on making alternative arrangements to fulfill subsistence biomass needs, coupled to alternative sources of income for the rural people who depend on the sale of fuelwood



Thoroughly degraded vegetation on land under very short fallow shifting cultivation on Maharashtra Western Ghats in south India. Revegetation of such lands by raising indigenous fruit trees like mango and a variety of other plants providing nontimber forest produce could restore part of the lost biodiversity. Photo: M. Gadgil.

and of milk and dung for a living. These biomass needs are large, in the order of 150 mill tons of fuelwood and 500 mill tons of fodder. They could be substantially reduced through the use of much more fuel-efficient wood stoves and biogas plants and a switchover to a smaller number of stall-fed cattle. In addition, all 12 mill ha of pasture lands plus some 25–30 mill ha of degraded protected and reserve-forest lands would need to be managed far better to fulfill the rural biomass requirements, an issue discussed below.

If commercial wood production is shifted to tree farms and subsistence biomass production to a specially organized system of community lands, around 45–50 mill ha of reserved forest land could be dedicated entirely to provision of environmental services. These could include watershed protection, build-up of tree biomass, leading to carbon sequestration, and conservation of biodiversity. All these services are compatible with sustained utilization of NTFP. Forests in Uttara Kannada, produce a very wide range of these including fiber, tannins, resins, oils, spices, drugs and pesticides. Over a hundred species provide NTFP and these include plants of all growth forms occupying a whole range of habitats. The natural-forest communities of Uttara Kannada could therefore be enriched by species yielding NTFP without drastically reducing their diversity. Collection, processing and marketing of NTFPs could be organized to form a substantial source of income for the ecosystem people of Uttara Kannada, motivating them to protect the reserved forest lands (14).

SHIFTING CULTIVATION

Another important category of degrading lands are those under shifting cultivation. Such lands amount to a total of 1.85 mill ha and are primarily concentrated in northeastern hill tracts bordering China, Myanmar, and Bangladesh. The traditional systems of shifting cultivation with cycles involving 2–4 years of cultivation and 15–30 years of fallow were sustainable. Not every piece of forest came under the axe, some patches were set aside as sacred groves retaining climax vegetation. Furthermore, clearing for cultivation did not necessarily involve cutting down every tree. Individuals of several species, especially of fruit yielding trees, were left intact. Such a system probably enhanced landscape level diversity, while leaving total biodiversity largely intact. The system is however, now under considerable stress because of commercial pressures leading to the export of wood, a decrease in the area available for shifting cultivation along with a rapid increase in the population. Fallow periods have now decreased to 3 to 10 years and sacred groves have been increasingly eliminated, although several do persist. The old systems of community control are collapsing and tribal chiefs are removing tree growth to make some money.

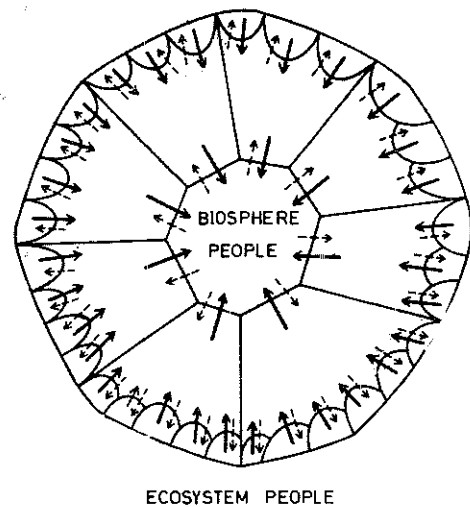
The production system of shifting cultivation areas currently includes grain and tubers for subsistence and wood for the market. All the shifting cultivation tracts have high levels of rainfall and could support economically viable horticulture, a transition that is being actively promoted by the government. This could be supplemented by the production of a diversity of NTFP on the remaining land area, with collection, processing, and marketing of NTFP so organized as to support the local economy. Such a system should be coupled to adequate levels of wood production on tree farms to meet the commercial wood requirements.

VILLAGE COMMON LANDS

Fairly substantial tracts of land, of the order of 10–20 mill ha controlled by the forest department and another 10–20 mill ha controlled by revenue authorities, have been set apart to fulfill the biomass requirements of inhabitants of tribal hamlets and peasant villages. No precise information is available on the extent of such

BOX 1

Global resource fluxes are highly imbalanced because the terms of exchange greatly favor goods and services generated by the organized industrial sector in relation to biological and mineral produce. A minority of the world's population residing in the developed countries and in the urban-industrial enclaves in the developing countries, the "biosphere people", can therefore access resources from all over the world and are shielded from the consequences of environmental degradation in rest of the world. Most people residing in the Third World countryside have to accept unsustainable levels of decreasing natural resources from their localities in exchange for a trickle of produce for the industrial sector. With low purchasing power, these "ecosystem people" are forced to subsist on resources gathered or produced within their own surroundings. It is these ecosystem people who bear the burden of the negative consequences of environmental degradation even as they exacerbate the problems in their efforts to survive.



land and a significant portion of it is currently under illegal cultivation.

Studies in a cluster of 42 villages in Tumkur district of Karnataka state (13° 20' N and 77° 5' E) revealed that fully 95% of 13 400 ha of such common lands are being cultivated. In Honnavar county of Uttara Kannada district (14° 20' N and 74° 30' E) the encroached land under cultivation is much smaller; i.e. about 2% of 35 000 ha. Such encroached land is largely quite infertile and ill-suited for the cultivation. However it does provide meager subsistence to a growing peasant population. Thus, it would be difficult to reappropriate as state-controlled common land. The best solution would be to turn over this land to horticulture or commercial tree farming.

Such encroachment for cultivation, along with population growth, at least one-third of whom are still dependent on biomass gathered from their own environment, is increasing the pressure on the remaining common lands. However, it is not just this pressure but the prevalent open-access regime that is at the root of degradation of the common lands. In pre-British times autonomous village communities controlled their own common lands. A council of the leaders of the different caste groups in the village dominated by the upper castes provided a fairly effective community-based system. They involved quotas on quantity of fuelwood gathered or number of cattle grazed, restrictions on season as well as methods. The regulations were enforced by the community employing watchmen from amongst its own members.

and fining or otherwise punishing offending members. Pre-British regimes recognized the authority of such local communities, which paid taxes to the state as a group and which could both keep out non-group members from common lands and impose sanctions on group members. The British refused to recognize this form of authority; the state dealt directly with individuals to collect taxes and the state judicial apparatus took authority to deal with all offences, including those relating to utilization of common lands. Common lands became state property controlled either by forest or revenue authorities. Rural people were granted privileges of biomass harvests from such lands without explicitly a particular piece of land being assigned for use by a particular group. No group had authority to prevent others or members of their own group from exercising such privileges, even if their behavior was perceived as leading to excessive resource harvests. This meant that all common lands came under an open-access regime, no man's land subject to totally unregulated usage. The natural outcome was a tragedy of the commons (15, 19). For instance, our studies in the coastal Kumta county of Uttara Kannada district (14° 30' N and 74° 25' E) of 13 such common forests show median standing biomass of 29 tons as compared to 350 tons in relatively undisturbed evergreen forests of the same tract. Vegetation diversity is also reduced, with a few species with poisonous latex such as *Sapium insignae* making up the bulk of tree population on common lands. This depletion has strongly affected the availability of biomass for subsistence use, as well as for marketing (Subash Chandran, pers. comm.)

Village communities and the state apparatus have periodically responded to this situation in a variety of ways. The villagers have privatized these lands and the state apparatus has legalized such transactions. Alternatively, the state has handed over such lands to private industry. The state also consolidated its own hold over the lands by reducing the privileges conceded to the villagers. All these responses have led to a monoculture of annual crops or tree crops, reducing biodiversity and exacerbating biomass shortages for villagers. Where village communities have successfully re-established their own control, there has been a tendency to maintain a diversity of species and to promote availability of biomass for use by local people. Such community-based control has continued nearly unbroken in a few remote tribal localities, as in parts of Mizoram. Notably, in this state village, woodlots subject to regulated extraction and the adjoining sacred groves are termed *supply forests* and *safety forests*, respectively (20). Community-based control was organized through village forest councils in certain parts of the country such as Kumaon in U.P. Himalayas in the late 1920s (21). In the last few years there has been a widespread resurgence of such experiments, following successful organization of village forest-protection committees in parts of West Bengal (22). In one cluster of 12 villages in Midnapore district of West Bengal (87° 20' E 22° 25' N) where such committees are effective, the villagers were found to utilize as many as 155 plant species out of a total of 214 for a variety of purposes. In any given village, between 32 to 64 species were in regular use. Community-based management is thus the option most compatible with maintenance of biodiversity. Moreover, it is also the option most favorable to promotion of diversity in attempts at ecorestoration (23). Surveys of 59 village communities in hilly areas of Karnataka Western Ghats showed villagers consistently in favor of use of a much larger number of species in plantations on common lands, than were attempted by the state forest department (24).

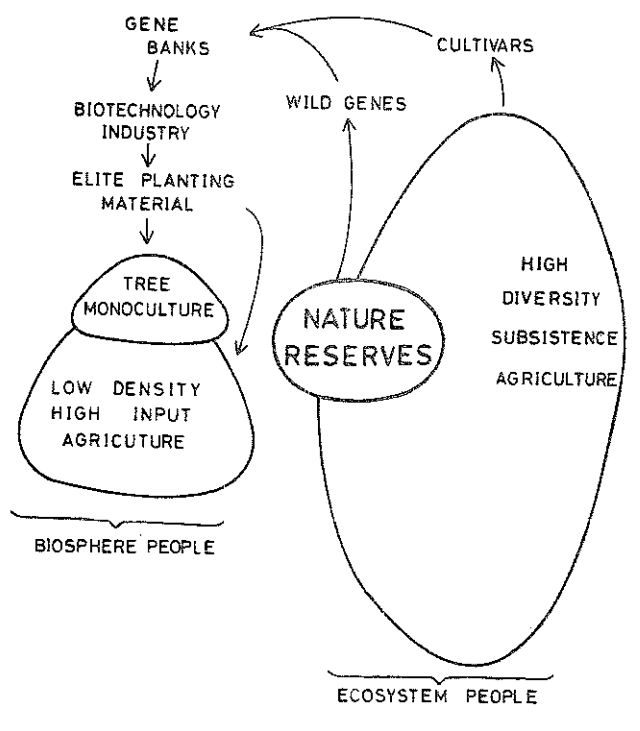
CULTIVATED LANDS

Agriculture is by far the most dominant form of land use in India involving some 550 mill. people. Official statistics rate 56% of land under cultivation as undergoing some form of degradation. Associated with cultivation are irrigation channels, farm bunds,

rural roads and house yards, all of which traditionally supported a large number of plant species. Over most of the country, species of the genus *Ficus* have been held sacred and protected, sometimes even in the midst of cultivated fields. Thus, these keystone resource species tend to constitute an important component of plant populations in rural India. In Ungra village in the state of Karnataka (76° 45' E and 13° 5' N °E) they constitute 5% in number and 15% in biomass out of 56 tree species in an area of 360 ha (25). An evergreen tree, jamun (*Syzygium cumini*) and a deciduous tree, neem (*Azadirachta indica*) both with fleshy, bird-dispersed fruits are common everywhere as are leguminous trees belonging to the genera *Acacia* and *Prosopis*. One species of the latter genus, khejadi (*P. cinerarea*), is notable for its economic utility as well as widespread occurrence in the arid tracts of northwestern India, especially in Rajasthan. One local farming community called Bishnois considers it an offense to uproot or destroy any seedling, sapling or tree of this species even in the midst of farmland. Their villages are therefore islands of greenery amidst very dry, barren tracts. The tree provides farmers with fencing material, leaf fodder, food in the form of pods, especially for goats, and fuelwood. Bishnois also protect peafowl and antelopes and their village areas teem with wildlife (26).

BOX 2

Much of the world's biodiversity currently resides in natural biological communities, and in the land races of crops and livestock of the Third World countries. Inhabitants of these regions, the "ecosystem people" have little bargaining power, and are unlikely to benefit from the rapidly emerging technological applications of biodiversity. These profits would largely accrue to "biosphere people" who control industrial production and who can draw resources from all over the world. They are engaged in high input-agriculture-forestry, which is highly productive but based on a narrow diversity base. The attempts of biosphere people to organize preservation of islands of high diversity surrounded by oceans of degraded countryside in the Third World tropics are unlikely to succeed. Instead, a system should be devised through which the ecosystem people would benefit from and become motivated to conserve biodiversity.



The traditional tree diversity of rural India is undergoing rapid depletion, not only to meet rural fuel needs, but more importantly for use in packing cases for fruit like mango and fuel for country brick kilns. At the same time new trees tend to be grown wherever irrigation canals transport water to rainfed areas, although these areas are much smaller in extent. Some economic incentives must be introduced to ensure continuation and restoration of diverse plant cover in rural India.

CONCLUSIONS

India's biodiversity should not only be conserved in the protected areas system that currently covers around 8.1 mill ha, but conservation should be in the much larger matrix of forest areas (an additional of 66 mill. ha), pastures (12 mill. ha) and on farm and canal bunds and in houseyards; over 143 mill. ha of cultivated tracts. As many as 250–300 mill ecosystem people of India depend on gathering a variety of biological produce from these 211 mill. ha and would greatly benefit from these lands continuing to support biologically diverse communities. Perhaps 5% of India, in such a matrix might be devoted to biodiversity conservation in the form of a highly dispersed network of tiny protected areas ranging in size from individual *Ficus* trees to groves of a few hundred m² to a few ha in size. *National Wastelands Development Board* (1991) has suggested the creation of such species rich areas as an integral component of programs of restoration of degraded lands. Such an ecologically friendly matrix would greatly help in the long-term conservation of biodiversity in the protected area system.

The economy of "biosphere people" does not place a value on diversity. It has been responsible for large-scale clearfelling of species-rich forests to replace them with plantations of teak, Eucalyptus or pine. It has also vigorously propagated agriculture based on just a few strains of wheat, rice, cotton or tobacco. The open-access conditions that have been forced upon rural commons have led to their abuse, and demands on rural economies have prompted peasants to cut down sacred fig trees to fire brick kilns. Devolution of power to the ecosystem people and greater attention to their interests in organization of the economy must therefore accompany attempts at conservation and restoration of biodiversity on a larger scale.

In India, a number of positive steps in this direction have been taken in recent years. The new forest policy, accepted in 1988, gives primacy to the needs of ecosystem people. A resolution of the Government of India, promulgated in June 1990, encourages involvement of local communities in co-management of forest resources. Since 1989, the *National Wasteland Development Board* has initiated a program of local-level micro-planning for rehabilitation of degraded lands in which local communities are expected to play an active role (27). This program emphasizes the need to use a wide variety of species of local utility in the ecorestoration programs.

Vigorous nongovernmental initiatives have preceded and indeed catalyzed these developments over the past 15 years. These include grassroots programs where small tribal or rural communities have spontaneously organized themselves to manage common lands or protect biodiversity, the best known of these being the Chipko activism in Himalayas, as well as activities of well-funded, urban-based NGOs like World Wide Fund for Nature-India (28). There are many positive indications in India, as in other parts of the world, that a broader based, people-oriented approach to conservation of biodiversity is beginning to take root. Restoration and maintenance of biodiversity over degraded lands in the Third World tropics would certainly be an important element in this effort.

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