CHAPTER 1

Biodiversity: Nature and Humanity

Introduction

In this chapter an overview of the biodiversity problem is provided[1]. An understanding of biodiversity, based on the history of the idea of biodiversity and various controversies on biodiversity and conservation is provided to highlight the fact that biodiversity is much more than a natural phenomenon. The issues relating to valuing biodiversity and the limitations of an economic perspective are highlighted. Finally an analysis of the biodiversity politics is provided and it is argued that biodiversity is a contested terrain. The objective is to provide an unconventional perspective on biodiversity and to lay the ground work for some of the arguments developed in subsequent chapters. It is argued that the complex nature of biodiversity politics needs insights from social sciences and the co-production of biodiversity can be understood as a reflection of the relationship between nature and society.

Biodiversity and Conservation : Concepts, Controversies and Contexts

Biodiversity has been defined in many ways by many scholars and the definitions will helping understanding biodiversity. The definitions highlight some important aspects of biodiversity. The idea of biodiversity is inseparable from variety and complex ecosystems.[2] A widely cited definition of biological diversity is given in The Convention of Biodiversity.[3]

Biodiversity can be conceptualized as a hierarchy at three levels genetic diversity, organizational diversity, and ecological diversity. To measure and understand diversity systematic surveys and classifications are essential. Species have to identified, grouped and classified in terms of families. Thus a study of biodiversity requires systematic listing and classification of living species. The modern starting point of listing and classifying could be

traced to the works of Carl Linneaeus whose text published in 1758 recorded about 9000 species, both plant and animal species. Our current understanding of global biodiversity, though incomplete can give an idea and, there many species are yet to be classified and studied[4]. But the tragedy is current extinction rates are very unusual and result from the actions or inactions of the humans[5].

Unfortunately the current rates of extinction are not only alarming but also resulting in mass extinction in an unprecedented scale[6]. The loss of biodiversity is not a question of scientific curiosity or extrapolation. It has important consequences for ecosystems and hence for human kind which depends upon ecosystems for its sustenance. The ecosystems provide us so many services, which are essential for life on earth to survive. An attempt was made to compute the worth of the ecosystem services came up with a mind boggling figure.[7] But the question is can any price be put on the ecosystems which are essential for the survival of humankind. The point is current notions of valuing ecosystem services are based on the assumption that humans could value them on monetary units. But almost all ecosystem services are so unique and essential that there is no substitute for them, nor can humans build technological alternatives or substitutes for them. So anything that diminishes the capacity of the ecosystems should be of serious concern to humankind. Biodiversity is crucial for functioning of the ecosystems. But whether the environmental policy of today is sensitive to this fact is a question that cannot be ignored. The policy framework may not be attuned to the reality that biodiversity and ecosystems are essential for our survival.[8]

Thus loss of biodiversity is not a loss that can be substituted. Humankind is destroying what cannot be replenished and humankind has no idea about the value of the biodiversity that has been lost. Thus loss of biodiversity is not a just a loss of o few exotic species or landscapes or forests. Loss of biodiversity and destruction of ecosystems go hand in hand. The web of life is in danger when both are destroyed. Little is known about the web

of life still many decisions are taken on the basis of poor knowledge or paraphrasing Jerry Ravetz, because of the ignorance of humankind's ignorance. (Ravetz used the term 'ignorance of ignorance' to characterize one aspect of modern science). According to a study on the state of the ecosystems the productive capacity of ecosystems is in danger and this could have serious repercussions for the human species, present and future. [9]

Over last hundred years half of the world's wetlands have been lost .The area covered by forests has declined by almost 50% and the loss of forests still continues as humans convert forests for farms, roads etc. Over fishing and over harvesting have resulted in not only the decline of catch but also in decimation of fishing stock in oceans.[10] The root cause of biodiversity loss can be traced to demographic change, poverty and inequality, public policies, markets, and politics, macroeconomic policies and structures, and, social change and development.[11] Loss of habitat/degradation of habitat is the single most important reason for biodiversity loss. This occurs due to many factors which have been called as 'social, economic and political drivers'.[12]

Thus the loss of biodiversity is linked with the decline of productive ecosystems and the loss of productivity for future. Although the damage done to ecosystems can be minimized or reduced later it is no way possible to restore the ecosystem to its former state. Thus what is done cannot be undone in almost all cases. The resilience of ecosystems is not infinite and in any case the current knowledge about ecosystems and their resilience is limited. Any resource management policy that is based on the idea that humans could estimate the maximum sustainable yields (of timer, fish etc) and level of perturbation that the system could handle is based on a false and limited understanding.

Ecosystems are not jigsaw puzzles, they are composed of flows of matters and energy and the interconnections are critical and often fragile. Any disruption that can result in ecosystem disintegration will result in decline in productive capacity and the in-built

absorptive capacities. Ecosystems are not static entities with fixed equilibriums, but are dynamic systems. But this does not mean that they have infinite capacity to absorb the external shocks or disruptions and somehow spring back to normalcy after all the stresses and strains that damage the flow of energy. So for decline in biodiversity it is not necessary that a significant portion of the ecosystem should be lost or damaged. Damage to a small but critical portion of the ecosystem could result in sudden loss of species or biological diversity. The ecosystem is more robust only if the species mix is more heterogeneous and richer. Thus diverse ecosystems could be outcome of processes about which not much is known. And ecosystems have the capacity to adapt and how an ecosystem accommodates an increasing number of species and how it evolves over a period of time are matters of research and the research indicates that linkages across ecosystems in space and over time increases the ecological resilience. Thus diversity is not only a cause but an effect of the processes that result in an ecosystem. In other words any destruction of biodiversity will have cascading effects on the ecosystem resulting in irreversible consequences. The weakening of the absorptive capabilities of an ecosystem could be severe to such an extent that attempts to restore the ecosystem will have limited impact. The decline in biodiversity affects the essential functioning of the ecosystem itself. This could result in less capability to survive and reproduce and to withstand further pressure.

But the destruction of biodiversity has not resulted in greater human welfare and well being when compared to the extent of destruction. Neither nature nor humankind has benefited from such a destruction which is irrational[13]. There are many examples like this which illustrate the follies committed by humankind. So efforts are on to protect the hotspots which currently occupy about 1.4 % of the land surface but which are still home to about 50% of plant and animal species are important as international and national laws have failed to halt decline of biodiversity. [14]

But unfortunately biodiversity conservation is more complex than saving few hotspots here and there. The problem is hotspots do not occur in vacuum and destruction of habitats outside hotspots, in those linked to them could result in extinction. This has serious implications for resilience and the hotspots though may seem to be intact, may not be resilient or vibrant enough to absorb the stresses and shocks. Hence the critical issue is how to act in the context of competing needs and the limits of knowledge and understanding, in the context of biodiversity. The extinction rate can be reduced if not brought to nil if only the importance of biodiversity is realized and is considered in development policies.

But the loss of biodiversity is an important cause for worry for more than one reason. What is at stake is more than the future of species facing extinction or the general decline in biodiversity. According to a report by UNEP

Our growing use of the environment is beginning to exceed the assimilative and regenerative capacities of the Earth's major biological and physical systems both regionally and globally .The Earth may be approaching a point where it may not be able to make the demand for environmental goods and services. These changes are beginning to have adverse consequences for human populations, especially the poorest segments of society.[15]

The human domination of ecosystems has been studied by scientists who have affirmed that the natural ecosystems and cycles are being disrupted to a point which is close to beyond repair.[16] This has adverse consequences for biodiversity as well as the integrity and resilience of the ecosystems.

However the biological diversity is a term that is amenable to easy definitions and scientists have defined in many ways. This is not a question of quibbling over definitions but the biological diversity as an idea emerged from scientific discourses and reports and captured the attention of the public only during the last two decades or so. The volume edited by E.O. Wilson and published in 1988 and the subsequent developments like the Rio

Conference in 1992 have put biodiversity in the limelight. But biodiversity is a very recently coined term. It became popular only in the context of the biodiversity crisis which was highlighted by the scientists and with the advent of biotechnology which expanded the capabilities of human kind to manipulate the genetic structure of organisms and thus ushered in a new area in many disciplines.[17] Thus as an idea and as a productive force biotechnology changed the way biodiversity is being viewed. It is not that biotechnology invented biodiversity but it was biotechnology which made the humankind to realize that biodiversity is a resource that could be exploited with biotechnology and biotechnology needs biodiversity as a raw material and biotechnology in turn can help in conservation of biodiversity.

The concept of biodiversity has evoked a wide variety of responses from scientific community.[18] One reason for such a diverse view on defining biodiversity is that scientists look at it from their fields of specialization and disciplinary perspectives. The term is of recent origin.[19] The consensus over protecting biodiversity is also of recent origin but there is no consensus on what to protect and how to justify protection of biodiversity. Thus although biological diversity is an idea that has roots in biology and the conceptual basis of biodiversity stems from the idea that diversity that exists at various levels, from molecules to complex ecosystems and the debates over biodiversity are not confined to biology or science.[20]

What to Save, What Not to Save, How to Save? Conservation, Biodiversity, Ethics: An Overview

Although it is acknowledged that biodiversity is invaluable and is essential biodiversity protection has not received the attention it deserves. One way to understand the issue of biodiversity and the response of humankind to biodiversity is to look at it from an environmental ethics perspective. The Human response to biodiversity can be understood

with reference to the way humans have valued, responded to nature and particularly the diversity in natural ecosystems.

In 1949 American conservationist Aldo Leopold wrote criticizing the attitude towards land and nature.[21] Leopold advocated land ethic as a solution and went on to defend land ethic as an idea that would help conservation and would integrate ethics and aesthetics. The idea of land ethic is his seminal contribution to conservation movement.[22] The debate over conservation evoked different responses. The two major perspectives were eco-centric perspective and the anthropocentric perspective. Even today most of the perspectives stem from either of these.[23]

In the next few decades the issues were addressed by many scholars and an overview of thoughts of some prominent thinkers which have relevance for law, public policy is given in this section.

Christopher Stone, famous for that classic article "Should Trees have Standing" advocates "Moral Pluralism". Stone argued that the idea of "legally right less" entities had undergone changes over the ages and what were previously thought of having 'no standing' had been conferred rights. Hence according to Stone endangered species and threatened forests although had 'no standing' special guardians should be empowered to speak for them.[24] Thus whether Nature has 'standing' or not, the interests of the voiceless should not be left out.[25]

Mark Sagoff has argued that environmental problems are moral, aesthetic, cultural and political problems as well.[26] Although it may be tempting to reduce the debate on ethics, environment and conservation of biodiversity as debates between two competing perspectives, anthropocentrism and biocentrism, the debate is not so. The anthropocentric perspective is not negated in total but its assumptions are questioned by many. Similarly the

limits of eco-centric perspective are also acknowledged. Leopold's Land Ethic tries to bridge both these perspectives.

Some philosophers (e.g. Baird Callicott, Holmes Rolston III) have taken this further and used it in their writings on environmental ethics. Deep Ecology, also known as Ecosophy-T is another ethical theory that has posited a critique of the industrial society and Deep Ecology has its roots in the eastern thought (e.g. Buddhist, Gandhi's ideas). Deep Ecology is bio-centric and rejects the anthropocentric perspective. Expounded by Arne Naess this has found wide support. The deep ecology perspective argues that irrespective of usefulness for humans, non-humans and nature have intrinsic value. It also posits that richness and diversity are valuable and are values themselves, and, hence humans do not have the right to cause harm to this richness and diversity except to meet vital human needs. Further the deep ecology platform advocated B. Naess and George Sessions states seven key principles which form the core of deep ecology. Deep Ecology thus represents an eco-centric view which concedes that nonhumans have intrinsic value irrespective of their utility and hence they should not be subordinated to human needs and wants.[27]

But it has been criticized by many, particularly by eco-feminists.[28] Although Deep Ecology did not become a mass movement its principles have wide influence in environmental thought and action. Modern environmental movement is comprised of various streams of thought ranging from deep ecology to socialist ecology.[29] The conservation movement is also influenced by the trends in environmental ethics and philosophy. Thus while the issues relating nature and valuing nature and protecting nature have been debated in academic works, in praxis radical ecological movements and groups like Greenpeace and Friends of the Earth have tried to influence public opinion and policy makers. The praxis cannot be understood without the underlying philosophy. But the dilemma of conservation vs. development persists, although the idea of sustainable

development is supposed to be a via media that balances present concerns with needs of the future generations and the vulnerability of the ecosystems.

In case of preserving biodiversity although it can be argued that it has benefits for human beings, can utilitarian perspective be the basis of conservation? In case of competing species that deserve to be protected which should be given the priority and how to assign the priorities in conservation? Bryan Norton a philosopher who has written extensively on conservation had suggested that wild species are valuable and deserve protection because they could transform human values.[30]

But the economic perspective which stresses the utilitarian over the intrinsic value is the dominant perspective. It concedes that resources should not be over exploited to the level of depletion but argues for optimum solutions to resource exploitation. On the other hand for conservationists who value nature for its own sake such thinking represents a reductionism. For some critics the problem lies with both science and economism and both are ill suited to defend nature and hence conservation cannot rely on them as useful allies.[31]

Economism and Deep Ecology are the two theories that figure prominently in the debates over values and biodiversity. There are variants of both, but still, both these theories are important as they articulate two different views on values and biodiversity. According the former theory environmental values are economic values and hence components of nature can be valued like any other commodity. In contrast, deep ecology and other non-anthropocentric world views emphasis on the intrinsic value of nature and object to the utilitarian and instrumentalist perspective. They point out that nature and its components have inherent value and hence deserve to be 'preserved for their own stake'. Thus the logic of conservation need not be justified in terms of economic valuation or the value determined by market. In other words Nature Matters not because we value it through our own preferences and value systems but because of its intrinsic worth. But in planning and development projects the

economic criteria particularly cost-benefit analysis is applied and hence some sort of valuation of nature is inevitable. However problematic the economic methodology be, planners and investors need some figures and projected benefits and costs not only to evaluate the projects but also to choose from competing projects. Valuing the services of nature or assigning a value to an ecosystem or valuing the biodiversity component in a project is difficult partly because for most environmental goods and services there is no market. It has been pointed out that the attempts to estimate the monetary equivalent of nature's service have been criticized. Various schools of thought in environmental ethics and philosophy approach nature in different ways and hence although the concern about nature may be expressed the disagreement on solutions springs from the diverging assumptions and core ideas about human-nature interaction.[32] The words Nature and Values are amenable to many meanings and interpretations and hence the diverging views actually represent different understandings of the two words in different contexts.[33]

The divergent worldviews on nature and valuing nature have implications for conservation policies and hence in protecting and valuing biodiversity. As a result the debates tend to get polarized and an inclusivist ethic is needed but that has not occurred so far. As a result the endless debate over economics vs. ecology is reaching nowhere.[34]

There are problems with the assumptions in both the theories. Hence valuing biodiversity is problematic on one ground or other. But for solving practical problems and to choose an optimum solution the rhetoric of intrinsic value is not of much use. Even when the assumptions and values in the economist perspective are laid bare, the solution lies in not rejecting it entirely but in understanding the limitations of various tools employed in valuation. For example in the absence of markets economists use methods to determine the human preferences on the environment.

In case of biodiversity the problem is all the more acute as priorities in conservation have to be decided and some hotspots have to be saved at any cost although this may result in allocation of less money for other areas or projects.[35] But conservation is often overlooked and as it has been observed that biodiversity concerns should get reflected in other policy areas. As biodiversity is often given less importance than short-term interests the long-term consequences of this are inimical to biodiversity.[36]

Even if it is assumed that conservation of biodiversity is important, there are many unresolved issues relating to conservation. While some are in favor of keystone species some are against that view and argue that all species are important. Another controversy is with reference to ecosystems and hotspots. Is it sufficient that humanity pays attention to hotspots as a matter of priority or should large ecosystems also be paid attention irrespective of the fact that all such ecosystems need not be equally rich in biodiversity. In fact they are not and some areas are more endowed with biodiversity with other areas.

Another issue is the role conservation biology can play in conservation and whether conservation efforts have really succeeded or have conservation has failed despite all the talk and money spent on conservation.

One reason why these are raised in this dissertation is the fact biodiversity is a subject which evokes mixed responses. On one hand there are conservationists who insist that biodiversity conservation should be a global priority and demand that human kind should pay more attention to biodiversity and halt the process of the sixth extinction. (e.g. E.O. Wilson, Norman Myeres, Thomas Lovejoy). On the other hand there are social scientists who raise fundamental questions about biodiversity as a concept, values in conservation and the challenges to our understanding from recent developments in ecology in which the dynamic condition of nature is preferred over a static concept of nature and the implications of these

new concepts for environmental law and policy, not to speak of conservation and biodiversity politics.

To put it other words, biodiversity cannot be understood as a matter of science alone and that science is a contested science and the interface between science and society is significant in this issue. Thus biodiversity issue is more than what popular books and scientists say about biodiversity and biodiversity should be viewed in a broader context. This is not to deny the importance of biodiversity or underestimating or denying the human induced extinction. An informed critique of the current discourse on biodiversity thus is necessary to understand the values that are not explicitly stated in the discourse and the assumptions invisible to 'outsiders'.[37] The biodiversity problem can be understood using three stage model.[38]

1. Assembling the facts – the scientists assemble facts, analyze them and conclude that there is a crisis or problem that has enormous implications for humankind. In case of biodiversity the various conferences and publications since the early eighties have framed the problem through the analysis of facts and studies and have come to the conclusion that the sixth extinction has to be halted and biodiversity conservation can be defended on various grounds.
2. Presenting the problem – the problem is put forth the public and policy makers and is presented as a key issue facing the human kind. When the problem is presented the scientists also highlight the options available and why timely action is a must to save the remaining biodiversity.
3. Contesting the problem and finding a solution: As in the case of many problems there are many views on the problem and the seriousness or importance it deserves. Again there are different views on rates of extinction or priorities in conservation. But such

differences in views do not obscure the basic fact that biodiversity crisis is a major crisis that has to be addressed.

In case of global climate change and green house gas emissions the scientific view outlined in IPCC reports was challenged and the likely impacts of human induced climate change or the impacts of global warming were questioned. Further as it involved reduction in green house gas emissions it became a contested debate which involved issues of equity and justice and managing the global commons-atmosphere. In case of biodiversity although there were dissenting voices it did not become as controversial as the global climate change issue. Rather the terms of the debate were on political issues and the North-South divide on sharing the benefits of biological diversity. In this context the scientists who drew the attention of the public on the biodiversity crisis and the policy makers who have taken this as a serious issue constitute the epistemic communities.[39]

These communities share a common understanding of the issue and their contribution is significant as such communities mediate with other groups/actors and provide a basis for the justification of the policies or programs and affirm that the issue on hand deserves attention. The epistemic communities need not consist only of scientists or policy makers. But the claims of the epistemic communities need not go unchallenged. The controversies over global warming, GM foods in agriculture show that the counter experts challenge the legitimacy of the findings of the epistemic communities.

In case of biological diversity the knowledge base stems from biological sciences, but the term is of recent origin. It has been pointed out this term is absent in The Growth of Biological Thought (by Ernst Mayr), published in 1982.[40] As it has been pointed by Tackas, and others the idea of biodiversity gained popularity in the late seventies and eighties and was taken up by many NGOs concerned with conservation and by UN agencies like UNEP, UNESCO. Scientific bodies and organizations also played an important role in this. The

biodiversity crisis was taken up by the Brundtland Commission also which advocated specific measures for conservation and devoted a chapter on biodiversity. Thus by the mid/late eighties there was a consensus on the nature of the biodiversity problem, and the issue became an international issue. Slowly the demand for a global convention gathered momentum, and this has been discussed in detail in the chapter on Convention on Biodiversity.

The scientific discourse on biodiversity thus represents one facet of biodiversity. But the biodiversity discourse is articulated in the global contexts and it cannot be neatly separated into science, economics, and culture. For example any discussion on conservation inevitably draws economic factors. The cultural dimension of biodiversity is too well known to be negated now. Hence it is better to contextualize biodiversity instead of trying to separate that as a matter of science only.[41] The insights from scientific disciplines are necessary but they are not sufficient to address real world concerns about conservation and biodiversity; they may well become an impediment in addressing 'wicked problems' of the real world.[42]

Conservation is also a contested activity with various actors functioning with different priorities and objectives. Although biological diversity, shortened as biodiversity seem to rest on a solid body of scientific knowledge it is not so. At this juncture it can be pointed out that the understanding of nature has undergone a change thanks to postmodernist perspectives which have questioned the idea of nature being 'out there'. The postmodern perspective deconstructs nature and argues that nature cannot be understood in isolation of the relationship between nature and society. However as such a perspective questions some of the cherished assumptions of conservationists it was met with much disdain by the conservation community.[43] But are there limits to conservation science? According to two scholars, writing in the context of conservation biology and conservation in the real world the answer is a qualified yes.[44]

The issue is what are the uncertainties in conservation and how best the understanding and knowledge of biodiversity can help. Obviously uncertainty is no excuse for inaction. Rather what is known is not adequate or more needs to be known and accept the uncertainty as inevitable when conservation is planned or discussed on a large scale and there are limits to modeling.[45] The importance of the questions related to value, ethics and insights from other disciplines in public policy relating to conservation has been acknowledged by scientists themselves who are well aware of the issues relating to uncertainty and limits to disciplinary perspectives in conservation issues.[46]

The debates over single large reserve versus several small scale reserves illustrate that conservation biology is not controversy free. The issue is whether a single large reserve is preferable to several small-scale reserves. Both are desirable and have their own advantages and disadvantages. But the debate has been dominated by ecologists who prefer single large reserve over several small reserves.[47] This has implications for conservation for those who prefer large reserves are in favor of committing large areas as protected areas and often it is insisted that protected areas should be treated as reserves in which there could be no human settlement.

Is biodiversity a single body of knowledge or is there more than one type of knowledge about biodiversity. Prima facie it may appear that biodiversity is a matter of biology, of facts and figures and the subject matter for study by scientists. But even before scientists alerted the public about biodiversity loss and advocated various policy prescriptions there has been conventions that deal with issue, although not comprehensively. Before the signing of the CBD in 1992 there were many conventions and treaties dealing with endangered species, protection of wetlands and important ecosystems, birds and migratory species etc.

For example The Ramsar Convention and CITES were in vogue much before the CBD.[48] Many nations had their own laws on endangered species and their protection and had set aside particular areas as protected areas and national parks. Although much of this was done in a fragmented manner and without a holistic perspective when the negotiations on CBD were in progress there was a whole body of legal literature available and although this was based more on the experiences in conservation and in implementation of laws, than on conservation biology. Thus the important role played by other perspectives on biodiversity or other knowledge representations of the biodiversity problematic cannot be ignored.

Another important source of knowledge about biodiversity is the traditional knowledge or indigenous knowledge or ethno ecology or traditional ecological knowledge. Called by various names this knowledge about biodiversity is closely linked to the cultural diversity as well. What is significant is most of this knowledge is based on the experiences and observations made by indigenous groups and others in various parts of the world. Such a knowledge does not claim to be universally applicable or true but is validated by the local ecological conditions and the human community that depends on it. It does not talk in scientific terms like ecosystems, dynamic models, ecosystem processes but it not also a bunch of unverifiable claims. The biodiversity and cultural diversity aspects of this knowledge are inseparable.[49] Again this knowledge is not static or just a knowledge being handed down over the ages. It is also an evolving knowledge. The western science has recognized this knowledge as useful although it may not agree with the spiritual or cultural dimension of this knowledge.[50] From a utilitarian perspective it makes sense to use this knowledge without examining its other dimensions. Thus for a scientist a shaman could be someone who has valuable knowledge and could be useful in identifying useful plants and species but for the community he is also a healer, among other roles he plays.

The modern and western 'understanding' of shaman and indigenous knowledge has undergone changes over the centuries. But the biodiversity knowledge of the indigenous people is an inseparable part of the culture and hence it is more appropriate to speak of bio-cultural diversity than biodiversity. The scientific worldview and its understanding of biodiversity and the bio-cultural understanding of biodiversity are often at odds.[51]

So biodiversity is a contested terrain – epistemologically and otherwise. It is easy to treat biodiversity as natural phenomena and write/speak in terms of species, ecosystems, hotspots and extinctions. But as argued by Escobar and others biodiversity discourse is under challenge from social movements and indigenous peoples, NGOs and others and this challenge has serious implication for theory and action. Thus almost all the issues relating to biodiversity have been contested from various perspectives. Hence issues within biodiversity debates are debated by social movements, NGOs, indigenous communities and hence the dominant views and paradigms are under challenge.[52] For example in case of reserves and protected areas the conventional thinking that no human settlement or community should live within them has undergone some change atleast because of the alternative perspectives.

Thus biodiversity is much more than ecosystems or the state of nature described by science. Biodiversity is a site of struggle and the controversies in biodiversity and conservation reflect the contentions of various actors. A detailed examination of this is beyond the scope of this chapter.

Valuing Biodiversity: Economics and Beyond

Economists use a formula to arrive at the Total Economic Value of natural resources. The same can be extended to biodiversity also.

Total Economic Value (TEV) = Use Value + Non-Use Value

However it is difficult to use this as a universal formula because of many constraints. There are both theoretical and practical problems in using this. In case of extending this formula to biodiversity the problems have been discussed by economists themselves.[53]

The economic analysis cannot capture all the values of biodiversity.[54] Biodiversity economics has been helpful in furthering the case for biodiversity conservation and creating awareness about the importance of biodiversity.[55] So while an economic perspective does have a role in conservation it is difficult to justify all conservation efforts in terms of economics alone. This is evident in the case of bioprospecting where it has been argued that bioprospecting will not generate adequate funds for conservation and conservation has to have a different rationale.[56] The issue is whether biodiversity conservation is a question of moral principle or a question of use value. The emphasis can be on use value and it can be argued that the use value of biodiversity is significant and the use value of eco systems are too valuable to be ignored. Some ecologists have tried to do this.[57]

Option value can be a justification for biodiversity conservation. A typical example would be the argument that a rare strain of corn or wheat in some tropical country might help in creating new varieties that are resistant to a pest, should that pest become a major problem or conserving germplasm for its exotic qualities which may be useful later. Thus for plant breeders and biotechnologists the option value of biodiversity is important. But the problem with this view is that it reduces germplasm or biodiversity as a resource to bank upon.[58] Similarly another justification for biodiversity conservation to view that as insurance.[59]

Still the ignorance about the species and their 'value', attributes, utility is very much an issue. Scientists do not know exactly the number of species present or waiting to be discovered. In the absence of any conclusive proof on this the option value in monetary units can be estimated only after science tells what are all there and after identifying them. Again tomorrow science or technology may come up with a new use for a resource (say species or

plant) which was undervalued previously. So apart from conceptual problems, in reality, assigning option values is beset with practical problems also. The biologists have made only reasonable guesses about the number of species and probable future discoveries also should be taken into account.[60]

The existence value cannot be quantified. It is subject to individual preferences and values. For someone Himalayas may be very important although that person may have no intention to visit the Himalayas and for him/her Alps need not matter at all. Hence justification for conservation in terms of existence value is nearly impossible. Thus using monetary units to justify conservation or protection of biodiversity is desirable at one level for the numbers will give some idea about the value of the biodiversity but another level the numbers game and assigning monetary values can also amount to a very utilitarian perspective on biodiversity. Taking such a perspective it can easily be argued that as some ecosystems do not seem to contribute much, they can be put to better use by maximizing their utility. For example it can be argued that industrial plantations and fast growing trees can be substituted for forests which do not support many species or for forests that are so severely degraded that there is no scope of restoration. Similarly monoculture yields more in terms of quantity and hence growing the same variety of the crop makes much sense over growing variety of crops which do not yield. The economic justification for green revolution over traditional agriculture was traditional agriculture latter was backward, low yielding and the productivity was not high. But Green Revolution was also the cause for decline in genetic diversity of crops planted as many traditional varieties were replaced by modern varieties.

Hence applying the economic paradigm mindlessly to biodiversity will be self-defeating. Yet often conservationists like E.O. Wilson highlight the utilitarian aspect of biodiversity also. Thus although there is a consensus on the importance of biodiversity applying economic models and valuation to biodiversity is controversial. In other words

economics cannot the sole logic for justifying conservation and protection of biodiversity. At the same time the economists have played an important role by pointing out that market prices do not capture the loss of biological diversity and both market and policy failures have been main causes for biodiversity loss.[61]

Hence while the attempts of the economists to assess the importance of biodiversity and alert about the significance of market and policy failures and economically unsound policies for biodiversity loss, deserve appreciation that economics alone will not provide all the reasons for biodiversity conservation or can fully assess the significance of biodiversity for humankind. For policy makers and global institutions long used to Cost Benefit Analysis and other tools for assessing projects economics can help in highlighting the problem of undervaluing natural ecosystems and overestimating the benefits arising from projects. Hence biodiversity economics has become an ally of the conservationists and advocates of sustainable development.

Property Rights, Intellectual Property Rights and Biodiversity

Defining property and property rights has been a challenging task. Property is no longer viewed as 'a thing ', is now viewed as a 'bundle of rights'. The idea of property has undergone changes in legal scholarship and property is an umbrella term covering many areas[62]. Bromley's definition also mentions about the social relation aspect and the benefit stream arising out of ownership[63]. Can biodiversity be owned? Yes if it is covered under property rights. But can the information be owned or can the genetic code be owned? Such questions arise because if biodiversity is viewed as a public good and whose consumption is non-rivalrous then benefits are non exclusionary and one can free ride on others contributions. For example the contribution of forest to enhancement of the quality of atmosphere is useful to all and 'use' by one person is not at the expense of the other.[64] Since biodiversity is a resource that has more than one use and contributes to the betterment of

quality of life of humankind it can be viewed as a global public good in which the whole humanity has a stake. And hence it can be argued that any private property rights in biodiversity should not result in any action / impact that goes against that common interest. But is biodiversity is a pure public good, with non-rivalrous and non exclusionary. It is a difficult question to answer because the views on biodiversity will vary. As shown elsewhere in this chapter biodiversity is subject to sovereign rights and any restrictions imposed by sovereigns on use and ownership. Hence the issue of property rights over biodiversity is more complex than issue of property rights over things or land.

In case of genetic resources the use of a resource is rivalrous but when it comes to the information encoded in the resource it is not so. Since use of information is non-rivalrous and as information can be copied easily often at zero marginal cost the need for a property right to give exclusive rights over that information are required if that information is to be used as a private resource. But since all that is needed is a few samples to decipher that information mere possession of samples by one cannot restrict other person from decoding that information. So although a person may own a plant that person will not have any right over the information encoded in that plant. Thus ownership over information encoded in genetic resources prima facie appears to be a pure public good. But it need not be so in practice. Because through legal regimes it is possible to grant exclusive rights or grant the right to charge for that information. The role of intellectual property rights in this is obvious. But should property rights be granted on biodiversity and whether information encoded in genes should be covered by IPRs? These are controversial issues and the answers vary.

It has been pointed out that property rights are not absolute rights and viewed as a social relation and right, there are strong reasons for defining property rights over biodiversity, in view of the ethical, social and other factors also, apart from legal aspects. [65]. One reason against property rights in biodiversity is that rights do not occur in a cultural

vacuum and different cultures have different concepts about property rights, ownership and access rights to resources like biodiversity. Hence it will not be proper to extend the western notion of property rights over resources to all resources in all contexts and places. But it is also argued that absence of property rights can result in many problems including free rider problem, resulting in the decline or degradation of the resource. And lack of property rights does not provide for biodiversity conservation as users have no incentive to care for or maintain in the absence of property rights. Most of such arguments are either based on the notion of tragedy of commons as described by Garret Hardin or on economic analysis. But in case of biodiversity there are many problems in extending such an analysis and it is not just a question of absence of property rights alone. Market is not an appropriate mechanism for valuing biodiversity and even property rights need not necessarily result in conservation. This is because land and forests could be put to multiple uses and the value of biodiversity is often unknown or difficult to estimate and short term interests may get priority over long term interest. For example a country rich is biodiversity but short of foreign exchange may decide to earn foreign exchange by export of timber and hence can give preference to deforestation than protecting the forests. Similarly for a farmer who is using traditional varieties it may be beneficial to sell the land to a property developer if that is a better solution financially. The value of traditional variety in terms of genetic information may not even figure in this. Again biodiversity being a non-rivalrous public good a state can decide that converting a portion of the forests is better for development of the country. So neither property rights nor sovereign rights can ensure that biodiversity will be protected. Thus property rights over biodiversity have to be viewed in the institutional context and not in terms of ownership alone. But conservationists have argued that economic incentives are necessary to preserve biodiversity and the institutional mechanisms are needed to provide such incentives.[66] Commercial use of genetic resources as an input for research and development to promote conservation has been

one of the ideas suggested to create an incentive for conservation. Since the use of genetic information may generate income for providers/owners of that resource, they may tend to protect biodiversity and exclude uses that are unfavorable to biodiversity.[67] However this view has been controversial as whether the potential revenue is adequate to offset the costs of protection and whether there is a significant market for such resources to use this as a strategy. The opinion on is this divided. It is observed that no generalizations can be made and market induced incentives depend on the specific demand-supply in the market.[68] Thus whether such

Incentives are adequate to promote conservation is a controversial issue. So while property rights may play an important role they themselves need not result in promotion of conservation. But the linkage between conservation and using resources for development has been taken into account in CBD. Thus there is little dispute about using the resources but the issue whether such a utilitarian perspective is enough to justify conservation. On the other hand it has been contended that markets cannot be effective mechanisms to protect biodiversity because of many factors like markets may be missing or market valuation may not be the appropriate base for valuing biodiversity or market is not equipped to handle biodiversity resources when there are problems in determining the net or future values of biodiversity or market may undervalue the genetic resources as their true value is not known at present.[69] Another argument against assigning private property rights in biodiversity is it amounts to commodification and alienation and it cannot be justified on moral grounds and biodiversity need not be reducible to benefit streams.[70] But as the economic rationale for conservation is unthinkable without property rights, despite such observations, the relevance of property rights in biodiversity conservation and use of economic incentives has been widely acknowledged and is used in policy formulations also. However this preoccupation with property rights can be traced to the famous essay by Garret Hardin 'The Tragedy of the

Commons' published in 1968. The solutions put forth by him to avoid the tragedy included allocation of rights to individual herders so that they would act in their own self interest and reduce the number of cattle. However subsequent studies have proved that the tragedy does not occur always and hence Hardin presented a picture which is not universal.[71] The work done on common property rights during the past two decades has shown that common property resources are managed in many different ways and hence one cannot universalize to say that in the absence of property rights the tragedy of commons would occur.[72] Thus the issue of property rights over biodiversity has evoked mixed response.

In case of IPRs and biodiversity it is a well settled principle that products of nature cannot be patented per se. But naturally occurring material is patentable provided it can be isolated, purified and is 'new' and criteria for patentability should be fulfilled. This is true for genetic resources also. However in case of genetic resources as there are different varieties the scope of IPRs has undergone changes over the years. With the advent of biotechnology there has been a sea change in this[73] . Whether the products of nature bar is valid in practice is an interesting question. Most commentators do not think that it is a bar anymore.[74] It has also been pointed out irrespective of the doctrine, in practice this limitation is considered as a mere problem of claim drafting and can be overcome.[75]

Hence the product of nature doctrine is dead for all practical purposes. On the other hand the expansion of IPRs over what was earlier considered to be beyond the purview of IPRs has raised many questions. For example the decision given in John Moore v Regents of the University of California gave rise to questions about ownership of bodily organs and tissues and property right claims over human organs. The Court rejected his claim over ownership of the patented cell line and declared that he neither owned the cell line nor he could[76]. The IPRs over genetic resources do not control the rights of others on that resource but give the patent holder exclusive rights over what is claimed in the patent. And patent

claims could be on genes as well as on the genetic information.[77] Hence the issue of patents on genes has been controversial and there has been much debate in academic circles on the proper nature and scope of patents in biotechnology, particularly patents on genes and genetic material.[78] In case of plant genetic resources as indicated elsewhere the nature and scope of the IPRs vary. As product of nature doctrine is not applicable in developed nations there is no bar in patenting purified and isolated products of nature. However the right over the physical matter and the IPRs over the information or process or the product are different. This can be illustrated with the following example.

Property rights that govern access to, removal, and utilization of a plant genetic resource as a physical material which also has genetic information are tangible property rights. These rights relate to economic utilization of the plant genetic resource, using some mechanism to access or use that resource and thus deal with the right to control the material which also has genetic information. On the other hand IPRs deal with legal protection on the use of that information encoded/found within the genetic material and hence they are intangible rights. For example the information contained in rice genome is relevant for IP rights as it could be used for further development or for other purposes and this does not control the rice varieties in the world. It is possible to create copies of the information coded in rice or transfer the information into a database and thus claim IP rights. When IPR regimes do not distinguish between natural genetic material or artificial or (hu)man made genetic material appropriation occurs. In case of genetic resources the source of information or origin is irrelevant but what matters is the nature of the claim and whether that claim can meet the criteria laid down by law.[79] Thus genetic resources can be covered by both tangible property rights and intangible property rights. (But if genetic resources are considered as Common Heritage of (hu)mankind or part of public domain the issues are different. This will be taken up for discussion later). It is here the role of intellectual property rights becomes crucial.

Intellectual property rights confer rights which go beyond mere property rights. Also the ownership of genetic resources or biological resources can be subject to control by state which exercising sovereign rights over resources can impose conditions on use and access. For example state can control or impose restrictions on use of biological resources in private land also. Similarly the legal regime can restrict what can be patented or what cannot be.

Biopolitics: The Local-National-Global Dimensions

The agricultural crops are not uniformly distributed throughout the world in terms of diversity and the Russian botanist N.I. Vavilov recognized this and developed the idea of centers of origins of crops in the mid 1920s. This idea was explored further by biologists who refined it further and identified secondary centers of diversity. The level of agricultural biodiversity has increased over the ages thanks to human intervention. Thus diversity in terms of varieties within crops utilized in agriculture is high although the number of such crops is relatively smaller. However the centers of origin are not always the important zones of production. Thanks to the transfer of germplasm over thousands of years many crops had been domesticated and cultivated extensively in areas other than the centers of origin. As a result the interdependence of countries on PGFRA is high. This is true of both developed and developing countries. For example more than two thirds of developing nations produce more than half of their crop production from crops originated or domesticated in other regions. Although none of the twenty major food crops originated in North America or Australia, the countries in North America and Australia are major food producers today. The transfer from Brazil to Malaysia resulted in extensive rubber plantations in South East Asia. At a time when most of these transfers took place there was hardly any rules to regulate them and such transfers were facilitated by the colonial expansion and the Columbian Exchange. The establishment of Botanical Gardens in different parts of the world also helped in research on plants and they served as gene banks as well. Thus thanks to human intervention and human

activities diversity was created as well as dispersed across the globe. Genetic diversity is an important resource in agricultural research. Hence national governments and states often had a keen interest in germplasm collection, storage, propagation and utilization. Pistorius and Wijk characterize the three stages in which this was done and point out how in each stage the state has played a crucial role in determining the usage of the genetic resources.[80] As Kloppenburg points out the exotic germplasm from elsewhere was used by the nascent US society to transform its agriculture and the state actively engaged in germplasm collection, seed distribution and encouraged farmers to try new varieties. It is estimated that a significant portion of the increase in yield in USA is due to utilization of genetic diversity in agricultural research to produce new and better varieties.[81] In plant breeding national security concerns prompted much needed investment in developing new varieties and green revolution was formulated as a strategy.[82] According to Perkins it was the fear of the population growth and the projected food scarcity apart from security concerns that were the main factors in the involvement of many states and foundations in promoting green revolution. However for developing new plant varieties the plant breeders had to fall back on the germplasm stored in genebanks and these genebanks were concentrated in the developed countries and a major portion of the global germplasm was under the control of gene banks located in developed countries or in gene banks under the control of CGIAR.[83] Ever since Vavilov made the important discovery about the centers of genetic diversity and the importance of collecting germplasm from these centers the understanding about the need for germplasm has undergone a sea change. The Green Revolution resulted in an alarming decline in crop variety discovery and it was argued that for the sake of the future conservation of germplasm should be given priority. However whether in situ conservation is as important as ex situ conservation became a controversial topic. At the same time the global interdependence for germplasm also became obvious. Hence while a country could be a country of origin but that

need not be the only source of germplasm for that crop/plant. A classic case is Soy which originated in China but it was grown extensively later in the Americas and today the Americas are also important source of soy germplasm.

An analysis done by Kloppenburg and Klieman in 1988 showed that the interdependence among countries for germplasm was very high. In other words no country can claim that it is 100% self reliant in terms of germplasm. The North has depended on the germplasm from the south and if the contribution of this germplasm is taken into account it runs to billions of dollars. On the other hand although South has also benefited much from international germplasm transfer and agricultural research the North has made better utilization of the germplasm from South thanks to its technological capability and the presence of most gene banks in the North. But as intellectual property rights were obtained on products developed using the germplasm from South and South received nothing in return in the early 1980s the issue became a North South controversy.[84]

The genetic diversity in agricultural crops was considered as 'common heritage of mankind' implying that it should be freely available to anyone or any country.[85]. Further the Article 1 of the 1983 International Undertaking on Plant Genetic Resources referred to plant genetic resources as 'a heritage of mankind' and hence they should be available without any restriction. It is worth noting that it spoke of 'a heritage of humankind' and not 'the 'common heritage of humankind.[86]. However this common heritage of humankind has been interpreted to include both responsibility as well as commitment.[87]. In 1991 it was clarified through a resolution that the common heritage of humankind as indicated in the Undertaking was subject to sates' sovereignty over plant genetic resources.[88] With the advent of CBD the national sovereignty over genetic resources was accepted and CBD used the term 'common concern of mankind'. The common heritage of mankind terminology was avoided so as to

clear the misunderstanding that it would result in either internationalization of genetic resources or provide common right of access and benefits from these resources.[89]

The Common Heritage of Humankind was repudiated by the developing nations who found that they gained little from this approach. But it enabled developed nations to get access to genetic resources at free of cost and more importantly access without any restriction. On one hand the Common Heritage of Humankind approach facilitated free flow of germplasm and collection by scientists for research purposes and often states did not restrict such collecting activities. It also enabled the formation a global network of genebanks and international agricultural research centers, which were later brought under the aegis of CGIAR. But repudiation of this principle and its substitution by state sovereignty is not without problems. For example scientists have complained that access is restricted unnecessarily and states fail to understand the need for use of germplasm for research and because of CBD and accusations about biopiracy there is suspicion about even typical scientific research collaboration. Proliferation of national level legislations with unrealistic assumption and procedures has made the situation worse. As a result scientists face many problems in access, collection, and transfer of germplasm. One reason for this is state sovereignty is the key principle in CBD.[90] It has also been pointed out that Common Heritage Approach on crop resources did have a positive impact on movement of these resources as well as on creating new varieties.[91]

For a political ecology perspective this controversy represents the struggle over controlling nature and the stakes are high because regulating nature means not only regulating access but also asserting sovereign rights. But biodiversity politics is complex because at different stages, different actors with different stakes are involved and hence strategies, coalitions, negotiations and the institutional contexts determine the outcome.[92]

The biodiversity politics is thus a global as well as national as well as local phenomenon. A political ecology perspective on biodiversity politics will inevitably focus on the role of the state in this and will examine how the State mediates the conflicts and assumes different roles in different contexts. For example while developing nations assert that they have sovereign rights to decide what is the best way to utilize natural resources and hence brush aside critiques of northern NGOs as unwarranted interferences they have no hesitation in promoting unsustainable practices and mega projects in the name of development without respecting the human rights and the right to livelihood of their citizens. Thus in the biodiversity politics the framing of the issues and the associated discourses are very important.

However to assume that State does not undergo change or asserts its sovereign rights without compromise will be wrong. For during the past two or three decades the State has gone under transformation all over the world and under the neo-liberal ideology the State has given up much of the regulatory powers in favor of the market and at the same time it has ensured that private property rights are safe guarded and its policies facilitate investment and the conditions are conducive for global capital to invest, accumulate and mobilize financial resources without much restrictions.[93]

In the case of biodiversity, the role of state in controlling or regulating germplasm has been examined by scholars.[94] Thus biodiversity politics is not a question of natural resources alone, it also involves many other factors and the biodiversity issue gets defined and redefined from each actor's perspective and as a result there is no consensus on most issues. For example the conservation initiatives that aim at sustainable use of forest resources by various methods (bioprospecting, debt for nature programs etc) evoke mixed response. For NGOs and governments this is a strategy to save the remaining forests but it has been criticized as an attempt in selling nature to save it.[95]

But what is interesting is that biodiversity politics being a contested terrain it cannot be reduced to an understanding based on some form of determinism or crude formula. The role of the state itself is subject to pulls and pressures. And that is why some of the ambitious projects have met with much resistance. Hence a political ecology perspective on biodiversity can help us to deepen our understanding of biodiversity politics at various levels. It is now widely acknowledged that biodiversity change cannot be understood as a mere ecological process and biodiversity loss and conservation should be seen in the context of social processes.[96] During the past decade a significant body of literature has emerged on the biodiversity issue and scholars from many disciplines (e.g. geography, anthropology, environmental history, and environmental sociology) have given many insights on biodiversity and related issues. Thus today biodiversity cannot be considered as a natural phenomenon alone. On the other hand the debates on concepts in ecology and debates on conservation practices and policies have brought a better understanding of biodiversity and conservation. The significance of bio-cultural diversity is much better appreciated and acknowledged now today than ever before. Simultaneously the importance of farmers' practices for conservation, sustainable use of genetic resources has been acknowledged.[97]

In short biodiversity is a contested terrain. So biodiversity cannot be understood in isolation. Biodiversity as a concept has different meanings and as it has been pointed out earlier unless an awareness of the history of biodiversity as an idea is essential to understand the multi-dimensional nature of biodiversity. In short biodiversity and the related bio-politics are too complex to be described or understood from a single disciplinary perspective. This chapter has highlighted some aspects of this with a view to go beyond the conventional approach to biodiversity and conservation.

Conclusion

Biodiversity crisis is real but the biodiversity discourse has been deconstructed and the various narratives on conservation, biodiversity and society have been examined by scholars and activists who have challenged the dominant paradigms. During the past two decades or so there has been a sea change in the understanding on biodiversity and humanity and the insufficiency of a perspective based on the sciences has been acknowledged. As the analysis on plant genetic resources and their history shows biodiversity is as much natural as much social and culture and nature are inextricably intertwined. Hence the term bio-cultural diversity is opt in the context of describe the agricultural biodiversity and plant genetic resources.

Notes and References

[1] The term biodiversity has become popular over the last two decades and is used in this chapter as a synonym of biological diversity.

[2] For example biodiversity has been defined as

"The variety and variability among living organisms and the ecological complexes in which they occur" (Office of Technology Assessment cited in Dobson).

"Biodiversity can be understood as an assemblage of several hierarchical components: we can count the number of ecosystems, ecological communities, species, populations, or genes in any defined area" Dobson (1996)

"Biological diversity, in the biologist's sense of the word, is the natural stock of genetic material within an ecosystem. This stock may be determined by the actual number of genes existing within the system..... The greater the variety in the gene pool, the greater is the variety of organisms which exist or which will exist in the near future" Swanson (1997)

[3] Biological diversity means the variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part: this includes diversity within species, between species, and of ecosystems

The Convention on Biological Diversity Article 1

[4] Estimates about the total number of species varies although the current opinion is that there are about 10 million species Heywood (1995).

Of these humankind an claim to know about 1.5 million species only and in most cases we do not have know much about these species. The gaps in knowledge about biodiversity are acknowledged and programs have been launched to further our knowledge. See ICSU (2002) for an overview about the science relating to biodiversity.

[5] Scientists have tried to estimate at the extinction rates and the picture is alarming. Although the estimates may vary there is a consensus that the extinction rates are too high. For instance it is estimated that they are 100 to 1000 times more than the normal extinction rates (Heywood 1995). Although a species may be endangered due to various factors there is a time gap between ultimate extinction and the species becoming irrevocably extinct. The current rate of extinction is 27000 species per year, 74 each day, 3 each hour. E.O. Wilson (2003).

Scientists have estimated that there had been five mass extinctions in the earth's life history and the extinction on account of human action and inaction is the sixth mass extinction. The sixth mass extinction is resulting in loss of species even before we know what they are. This is happening at very rapid rates, much above the pre-human levels, often threatening an entire group. The enormity of the extinction is linked to deforestation and as tropical forests are home to a good portion of the global biodiversity the threats to the forests inevitably result in biodiversity loss. Another scientist estimates that given the current rates of deforestation, 4 to 8% of world's tropical forest species will become extinct in the next two and half decades, and 9 to 19% over the next five decades. It is estimated that about 50 to 90% of species live in the tropical forests and based on the estimated extinction rate about 4000 to 14000 species would be becoming extinct on account of tropical forest deforestation alone. In this estimate it is assumed that there are about 5 million species on the earth. The decline in tropical forest species under various scenarios thus range from 4 to 8% in 2015 in mild scenario assuming that 10 million hectares of forest would be deforested and it is 6 to 14% in a High scenario assuming that 15 million hectares would be deforested.

[6] According to Tuxhill the current rate of extinction, i.e. 1000 species per year is very high when compared to the recorded loss of 1 to 4 species per year, as evident from fossils J. Tuxhill (1999) Pp 96-114.

The plants that have survived previous extinctions have become vulnerable to extinction now. The various estimates highlight the fact that the humankind is undoing what has been done over the millennia and this evolution in reverse will have serious consequences for humankind

[7] Costanza, R. et.al. (1997) estimate that the fundamental ecosystem services are 'worth' $33 trillion, whereas the global gross national product is just $18 trillion. The study claims that they have not valued fully many ecosystem services and this figure is just an indication.

This study was critiqued by Mark Sagoff , See. Sagoff, (1997), Sagoff (2002), See also Farber, Stephen, C. et. al. (2002)

[8] Echoing this concern Tilman writes Tilman, David (2000) at 210

"The loss of biodiversity will diminish the capacity of the ecosystems to provide society with a stable and sustainable supply of essential goods and services. It seems likely that environmental policy that is optimal from societal perspective would be remarkably new from that of 250 years ago. However we still use environmental and land use ethics codified in law that were articulated during an era when the human population, at one tenth of its present size, tamed wilderness with axe and ox." Tilman, David (2000) at 210

The Earth will retain its most striking feature, its biodiversity, only if humans have the prescience to [establish an ethic as long lasting as a constitutional bill of rights or as religious commandments]. This will occur, it seems, only if we realize the extent to which we use biodiversity. Ibid 211

[9] World Resources Institute (2000) examines this in detail.

[10] ibid

[11] Wood, Alexander, Stedman-Edwards, Pamela Mang, Johanna (2000)

[12] Dirzo, Rodolfo, Raven, Peter (2003)

[13] For example although the humid tropical forest, which covered 14% of the global land surface, which was also home to 67% of the terrestrial species has been cut down to half of its earlier size, but a good portion of the land cleared in this manner is unfit for agriculture. Pimm, S.C. et. al.(2001)

[14] See Kunich, John Charles (2003) for a discussion about how and why the international law has failed biodiversity and an alternative proposal. Conserving hotspots is necessary, but whether this is sufficient to stem the loss of biodiversity is controversial. But it is an essential step that will safeguard at least what is remaining. According to some experts protecting a mere 5% of the topical moist forest areas can safeguard 50% of species. Hence conserving the hotspots has been given priority by conservation NGOs like Conservation International.

[15] UNEP (2000) P4.

[16]For an overview see Vitousek, Peter.M et.al (1997)

[17] For example see Potthast (1996), Flintner, Michael, Heins, Volker (2002), Takacs ,David (1996)

[18] For instance Takacs, David lists the following responses from scientists to the question what is biodiversity

"It obviously means to some people species diversity; other people expand that to include populations. To other people it means really genetic diversity, heterozygosity, allelic diversity, often within

population. To many it means variety of ecotypes or ecosystem types, landscape types" – David Ehrenfeld

"The living resources of the planet" – Paul Ehrilich

"A measure of difference" – Donald Falk

" The product of organic evolution" – Terry Erwin

"A fundamental property of life" – G.C. Ray (See Takacs, David 1996).

[19] See Potthast (1996) for a discussion on this.

[20] For example

"Thus biodiversity is understood as a basic trait of life. It is embedded both within systems theory as well as the concept of hierarchy. However, it should be critically remarked that "living entities" (i.e. organisms), "living systems" and "biological systems" do not exactly represent the same things. Genes are not living systems themselves, but necessary prerequisites of living organisms. On the other hand ecosystems consist of biotic as well as abiotic elements" (Pothhast (1996) at P 179

[21] "We abuse land because we regard it as a commodity belonging to us. When we see land as a community to which we belong, we may begin to use it with love and respect"

Leopold, Aldo (1989)

[22] For Leoplod " A land ethic, then, reflects the existence of an ecological conscience, and this in turn reflects a conviction of individual responsibility for the health of the land. Health is the capacity of land for self-renewal. Conservation is our effort to understand and preserve this capacity.. [e]xamine each question in terms of what is ethically and esthetically right , as well as what is economically expedient. A thing is right when it tends to preserve the integrity, stability, and beauty of the biotic community. It is wrong when it tends otherwise" (ibid).

See also Callicott, Baird. J (1989).

[23] John Muir, founder of Sierra Club advocated an ecocentric perspective which argues that nature should be protected because of its intrinsic value, irrespective of its economic benefits. Thus for Muir mountains and forests were "fountains of life" and not just resources to be exploited for timber and irrigation. On the other hand, for Pinchot who advocated scientific management of natural resources, forests were "crops" and economic development of natural resources is the basis for conservation of nature. Thus it is a stock of resources that has to be exploited and conserved in the long run. This perspective is an example of anthropocentric perspective of nature where nature exists for the sake of humankind as a resource and has no value or rights of its own. The eco-centric, also known as bio-centric perspective and the anthropocentric perspective are the two major perspectives on nature and conservation. And many other views/perspectives stem from either of this and bring in additional

viewpoints regarding religion, role of science and technology, culture to explain/understand the relationship between humankind and nature. Leopold suggested a land ethic that would guide human behavior with respect to land and natural resources. For him ethics, esthetics are very important, not just the economic aspect.

See Callicott, J. Baird (1989), Fox, Stephen R (1981), Nash, Roderick (1989),

White, Lynn (1967). Lynn White writing in 1967 argued that the roots of the ecological crisis could be traced to the view that humans should dominate nature and humans have the right to exploit nature and animals.

[24] Stone, Christopher (1972), Stone, C (1996)

[25] "It is not inevitable, nor is it wise, that natural objects have no rights to seek redress in their own behalf. It is no answer to say that streams and forests cannot have standing because streams and forests cannot speak" Stone, Christopher (1972)

[26] Sagoff, Mark (1988)

[27] See the Deep Ecology Platform available at http://www.deepecology.org/deepplatform1.html

[28] See Salleh, Ariel (1997)

[29] Zimmerman, Michael (1994)

[30] In his view "Because all species have considerable contributory values- in supporting other species and natural systems – and because human moral and other non-consumptive values are supported , in turn, by species and ecosystems, there exists considerable obligation to preserve all species. This is a prima facie value: species should be saved provided the social costs are acceptable. Therefore, a full realization of the human values served by wild species and ecosystems implies a policy that will protect all species"

Norton, Bryan.G (1987), P 237;

[31] For example according to Visvanathan

"In fact a philosophy of money economy only resonates with a philosophy of a western science which has been hostile to nature. Both combine to dissolve the very ecologies they are trying to defend". Visvanathan, Shiv (1997) P 89.

[32] See Elliot, Robert (1995)

[33] Thus according to Sagoff

"No two words in the English language may be used with as many meanings as "value" and "nature." Sagoff, Mark (1998)

[34] For a discussion on this see Norton, Bryan (2001)

[35] Norton. ibid. Tim O'Riordan estimates that $ 500 million would be needed to save the hotspots alone. (Tim O'Riordan (2002) p. 27 in O'Riordan, Tim, Stoll-Kleemann, Susanne (2002))

[36] UNEP (1998) puts forth such a view.

[37] For instance according to Takacs, David

"The term biodiversity's phenomenal success as avatar of a scientific discipline and a recharged conservation movement, which that discipline seeks to buttress, may be its own undoing unless biologists circumscribe what biodiversity represents, unless they lay bare the values that inform pronouncements, and unless they build a stronger case for the authority that allows them to make those pronouncements in the first place" [P 336].

See also Bowker, Geoffrey. C. (2003).

[38] See the discussion in Guay, Louis (2002)

[39] There literature on epistemic communities is extensive. The key articles on this include

Haas, Peter M (1994), Haas, Peter M. (1992)

Haas defines epistemic community as

"By our definition, what bonds members of an epistemic community is their shared belief or faith in the verity and the applicability of particular forms of knowledge or specific truths. Our notion of "epistemic community" somewhat resembles Fleck's notion of a "thought collective" - a sociological group with a common style of thinking. It also somewhat resembles Kuhn's broader sociological definition of a paradigm which is "an entire constellation of beliefs, values, techniques, and so on shared by members of a given community" and which governs "not a subject matter but a group of practitioners".

The role of epistemic communities in finding solutions to international environmental issues has been discussed by many academics. For example

"These epistemic community efforts were replicated at the international level during negotiations for the Vienna Convention on the Ozone Layer. In this case, a transnational epistemic community made up of officials from UNEP, the United States Environmental Protection Agency (EPA), the U.S. State Department as well as many international atmospheric scientists, succeeded in convincing government negotiators to adopt a strong treaty to control Chlorofluorocarbons (CFCs), even in the face of significant scientific uncertainty about cause and effect relationships. Other international relations scholars have similarly studied the influence of non-state actors on international policy debates and normative development. Their work, together with the ones cited above, show that it is no longer accurate to view international law as resulting exclusively from the actions of states. On the

contrary, international rules and contextual norms emerge from complex patterns of interaction between states and other actors at the international level."

Marong, Alhaji B.M. (2003) at 54,55

[40] See Potthast supra

[41] Writing for a political ecology perspective Escobar argues

As a scientific discourse, biodiversity can be seen as a prime instance of the co-production of techno-science and society that STS scholars analyze in terms of networks" Escobar (1998), See also Guay, Louis (2002)

[42] "It is futile to attempt to conserve species through protected areas if conditions leading to human encroachments are ignored. Forests cannot be conserved without consideration of their inhabitants. Problems resulting from climate change cannot be addressed without appealing to conceptions of social justice. Wicked problems cannot be addressed within the old disciplinary boundaries."

Ludwig, Donald, Mangel, Marc Brent Haddad, Brent (2001)

[43]See Soulé, Michael E, and Lease, Gary (1995). For a discussion on this, see also Cronon,

William (1995).

[44] Thus " It is an argument not at all *against* science, but *for* the recognition that conservation science may be reaching its limits in certain aspects" Seidler, Reinmar, Bawa, Kamaljit (2003) at p. 176

[45] According to Seidler and Bawa

"... means that prediction, a deep belief of classical science, is more difficult to attain. There may be a set of future states that models can predict with some certainty, but there may also be other possible states that escape model predictions' [p. 218].

[46] e.g Ludwig, Donald, Mangel,Marc Brent Haddad, Brent (2001)

"When science is used in support of policy-making, it cannot be separated from issues of values and equity. In such a context, the role of specialists diminishes, because nobody can be an expert in all the aspects of complicated environmental, social, ethical, and economic issues. The disciplinary boundaries that have served science so well in the past are not very helpful in coping with the complex problems that face us today, and ecology now finds itself in intense interaction with a host of other disciplines. The next generation of ecologists must be prepared to interact with such disciplines as history, religion, philosophy, geography, economics, and political science. The requisite training must involve not only words, but core skills in these disciplines. A sense of urgency has affected not only ecology but other disciplines that influence environmental problems: they are undergoing a similar transformation of their outlook and objectives."

[47] Commenting on this Lewis writes

"The marginalization of an otherwise scientifically sound position (that of Several Small) resulted from the monopoly of advocacy and advisory positions exercised by the supporters of Single Large position. ..... The last thirty years, besides seeing the SLOSS debate, also witnessed the deliberate movement of a group of ecologists into environmental policy advocacy. When these ecologists assumed positions of leaderships within the WWF, IUCN and the Smithsonian Institution they supported the Single Large mode, and they pushed to see that this ecological theory was accepted as orthodoxy"

Lewis (2003), P 214.See also Schwartz, Mark. W. (1999).

The debates over wilderness and protected areas and reserves illustrate the divergent views on biodiversity conservation. There is an ever growing literature on this, e.g. Rothenberg, David, and Marta, Ulvaeus (2001). See also Louka,Elli (2002). See O'riordan, Tim, Stoll-Kleemann, Susanne (2002), Zerner (2000) also for some case studies in conservation.

[48] Please refer to the discussion on other conventions that preceded in the chapter on CBD

[49] Posey (1999)

[50] Please refer to the discussion in the chapter on Indigenous Knowledge

[51] This has been pointed out by Escobar op.cit and Visvanathan , Shiv op.cit

[52] Escobar writes According to Escobar

"In subscribing to a view of biodiversity as linked to cultural and territorial defense, these social movements articulate an alternative political ecology framework "

When seen from this perspective, particular issues within biodiversity debates (territorial control, alternative development, intellectual property rights, genetic resources, local knowledge, and conservation itself) take on new dimensions; they can no longer be reduced to the managerial and economizing prescriptions offered by dominant views. By placing these debates in the context of the political ecology of social movements, the entire biodiversity network is transformed. Marginal sites, such as local communities and social movements, come to be seen as emergent centers of innovation and alternative worlds " (op.cit).

[53] 'How useful TEV classification is in practice is debatable. Existing valuation techniques can distinguish use values from 'non use' values but attempts to isolate option, bequest and existence values are more problematic 'Pearce, David, Moran, Dominic (1994).

[54] According to Pearce and Moran

"Economic value measurement will understate 'true' economic value because of the probable failure to measure primary life support functions. This kind of economic value is difficult to observe because it is unlikely to be recognized until some disastrous event has happened:

landslides consequent upon deforestation, loss of fishing grounds due to pollution and so on. Economic value does not capture –nor is it designed to capture –intrinsic value" (P.22 ibid).

[55] As Dasgupta points out conservation is still considered to be a luxury, and only developed nations could afford it. It has been perceived as an 'amenity'. The economists have shown that biological diversity contributes to ecosystem productivity, provides an insurance cover and also provides many valuable ecosystem services. (Dasgupta, Partha (2001)).

[56] Please refer to the discussion in the chapter on bioprospecting and Biopiracy.

[57] For instance Daily writes

"Our concentration is on use values; aesthetic and spiritual values associated with ecosystem services are only lightly touched upon in this book, having been eloquently described elsewhere" (Daily1997).

[58] According to Williams and Gaston

"Biodiversity conservation would then focus on maximizing the amount of 'currency' (the number of valued biological attributes, features or characters) to be held within the protection system 'bank' (the set of protected species, ecosystems or areas). Thus the paradoxical consequence of equal value for attributes as units of currency is that their owners, the individuals, species or areas, may have different values because they contribute different numbers of complementary attributes for representation in the protection system" (cited in Bowker (2003))

[59] e.g. Perrings C. in Swanson. T (Ed) (1995)

[60] Norton, B in Wilson. E.O (Ed) 1988

[61] e.g. Perrings, Charles in Heywood, V.H (ed) (1995)

[62] 'Now it may be understood to include a broad array of social relations in resources ranging from the radio spectrum to gene fragments' Heller, Michael. A (2004) at P. 62

[63] According to Bromley, there are few concepts in economics that are more confused than those of property, rights, and property rights. He attempts to provide some clarity with the following definition (Bromley 1991: 2): "property is a benefit (or income) stream, and a property right is a claim to a benefit stream that the state will agree to protect through the assignment of duty to others who may covet, or somehow interfere with, the benefit stream. ... Property is not an object but rather is a social relation that defines the property holder with respect to something of value (the benefit stream) against all others". Bhaskar, Vira (1999)

[64] The forest's trees and other biomass draw carbon out of the atmosphere and pump back oxygen. In contrast with the berries, my benefit from - my "use" of - the forest to restore a congenial carbon balance does not make it any less valuable in the same way to you. To put it otherwise, we benefit in a way that makes our consumption nonrivalrous. Indeed, this means that the forest's contribution to

enhancement of the atmosphere, unlike its contribution of berries, cannot be parcelled and priced in markets. Whatever contribution to atmospheric quality the forest provides, the benefits are also nonexclusionary. In other words, the same quality is supplied to each and every person on the globe, whether or not it is the precise quality each person would prefer, and whether or not that person contributed to the costs of its provision" Stone, Christopher (1995) at 581.

[65] See Bhaskar (1999) for an overview.

[66] 'The only way to make conservation ethic work is to ground it in ultimately selfish reasoning. ... An essential component of this formula is the principle that people will conserve land and species fiercely if they foresee a material gain for themselves, their kin and their tribe' Wilson, E.O (1984)

[67] Reid, W.V. et. al. (1993a), Rubin, S.M., and S.C. Fish (1994)

[68] Deke, Oliver (2001)

[69] See Muller, Frank. G (2000)

[70] These examples suggest that there are strictly *moral* reasons to prevent the commoditisation of certain benefit streams, even if it is economically efficient to do so. ...A case can be made against defining property rights over biodiversity, by pointing out that not all aspects of such resources are necessarily reducible to *benefit streams*. Pearce and Turner (1990: 129-37) identify three potential sources of human value for natural resources and biodiversity, namely use value, option value and existence value. Now, both use values (this includes aesthetic values) and option values can be understood to contribute to a stream of benefits that flow from the existence of biodiversity. However, existence value is more difficult to classify as a benefit stream. Pearce and Turner (*op cit*: 131) define existence values as "values expressed by individuals such that those values are unrelated to use of the environment, or future use by the valuer or the valuer on behalf of some future person." Similarly, Aldred (1994: 394) adopts a definition of existence value as a residual that captures all values which are *not* reducible to a benefit stream. Thus, *if* there is an existence value attributed to biodiversity, *then* this cannot be analysed as a benefit stream, and hence cannot be the subject of a property right as it has been defined here. Thus, if one of the reasons for humans to value biodiversity is existence value, then biodiversity cannot be owned." Bhaskar (1999).

[71] See Goldman (1998) for an overview.

[72] See Agrawal 2003), Ostrom (2002) for an overview, of issues in common property resources. These are cited as examples and for reasons of space more literature is not cited.

[73] Since the major cases and the interpretations as well as the changes in law have been discussed in the other chapters in the relevant context the same is not repeated here.

[74] Writing about the product of nature doctrine

"Although still extant, is effectively toothless, because biotechnology by nature involves isolating and replicating biological materials to produce 'unnatural' levels of purity." Golden, John M. (2001). See also Sagoff, Mark (2002). See Conley, John. M, Makowski, Roberte (2003a), Conley, John. M, Makowski, Roberte (2003b) for an analysis and evaluation of this doctrine.

[75] "The standard patent lawyer's response to the "**products of nature**" limitation is to treat it as a technical, claim-drafting problem. From this perspective, the prohibition against patenting **products** of **nature** only prevents the patenting of DNA sequences in a naturally occurring form that requires no human intervention.... Patents have thus issued on "isolated and purified" DNA sequences, separate from the chromosomes in which they occur in nature, or on DNA sequences that have been spliced into recombinant vectors or introduced into recombinant cells of a sort that do not exist in nature .... This is not simply a lawyer's trick, but a persuasive response to the intuition that patents should issue only for human inventions" Eisenberg, Rebecca (2000) at 786.

[76] For an analysis of this case and similar cases see Gitter, Donna. M. (2004).

[77] Eisenberg, Rebecca (2000)

[78] A detailed discussion on this is beyond the scope of the dissertation.

[79] "Kloppenburg, J. (1988) ("with germplasm, the resource of interest is physical matter only insofar as it is the carrier of *genetic information*") (emphasis in original).

[80] Pistorius, Robin, Wijk, Jeroen van (1999)

[81] "Since 1960, yield growth has accounted for 92% of the growth of world cereals production Genetic improvements have accounted for roughly half the yield growth of major United States (US) crops. The contribution of genetic improvements to yield growth in other countries has been similarly impressive Yield gains are the product of public and private investments in plant breeding and the collection, exchange, and conservation of plant genetic resources (PGRs)" Frisvold, G., Sullivan, J., and Raneses (1999) (citations omitted).

[82] Perkins (1997)

[83] See Plucknett, DL, Smith, NJH, Williams, JT & Anishetty (1987) for an overview and the role of gene banks

[84] See Fowler, Cary and Pat Mooney. (1990). Hobbelink, Henk. (1991)

See also Juma (1989), Kloppenburg (1988), Kloppenburg (1987), Aoki (2003), Virchow, Detlef (1999), Pistorius, R. (1997)

[85] Fowler, Cary (1993)

[86] '.. What it implies is no more than a *res communis regime.* ' Balsar,Kemal (1998) P 307

[87] "States have a responsibility to the international community for the conservation of genetic resources in their territories, and equally those states which do not have the necessary financial or technical means to carry out this responsibility should be entitled as of right to contributions from the international community" Cooper, David (1993) cited in Balsar (1998)

[88] The Undertaking was revised later to make it in harmony with CBD. Please refer to the discussion in the chapter on the Treaty.

[89] Balsar (1998) at 310

[90] e.g. Gomez-Pompa, Arturo (2004), Grajal A.(1999), Dalton, Rex (2004)

[91] Brush, Stephen B.(1999) "Moreover, it is clear that a significant public benefit arises from the common heritage of crop resources .... Thus, potato farmers in Rwanda, China and Idaho, receive part of the public value of potato landraces cultivated by farmers in the Tulumayo Valley" at P 542

[92] See Bridge. G. McManus. P (2000)

[93] For reasons of space this will not be examined in detail. See Hirsch, J (1998)

[94] e.g. Brand and Gorg,(2003), Toress (2002)). In case of Mexico Brand and Gorg write

"... international regulations have a greater chance to gain importance and have a greater chance to gain importance and can become nationally-significant issues when they serve dominant interests. In biodiversity politics it is intellectual property rights and more legal access to genetic resources. Other aspects like benefit sharing or prior informed consent which are international law but less in the interests of dominant actors do not have the same importance when they are not put on the agenda by other actors"

[95] e.g. Alier (1996), McAfee, Kathleen (1999),

[96] Jentz. A. et. al. 2003.

[97] FAO (1998)