

**SUSTAINABILITY THROUGH BIODIVERSITY :
Designing Crucible Of Culture, Creativity And Conscience ¹**

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ABSTRACT

There is a widespread concern the world over about non-sustainability of present developmental strategies and structures in both developed and developing world. Most debates have however, ignored the relationship between the regions of high biodiversity and high poverty. In this paper we have not only pursued the cultural and institutional roots of this relationship but also identified practical ways in which the people preserving biodiversity can be compensated. Paper makes a strong case for changing the nature of discourse and modifying existing epistemology of environmental debate.

In part one, the relationship between diversity and deprivation is analysed. In part two, the cultural and institutional aspects are studied. In part three, examples form indigenous ecological knowledge system including nature related folk songs generating eco-ethics are reviewed. Cultural diversity and the traditions of indigenous enquiry are pursued in part four. In part five, we discuss the reasons for protests emerging from these regions and the nation state's response. In part six, I discuss the mechanism for compensating farmers for preserving diversity. In part seven, the legal, fiscal and organisational routes for paying compensation are described. Part eight lists the ethical dilemma in conducting discourse on biodiversity. In last part, areas for follow up action by academics; planners and NGOs are illustrated.

"We live in a world of sad scientific ironies and economic enigmas. The regions where man first settled down to cultivate plants and thereby initiated what we now call "agricultural " are also the regions, which contain the greatest number of hungry people today. The regions which scientists designate as the centres of origin of crop plant are, strangely enough, the areas where the same plant is today giving one of the poorest average yields. The Jeypore tract of Orissa, which is believed to be an ancient centre of origin of rice, is a good example... "

(Dr.M S Swaminathan, Third Coromandel Lecture, February 29, 1973)

The poverty continues to be very high in the same regions even after about twenty years of above observation. The biodiversity has been reduced drastically in the regions of low poverty. Will people have to remain deprived and disadvantaged to keep biodiversity high? Is there some thing in their culture and creative potential, which we have not priced properly? Why should poorest people carry the heaviest burden of maintaining genetic diversity for future generations? This

¹ Invited introductory paper for the International Conference on Biodiversity and Conservation held at Danish Parliament, Copenhagen, Nov 8,1991 This is a slightly revised and updated version of original paper . *The fact that many of the fears expressed about sustainability ten years ago are still relevant makes inclusion of this paper even more relevant.*

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paper deals with several of these issues and provides illustrations of collective institutions by which the eco-ethics of biodiversity has survived among some of the most disadvantaged cultures. Is it then an issue of value system about which our conscience has learned to be indifferent?

Context:

How do people who live closest to the nature conceptualise the relationship our life has or is perceived to have with nature? Is there some thing in this perception, which on one hand unites the native population of East and the West and on the other, provides an alternative idiom for social discourse on Biodiversity?

Two examples of such perception are:

a) The case of Sea Otters

Larry Mercurieff (1990), Commissioner of Sea Otter Commission, Alaska, distressed at the pitiable condition of many of the Alaska natives (considered similar to the problem of poor people in third world), decries the tendency of Animal First activists to deny them autonomy in determining a sustainable coexistence with ecological context. He observes,

"They do not understand that in their desire to protect animals, they are destroying culture, economic and spiritual systems which have allowed humans and wild life to be sustained over thousand of years Theirs (Animal First activist's concept) is based upon a belief that animals and humans are separate and they project human values into animals. Ours is based on the knowledge from hundred of generations which allows us to understand that humans are part of all living things- and all living things are part of us. As such it is spiritually possible to touch the animal spirit. In order to understand them. Our relationship with animals is incorporated into our cultural systems, language and daily lifestyles. Theirs is based upon laws and human compassion..... Because we are intricately tied to all living things, when our relationship with any part of such life is severed by force, our spiritual economic and cultural systems are destroyed. Deep knowledge about wild life is destroyed knowledge which western science will never replace... I leave you with this last thought-we have an obligation to teach the world what we know about proper relationship between humans and other living things.

(b) The case of defeated civilizations and lost pride

K M Munshi, former cabinet minister for food and agriculture, Government of India realised this issue well. He exhorted the Indian scientists in a special general meeting of the Indian Council of Agricultural Research (November 1, 1950, New Delhi) to take a comprehensive view of the interrelationships between land, water and livestock resources. The ultimate objective he felt was the land transformation. He recognised the need to draw upon not only the agricultural science but also "the newer" sciences of anthropology, sociology and psychology. He organised *Vana Mahotsava* that is a 'forest festival' as a national event so that every year on this occasion people would plant trees. He launched the concept of *Bhoomisena* (Land Army) in 1951 with the objective of 'Land Transformation' i.e. to secure the utilisation of land on a rational basis so that the available resources of land, water and livestock are developed to the maximum extent. Taking a philosophical outlook in a seminar on extension at IARI (September 27, 1951) he observed:

At the Ministry of Agriculture I found many isolated and unrelated and, therefore, insufficient activities. I wanted a comprehensive outlook, a philosophy, an urge, and a faith. The conception that we must replant our philosophy of life in the soil came to me again and again. How can this be done?

The first thing I realised was the intimate relationship of man, his well-being and progress with the soil, sunshine, river system, forests and the natural surroundings of his native land. They are one whole; their richness and strength are one. If this equilibrium is disturbed, man dies.

The Carthaginians, the Egyptians and the Babylonians of the ancient world were civilised in their time. But they favoured man at the cost of nature with the result that their lands, through over-exploitation, turned into deserts. Their empires disappeared; they were effaced from the earth.

On the other hand, many early races of men disappeared: the Nagas, Gonds and Todas, the Mayas and Red Indians remained under-developed and were driven into precarious existence in forests and mountains. They found nature too powerful for them to be exploited; forests and swamps were too powerful for them.

Man and his environment must act and react on each other perpetually to escape the fate of races that lived in conditions in which equilibrium had been disturbed and they knew not how to restore it. Land Transformation is, therefore, the art of maintaining the equilibrium between man and his environment". (1951: 119, emphasis mine)

Is a better definition of the goal and philosophy of sustainable development through farming system research and development available? Is it possible to dispute the logic of hydro- logical cycle and the nutrition cycle that he spelt out to visualise linkages between crop, livestock, tree etc. In 1952, while speaking about *The Gospel of Dirty Hand* he said,

For the soil, hand of the worker on the land is the magic touch, which starts the unbroken change of action and reaction from the soil to the spirit, transforming the organism of life.... Informative publicity has no power to move the collective mind to action. Such power comes from an idea tabloid in an expressive and significant phrase, which moves men to action. We know the power in the word *Satyagraha* and 'Quit India' wielded in our recent history; they opened the flood gates of the mass response..... I coined the phrase land transformation/ *Bhu Parivarthan* or *Bhoomi Parivarthan* - just to emphasise the anchorage of our movement in the soil. By using the word 'Extension', you are shutting the door of mass consciousness to the work before you. The word 'Extension' has no appeal to our sub-conscious mind. It is an American word, the full significance of which is known obscurely only to a few; even 'extension' in education is familiar only to our academic world. It has no meaning for the vast number of our educated man; to them 'Extension is just Enlargement'. To the farmer it is strange and unfamiliar, a new-fangled, incomprehensible idea. And it is likely to encourage our middle class workers and officials to by-pass the unwelcome gospel of the dirty hand. Let us use words, which evoke a response in our sub-conscious, minds (1952; 183, emphasis mine).

It is this worldview which is shared by the natives world over and philosophers in the east that requires attention if the institutional black box has to fathom. The people's creativity expressed

through experimentation and innovation in resource use has provided the necessary variability to choose from. A recent newsletter viz.: Honey bee started by us last year provides detailed empirical illustrations of low external input sustainable technological solutions many of which cement the concept of Knowledge as a common property institution. See annexure one for more information on this newsletter.

The discussion on biodiversity can become authentic only if we probe deep enough into knowledge traditions of East and the West to discover the roots of the sustainable ethics. But this discovery requires preparing our mind for visions, which collide with our dominant materialistic worldview. The pervasiveness of life in all matters- stones, trees, animals, water, fire etc.- runs through the philosophy of nature-friendly communities living all over the world. How come that these communities have become marginalised in the global debate on biodiversity?

The case of sea otters demonstrates that the indigenous perception of life cycles and ecological and spiritual connectivity among various living beings are not shared by most environmental movements that have sprung up in recent past. The result is that articulated and eloquent voices of NGOs (mostly western in origin or supported by western NGOs) are given disproportionate weightage compared to the voices of the marginalised people, no matter how authentic their view of sustainability is.

The second case provides ample evidence of how the mind of elite in many countries has remained colonised even after these countries became independent more than fifty years ago. Had forewarning of K M Munshi been paid attention to in India in fifties, the path of development would have been far more different and perhaps also sustainable.

The paper provides argument for changing the nature of discourse. The existing epistemology relies excessively on the language of such elites whose own record of sharing their rent with providers of knowledge is not very honourable? When they plead for reforms, they advocate action by every one else in the world ranging from local Government to world bodies. But their own conduct and practice of life remains untouched by the logic of their appeal. I argue that such a code of conduct should be developed which makes sharing of rents with the providers of knowledge a necessary qualification for every professional /scientist /activist participating in the debate on Intellectual Property Rights (IPRs) or sustainable development.

Part One : Diversity and Deprivation : Why should the most poor people inhabit regions of high biodiversity?

Diversity in ecological endowment is much higher in high-risk environments compared to the low risk environments. The variability in edaphic, climatic and resultant biomass complexity is high in drought-prone regions, hill areas, flood prone regions, cyclone prone regions and forest areas. The soil fertility, structure, sub-soil characteristics, and groundwater availability and quality vary a great deal at short distance in these regions. With the variability in the soil and climate it is obvious that the human technological choices also get modified.

Enrichment through mobility, metaphors and experimentation: People inhabiting these regions have enriched the variability through their own mobility. Either through pastoralism or through seasonal migration people have had to move to regions providing employment and subsistence. These movements provide opportunities for transmitting and/or embedding ideas, tools, seeds, practices from one region to another.

The so-called rational and logical way of exploring nature and resource use may not permit apparently absurd experiments. But if society were to survive only through logical organisation of technology and institutions perhaps the civilisation would have become extinct long time ago. It is in art, culture, theater, music and other folk idioms like proverbs, riddles, and adages that we learn about human ability to combine the opposites or the non-comparable or the absurdity and common sense!

The absurd experiments became possible when people tried things out of fun, adventure, carelessness or just plain mischief. Through cornucopia of such experiments emerged diversity, which became available for selection by people - men, women and children, over time. Pursuit of oddity and search for means of survival, I have recently argued in portfolio theory of household survival, provide some understanding of the resultant biodiversity. (Gupta 1981,1984, 1985, 1991).

It is impossible in high-risk environments to survive by relying only on crop, livestock, trees, labour or craft activities. Within crop no one specie or variety of that specie can suffice given the variability in soil and climatic conditions. One needs crops and varieties which may be suitable if rains were early or too much or too little or too late. Diversity thus was inherent in the nature of endowment and human need for survival. Cattle mortality was higher in the dry periods while sheep mortality was higher in the rainy periods. Nature had provided for contra-variance among various biological systems to guarantee conditions of survival at certain level of demand.

The variation in demand of various resources is a function of monetised and non- monetised exchange relations mediated through markets, kinship networks or other systems of exchange. The cultural institutions generated an ethic for survival collectively rather than individually. Thus information about various edible and non-edible species, movements of wildlife and anti-dotes for various noxious plants and insects or niches for beehives or other useful sources of nutrition was shared among social groups or kinship linkages. Emergence of variability in human capabilities to process this information was recognised always. Emergence of experts thus was inevitable. However, the expertise so generated was often premised on knowledge as a common property.

Part Two: Culture, institutions and diversity

Emergence of common property institutions for resource management and knowledge management through cultural codes were two major steps taken by our forefathers that helped in linking diversity with collective survival.

Recognising the danger of too much reliance on utilitarian logic, moral boundaries were created around human wants and needs through cultural and religious mechanisms. The concepts of sacred groves, different deities in different 'auran lands' (the land left for gods and goddesses) or mountain peaks were evolved to generate spheres or protocol of retribution in case of offence. Sometimes the characteristics of deities also provided clue to the nature of diversity in a particular mountain or forest range. For instance, certain plants or animals found in abundance in particular niche were also considered the favoured foot or abodes of these deities. The rituals were institutionalised to honour, preserve and in fact reproduce the diversity through various kinds of offerings of different grains, meats, or other provisions to these deities not only to celebrate life but also to respect death. In fact remnants of some of these offerings in the graves have been an important source of information about the nature of diversity in past. As if our forefathers knew that some day we would need that information for reconstructing the path

through which we had evolved. Studies by National Research Council of USA on the less known plants have shown the potential that indigenous folk knowledge has for providing means of survival even in future.

Why has deprivation then been a consequence of this ethics of diversity inherent in high-risk environments. Part of the answer lies in the nature of ecological endowments. And part in the economic and political institutions. To some extent even the learned behaviour through social approval contributes to this process.

Even if ecological explanation is considered a kind of ecological determinism, I do not think we should feel shy in acknowledging the limits nature imposed on our choices and often in our own interest. The second explanation could be that markets and states always found it difficult to deal with diversity. Standardised cropping patterns through centralised irrigation system made possible the extraction of rent in a bureaucratically administered manner. The possibility of collecting rent in kind so variable in taste, shape, use etc., that converting equivalence would become almost impossible or difficult would have been an anathema to any state- feudal or capitalist. The generation of exchange value as against use value was one means by which resources were transferred from high risk to low risk environments.

Wherever market did support biodiversity in some cases, for instance, the urban demand for French wine extracted out of grapes grown in specific patches of soil but having unique flavours, the market demand has helped conserve the diversity. It appears that slowly a demand for organically produced irregularly shaped but tasteful fruits and vegetables is also growing in the West. The tragedy is that in the tropical developing countries, which caught on the development path rather late, the vision of the future is often moulded by the local elites in the model of western consumerism. The emergence of organic agriculture or preference for diversity is dismissed as an aberration rather than a pointer to a future trends. Thus the markets and state militate against diversity in farming systems or in forests. The diversity thus becomes a source of deprivation because the skills and resources are discounted by both-the markets and the state-in the process.

Design of delivery systems:

The organisations responsible for developing these backward high-risk regions often find it difficult to develop procedures and norms for catering to demand for resources or credit for sustaining highly diversified portfolios of enterprises. Studies on banking systems in India have shown that banks in their anxiety to finance short-term low risk activities specialise their investment portfolios. This specialisation implies availability of easier finance for certain activities and lack availability of finance for other activities. Given the shorter time frame even in the preferred activities the choice of technology is often capital intensive because of low rates of interest. On the other hand, people managing apparently high risk activities unable to borrow from banks either borrow from informal sources at high rate of interest or prefer to shift their portfolios towards labour intensive and responsive enterprises (Gupta ,1986, 1988). The high growth rate of sheep, goat or local breed of cattle or cultivation and grazing in the marginal regions - all the activities employing labour intensively- provide illustration of such a strategy of survival through destruction of diversity and impairment of ecological balance.

The organisational strategies and preference for standardised bureaucratic systems in most developing countries may give a sense of control to the ruling elites but these also provide a setting for future catastrophe. In the contemporary history we find evidence of peasant protests

generally in the cash crop growing uniformly endowed low biodiversity regions. However, increasing instances of violence around grazing lands by the migrating pastoralists and emergence of fissiparous or separatist movements in the backward regions clearly indicate that future is going to be different.

The cultures in these regions withstood the loss of bio diversity but seems to be unwilling to suffer loss of cultural diversity. Many of them are realising now that the loss of cultural diversity was inevitable with the loss of biodiversity.

Part three: Biodiversity as a culturally embedded ethics

In a Christian, Muslim or even some of the Hindu sects, prayers for only believers are valid and have social sanction. On the other hand a large part of Vedic mythology precludes prayers of sectarian kind. All living things must exist in harmony. The spirit of human, animals and plants are transmutable. The ecological consciousness pervades all relationships as far as normative belief system is concerned. The link between 'soil and soul' as Munshi put it (1951) can be mediated or pursued through a 'Gospel of Dirty hand' i.e. practising an ethic which elevates mental if it is eco-compatible and downgrades mental contribution if it is eco-alienating or destructive.

Again the limits imposed by group size (which permits the fear of 'what will people say' deter one from indulging in certain behaviours) also influence various kinds or layers of belief even if contradictory, to coexist. In a large village, mutual monitoring is difficult to perform. The liberty with group norms is possible. Stakes in common resources or belief sets (defined as core set of belief which is implicitly shared by most of the residents of a village) are segmented. Culture in such groups permits separation of private and public values, ethereal from material and human and animal or plant sub systems. Though even in such a village, if a common deity has to propitiate, pooling of material resources for ethereal purpose makes sense. In fact most of the social mobilisers ranging from Gokhale and Gandhi to Martin Luther King and Yeltsin have used religious symbols to seek widest possible consensus. Institutional analysis suffers when one insists on tallying the balance sheet of costs and benefits of any resource management systems entirely in material terms.

The role of fun, playfulness, joy and pain (also see, Richards, 1989, Gupta,1990) in enabling people to make sense of the uncontrollable events in life has not received adequate attention of researchers. The result is that while analysing a boundary of beliefs we tend to assume that the meanings are resource centred and independent of other layers of consciousness a household or a group there of, has.

Prior beliefs, dominant knowledge system and frame of reference can cause lot of violence to truth (as realistically perceived as possible). Herring quotes Bromely and Chapagain (1984) to express dismay over the tendency to dismiss any evidence of co-operation and not free riding around natural resources in Asian villages as anecdotes of doubtful generality'. Authors contend that any evidence which does not tally with what theory says (that free riding is rule) becomes suspect.

Herring (1991) observes,

“The reality is that both opportunism and co-operation, respect for nature and instrumental uses of nature coexist in societies of all sizes, buttressed by cultural norms and the structural conflict between economic opportunity and ecology (sic):”

The scope for unexplained (and willingness to leave it unexplained in a particular framework) may be necessary to achieve coherence in complexity of human choices. The eco-sociological (Gupta, 1984, 1989, 1990) worldview requires simultaneity, complexity, diversity and change in resource use as an alienable feature of institutional evolution. The institutional arrangements for one purpose may sometimes help resolve dilemma in use of totally different resource. While the resources may be scattered, differentiate, fragmented and sectioned, social space, experiential domain and ethereal boundaries are difficult to segment or separate from the very fabric of life ³

Case One -Drought, hungry parrot and a woman bringing fallen grains

This is based on a Lambada (a Rajasthani migrant tribe) song sung by women in a dry village of Shimoga ⁴

In a drought struck year, the crop has suffered very badly. A woman is coming back from the field after picking up whatever grains she could. On the way she meets a parrot. The parrot starts staring at her. She asks the parrot as to why was he looking at her so intently. The parrot replies that he was actually confused after looking at the women's necklace. The necklace had a green agate stone. He mistook it to be a grain. Only when woman came closer, he realised it was just a stone. Woman asks him had he not got anything for eating. The parrot replies that hadn't she brought all the grains from the field- even the ones, which had fallen on ground. The woman realises that parrot was hungry, and she also needed the grains very badly for her children. She asks the parrot to come home with her and share whatever she gives to her children. But the parrot flies away leaving the woman dumb founded. It is also possible that parrot realised that if he delayed search for grains other I people would also pick up whatever grains were left in the fields. He remembered his young ones who were waiting to be fed.

The song has several messages. It speaks about a cultural system in which the rights of birds are being debated vis-à-vis the right of human beings particularly in the period of food crisis in a drought year. Perhaps there were some reasons why the traditional varieties of millets or sorghum had loose set grain which was easy for birds to pick. At the same time there were elaborate designs of birds scaring devices built to reduce the loss due to bird attack. Perhaps people knew that bird would kill insects, some of which harmed the crops. How much of the contribution of birds was negative or positive would be reflected in the (a) technology i.e. selection criteria of local varieties, design and efficiency of bird scaring devices, (b) the spirit of co-existence with other parts of nature, and (c) collective consciousness as well as culturally approved behaviours.

How does one interpret this song would also depend upon how one conceptualised the right of different claimants over natural resources. If birds were also considered as legitimate stakeholders in the natural resources, then the viability, sustainability and effectiveness of any institution would have to be interpreted very differently. Many times, resource scientists have taken a very limited view of human nature - a view that excludes the rights of other natural beings. The conservation ethic is seldom anchored on such a view. At the same time, giving primacy to any one constituent over the rest may violate the very foundation of eco-sociological knowledge system as argued by the Alaskan leader in part one of this paper. A knowledge system, which generates concern for various parts of eco-system. obviously could not have evolved through just the individual innovations. It would have required evolution of cultural norms, folklores cemented by various kinds of sanctions and rewards for socially approved behaviour.

Case Two - Poaching in the desert: feeding birds as a punishment

In another case provided by Arun Agarwal (1990) a village *Panchayat* (assembly of elders) in Rajasthan devised a unique way of punishing a person who cut some branches of trees from common land where such poaching was prohibited. The person when caught was asked to stand barefooted under open sun in the hot summer and feed the birds two and a half kilograms of grains from morning to evening. It may be difficult to establish a relationship between the cutting of tree branches, reduction of bird arrival, increase in pest attack or decrease in biodiversity because of lack of seeds brought by the birds and the feeding of the birds. This relationship is entirely my speculation. It is quite possible that this punishment would have been interpreted differently by different people in the village with some common meaning but some uncommon meanings too. On the one hand the culprit was punished and on the other, he was supposed to have been blessed by the Gods for having fed the birds in such a hot environment standing barefoot.

An element of ambiguity characterising such judgements provides a creative ground for exploration and speculation. Institutions are seen to be embedded in the socio-cultural and religious worldview of the people. It is quite possible that access of various social groups or classes to the same common lands may not have been equitable for all the resources. However, to infer from inequity in availability of one resource, say, wild berries from common lands that inequity or indifference should exist in the institutions for other resources, be they of aesthetic or material nature would be a mistake. In this case the deliberations were guided not just by keeping the interest of human claimants on the natural resources.

Case three : Algae on a lake and a forlorn woman

In a folk song of Punjab, a woman is talking to a lake while sitting under a tree. Her husband is a soldier and has gone away on a war duty. She is inquiring from the lake, tree and birds about his well being. At one point, she asks the lake whether she would be told about her husband's well being if she removed the algae and moss deposited on the surface of the lake.

It is possible that the lake is a common property in this village. And yet, its maintenance, as a fresh water lake would depend upon periodic cleaning by the people individually or collectively. If a researcher looked for a common property institution in the property right framework he may not find any evidence of the same. The song provides a mechanism of building individual responsibility for this purpose through generation of norms, values and cultural motifs.

Case four : Pay what you owe and graze freely²

It is a Luyi's saying from Kenya implying a value that out of debt, is out of danger. It is an ironic reply to those who refuse to participate in a common activity but are always quick to find out what took place. Perhaps, it is intended to warn the free riders.

Likewise there is a Masai saying, " Never burn a slaughtering camp once you have used"³. Idea is that one should not leave a bad feeling behind.

Such sayings and proverbs are intended to generate responsible behaviour among pastoralists in Kenya. Each tribe or ethnic group would generally have such a reserve of sayings. It is not always

² AKL Mirimo, Luyi's Sayings, Nairobi: OUP, 1988:53

³ A Ol'olosoi Massek and J O Sidai, wisdom of Masai, Nairobi: Transafrica Publishers, 1989.

that the traditional wisdom favours the concept of knowledge as a common property. There is a Masai saying implying that one should not expose one's source of herbs to another medicine man, only the prepared sample ought to be given.

Case five : Blending religious regulations with modern institutions (Price, 1988)

In Nigeria, river authorities manage fishing sanctuaries (GUNTU) by secular and religious regulations. Do and Sorko are annual rituals pursued to please the river deities. Anybody who violated the restrictions on fishing in the sanctuary zones was punished by public shaming, fines, and sometimes exclusion from the regional fishing grounds. GUNTU is a particular deep section of river considered very critical for growth of flora and fauna. The river banks and under water shrines is worshiped to ensure that the deities cooperate with the people. It was realised that loud sound of on-board motors in the fishing vessels disturbed the deities. Special prayers were considered necessary to propitiate them. Similar instances are available in Himalayan hills and Rajasthani deserts in other resource sanctuaries. For instance, in Rajasthan one finds 'Auran' lands which are sacred groves left for God and Goddesses. No animal is allowed to stray into these. Even the fallen trees are not picked up, except for the funeral purposes of those whose kith and kin could not afford buying wood (Gupta, 1985).

In Malawi, large numbers of indigenous fruit species were found in undisturbed hilly terrain and vegetable species in low line *dambos* and very long undisturbed fallofts (Thoma and Kwapata, 1988).

The conflict among religious and other identities have to be resolved through open negotiations rather than through authoritarian interventions. Lot of traditional ecological knowledge has been retained through codes legitimised by religious or cultural institutions. Dissanayaka (1991) has emphasised that local knowledge systems can be understood by looking at the frame of reference, process of legitimisation and boundaries of network in which the knowledge is exchanged.

Case six : Quarantine as a collective institution

In Komathanga village of Wangudi, a very careful arrangement had been worked out to prevent its diffusion. If the village cattle got infected with this disease, two outposts were set up outside the village in the directions from where outsiders usually came. People from the village took turn to man these posts. No cattle from outside was allowed to enter the village lest it got also infected. Even the people visiting the village had to spend overnight at these check posts before coming to the village. This was a case where an institution had emerged not to optimise returns to individual or village. But to generate positive externality. It might be possible that if everybody reciprocated such a gesture, the diffusion of disease would of course be much lesser.

The combination of individual sanctions and collective rewards perhaps could be sustained through moral institutions and a bioethics in which long term survival was preferred over short term maximisation of return.

The innovation by the peasants whether in the field of technology or institutions requires production of knowledge. But the reproduction of knowledge took place through the institutions which had to be renewed over a period of time.

Case seven : Mobility and inter-herd disease transfer

Cultural norms can help in counteracting some of the 'rational' (in short term), but non-sustainable resource use strategies. A pastoral group can evolve norm of spending most time on patches with highest rate of return²; or can evolve norms of mobility even if resource supply did not warrant it. It could be guided by the need to avoid intermixing of yak herd with cattle herd to avoid disease transfer.

Traditionally, the yak would migrate 'downwards and cattle upwards on second day of the Bhutanese 4th month. The yak herd must leave about a month before cattle come up. This serves two purposes, (a) the grasses can regenerate and (b) the possibility of certain diseases being transferred from cattle to yak are minimised. Flowering of 'tseb' flower was also used as a signal for movement of yak back³ from lower to higher altitude.

Case eight: Pest as a common property problem

Several cases have been noted where people have realised that pest control requires collective action for both effectiveness and efficiency. In Tamil Nadu, D'Silva provides an example where a voluntary organisation viz., '*Jan Seva Mandal*' has mobilised children to collect the egg laden leaves for controlling red hairy caterpillar. Several other methods have been used for the same purpose. For instance, leaves of the cucumber plant sown on the field boundaries attract third and fourth larval instar. Leaves of *Calotropis gigantea* are spread in the fields so that the larvae of the pests collect on the same. Later, these leaves are taken out and destroyed.

In Bharuch district of Gujarat, Vasava Rupaji Bhai and other farmers of village Vagalkhor have evolved a very interesting collective institution to control pests in maize crop. Five to seven persons stand in a row and keep leaves of a local plant called as *Dhumas* in their bags. They start moving from one side of the field to the other in direction of the wind. On the way, they catch a few insects called locally as *sunga* from the air and crush these along with leaves by rubbing palms. A peculiar smell so emanated apparently repels the insects. As soon as the effect is reduced more insects are caught, crushed with leaves and entire village is so covered in the direction of the wind.

On enquiry, another farmer known as Botabhai located about fifteen kilometres away suggested another plant locally known as *Keji* for the same purpose.

Practices of this kind provide very rich insights about evolution of transient collective institutions to take care of time and location specific problems. These technical and institutional innovations presuppose a very intimate knowledge of the ecology and pest cycles. It is obvious that any one person howsoever resourceful cannot get full benefit of such a technology unless others cooperate. The externality of chemical pest control and high cost may deter people from attempting individual solutions.

The literature on common property institutions has given lesser attention to 'episodic' institutions as against concurrent or durable institutions. Episodic institutions come into being only at the time of a crisis and the rules, boundaries and sanctions evolve for a particular period. Subsequently, the lessons are retained either in the form of myths or general folk knowledge. An important aspect of these institutions is that given changes in the environment the technical solutions have to be continually innovated or adapted. In this sense these institutions do not

merely generate a collective consciousness but also reinforce an experimental ethic and an urge to treat knowledge as a common property.

The strategies and styles suitable for essentially the degraded environments dominate the global concern for sustainable development and conservation of biodiversity. Since degradation in environment inevitably is accompanied with the degradation of the institutions, these policies take absence of institutions as given. Much greater reliance is placed on public interventions which in turn mean bureaucratic interventions.

Part four : Cultural diversity and Traditions of Indigenous Enquiry

Few people have realised that biodiversity was maintained in no small measure through cultural diversity. Not only thousands of gods and local dialects of different languages signify the cultural diversity but also a whole philosophy of life, nature, existence and co-existence of different claimants of natural resources living, dead or to be born.

Any civilisation evolving through manipulation of natural resources, weather, land, water, plants and animals would have a continuous tradition of observation, experimentation, inference, replication, etc. Very often a scholar not familiar with nested knowledge systems gets confused on finding even a simple concept being related to a whole range of rituals, beliefs, some logical, some illogical. Needham in a 25 volume study of the 3000 years of science, discovery and invention in China demonstrates how several agricultural technologies were developed in China a few hundred years before they would develop in Europe. For instance the earliest European sea drill was patented by Venitian Senate in 1556 by Camillo Torello. The detailed description was available for another drill developed by Tadeo Cavaline of Bologna in 1602 (Temple, 1986). However, Dharam Pal refers to Encyclopedia Britannica 1910-11 to suggest that drill plough was first used in Europe and in Austria in 1662. Even though in India it had been used for ages (Dharam Pal, 1971, reprint 1983).

Ashis Nandy (1980) wonders why a defeated civilisation like India produced innovators who had to pursue their scientific enquiry according to western parameters. Dharam Pal believes that colonialism nipped the budding resurgence of Indian science in mid-eighteenth century. His argument is that transplanting an organisation of technology and action research not rooted in Indian culture and history was unlikely to produce major breakthrough in science (1971, 1991).

Interest in indigenous innovations in Indian sub-continent and China has been there for several centuries. The intensity of the interest has varied. Mazumdar (1946) traced the innovative practices regarding crop rotation, land preparation, crop-climate interactions etc., since Vedic times. Prasad (1987) looked at the theory of logic and particularly emphasised the four dimensions of time, space, mind and soul which characterised ancient propositions based on 'Nyaya' philosophy. It was recognised that without direct relationship between observer and object, the truth could not be perceived.

In more recent past Verma and Singh (1969) and Khanna (1969) provided a rich account of the indigenous Innovations that animal husbandry farmers had developed in hill areas of Himachal Pradesh as well as the then Punjab. Kumar and Hiranand (1979), Gupta (1980, 1984, 1987, 1989), Verma (1985) PPST Madras, Dharampal (1983), Sanghi (1987) and several others have done considerable work in India on local innovations.

Nandy (1979) and others argued in late '70s that the success of technological change in high growth regions should not blind us to the richness of the ethnic basis of local knowledge systems. Studies have shown that more diverse the environment and lower the population density, greater is the need for social networking. Box (1989), and Richards (1989) argue that knowledge networks provide a platform for farmers to satisfy their curiosity about different innovations being tried by different people and not always successfully. It is important to note that communications among people about innovations very often are not purposive. In a playful and performing mood, one's curiosity is pursued alongside the other chores of life. While doing things, travelling to different places and attending marriages or social functions, one also pursues information on new innovations, ideas, seeds or ways to solve some other problems. To that extent search for innovations is a set of continuous events rather than discrete events, accidents or milestones. It is a way of life rather than a detour or a bus stop.

Shekhawat and Bhandary (1986) have provided a rich ethno-botanical account of pastoral people in Rajasthan. Several other ethno-ecological accounts (Posey, 1990, Honey Bee 1990, 1991) are available which need to be built upon while analysing common property institutions.

One of the major limitations of most studies of indigenous knowledge systems (Honey Bee is an exception) is that the knowledge so collected from people is never shared back with them neither for fulfilling ethical obligations nor for scientific validation (Gupta, 1987). Even acknowledgement of the name of innovators is very rare. Farmers become anonymous though a fellow colleague is always credited. With the result such studies contribute towards further marginalisation of knowledge rich and economically poor populations.

To take a few more examples, Ramprasad in Hindi book on potato cultivation first published in 1920 referred to an experiment by Dilawari in Murshidabad district to assess suitability of different manures. the field was divided into different plots and manure of different ages was applied find out the effect. He also illustrates various practices of storing potato in to three inches layer of sand, treating the cut potato seed with turpentine or wood powder to prevent fungal diseases. He refers to a technology developed by Richer Gyonthoir in Frankfurt who around the turn of 19th century tried storing potato on layer of hard coal. It assumed that a gas similar to sulphur compound emulated from the coal thus keeping the potato safe. Two lessons follow from this example, (i) the process of experimentation systematically leading to data collection in control and experimental plots has been going on for a very long time, (ii) the development of technology at least at that time was taking proper cognisance of farmers own practices.

Raghunathmal Roy in several books on famine control, gardening, soil conservation etc., brings together his own administrative experience during 1906 to 1945 and very keen observation of farmers practices. He suggests that for increasing grass production in western Rajasthan drainage maps should be prepared in different villages and field should be divided into two or three parts depending upon direction of drainage. A 3-4ft bund should be developed to store water for at least three-four days. The grass seed should be collected from good plots and royal government was requested to distribute them freely. He underlined the need for ensuring that only suitable grass was to be tried looking into soil conditions. He also illustrated the basis of silvi-pastoral system. Regarding technology transfer, he gave example of a farmer Natha in village Phalaki who was persuaded in 1906 to build water conservation structures for, growing rainfed wheat. The technology was so successful and it diffused so quickly that villagers agreed voluntarily to give land revenue of Rs.300 to the King's government.

Durgaprasad Singh in a book on various kinds of manures refers to a debate triggered by the report of an agricultural chemist who came to India during 1899. Dr. Ulkar (Walker) apparently had observed that soil fertility had depleted. Durgaprasad Singh provides description of indigenous soil taxonomy of different regions and suggests use of manures of different animals for different types of crops and soils. He also refers to the folklores embodying some very relevant advice, for instance, about early sowing of wheat or well prepared tilth for wheat field whereas cloddy field was recommended for gram.

Extraction of Rent through collection of Local Knowledge:

The professional developers belonging to whichever discipline have contributed to the contempt of the cultural pluralism while analysing it in an ethical perspective. For instance, anthropologists and ethnobotanists would help in identifying useful plants, which can provide greater vigour to the modern state and its instruments. However, very few ethnobotanists would ever ask for greater control of the local people over their knowledge and its products.

Recently started newsletter- Honey Bee- acknowledges the intellectual property of people by citing the source with full address. We have also resolved to struggle for a fair share of these innovators in any return that may accrue through value addition in their knowledge. The Honey Bee provides inventory of farmers' innovations using local natural resources for plant protection, veterinary medicine, soil and water conservation etc.

Centuries ago India was said to be The Golden Bird. One after another, explorers came to fathom the secret of the glory. One thing that most travellers acknowledged was the exquisite craftsmanship, inquisitive mind and a strong experimental ethic. The scientific traditions however, did not evolve the same way as they did in west during the industrial revolution.

Slowly the Bird stopped singing loudly. It not only forgot its original song, it also started mimicking the western tunes. Nothing would have mattered as long the eggs were golden. But this was not to be. Why did it forget its original ability to sing? Why did planners in post independence India not find any thing worthwhile in the traditions of experimentation and excellence?

Way back in 1951, K M Munshi- the then Food and Agriculture minister in the union cabinet - Did sound early warning signals about the possible divorce between ecological and institutional concerns and search for modern technological solutions to the problem of hunger and poverty?

The success of 'Green Revolution' apparently became a reason for our failure particularly in the regions where endowments and infrastructure was not suitable for input intensive technologies. The quote in the beginning (Swaminathan, 1973) of the paper demonstrates that way back in 1973, the top policy makers were aware of the fact some of the regions having high agrobiodiversity were inhabited by the poorest people. Thus they can not be given benefit of doubt about not being aware of what they were doing when they ignored the connection during green revolution. Why did they ignore this connection and how do they explain the consequence of their actions which have led to erosion of hundreds of rice varieties from this and other regions.

Theories suggesting that the farmers in the tropics were resistant to change were dumped in sixties itself. However, the fact that sometimes a rational resistance to change could even be a sign of wisdom was not fully appreciated. Or the change could be in different components of a survival system or at different pace. In dry regions, hill areas, other high risk environments the

new technological solutions had limited applicability. Even in the high growth regions there are problems of sustainability which are difficult to solve through energy intensive external input oriented technology. The possibility that farmers, pastoralists, artisan, men and women might be struggling to generate solutions to traditional as well as contemporary problems did not prominently figure in the developmental plans and programmes.

Agriculture Scientists, capable as they are, took no time in perfecting the art of using modern scientific and technological tools for developing technological solutions. Their training and world view accordingly got modified. Many of them did look at indigenous innovations but did not find any platform to share their perceptions and possible reactions. The lack of platform and therefore visible dialogue between scientists and the farmers led some to conclude that the Indian scientists were perhaps unaware of the potential of indigenous innovations. Nothing could be farther from truth.

Honey Bee ; An experiment in People to people communication (i.e. Lateral learning) about innovation and experimentation

Honey Bee - an informal newsletter started last year is an effort to make the Golden Bird sing again. We had realised that much against the conventional understanding poor people were poor indeed but not so poor that they could not even think. For them the experimentation and innovation was a matter of life and death given the uncertainties of nature expressed through droughts, floods and hail storms.

Why Honey Bee?

Honey Bee does two things which we often are not sure of doing ourselves. She picks pollen without making the flowers poorer. She connects flowers to flowers through pollination. We, the researchers extract knowledge of people which sometimes results in exacerbation of their poverty. We very seldom connect farmers to farmers. We write in English language which connects us globally and also domestically with the elite but which prevents us from reaching the people from whom we have learnt. Thus while we grow in our careers and achieve wider recognition and professional rewards, the people suffer often silently. The ethics of knowledge extraction, its documentation, dissemination and abstraction into theories or technologies became thus our central concern.

We started the first issue of Honey Bee with a note prepared by a scientist of Gujarat Agricultural University illustrating the lessons learnt by him and his colleagues from careful study of farming innovations, traditional wisdom and localised experiments. This we thought would encourage the other scientists to make their tacit knowledge explicit. In any case nothing is gained by considering farmers as 'know alls' and scientists as 'ignoramus'. Dialogue very seldom takes place amongst people with unequal respect of each other.

We also enclosed with the first issue a letter in Hindi from a developmental worker in Bihar cautioning us about the possible hazards of documenting local knowledge. His contention was that poor had nothing else left with them. Do we want to drain them of this resource also? Will documentation and value addition not lead to a situation as in Assam where the people and workers who grow quality tea cannot afford to consume it. The best tea comes to London. Will the prospects of wider application of this technology reduce the local advantage and if not, how did we plan to avoid these dangers.

In the second issue we began with the discussion on the Gospel of Dirty Hand enunciated by Dr.K.M.Munshi in 1951-52 providing a framework for linking the soil, the toil of the field worker and the farmer with the soul of the learners and users of knowledge. Unfortunately he did not gain much ground in the bureaucracy or technocracy. We also referred to a Griffith Memorial lecture by Mazumdar in 1925 on the ancient Indian science of Botany in Calcutta. Two masters theses guided by Dr.Y.P.Singh, way back in 1965-67 on Indigenous Animal Husbandry provided perhaps the first acknowledgement of indigenous knowledge by formal scientists. Ashis Nandy planned a large research project on ethno-agriculture so that the science and culture behind farmers' wisdom could be systematically catalogued. He could never get through the labyrinth of bureaucracy because the 'Green Revolution' was serving us well in late seventies. Shri Dharampal in a book on Indian Science and Technology in eighteenth century (1971) brought together several travelogues by British visitors to India 150 to 200 years ago testifying to the brilliance of Indian scientific genius.

These references were intended to persuade the readers that they should not develop a false pride in being involved something very new or something very unique. The interest in learning from the peoples' knowledge has been there in every culture and practically in every era. It is just that the elite fails to build upon these enquiries and therefore societies get trapped in downward spiral of decay, degeneration and strife.

Honey Bee also appeals to fellow researchers, activists and planners in other developing countries to identify native wisdom both to inspire and also to provoke the young minds to explore. In every country a very strong oral tradition of knowledge generation, validation, scrutiny and diffusion exists. Honey Bee strongly believes that boundaries between formal and informal knowledge systems may, often be false. The informal system may have formal rules waiting to be discovered. The formal system may have informal beliefs, accidents, or conjectures providing impetus for further enquiry.

How did we collect farmers' innovations?

There has been of late an upsurge of so called Rapid Rural Appraisal (RRA) methods and approaches. To us nothing is more disdainful than to use shortcuts in learning. It is true that sometimes researchers get lost in long-term surveys which throw useful light but much after the event. Therefore, need for efficiency in learning, analysing and disseminating results is necessary. But that should not imply that one can abandon rigorous methods of research or analysis. At the same time one should not be too enamoured by the methods when it comes to exploring a phenomena.

A genuine faith, inquisitive eyes and willingness to court uncertainties, we felt would be necessary conditions for documenting peoples' own knowledge systems. We contacted the second year and third year students of rural colleges during their vacation. We began with documentation of their own experience of dealing with hardships in life or at their homes. Soon a long list started emerging of various approaches that the students on their own or their parents or relatives had tried to cope with the stresses in the agricultural environment. By underlining the one which impressed us most, we gave a signal about our biases.

A short checklist was prepared to enable the students to document farmers' experiments. In the first round we were very clear that breadth rather than depth was our priority. Getting to know of more and more interesting ideas that people were playing with was our priority. We planned to follow up each of the interesting practices with more intensive investigation. Idea was to use

interactive and iterative learning approach so that all the relevant questions did not have to be asked in one round or even at our suggestion alone. Scope was given for students to show their own creativity in dealing with others creativity.

Samples of plants or other minerals/materials used for plant protection, animal veterinary medicine, soil reclamation, etc., were collected for subsequent scientific identification. Each practice was mentioned with full address of the farmers innovators, or the name of the village along with the name of the communicator, i.e. the students or other correspondents of Honey Bee. We are very keen that intellectual property of the people must be protected. We do not know whether we will succeed in ensuring proper rewards to the people for their excellence and innovation. But we are trying.

We have already collected more than five hundred innovative practices predominantly from dry regions to prove that disadvantaged people may lack financial and economic resources but are very rich in knowledge resource. That is the reason we consider the term 'resource poor farmer' as one of the most inappropriate and demeaning western contribution. If knowledge is a resource and if some people are rich in this knowledge, why should they be called resource poor? AT the same time, we realise that market may not price peoples' knowledge properly today.

It should be remembered that out of 114 plant derived drugs, more than 70 per cent are used for the same purpose for which the native people discovered their use (Farnsworth, 1988).

What does it prove?

It proves that basic research could link cause and effect had been done successfully by the people in majority of the cases. Modern science and technology could supplement the efforts of the people, improve the efficiency of the extraction of the active ingredient synthesise analogue of the same, thereby improving effectiveness.

The scope for linking scientific search by the scientists and the farmers is enormous. I am beginning to realise that peoples' knowledge system need not always be considered informal just because the rules of the formal system fail to explain innovations in another system. The soil classification system developed by the people is far more complex and comprehensive than the USDA classification systems. Likewise, the hazards of pesticides residues and associated adverse effects on the human as well as entire ecological system are well known. In the second issue of Honey Bee out of ninety four practices thirty four dealt with indigenous low external input ways of plant protection. Some of these practices could extend the frontiers of science. For instance, some farmers put cut thirty to forty days old sorghum plants or *Calotropis* plants in the irrigation channel so as to control or minimise the termite attack in light dry soils. Perhaps hydrocyanides present in *Sorghum* and similarly other toxic elements in *Calotropis* contributed towards this effect. There are large number of other plants of pesticidal importance found in arid and semi arid regions, hill areas and flood prone regions which can provide sustainable alternatives to highly toxic chemical pesticides. It is possible that private corporations may not have much interest in the development and diffusion of such alternatives which pass control of knowledge in the hands of people. However, an informed, educated and experimenting client always spurs better market innovations as evident from the experience of computer industry. Therefore, I do not see that there is a basic contradiction between the knowledge systems of people and the evolution of market rules to strengthen and build upon it. However, such a model of market would be highly decentralised, competitive, open and participative.

Honey Bee in that sense is an effort to mould markets of ideas and innovations but in favour of sustainable development of high risk environments. It is an experiment to prove that an ethical practice is also more efficient and effective. A decade of existence has also brought out certain failures. As I mentioned in the editorial of last issue of Tenth year(1999) that despite all the dialogues on local knowledge and need for greater accountability of researchers and others documenting local knowledge for commercial and non commercial uses, the norms of citation and reciprocity towards knowledge providers have not changed. Ethnobotanists still do not consider it proper to acknowledge local knowledge by citing their informants and local knowledge experts. They still do not share their research findings with local communities in local language before publishing these elsewhere. The journals, funding organisations, and science councils and associations still do not consider extracting knowledge of local innovators, communities and other experts without any financial and non monetary reciprocity unethical. It seems we have made no difference to this world. But may be I am being too harsh to ourselves. National Innovation Foundation (NIF) set up by Government of India in March 2000 with an initial corpus fund of about USD five million is a small step in the right direction. NIF will develop a national register of innovations and try to protect the IPRs of individuals and communities besides helping them link their innovations with entrepreneurs and investment funds so that they share benefits through value addition in their knowledge with NIF at their back to support their rights and entitlements.

It is true that most CG institutions as well as World Bank, UNDP and other national and multilateral agencies have not yet resolved to provide their project documents to local communities in local language before implementing their projects. But then ethical change has seldom begun from the top.

Part five: Deviant cultures, state coercion and protest

Insistence on common language or common culture often implied dominance of one social or ethnic group over another. Since democratically such a dominance was difficult to be organised, the coercion by state was an unavoidable instrument of ensuring compliance. Sometimes the cultural diversity was controlled by confining the stubborn cultures in clearly identified and enclosed regions. For example, the Indians in America or aborigines in Australia.

Sometimes new states were created cutting across cultural boundaries such that same ethnic group got divided into population of different states, for instance, Bengalis in India and Bangladesh, Kurds in Middle East, Arabs in *Maghreb* or *Saharawi* regions or large number of states in Africa or Latin America. Celebration of five hundred years of Spanish Conquest in Latin America may be a matter of pride in Europe but is a matter of terrible shame, guilt and agony in the conquered countries. With rise in the power of unified state and the dominance of any particular group, the biodiverse regions like forests also become the sanctuaries of rebels. The conservation of diversity has often been seen to be high in the regions where local populations is often unresponsive to state control. For instance, in *Jhabua* - a tribal region of Madhya Pradesh, Central India, one finds forests intact only in those pockets which had most ferocious and 'uncivilised' tribals. Similarly, in northern Burma and southern Nagaland the regions of high gorilla activities are also the regions of high genetic diversity.

The paradox is that modern state would like to benefit from the knowledge of the deviant and non-submissive cultures but at the same time would use such educational system or developmental strategies which will make the survival of these cultures more and more difficult. Even if they are educated, they are taught to reduce their pride in their local folk practices or

ethics of survival. The progress is defined according to the parameters on which they are rated as low. Once an inferiority complex is institutionalised, cultures can work towards their own destruction. Cutting forests or excessive exploitation of medicinal plants becomes completely defensible when social recognition, status and esteem are available mainly on the basis of accumulation of wealth, no matter how.

The learned helplessness may contribute to lack of protest by the disadvantaged people inhabiting bio-rich environments. The oppression of these people does not always make media headlines.

When persistent protest does not invoke popular sympathy or responsible response from the state, people realise the futility of protest. But this does not happen always. There are many bio-rich regions which pose continuous 'law and order' problems to the state. Many of these so called insurgency movements are actually protest against the destruction of their habitat. Some times declaration of certain forests as sanctuaries also leads to tensions with the people who either resided there or grazed their animals there or collected various forest products. We have argued elsewhere that diversity and human interactions are closely linked. Even on the issue of forest fires, there have been debates for last two hundred years but expert opinion seemed in favour of allowing this practice to continue (Gupta and Ura, 1990). It is the market oriented interference in the forests and other such regions which causes destruction. And local people become part of it often only when other avenues of survival are exhausted or they find the resources being depleted regardless of their conservation efforts.

The rate of capital accumulation and nature of its investment and distribution depended upon the nature of institutions which were established to collect various kinds of tributes or taxes or reward services or loyalty to the state. People living in harsh environments have always been headstrong, obstinate and difficult to be tamed by any centralised authority. There are a number of examples when these people struggled but were tamed. Over a period of time they lost their ability to protest or became dependent for their survival on the mercies of the state.

The more able individuals particularly the males often migrated out in search of better opportunities and got assimilated in the culture of high growth-low risk environments. Some of these peoples were an important constituent of armies and thus provided institutionalised mechanism for showing their chivalry. However, those who were left behind realised that their knowledge of diverse resources and their skills of reproducing or maintaining this diversity were not in demand in the market place. Local festivals and rituals required certain types of crop fruit or livestock variety and therefore some of these were maintained for cultural reasons.

Sometimes the urban demand for some of the low productivity but better taste varieties also stimulated maintenance of some of these varieties. But mass production of uniform quality outputs amenable to centralised procurement, marketing and distribution or decentralised procurement but concentrated consumption made continuance of this mode of production difficult. This implied that market would not support diversity as a commercially viable strategy.

Biodiversity and International Dialogue:

There is a need for rethinking about the nature of state being created and recreated through the hegemony of international power politics. It is not in the interest of long-term survival of people

in the developed part of the world, if cultural diversity and the consequent biodiversity is curbed or annihilated through support by international superpowers or multinational corporations or even UN institutions.

A good instance of United Nation's contribution to reduction of cultural pluralism is the method and approach used for developing national conservation strategies. Almost in every country these strategies were developed through bureaucratically organised expertise comprising people who often had shown no professional sensitivity to cultural pluralism. They had never communicated their work in local languages to the people from whom they had collected data for their analysis and growth of expertise. Even these strategies were never discussed in the countries that I am aware of, among different political, cultural or religious groups. Even when some of these experts genuinely emphasised the need for pluralism and respect for local cultures they failed to build upon the work of native genius often unavailable in English language. This experience is true not only in small countries but also in large countries. The global documents set the trend. The way to prove this contention is to look up the bibliography of most such conservation strategy documents. The earliest reference in *Caring For The Earth: a Strategy For Sustainable Living* published by IUCN, UNEP and WWF in October 1991 pertains to 1979. About ninety percent references in this document are post 1985 and majority of these are western in origin. What is the inference?

The Vedic, Mohammedan, Zoroastrian, Chinese, Buddhists, Masai, Inca, Inuit, Eskimo, Red Indian, Arabic and other traditions have nothing to offer for generating a sustainable world view? How can this be true. After all, do not we find the only surviving eco-adaptive evolutionary institutions among some of the believers in these faiths (or other locally defined faiths) who despite remaining disadvantaged have maintained a sacred grove, a fish pond, an untouched mountain peak or revered forest range. Amish of USA, Mohawaks and Inuits of Canada, Eskimos and bio-dynamic farmers of Europe and Fukokowa of Japan have provided an alternative perspective. Even in Christian faith, there are psalms emphasising non-consumerist nature respecting world view. Occasionally a genuine concern has been expressed about the need for cultural pluralism and growth of biodiversity (McNeely, 1989). However, the development which "tends to destroy the only cultures that have proved able to thrive in these (forests, deserts and other isolated environments) environments" (McNeely, 1989:5); is made possible through a non-sustainable system of governance. For instance, I am not aware of any example where a project financed by UNDP has ever been discussed in local language with the people likely to be affected by the project. In fact the project document is often a classified document not available to indigenous people even in English, of course never in local language. The articulation of cultural pluralism through structures of the accountability which are seen to be responsive to the urges of the local cultures is necessary.

United Nations organisations and particularly FAO with its very explicit bias in favour of agribusiness has not learnt any lesson from the concerns expressed in some of the IUCN documents. It is not enough for world conservation strategy to say that traditional communities, "often have profound and detailed knowledge of the ecosystems and species with which they are in contact and effective ways of ensuring they are used sustainably." The strategy should have tried to link the efforts of national governments to balance their books of accounts through borrowing or exports disregarding ecological balance. The global mechanisms of discounting this knowledge should be made explicit. Neglect of biological resources of limited current value was inherent in such a 'new world order'.

But could the pressure of stakeholders in many of these institutions be the reason for lack of explicit recognition of the problem?

Susan Meeker-Lowry in a recent issue of *Catalyst* (vol: vii, no. 4. 1990) wonders, "How can organisations adequately defend the Earth when their directors, as well as funding sources are among the nation's top polluters?" She provides the list of 15 top corporate polluters accounting for 1.6 billion pounds or 26 per cent of all reported toxic chemical releases (Environment Protection Agency and Citizen's Fund in *Catalyst*) including Dupont, Monsanto, American Cyanamid etc. The complete list of the directors is given in *Multinational Monitor* (P O Box 19405, Washington, DC 20036). To illustrate, World Wildlife Fund (0 989) had Union Carbide, Pacific gas and Electric, Philip Morris, Exxon etc., on its board. World Resource Institute had Weyerhaeuser, Southern California Edison, Unisys, Union Carbide etc., on its board.

I would keep my judgement in reserve. I do however, suggest that one need not give up any one - even the worst polluter. In the true Gandhian tradition, one has to deny the badness of the deed but never hate the doer. That might reduce the chances of negotiated conversion. It may be utopian to ask for optimism but ask we must. Any alternative method of social discourse may generate intrigues, cliques and even violence. The sustainability of discourse through non-violent means is vital for maintaining biodiversity. Non Sustainable and unaccountable institutions, no matter howsoever well intentioned may soon become indifferent to the concerns of the masses. This is one lesson from East European experience. But the merit of negotiated outcome is also apparent from the South African reforms though very slow and insufficient as these are.⁷

The relationship between the sponsorship of environmental debate in the Western nations and the nature of questions debated is being pursued in the West itself. The enlightened NGOs and the networks of the concerned scientists have to play even more important role in future. Assuming that we can generate a consensus in favour of the rights of the people for managing a biodiverse society, how shall we compensate them for this effort.

I

The issue essentially is how the quality of life is defined in a given society and what methods are followed to ensure reasonable availability of good quality of life to most disadvantaged people. The cultural diversity also influences the concept of quality of life and attendant mechanism for achieving the same through various technologies, institutions and compensatory routes.

Part six : Compensating Local Communities and Individual Farmers for Preserving Diversity

It is not a paradox that the people who conserve biological diversity best are the ones whose expectations from life are minimal. It is not that they lack entrepreneurship or adventurism necessary for technological transformation of local ecological environment. But the range of disturbance which is permitted by the given culture to manipulate ecological parameters is well defined. There are traditions of leaving three rows of crop (known as Akkadi - one run of a drill) in the field for birds or animals (Talwar, 1991). Likewise first bearing of fruits in mangoes was forbidden for collection. Perhaps different norms of sharing have evolved as a part of bioethics. The sharing could be guided by at least three set of factors:

(a) Whether the act of sharing is compensatory in nature (I have scared birds all this while, I have denied food to so many cattle trying to stray into my field etc.), or conciliatory (I have offended different gods using owls, other animals as their abodes, I need to have peace with nature,

sacrificial (I must offer something I need most to placate god, nature force - *prakriti* - invite helpful insects/birds etc.); or just conformity (to what others do, have no particular reason to deviate).

(b) Whether the sharing is a conscious effort to restore the ecological balance

(c) To what extent religion, culture and other collective institutions sanction such behaviour.

The ability to extract more but willingness to extract less than the permissible limit of resource use is guided by very strong cultural norms. How does one compensate the communities practicing shared and restrained use of resources.

It is being realised world over that the task of maintaining biodiversity is not just a technical or a biological process. It also involves institutional development for enabling individual and community responses to the need for biodiversity. Some of the alternative ways for compensating farmers and communities could be the following:

There are several ways in which compensations can be routed to the generators and maintainers of biodiversity:

(1) Valuing biological diversity of potential future use: It is always a difficult question as to how much value one should assign to a resource of which current value is either low or nil. Several common property resources suffered not only because institutions managing these resources were weakened over time. But also because the local perception of these resources often did not match with the external or governmental or global perception of these resources.

The conventional norms, boundaries and institutions regarding common property resources must be respected. Recent fight in Canada between the state (Quebec) and local Indians (Mohawks) is a case in point. The indigenous population respected a particular region because it had graves of the important deities and respected people of the community. The local government authority wanted to make a golf course on this land - undoubtedly very rich in biological diversity.

There are similar cases almost in every country. In India, government wanted to build a missile testing range in Balliapal in Orissa which finally had to be given up due to strong protest by local population. Silent valley project in Kerala, south India is another instance when government had to abandon a power project because the local people protested against deforestation of a rich and biodiverse tropical rain forest. It is often argued that development can not be achieved without a price. The issue is why this price should be paid always by the marginal populations in disadvantaged regions.

Two implications follow :

One the conventional boundaries of common property resources were first violated during the colonial era in most developing countries. Even after independence the violations continued. The state control proved in many cases worse than the feudal control. Can these boundaries be reenacted to the extent possible? Can state allow local communities to evolve norms for governing these resources and renew their biological diversity? It is possible that the hegemony of local powerful people would assert itself. The answer to that would be setting up of environmental courts supported by jury, comprising affected populations in greater number.

Second A royalty may be paid to the communities which conserve the most diverse CPRs through taxing the consumers of a specific nature. For instance, Ignacy Sachs (1989) suggested automatic financing at the level of one dollar per hundred thousand of the world gross product (approximately 150 million dollars) to reach at the level of one per ten thousand ten years later. He observed that :

“a maritime toll of US 30 cents per 10 thousand tons/mile of oil transported by sea would yield in 1988, 156 million dollars, a toll of 1 dollar per 10 thousand tons/mile of oil products 146 million dollars, and another 17 million dollars could be raised with a US 10 cent fee for 10 thousand tons/mile of coal. An air toll of 1 dollar per 10 thousand passengers/mile would yield 65 million dollars and a tax of 1 per thousand on the turnover of 31 thousand tourist agencies in the world US\$ 250 million" Owel (1987).

Juma (1989) feels that the logistics of tracking the global flow of germplasm might make the process of compensation extremely complex. He suggests an 'incentive principle' of the kind recommended above under which farmers would be encouraged to conserve genetic resources and be rewarded for it financially. Farmers could be allowed to bargain for their varieties. He also feels that an alternative system could be to have a levy on global seed sales to be used for international fund to compensate farmers in their work. There are many other suggestions made drawing upon African experience by which the farmers rights can be protected.

In Peru examples have been found where local communities charge as much as 2000 US dollars per potato. They have an effective system of checking the outsiders at the exit points (Mario Tapia, 1991, Miguel A. Altieri). It has been observed that greatest genetic erosion has taken place in the low land regions near urban centres and markets in Latin America (Altieri, 1991). Access on markets and municipal corporations could be an answer. In Maharashtra State in India a professional tax imposed in only one metropolitan city Bombay has enabled financing of a multicore Employment Guarantee Scheme in drought prone regions since 1972. Given political determination the compensatory taxes can be used to operationalise the concept of transfer pricing.

(2) Pricing traditional/indigenous knowledge having current commercial value.

Studies have shown that out of 119 pure chemical substances extracted from higher plants and used in medicine throughout the world, about 70 percent medicines were used for the same purpose as identified by the local communities (Farnsworth, 1986). The intellectual property of the people has been usurped by the multinational drug companies which spent about 4.5 billion dollars on research and development in 1985. Farnsworth (1986) estimates that in one drug (oncovin, velban) based on vincristine generated about 100 million dollars revenue of which about 88 percent was profit for the company, Lilly Research Laboratories (Svobada in Farnsworth, 1986). He regrets that more systematic effort were not being made to utilise indigenous knowledge about plant resources. He unfortunately does not make a case for sharing part of these profits with the communities.

McNeil and McNeil (1989) make a forceful case for appropriation of proper (share for the social communities which have produced, maintained, and improvised various technological practices. They refer to provisions in the American Law under which such claims can be filed.

In another instance, Iltis (1986) shows that discovery of a wild tomato seed number 832 contributed to about 8 million dollars a year because of slight increase in the soluble solids. It

costed US government about 21 dollar at 1961 prices to collect each specimen. While most ethnobotanist do not deliberate on the ways of sharing value earned out of local knowledge with the people, there are some exceptions like Saxena (1976), Bhandari (1977). Ehrenfeld (1986) on the contrary argues, "assigning value to that which we do not own and whose purpose we cannot understand except in the most superficial ways is the ultimate in presumptuous folly". He fears that by the time we finish assigning values to biological diversity, we may not have much diversity left. It is obvious that such a view would appear extremist. However, Ehrenfeld clarifies that what he is questioning is the economic value of biodiversity. He observes :

Value is an intrinsic part of diversity; it does not depend on the properties of the species in question, the uses to which particular species may or may not be put, or their alleged role in the balance of global ecosystems. For biological diversity, value is. Nothing more and nothing less. No cottage industry of expert evaluators is needed to assess this kind of value.

To him diversity must be protected through appeal to basic human values and faith in God or any other force that caused diversity to exist in the first place. On the other hand, Randall (1986) prefers a utilitarian account that extends beyond commercial goods to biodiversity.

My contention is that locating the principles of accountability towards the unarticulated and disadvantaged communities engaged in conserving diversity, in the ethics of global responsibility is not worthwhile. The entire debate on TRIPS and farmers rights has brought out the hesitation that international capital has in paying any dues to the tropical developing countries that are responsible for conserving some of the most biologically diverse ecological sites. In a way passing on the resources to the elites in the metropolitan capitals may also not be of much help.

(3) Decentralised Governance : Regional Development Boards comprising the representatives of different interest groups might be able to work out viable democratic alternatives for sustainable management of bio diversity. In situ conservation will not be very effective in retaining genes that may not express in the insulated research station environment. Ex situ conservation through botanical gardens can be useful as a refuge of last resort and as Ashton (1986) observes: "a high-risk refuge, perhaps of no escape. The immediate role of botanical gardens in the ex situ culture of rare and endangered species lies in research and education rather than in conservation *per se*". Perhaps internationally generated resources can be used for funding establishment and management of botanical gardens in dispersed bio-rich locations.

(4) Rewarding farmers through fairs and competitions: Another way tried by NGOs and professionals from the universities could be organisation of farmers fairs which reward not the best samples or the specimens but the farmers who kept the widest diversity and knew most of the characteristics of what he or she had saved (Tapia et al, 1990; Franco, 1990; in Altieri, 1991). This strategy, the author contends, "may or may not promote reproduction or distribution of exhibited materials. Its basic aim is to stimulate farmers to keep diversity in their fields, hoping that incentives (such as public recognition, diplomas or tools for the farm) will make other farmers adopt or recover local varieties. Compared to the other three, this strategy is the one that needs less financial resources and demands less facilities. It is also the one that leaves most initiatives and decisions to farmers themselves. Its potential to promote living diversity is highest; however, its effectiveness may vary significantly according to the granted incentives" (Tapia et al 1990).

In 1956, in the 16th All India Cattle Fair, a committee comprising various former rulers of princely states in India and chaired by Union Minister for Agriculture, prizes were given for the best cow of different breeds found in various regions. Such fairs unfortunately became less important with the onset of 'Operation Flood' and other such internationally funded dairy programmes. The focus got shifted from preservation and improvement of local breeds to large scale cross breeding. The results are well known. Thus there is a need for EEC and other international agencies funding programmes like Operation Flood that they insist that a significant energy and resources are spent on building upon local knowledge about bio diversity.

(5) There is a clear trade-off in maintenance of genetic diversity through grass root level efforts and through global or international research centres in collaboration with multinational companies or otherwise. Altieri cites example of Columbian NGOs who were concerned after being informed by a CIAT researcher that it was abandoning work on bean varieties destined for marginal conditions (Diaz in Altieri, 1991). However, the cost and management aspects of decentralised grass root conservation centres either in the form of botanical gardens mentioned above or as informal research centres have to be carefully looked into. There will be a definite harm done to the cause of maintaining biodiversity if state and corporate sector disown its responsibility because the NGOs are supposed to be engaged in the task. The danger becomes all the more serious if these NGOs are large and funded by international agencies without any explicit accountability to local communities. In South Asian context, it is not uncommon to find large NGOs which are as inefficient in resource use as perhaps some of the state organisations may be. Also the programmatic preferences of NGOs keep changing with the preferences of the donor agencies. Obviously, a long term commitment to conserving biodiversity is unlikely to emerge in such NGOs.

(6) There is a view that farmers rights should not be considered as an intellectual property system. Instead farmers should be compensated for the work that they do for the conservation and breeding of various species (Altieri, 1991). The problem with this view is that the task involved becomes a very diffuse category so much so that it involves almost all aspects of survival. Accordingly the demands for farmers rights would incorporate the political economic aspect of the very governance by any state.

is possible that the farmers who do not maintain diversity because they produce high yielding varieties ask for compensation at par with those who do because they may claim that the lack of diversity at their farms is a consequence of conscious decisions by the state. Once the boundary of claimants is expanded, every individual or collective claim becomes weak. We do not wish this to happen. Accordingly, the intellectual property of the peasants, pastoralists, horticulturists, fishermen and women etc., would need to be properly recognised and honoured. The fact that diversity and economic backwardness co-vary, what one is demanding through this argument for farmers rights is a new criterion for allocating fiscal and other physical resources to high risk low employment and low income regions from national and international agencies. The only difference is that only those communities are sought to be compensated which have maintained diversity despite all odds. Two problems may arise in operationalising such a system of compensation: a) isolation of human contribution to maintenance of diversity from the ecological contribution may not always be easy. There may be some sites inherently more diverse and not amenable to uniformity in biological endowment. The human contribution in such a case is that of refining and value adding to the existing base of diversity; Also by generating an ethic which advises stay in those disadvantaged regions having the burial grounds or cremation sites of their elders, rather than migrating away, people may have contributed to the diversity. b) the institutions for maintaining diversity may be dominated by the local power lords. Routing compensation through them may make the marginal population even more marginalised.

7) The international insurance companies can underwrite the premium obligation through national companies for farmers, fishermen and women, pastoralists who maintain biodiverse farming systems. This will help cross subsidise the biodiverse systems which otherwise are poor risks and often remain out of the formal banking system. This type of insurance is similar to credit-linked insurance recommended by Gupta (1983) and implemented by central bank in India for last several years. The problem is that the farmers in high growth and low biodiversity region do not participate under this scheme and thus deprive the insurance company of transferring costs. Unless some initiative is taken in this regard, it is unlikely that much difference would be made in the situation.

The premium can be fixed by the companies on the basis of *ex-situ* biodiverse farms maintained per 1000 ha or 10,000 ha. Other ways can be developed on the basis of species level diversity and fallowing index so that diversity of flora and fauna is enhanced.

There are no easy answers. However, we have come across cases where individuals have decided to go against the current methods of farming or resource management to aid biodiversity. For instance, Haribhai in Baglu village of Junagadh district, Gujarat, Western India, decided seven years ago to stop total application of pesticides in his fields. He observed very closely the relationship between birds, toxicity in the pests killed by the pesticide and eaten by the birds with the disastrous consequences. The non-violent ethic generated by his religious beliefs further created dilemma in his mind. To his pleasant surprise he found that his yields were as good or in fact better than the neighbouring farmers who used pesticides. In addition, he had a larger variety of insects and pests, birds, frogs, earthworms, etc. in his field than any other field in the village. He didn't do it to maintain or enhance biodiversity. He did not claim any special price for his product unlike organic farmers of western countries. When we met him and asked about his motivations, it was obvious that his religious and cultural beliefs seemed to have played a greater role in his decision to pursue organic farming than any so called rational economic considerations. He did acknowledge, however, that his cost of cultivation was much lesser than the rest.

How do we compensate carriers of bio-ethics of this kind. Do we compensate them by according social esteem and providing opportunities for further experimentation? Or do we price this ethics at all?

My suggestion is that we need to use various kinds of incentives i.e. material and non-material and specific and non-specific *vis-a-vis* a community of farmers or an individual. A material specific incentive is like royalty payment or patent fee. Material non-specific incentives refer to resource transfer for institution development favoring maintenance of biodiversity. The debt swap and special concessionary finance for investment in backward regions may also help. Non-material specific incentives include honours, awards, media coverage, special privileges etc., to specific communities or individuals. Non-material non-specific incentives refer to the privileged access of the countries doing most to preserve biodiversity in-situ conditions to the genetic resources of other countries.

In the above case it will be useful to honour Haribhai and give him due acknowledgement while pursuing research programme on non-chemical based pest control. He should also be given opportunity to visit other farmers in different parts of the world pursuing similar goals. As far as the religious and cultural ethics is concerned, tolerance and appreciation for such values may be

the major means of positive reinforcement. It will be improper to suggest that any one religion can only generate such an ethic.

Part seven: Legal, Organisational and Fiscal Instruments for routing compensation for preservers of biodiversity

The estimates of the value of drugs derived from plants found in tropical rain forests in developing world have ranged from dollar 43 billion to 1468 billion per year (McNeil & McNeil, 1989).

Legal Framework:

The legal arguments about biodiversity being a common heritage and possibility of value addition only after making huge investments in education, equipment, research, infrastructure, testing of products etc., have been derived from Locke's (1690) theory of ownership. McNeil & McNeil (1989) further add that community's own investment in developing indigenous knowledge is quite large. They suggest that asymmetric transactions "may sometimes be sufficiently one sided as to be immoral or illegal or both". They refer to the international Bill of Human Rights, Article 27 of which says, "everyone has the right to the protection of the moral and material interests resulting from any scientific, literary or artistic production of which one is the author". The American Convention on Human Rights (Williams, 1981) signed but not ratified by the United States says in Article 21, "no one shall be deprived of his property except upon payment of just compensation". The property law, contract law and tort law, McNeil & McNeil observed should be applied to protect the intellectual or tangible property. Transfer of benefits ought to be set aside if unilateral mistake is established and recovery based on fraud or misrepresentation is established.

The authors after citing various property theories observe

Information which was derived by a group after generations of experience; treated by the group as important, essential, or perhaps even sacred; and useful to the group in meeting the demands of their environment would reasonably fit within the trade secret definition (McNeil & McNeil, 1989:33).

While referring to the case of constructive trust, they observe (1989:34)

This also might provide a theory of recovery, since the money acquired by the wrongdoer's actions might be seen as the product of improperly taking advantage of indigenous people "incompetent" to transact business beyond the confines of their culture.

Our conclusion is that many immoral and illegal transactions may have occurred and that the original owners of cultural information may have a just and legal claim for compensation. Perhaps more important, we need to search for new and modified institutions which will reduce the likelihood and severity of future unjust transactions and provide for a more fair distribution of wealth generated.

Kloppenburg(1988) prefers a multilateral approach over market oriented competitive approach for third world countries to claim compensation for their genetic wealth. He prefers this because he fears that a market approach would generate competition among the third world countries and isolate them rather than encouraging a collaborative effort. He suggests a FAO managed International Plant Gene Fund that would "support plant genetic conservation, construction of

gene banks, and the training of plant breeders in the third world'. Money to this fund was to be paid by the advanced industrial nations which have free access to the international germplasm banks. Size of this payment was to be determined by the "size of the national seed industry, value of the national agricultural production, and frequency and size of drafts upon the FAO's global gene bank". Organisational structure:

While I agree with the spirit of Kloppenburg's suggestions, I have less faith in some of the multilateral UN institutions. Not only their establishment cost is extremely high but also they are often less cost effective in undertaking various training and other support functions. For instance India has trained manpower in most of the relevant fields and can provide support to most third world countries at costs which would be fraction of what it would be if FAO did the same functions. However, political interests of some of the super powers may not accommodate the idea of India or other such countries providing such a support. This contradiction becomes apparent also when one looks at the conduct of International centres of agricultural research. My preference therefore is for a multilateral institution with a low cost profile, small size and very clear ethical and professional norm of accountability to be set up in collaboration with FAO, IUCN and third world institutions. The professionals from the western countries like Kloppenburg, Warren, Paul Richards, McNeil, Wilson, Farnsworth, McNeely, Ashton, Altieri, Mollinsdn etc., can be involved in the structure of governance. Third World centres of expertise like ACTS(Kenya), NBPGR(India), IIMA etc., can also be involved. The FAO, IUCN and CGIAR would need to support it through existing institutional channels. A consortium of legal experts will have to be formed to provide legal advice for TRIPS and GATT negotiations such that the issue of farmers' rights does not get obfuscated again as in past.

I agree with the suggestion of McNeil and McNeil(1989) that international aid agencies have also to do a lot of homework to modify their sensitivities on the subject. Perhaps this modification will not take place unless pressure on these agencies is increased. One way to increase this pressure would be to perform social and ethical audit of these agencies from the point of view of protection of intellectual property, biodiversity and farmers rights.

There is also a need for global network of activists, professionals and NGOs engaged in preservation, development and enhancement of biodiversity. Organisations like International Work Group for Indigenous Affairs (Denmark) should be involved in the discussion. They have rightly pointed out in the context of the wild life issues that many times the restrictions which are put on commercial loggers and users of forest resources are imposed on the native forest residents too. Cutting a tree for their livelihood or killing an animal for their subsistence becomes a crime. At the same time state claims inability to provide them basic necessities at the places where they live and at the price which they can afford. Thus new sources of subsistence are not added while old sources are denied. In any cases much of the diversity, domestication and development of the natural reserves in past was done by these very native people. Organisationally, IWGIA has provided them a voice which other international organisations have failed to do so far. IWGIA does not accord as much attention perhaps for good reason to biodiversity related issues as may be necessary. Once they are involved, they may do it.

It is true, as I said earlier, that many national governments are no more sympathetic to the interests of the disadvantaged people living in the bio-rich but poverty ridden regions than the international development organisations. Swiss constitution perhaps is an exception that it provided for its aid to reach the poorest in the host countries. In actual practice it may not happen in many cases but certainly such provisions do help. Routing resources for bio-conservation through national government in many cases will be necessary despite these limitations. But local

committees and structures can be created to ensure proper accountability of the concerned public institutions. Any organisation (public, private or non governmental) must share its balance sheet with the people for whom the resources are being received. It is not enough to compensate people in the developing world for their contribution in past. It is also necessary to protect their experimental ethic and cultural and technological skill of nurturing biodiversity.

Intellectual Property Rights and need for Redefining Indian Position

organisations like Indian Drug Manufacture Association (IDMAa) and Chambers of Commerce and Industry urge the government not to change the patent system lest it gives a blow to Indian pharmaceutical industry. It may be mentioned that more than 60 per cent of the drugs marketed in India have been found to be non-essential and in many cases redundant for the purpose for which they are marketed.

National Working Group on Patent Laws was set up by several NGOs and individuals opposed to changes in patent law in 1988. This working group argues that Indian Patent Law has served the Indian interests very well. This group intends to keep biotechnology outside the purview of Patent Law.

However, having signed the TRIPS under GATT and having faced the pressure of Super 301 by USA, India has started changes in its laws. Patent Amendment Bill 1999, being considered by Jt. Committee of Parliament does change the duration of patent, provides the protection of product patent except to drugs and agricultural products till 2005, the grace period available under TRIPS. Plant Variety and Farmers' Rights Bill is also under revision which provides for a national gene fund to compensate farmers whose varieties have been used to breed protectable varieties.

The debate on the germplasm conservation between IBPGR (dominated by the Europe and USA), and FAO sponsored Plant Breeders Right has at long last accepted the concept of farmers' rights although the precise mechanism of enforcing these rights have not been spelt out. Although some of the alternative ways have already been reviewed in this paper.

The Breeders' Right in Europe are being extended in such a manner that in future any company will be prevented even from incorporating a small part of the patented germplasm. The EEC directive on patenting of life form "seeks to end both these exemptions. Article 12 of the directive seeks to extend patent protection to the product initially obtained by the patented process, but also the identical or differentiated products of the first or subsequent generations obtained therefrom. Similarly Article 13 stipulates that the patent would be applicable to all products in which genetic information pertaining to patented product has been incorporated..... (Economic Times, Feb 13, 1990). The small European companies would find it difficult to compete with large European and American Seed Companies. In a conflict of this kind both the large and the small Indian seed companies might suffer. It is a case where India and other developing countries may find allies in the small European seed companies.

Unless India protects the farmers' varieties available in India and provides a similar facility to other developing countries there is no way the Indian seed companies and R & D institutions can withstand the onslaught of western multinationals. Indian position should be to respect the patents and simultaneously apply for Intellectual Property Protection to all the wild and discovered domesticated plant and animal resources. China and France provide Plant Variety Protection to wild discovered plants having DUS, (that is distinctiveness, uniformity and stability properties) India must insist that all seed companies using genes from the parents collected from India

directly or through CG Centres (Consultative Group on International Agriculture Research) pay royalty to India and other developing countries as the case may be. The argument that land races i.e. varieties and breeds selected by the farmers are a 'common heritage' of mankind will not then wash. Indian subsidiaries of large seed multinationals might be able to transmit germplasm or part of it to the parent companies without any hindrance under the present laws. Unlike the repatriation of the profits, the repatriation of germplasm or genes was far easier. However, thanks to the efforts of the scientists like Dr Lalji Singh, India is perhaps the only developing country which has entirely indigenous technology on DNA fingerprinting. It is possible thus to trace the transfer of genes illegitimately from one country to another. India can extend this expertise to most other countries and international agencies can help defray this cost.

India like many other tropical countries has a very high genetic diversity. In collaboration with the countries like Bhutan, Nepal, China and some other African countries, India can insist on a very major income transfer from the European and Western Seed companies to the developing countries. At the same time, the returns to research on this subject would improve and Indian companies in private and public sector may be able to compete with the best in the world.

I suggest that Indian Government revises its policy on the Law of Patent as it applies to Biotechnology and land races if we have to harness the comparative advantage we have in our natural endowment of genetic diversity and institutional capacity of building upon this knowledge. The new Plant Variety Protection and Farmers Rights Bill (1999) at present being considered by Parliamentary Joint Committee does provide protection to extant varieties as well as to Farmer bred varieties. I have made suggestions to the committee recently to modify certain provisions so that farmer breeders are not at disadvantage while seeking protection of their contribution compared to the corporate.

It is a pity that a very small fraction of national resources is spent on research, on the indigenous systems prevalent in developing countries. This is the case when more than eighty per cent of the human and about ninety percent of animal health is still guided predominantly by the indigenous health system

I had anticipated two responses in 1991 from the western multinationals. One, they may shift their ground and start negotiating the historical rent extracted by using farmers' knowledge. Second, They may agree to reduce the life of the patent so that profits foregone may become profits transferred. In any case the third world countries have to negotiate from the positions of strength. The evidence subsequently has shown that I was wrong on second count and only partly right on the first count. The international institutions have not made a great deal of adjustment in their position either under CBD (Convention of Biological Diversity, where in COP 5, May, 2000, the Article 8(j) dealing with compensation of knowledge, innovation and practices of indigenous and local communities and individuals are being discussed) or under International Undertaking on Plant Genetic Resources under FAO. The responsibility for Farmers' Rights has been transferred to each nation state without any international fund to compensate the local communities.

Part eight: Ethical dilemma in conducting discourse on biodiversity

Very often spirited professionals face a paradoxical situation while advocating on behalf of the disadvantaged communities. They have to seek support from the agencies whose policies they do not approve of.. In my view there is no way one can avoid this issue. My personal belief is that the rules of the game should not be different for the academic professionals and other interest

groups. However, in some cases one cannot insist on complete agreement before deciding to work with a particular organisation. Some of the normative principles which may guide one's choices are

- a) The data and its possible uses after compilation must be shared with the communities or the individuals from whom data on biodiversity was collected.
- b) One should follow the same norms of acknowledgement of intellectual properties as one follows while dealing with the oral or written works of professional colleagues. In a recent newsletter *viz.*: Honey Bee, I have followed this principle. It will call for communication in local language.
- c) The organisation from which one seeks support should be persuaded to accept the concept of cultural and institutional context of indigenous knowledge system.
- d) Wherever difference of opinions exist the same should be made explicit.
- e) If a professional gets an award, honour or remuneration by working on the indigenous knowledge systems, a share of the same should be made available in the direct monetary form to the providers of knowledge. Or a proportionate time out of one's personal quota should be spent in advocating on behalf of the indigenous people and their rights.

The nature of intellectual discourse should be such that the espoused and in-use values do not diverge too much. There is no justification for distinguishing the theory and the praxis completely. It has to be admitted that the professional strength for pursuing a case steadfastly cannot be achieved without sharing spiritual and cultural concerns of the people who have maintained biodiversity forgoing some of the privileges to which we are accustomed.

In each developing country traditions exist about indigenous thinking on the subject. In India ancient texts like *Vriksha Ayurveda*, *Krisi Parasar* (Majumdar, 1925), 'Gospel of Dirty Hand ' (Munshi, 1950), Indian Science and technology in eighteenth century (Dharampal, 1972), indigenous animal husbandry knowledge (Verma and Singh 1969) etc., are some of the early references. If the conservation ethics has to be revived, there is no escape from building upon these traditions in each country. Any other approach will be non institutional and even unethical. Many well meaning scholars commit this mistake not realising how cultural memory (ignored for long) erupts like a volcano at certain critical moments in history and wipes away all the false edifices.

Part nine: Illustrative areas of interventions

Some regions are under the spell of another drought. How many more landraces would vanish because the people are too poor to maintain the seeds or save the pastures, only time will tell.

Unless the discussion on maintenance of property rights about genetic resources includes the stakes of the communities (farmers, labourers, fishermen, pastoralists, hunters and gatherers etc.), I do not know if we would be able to even conceptualise the design of proper institutional mechanisms.

- a) Building pride in local knowledge traditions: curriculum reforms

The continued functioning and the strength of the institutions, that kept the environment protected, depends on how successfully the future citizens of the country are introduced to the heritage which generates respect for these institutions. The viability of these institutions depends on the inculcation of these values in the children especially in schools.

b) The culture provides a 'grammar' while technology provides new 'words'.

The meanings of life which is ecologically sustainable and economically just can be discovered only through blending of both. "Oral traditions", as Gold observes, "as aesthetic compositions and as cultural performances, provide substantial articulations of an indigenous perspectives" (1991). A repertoire of these nature respecting traditions needs to be built as a part of developmental strategy. Adult education programmes could be built around a systematic discussions of these parables and puzzles. Collective processing of these knowledge traditions would generate new perspectives about modern problems. Since local communities and networks would have certain meanings which would be common to them as well as some meanings which would be uncommon, the discourse would give rise to a creative situation of mutual learning.

c) Technological innovations for resource management need be inventoried and disseminated in local language so that institutional context of the resources becomes explicit.

Many times the rules governing management of resources are contingent on the choice of technology which may in turn be determined by ecological and socio-economic factors. Inequity in the access to resources does modify individual incentives or disincentives for choice of technology. At the same time, the ability to innovate does not necessarily deplete with decline in social or economic status.

The institutions can compensate some of the disadvantages that individuals may have in bearing the transaction costs involved in choice of group technologies. It may be useful to account for these costs (economic as well as socio-psychological) explicitly so that group dynamics tries to even out individual level differences.

d) Revival of religious identities sometimes indicates weakening of other social assurances.

It is inevitable that with increase in emphasis on emotive symbols the rules become more and more positional or contingent on nature of actors. The advantage of such an institution is that policing cost may decline with increase in moral fear. The disadvantage is that the intra group differences are masked in deference to group pressures. The ecological balance is maintained but economic imbalances continue.

e) With increase in market penetration, the weakening of moral and cultural institutions is understandable.

However, market incentives can be created such that the non formal cultural channels of communication are reinforced. The role of festivals and other rituals which are eco-positive can be underlined through market mechanisms. The legitimacy of such a fusion between cultural and market instruments would depend upon the nature of resource scarcity and peer approval. It is

possible that the competitive prices are used to extract rent which is in turn invested in local socio cultural institutions. During our action research in Karnataka we came across several common properties such as temples, furnishing in schools, public address system in a village temple which were procured by pooling the bid or discount amount of rotating saving and credit association. Thus bidding was done on the market principles. But the rent so collected was used for a common utility. This is a fascinating area of institutional design compatible with cultural and ecological contexts.

f) One dimension which has remained under studied relates to folk knowledge and folk philosophy.

g) Creation of demand groups of the 'farmers on fringe' by the scientists may help in counteracting the demands made by already well endowed articulated farmer groups.

Let us recognise that such dispersed, disadvantaged and poorly articulated farmers cannot be expected in the short run to demand different types of technologies from the scientists.

h) When the resources are scarce the need for networking is higher.

However, which scientists group will network with whom will often depend upon the way top leaders of R&D system monitor the performance. If the purpose is to reorient the forestry or watershed development , appropriate arrangements for networking and inter-organisational co-ordination will have to accompany the technology development and transfer. For far too long the institutional issues have been taken as constraints to be adapted to. If technologies and institutional arrangements for managing the natural streams or '*Kools*' have to be modified than the strategic linkages would be of qualitatively different type than would be the case if scientists were responsible for most of the functions over a given spatial unit(as is the case in on-station research). Need for on farm research is all the more high when ecological diversity is high and technologies developed at one location can not be replicated at another location even at a short distance away.

i) Recognition for developing technologies for limited diffusion:

If sustainability of technology in fragile regions depends upon compatibility with the diverse ecological systems than the possibility of developing technologies, which diffuse widely, is limited. Organisational rewards for work, which cannot be measured necessarily in terms of numbers of farmers, or acreages under cultivation of a new technology may be necessary.

j) Need for larger number of experimental sites and higher budgets:

Higher the risks and greater the variability in the production environment the greater would be the number of observations required to validate any experimental research. The challenge before the scientists is to develop network of experiments broad based such that sufficiently robust results can be achieved (1 989), this has to be seen not merely from the utilitarian perspective but from the semiotic, value building or analytical perspective also.

The knowledge system perspective requires us to deal with not merely utilitarian, evaluative or analytic dimensions. We have also to look at cultural, spiritual and historical aspect of the technology development and diffusion both at individual as well as collective level. There is no way by which knowledge systems can grow if the traditional cultural anchors are not properly located.

TO know a thing is to understand it. To understand one has to relate it to something already known, understood, labelled or named and assimilated. When something is discovered which does not tally with one's prior range of meanings or repertoire of concepts one tends to explore both within and outside. The search within becomes part of metaphysics. Search outside becomes part of socially constructed discourse in which the new discovery may be validated, invalidated or accepted as a conjecture.

The process of validation need not require exchange of ideas and information with other people within the family or outside. There are farmers who have tried new ideas but never felt excited enough to share it with others. There are others who are known for their crazy experiments or even hypothesis. Sometimes one validates ones meaning through repeated trials. Although we have adages such as 'ones bitten, twice shy' there are also adages which suggest that once is not enough. Knowledge gathering thus is a process where different branches of the tree grow in different directions but still retain connection through the trunk with the roots. The overall architecture of the tree unlike in biological species is determined by the periphery of language, culture and institutions. Thus language of fishermen or Eskimos includes large number of words for different types of sea waves or snowflakes. But the language used by the people in the mainstream living on the river basins often does not have these words. Over a period of time every language comes across concepts which had not been thought out before. That is how the languages grow through exchange of ideas and terms from other languages.

The language of innovations needs to be understood not only at the level of concepts but also at the level of a pattern of discourse. In other words sometimes same words or concepts may be exchanged very differently depending upon how and where the exchange was organised. If knowledge is conceptualised as a common property, there is no doubt that individuals developing innovations would not have much incentive to share their discoveries except if the values of the society demand such sharing and put premium on such a behaviour. A teacher not answering a question of a student, despite knowing it (but fearing that the student might not acknowledge his contribution) is unlikely to be considered a good teacher. At the same time if a teacher tries to communicate concepts suitable for a post- graduate level student to a school boy or girl, he may be considered equally incompetent.

Thus knowledge requires like a mirror, an object and a reflector but both need to be compatible. That is why some mirrors have a convex surface while other have concave or a flat surface depending upon the purpose.

Summing up

Biodiversity in the third world is fast depleting as an inevitable consequence of the modernisation. It is depleting in high growth regions as well as slow or negative growth regions. In former case, the agri-business has provided opportunity for short term non-sustainable growth spurred by CGIAR centres. In the latter case, lack of alternative technology, declining demand for their products, continued exclusion by market forces and poor political articulation have combined to produce a very adverse economic environment. The cycle of drought, floods, cyclones etc., further impair the household resilience. Under the circumstances a set of bold initiatives are called for.

Several modern technologies including DNA fingerprinting, recombinant DNA, tissue culture etc., have generated a false hope that genetic diversity can be preserved entirely by laboratory methods. I do not share this optimism. In my view, biodiversity is not a static concept. People living in bio-rich and economically poor environment keep on making selections of one kind or the other to enrich the given diversity. Therefore the need for institutional mechanisms that safeguard the ability of these people to continue the process of enriching biodiversity. Given the fact that most of the poor people in these environments have to out migrate seasonally or permanently to cities or other high growth rural regions proves that most countries do not value biodiversity properly. In view of the unequal terms of exchange and misguided tariff and taxes policies, most developing countries have a very precarious balance of payment position. They are dependent upon developed countries. Elites in the developing countries aspire for the same life style that their counter parts in developed countries use. The policy planning system is often manned by the same elite. Thus it is not going to be an easy task to reorganise institutional and policy framework to sustain biodiversity.

At the same time there is a global concern that something has to be done to prevent very fast loss of genetic diversity. I have argued in this paper that the persistence of poverty in the bio-rich regions is not accidental. It clearly shows the low value that various national and international bodies place on the efforts made by local people in producing and reproducing this biodiversity. This is not a technical problem alone. It affects the whole political economy or political ecology of generating wealth through agri-business approach of standardisation in agriculture.

Sustainability of this approach is being questioned even in the developed world (see recent report of National Research Council of USA on Alternative Agriculture). But most of the developing countries have still to realise the value of what they possess. It is not being sufficiently realised that the genes for disease resistance, stability and survival in harsh environment are available only in tropical, Himalayan and Andean environment. If global climatic changes are likely to be even half as serious as these are being made out to be, the skills of reproducing biodiversity under harsh conditions are going to be in great demand. I would not be surprised if the pastoralists, forest people and the mountain communities become the dominant cultures. But the global efforts do not have to await that inevitable eventuality.

Once we have found a satisfactory way of conducting discourse on biodiversity, I think we would have also discovered a way of operationalising our concerns through grassroots oriented action plans.

The disadvantaged communities have become a source of cheap 'unskilled' labour for infrastructural projects. National Commission on development of Backward Areas (Planning Commission, Government of India, 1981) in fact went to the extent of cautioning against too much effort in stemming migration from the backward regions, lest the supply of cheap labour is affected adversely. Such a perspective is at the root of the problem.

During a very severe drought in 1987, about 20 lakh cattle and their rearers were in the cattle camps of varying quality. Even though an effort was made to catalogue the good breeding bulls at our insistence (Gupta and Kumar, 1987) nothing much came of it.

If we believe that research on building sustainable institutions cannot be pursued in a meaningful manner without building upon indigenous ecological knowledge then involvement of people in research process itself would be most necessary. The findings of research must be shared with the people from whom data have been collected, not only ethical reasons but also for scientific

reasons. Only when indigenous groups take note of our explicit acknowledgement of our inadequacy will they offer to share with us insights and ideas that in the normal course do not make sense.

The sense making is a group process in which nested networks of knowledge of different resources and institutions interact. These interactions can be understood and measured only or mainly by looking at semiotic, linguistic, religious and social cultural dimensions of natural resource management. Meanings of most of the ecological symbols, rituals and institutions become apparent when we realise that certain values can only be retained in the form of myths. The myths act as memory cells of the organisation of the social groups. However, which myths are invoked when and for what purpose depends upon the ability of groups to deal with metaphorical or analogic communications. The need for an unsaid to remain unexplained can be appreciated when people are willing to invest in long term exchanges and negotiations.

_ë Most of the sustainable institutions require making reference to past events, stories or folklores. Inadequacy in the current reserve of energy or momentum may often be compensated by reference to historical folklore.

The major contention here is that traditional knowledge comprises several building blocks such as: historic repertoire of risk adjustment options, evolution of ethical norms justifying management of resources individually or collectively, concept of knowledge as common property and development of appropriate. communications stem, a peer group for appraisal of innovations, experimentation and revalidation of certain technological or institutional solutions. In some cases the innovations emerge because collective survival is given precedence over individual survival. In other cases innovations may be a consequence of serendipity, thoughtful evolution, amalgamation of traditional and modern materials and norms.

Biodiversity is outcome of creativity, triggered by cultural institutions and indigenous knowledge system. What weight this creativity of disadvantaged people inhabiting these highly biodiverse regions should place on our conscience is the issue to be explored. We have suggested challenging opportunities that are available before the concerned leaders and NGOs, scientists and citizens of developed countries. It is a struggle in which North-South divide has to be overcome. We are passing through an era of global reconciliation. It is a journey in which travelling together has to be a greater fun than reaching some where. This is how we look at missions of life in our part of the world- a part which is partly yours too.

The criteria and indicators of sustainability would thus require above all, an ethical foundation, which this paper has tried to demonstrate, has been laid long time ago. The knowledge rich people in high biodiversity regions can not be kept poor just because they have shared their knowledge and resources so generously. Unless, we learn to respect the underlying local knowledge, innovations, practices and institutions, it is possible that we will be left with a library of natural resources without a catalogue. The plants would become weeds.

REFERENCES

- Agarwal Arun, 1990. Personal Communication.
- Altieri, Miguel A. 1988 Sustainable agricultural development in Latin America: Exploring the Possibilities. Agric. Ecosystems. Environ. UC Berkeley, Mimeo
- Anthony Stocks (1987) "Resource Management in an Amazon Varzea Lake Ecosystem: The Cocamilla Case", pp. 108-120 in Bonnie J. McCay and James M. Hcheson (eds.) The Question of Commons: The Culture and Ecology of Communal Resources, The University of Arizona Press, Tucson.
- Arnold Pacey 1990, Technology in World Civilisation a Thousand-Year History, Basil Blackwell Ltd..
- Atte David O. 1989. Indigenous local knowledge as a key to local-level development: Possibilities, constraints and Planning issues in the Context of Africa seminar on Reviving Local Self-Reliance: Challenges for Rural/Regional Development in Eastern and southern Africa 21-24 February, 1989, Arusha, Tanzania.
- Bhandari, M.M. 1974. Famine Foods in the Rajasthan desert. Economic Botany 28 (1). 73-81.
- Brayan Norton, U 1988 commodity, amenity & Morality: The Limits of Quantification in valuing Biodiversity. In : Biodiversity, E.O. Wilson, National Academy Press, Washington, D.C. 1988, 200-205
- Chargaff, E. 1978 Heraditean Fire: Sketches from a Life Before Nature. Rockefeller University Press, New York, 252 pp.
- Chhatrapati U. 1987. How scientists saved Russia's "seed of hope", The Economic Times December 20 1987
- David Ehrenfeld 1988 Why Put a Value on Biodiversity? In Biodiversity, E.O. Wilson, Washington, E.C., National Academy Press 212-216
- Dennis Michael Warren 1990 Indigenous Knowledge and development (revised version), Seminar series on Sociology and Natural Resource Management, agriculture Department, The World Bank, Washington, D.C. 2043, Dec. 3
- Dharam pal 1983 Indian Science and Technology in the Eighth-Ninth Century, Academy of Gandhian Studies, Hyderabad, 1983, 325.
- Dorji, Kinley, Agricultural Department, RGB, Thimpu, Bhutan, 1990, Personal Communication
- Gehlot H. 1933 Preservation of farm animals Udaya art Printing Press, Jodhpur, , 140
- Farnsworth, Norman R. 1988 Screening Plants for New Medicines, in Biodiversity, Ed. E.O. Wilson and National Academy Press, Washington, D.C. 83-97. Of India,

Gupta Anil K 1989 The Design of Resource-delivery Systems: A Socio-ecological Perspective, *International Studies of Management and Organisational Behaviour*, Vol. XVIII, No. 4 pp., 64-82

Gupta, Anil K 1985 On Organising Equity: Are Solutions Really the Problem? *Journal of Social and Economic Studies* 2,m 4 pp. 295-312.

Gupta, Anil K 1981 Viable Projects for Unviable Farmers – An Action Research Enquiry into the structure and Processes of Rural Poverty in Regions Paper presented in the symposium on Rural development in South Asia, IUAES Inter Congress, Amsterdam.

Gupta, Anil K 1981 A Note on Internal Resource Management in arid Regions Small farmers-Credit Constraints: A Paradigm, *Agricultural Systems (UK)*, Vol. 7 (4) 157-161.

Gupta, Anil K 1982 Drought-Deficit-Indebtedness: Deprivations and Developmental alternatives before small farmer p.79, included in “SFAA” Annual Meet 1982 symposium, ‘Coping with scarcity’ in *International Agricultural Development*, March10-14,1982, Lexington, Kentucky, USA.

Gupta, Anil K 1983 Impoverishment in drought Prone Regions: A view from within: (Joint field study SDC/NABARD/IIM-A) *CMA, IIM, Ahmedabad*, p 573.

Gupta, Anil K 1984. Socio-Ecology of Grazing Land Management, published in *rangelands: A Resource Under siege*, Proceeding of the Second International Rangeland Congress, edited by P.J. Jose, P.W. Lynch and D.B. Williams, Australian Academy sciences, Canberra, 1986, (IIM Working Paper No. 525, p. 33, paper presented at Commonwealth Workshop on Land Use Planning in Tropics, BARI & IIMA, Jan 28- Feb 2, Ahmedabad.

Gupta, Anil K. 1984. Socio-Ecology of Land Use Planning in Semi-Arid Regions”. September 1984, IIM Working Paper No. 525, p. 33, paper presented at Commonwealth Workshop on Land Use Planning in tropics, BARI & IIMA, Jan 28- Feb 2, Ahmedabad.
in *Agriculture*, Indian Institute of Management, Ahmedabad.

Gupta, Anil K. 1985. Socio-Ecological Paradigm for Analysing Problems of Poor in Dry regions, *Ecodevelopment, News*, No. 32-33, March, pp 68-74.

Gupta, Anil K. 1985. Small Farmer Household Economy in semi-Arid Regions: Socio-Ecological Perspective – CMA Project Report Based on field Survey in 1979-80 and 1982-83, Centre for Management in Agriculture, IIM, Ahmedabad, Mimeo, Summary of Findings contributed to Annual conference, Association of arid Land Studies, Texas,

Gupta Anil K (1986) Socio-Ecology of Natural Stress, Technological Change and Human Response in Bhutan Preliminary draft Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad.

Gupta, Anil K. 1986. Drought and Deprivation: Socio-Ecology of Stress, survival and surrender, Paper presented at the seminar on control of Drought desertification and Famine, IIC, New Delhi; IIM-Bangalore; INTACH, May, 1986 and revised draft at World Congress of Sociology, New Delhi,

Gupta, Anil K. 1987. Role of Women in Risk adjustment in Drought Prone Regions with Special Reference to Credit Problems, October, IIM Working Paper No. 704

Gupta, A.K. and Ajay Kumar, 1988. Drought in Gujarat: Is it too late to act? Economic Times, February 3,

Gupta, A.K, 1986. Socio Ecology of Stress: Why do common Property Resource Management Projects Fail?: A Case Study of sheep and Pasture Development Project in Rajasthan, India – Paper presented at conference on Management of CPR, organised by National Academy of Sciences, BOSTID, US, Annapolis, April 21-26, 1985; proceedings published by National Research Council, Washington, D.C. USA, pp. 305-322

Gupta, Anil K. 1985. Managing Common Property Resources: Some issues in institutional design, Paper presented in NAS Conference on CPR, Annapolis, April 21-26,

Gupta, Anil K. 1983. Designing developmental Organisation: Search for an Indian Theory, W.P. 444, 1982, p. 28, accepted in the XIX Congress International Des Sciences Administratives, Berlin, held in September

Gupta, Anil K. 1987. Why Poor don't Cooperate: Lessons from Traditional Organisations with Implication for Modern Organisations, in Clare G. Wanger (ed.) Research Relationship Polics and Practice of Social Research, George Allen and Unwin, London, pp. 111-127.

Gupta, Anil K. 1986. Creating demand systems: Journal=2, A field report of an action research project on creation of demand groups of poor by bureaucracy in three tribal districts with similar people and dissimilar administration, a joint a CMA-PSG project, 1982-1985, IIM Working paper,

Gupta, A.K, N Alam. Z Abed and M M Rahaman, 1986. Generating Ecology and Class Specific jointly with Research Priorities: Socio-Ecological Perspective on FSR. Paper presented at in International conference on farming System Research, University of Kansas, Kansas, October 5-7.

Gupta, Anil K. 1985. Matching Farmers Concern with Technologists Objectives in Dry Regions: A Study of Scientific Goal Setting: a CMA research project, IIM, Ahmedabad, mimeo.

Gupta, Anil K. 1998. On the Concept of Knowledge: The conundrum of Criticism Control and Commitment in Peasant Science, presented as key note paper at a conference on farmer Participatory Research at Loused, ILEIA, April 11-12-1998

Gupta, Anil K. and Karma Ura, 1990. Blending Cultural Values, Indigenous Technology and Environment: The experience of Bhutan. IIM, Working Paper No. 883 P-42, presented at International Conference on Integrated Mountain Development, ICIMOD, Kathmandu, September 10-14, 1990.

G. Carleton Ray, 1988. Ecological Diverse in Coastal zones and Oceans, in Biodiversity, E.O. Wilson, Washington, D.C., National Academy Press, 36-50.

Honey Bee, 2(1) Ed. By Gupta Anil K., 1991. Centre for Management in Agriculture, IIM Ahmedabad, May 1991, 22

Hugh H. Iltis. 1988. Serendipity in the Exploration of Biodiversity: What Good Are Weedy tomatoes? In : BioDiversity, E.O. Wilson, National Academy Press, Washington, 98-105

Jack Ralph Kloppenburg Jr., 1988. First the Seed The political economy of plant biotechnology, 1492-2000 Cambridge New York Cambridge University Press,

Jain SK, 1991. Custodian of Ethnobotanical Heritage – A New Role for Botanic Garden, in contribution to Indian Ethnobotany. Ed. S.K. Jain, 5-A, New Pali Road, PO Box 91, Jodhpur 342 001, Indian Scientific Publishers, 322.

Juma C, 1989. The Gene Hunters: Biotechnology and Scramble for seeds, Princeton University Press, Princeton, New Jersey,

Hira Nand, 1979. Ph.D Thesis on Indigenous Dry land Technology HAU Hisar

Jodha N.S. and Mascarenhas A.C., 1983. Adjustment to Climate Variability in Self Provisioning Societies: some Evidence from India and Tanzania. ICRISAT, Economic Programme Report No. 48, March PP 10-12

Kumar, K. and Hiranand, 1981. Scientists and farmers comparative perception of the attributes of dry farming innovations, Haryana Agricultural University, Journal of Research, vol-11(2) pp. 185-197

Munshi K. M. 1952. Land transformation. A Philosophy and a Faith, Ministry of Food and Agriculture, New Delhi.

Netting Robert, M.C. 1972. Of Men and Meadows: Strategies of Alpine Land Use, Anthropology Quarterly Vol. 45 pp 123- 144, in Gilish and Palmer, Op. Cit.

K.M. Munshi., 1951. A Great Service to Perform, in The Gospel of the Dirty Hand. Ministry of Information and Broadcasting, Government of India, The publication Division.

Manila K.S, 1991. Ethnobotany of the Riches of Malabar in Contribution to Indian Ethnobotany Ed. S.K. Jain, 5-A, New Pali Road, P.O. Box 91, Jodhpur-342 001, India, Scientific Publishers, 243

McNeely J.A, 1988. Economics and Biological Diversity Developing and Using Economic Incentives to Conserve Biological Resources, IUCN, Gland, Switzerland, November, Mittre Vishnu, Wild Plants in Indian Folk Life – A Historical Perspective, Contribution to Ethnobotany of India, Scientific Publishers, 1991, 30-39.

Mollison Bill, 1988. Perma Culture, A designers' Manual, Tagari Publications, PO Box 1, Tyalgum NSW, Australia, 2484, , 576.

Nandy Ashis. 1980. Alternative sciences: Allied Publishers Private Limited, New Delhi, 155.

Niels Roling and Maria Fernandez, 1990. Farmer's Technology criteria and Institutional Assumptions: Exploring MIS-Anticipation for Points of Leverage: Paper for the 10th Annual

AFSRE symposium, Institute for International Agriculture, Michigan state University, East Lansing, Mich., 48824-1039 USA, October 14-17,

Pal D.C. 1991. Plants Used in treatment of Cattle and Birds among Tribals of Eastern India, in Contribution to Indian Ethnobotany, Ed. S.K. Jain, 5-A, New Pali Road, PO Box 91, Jodhpur – 342 001, India. Scientific Publishers, 287.

Prasad Jaya, 1987. Methodology of Science used in past Indian and its relevance to present day Context, Indian Journal of History of Science: 229(2), 99-102

Ray Raghunathmal, 1942. *Akal Kasht Nivarat*, , Shri Raghunath Ayurvedic Pharmacy, Maharashtra, , 96.

Richards P. 1989. Agriculture As a Performance. Farmer First Edited by Robert Chambers, Sarnold Pacey, and Lori An Thrupp London: Intermediate Technology Pub. 39-43

Richard J. McNeil, 1989. Ownership of Traditional Information Moral and Legal Obligations to Compensate for Taking. Cornell University, Northeast Indian Quarterly Fall, 30-34

Robert L. Jarret and Wojciech J. Florkowski. In Vitro Active vs. Field Genebank Maintenance of Sweet Potato Germplasm: Major Costs and Considerations FEATURE A Publication of the American Society for Horticultural Science, Alexandria, VA 22314

SACHS Ignacy, 1989. Sustainable Development: From Normative Concept to action – Background Paper for the seminar on Environment – XXXth Annual Meeting of the Inter-American development Bank, Amsterdam, March 23, 1989.

Savnur, H.V. 1950. A hand book of Ayurvedic *Materia Medica* With Principles of Pharmacology and Therapeutics, Dr. Father and Sons, Maruti Street, Belgaum, 312, XVIII

Saxena S.K. 1981. Economic Plants of Indian arid Zone. Man and Environment 5, 32-40.

Sebastian and Bhandari M.M., 1990. Medico Ethno-botany of Mount Abu, Rajasthan, India Department of Botany, Jodhpur University, Mimio.

Verma, M.R. 1967. Dairy Husbandry of Nomadic Gujjars in six South-east Himachal forest Ranges – A Study in pastoral animal husbandry, M.Sc. Thesis, Hissar Punjab Agricultural University

Verma. M.R. and Singh Y.P., 1969. A Plea for studies in traditional Animal husbandry Farmer, Vol XL 111 (2), PP. 93-98

Vartak, V.L, Observation on wild Edible Plants from Hilly Regions of Maharashtra and Goa Contribution to Ethnobotany

Wilson, E.O. 1988. Biodiversity National Academy Press, Washington, D.C.