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Rewarding Traditional Knowledge and Contemporary Grassroots Creativity:[1]

:The Role of Intellectual Property Protection

The creative and innovative traditions in various developing countries have been masked by historical misrepresentations by outsiders as well as by pedagogic and policy-induced blinders domestically. From an early age students learn the major inventions made by Europeans, and rightly so, but seldom do they learn about grassroots or higher level inventions and innovations developed by local individuals, institutions or communities with in their respective countries. When local contributions are indeed taught, these are recalled with terminology which may generate disdain rather than respect for native genius.[2] But this is only one reason why the possibility of building upon grassroots traditions of invention and innovation has not been pursued in most developing countries. There are several other possible reasons for this, such as: a lack of awareness about such traditions among policy planners, the education systems, and civil society at large; the influence of aid agencies whose work often results in increased dependency rather than self-reliance; an education system which does not create curiosity and an experimental ethic and instead reinforces a culture of compliance and conformity; the science and technology establishment which does not encourage local traditions even if they are functional and viable, whether in the past or in the present; the increasing influence of the media which popularize Western images of progress and so-called "Development" rather than indigenous notions of the same;[3] the lifestyles of the elite which do not inspire any respect for local knowledge systems;

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comments and additional references, ideas and critical suggestions are invited and can be sent at anilg@iimahd.ernet.in, sristi@vsnl.com, or anilkgupta4@hotmail.com

[2] The 'minor millets,' a group of plants such as 'ragi', 'kodo', finger millet, fox tail millet, and other such small millets crops which provide the major means of subsistence to millions of poor dry farming households, are called 'inferior millets' despite the fact that these are actually superior to many other grains in nutrition and other agronomic characteristics.

[3] The attribute 'indigenous' is used in this paper to refer to 'originating in and characterizing a particular region or country; native' (Webster's Encyclopedic Unabridged Dictionary of the English Language, New Revised Edition, Gramercy Books: New York,Avenel, 1989). It is not used in the technical sense of the Working Group on Indigenous Populations of the United Nations High Commissioner's Office for Human Rights or Convention 169 of the International Labor Organization (i.e., as meaning 'The existing descendants of the people who inhabited the present territory of a country wholly or partially at the time when persons of a different culture or ethnic origin arrived there from other parts of the world, overcame them and by conquest, settlement, or other means reduced them to a nondominant or colonial situation; who today live more in conformity with their particular social, economic, and cultural customs and traditions than with the institutions of the country of which they now form a part, under state structure, which incorporates mainly the national, social, and cultural characteristics of other segments of the population which are predominant" (Working definition adopted by the UN Working Group on Indigenous Populations').

declining respect for local healers and herbalists among their own communities who are exposed to modern medicine capable of instant effects, irrespective of side effects; declining communication between the ”grand parent generation” and the ”grand children generation” due to the disappearance of extended families and the increase of nuclear families; a lack of incentives for creative people at the local level; and, most importantly in this context, inadequate intellectual property rights for local communities, informal innovators, etc.

Gloria Emeagwali (1989) observes, “(m)ost of the technological creations of Africa are assigned to artistic designations. Africans find some of their scientific and technological achievements confined to fine art museums. The scientific and technical processes underlying the creation of various inventions are deliberately trivialized”.[4] The creativity in Africa and other parts of the developing world did not receive adequate attention and recognition. [5] She perhaps implies that a lack of historical recognition may have influenced the contemporary consciousness about creativity and innovation in Africa. To improve the role of IPRs in the benefit sharing of TK, current IP debates need to study systematically what I call the ‘tradition of Invention’ instead of ‘inventing a tradition[6]’ (Gupta, 1993)

Widespread piracy of cassettes and videos did not generate incentives for many young performing artists to consider the arts and music as a career. Once the market for authentic reproductions increased, the emergence of new artists also becomes easier. India is one good example of this phenomenon. Likewise, the increasing demand for herbal drugs often sold as food additives[7], has proven that global perceptions of traditional knowledge-based products are changing. After all, 80 per cent of modern plant-based medicines are used for the same purpose for which native people discovered their use (Farnsworth, 1981). The correlation between claims of local communities and the evidence from modern pharmacological science was more than 85 per cent in the studies pursued in a part of Nigeria (Iwu, 1999). Chinese right holders held about 45 per cent of all herbal-based patents in 1996, followed by the Japanese and Russia with 22 per cent and 16.5 per cent respectively[8] (Gupta, 1999). The issue is no more whether traditional knowledge and contemporary improvements should be given importance and recognition. Most people accept the need for it. The issue is: how do we recognize this extremely important source of solutions (or

[4] Gloria Emeagwali, Science and Public Policy, Journal of the International Science Policy Foundation, Surrey, UK, volume 16. no.3.1989**,** see modified version of this paper, Eurocentrism And The History Of Science And Technology available at web site address: H ttp://members.aol.com/afriforum/colonial.htm 1999. The quotation is from modified internet version and is not available in the original paper.

[5] Only recently Sir J. C. Bose, a pioneering Indian plant physiologist, and inventors of several electronic instruments was credited with the invention of telegraph, rather than Marconi, as we had learned since childhood (and perhaps most textbooks still teach the old attribution). (The Telegraph, Calcutta; Oct 31, 1997).”As for the claim that Bose's primacy was acknowledged at an international IEEE conference in June in Denver, this refers to the 1997 IEEE MTT-S International Microwave Symposium. The MTT-S did organize an historical exhibition and Special Session on Bose in honor of his centennial. However, they did not take a position on Bose's primacy” (Robert Colburn, ISEE History Research Center, Rutgers, personal communication, Feb 3, 2000)

[6] That is claiming a historical past when every thing was much better and harmonious devoid of any expression of human greed or other frailties. Lamb and the lion drank water, so to say, from the same side of the pond !

[7] The sale of over the counter herbal drugs is estimated to be about 3.5 billion USD in 1996 in Germany alone, about 7 billion USD in Germany, Spain, UK, Italy, France, Netherlands (Blumenthal, et. al., 1998, in King, et. al., 1999). The sales of herbal drugs (about 5 billion USD) were 55.4 per cent higher in 1998 in the USA over 1997 while only 11 per cent higher still September 1999 over the same period last year (Blumenthal, 1999).

[8] These figures are based on the Derwent Pharmaceutical database.

”leads” for developing solutions) to the problems of food, health and nutrition and many other needs of the modern world. How do we generate reciprocity among knowledge providers and knowledge- and resource-users, particularly the ones who have commercial goals? Equally important is the goal that traditional knowledge systems with attendant cultural edifices are not stripped of their socio-cultural context.

Many times researchers have tried to portray traditional knowledge systems as totally different and opposed to the so called modern and western knowledge systems. Nothing could be further from the truth. Some aspects of traditional knowledge systems contain most of the elements that make a scientific proposition valid. At the same time, many scientific institutions use traditional cultural symbols and practices to generate an extra ounce of confidence or certainty. For instance, when a farmer decides to sow his crop at a particular time, taking various factors such as meteorological conditions, soil, moisture, temperature, etc., he is using his empirical knowledge which generates replicable, refutable, and verifiable results. No matter who sows crops at that time under the given conditions, other things remaining the same, he or she should get the same result. Likewise, every time the same crop is sown with similar conditions, it should give similar results and if one wanted to prove this wrong, it should be possible to sow early or late and get different results. The scientific nature of much traditional knowledge formed the basis and philosophy of grassroots innovators‘ own initiatives for benefit sharing in their traditional knowledge. For example, the Honey Bee philosophy about the scientific nature of local innovations was the basis for the creation of the Honey Bee Network a decade ago. At the same time, I and other members of HB network realized that there are cultural codes and institutional mechanisms associated with some of the traditional knowledge systems which ensure that the knowledge, innovations and practices are understood and explored in a given context. This is not to say that all the elements of this context are scientific in nature. Cultural contexts based on shared beliefs may provide a basis for dealing with a whole range of uncertainties and at the same time provide a common understanding of social, biological, cultural continuities.

Whenever some members of a community recognize the need for a discontinuity, a major transformation takes place. A new crop is introduced, a new implement is invented, a new variety is developed through selection or sometimes through grafting or budding -- an innovation takes place. Some of these innovations over a period of time get embedded in the socio-cultural contexts. While constructing a modern building, setting up a laboratory, installing a new machine, prayers are routinely held in many parts of the world as if the technological insurance is not sufficient, a kind of spiritual assurance is sought even in most of the modern institutions. It is true that causal explanation of modern scientific proposition is sought and provided in the material structures of science i.e. verifiable principles governed by universal laws and which can be tested and measured. In certain aspects of traditional knowledge systems, non-material beliefs and cultural codes are supposed to explain or guide the consequences of material transactions. For instance, a healer may not reveal his or her knowledge lest it loses its significance on being told. It is possible that this belief seemingly unscientific might have been a means of ensuring that a complex or risky recipe is not pursued or practiced by someone untrained or untutored in the art. It is also possible that it is just a superstition, but in any case it lends a coherence to the knowledge system and the surrounding context. It is not my contention to argue that traditional knowledge systems and associated institutional arrangements cannot be dismembered at all. However, in many cases, when we take a plant or some other element of local knowledge systems out of its institutional context, even if a scientific relationship between cause and effect does not get adversely affected, the *institutional* context in which the plant is collected (for example, only when

necessary and only in limited quantities) may get affected. Therefore, we may be able to develop a good and effective drug by just dealing with the utilitarian part of the traditional knowledge systems. But we may not necessarily maintain the restraint that may have been kept in place by some of the traditional institutions for conservation of that plant. That is the reason why many groups oppose bio-prospecting by outsiders in order to avoid the risk of over exploitation of the resource itself. What they however, miss is that the problem is not so much withg bioprospecting as with the insitutional arrangement.

The context of local knowledge systems combining traditional skills, culture and artifacts with modern skills, perspectives and tools is not something that has happened only in the recent past. From time immemorial, new crops were introduced from one part of the world to another and cultural and ecological knowledge systems evolved while adapting these crops, animals, trees, tools, etc., into their new contexts. This is an ongoing process. What may set the traditional ways of dealing with local resources and external knowledge and inputs apart, may be a slower trial and error approach which may not necessarily be unscientific. But, it may not be fully compatible with modern methods of experimentation, validation, and drawing inferences. In some cases, the correspondence is close but in many case it may not be. However, it is possible that through flexibility, modification and mutual respect and trust, traditional knowledge experts can and may work with the experts from modern scientific institutions to generate more effective solutions for contemporary problems. After all, the "tool view" of science implying excessive reliance on specific methods of solving problems has never helped in taking scientific research very far. Traditional contexts reflect and embed certain rules about how we relate to nature, to each other and to our inner selves, which can help in generating sustainable and compassionate approaches to solving problems. Incentives for creating a sufficiently strong desire for experimentation will become embedded when modern institutions *recognize, respect and reward* the experiments done in the past. The experiments and innovations have led to very significant and identifiable advances in our knowledge about biodiversity and other natural resources and their application in our day to day life. One can make an equally strong case for recognizing traditional art and craft forms, music and other kinds of expressions of local creativity of individuals as well as communities based on traditional as well as modern materials.[9] However, in this paper, we are not dealing with other forms of creativity, but only those which deal with biological materials.

This paper deals with three issues: (a) the nature of traditional knowledge, (b) types of incentive systems that can be matched with different kinds of knowledge systems, and the modes and motives of outsiders seeking access to local biodiversity and associated knowledge systems and (c) the

[9] In many Mali villages, food storage vessels are made of dry gourd skins. These sometimes get cracked or broken. A Bela woman would stitch these pieces together with plastic cords so that these natural biomass-based vessels can last longer. This is an excellent example where the culture of recycling and repair, which is so integral to traditional communities (unlike Western culture which creates a lot of waste), combines a traditional vessel with modern plastic cord. Likewise, in a workshop in the Chittradurga district of Karnataka, India, a creative carpenter once shared an innovative solution (I regret having misplaced his name). He had a wooden plough made of acacia wood. When the shears got worn out, he still wanted to use the same plough since the acacia wood is scarce in that area. However, he wanted to put a shoe of metal on the worn-out shear. He began to look for different materials and waste iron pieces. Finally he found that the waste spring leaves or suspension springs of automobiles provide the right material having the appropriate combination of weight, torque, durability, etc. Similarly, the automobile repair workshops on the roadside use soap to plug small holes in the radiator. It is this approach of combining a traditional resource with modern materials that sometimes may not happen so obviously in the modern laboratories and academic research institutions. However, this process *per se* is not totally unknown to the modern methods of problem solving.

current pattern of the usage of intellectual property rights for dealing with traditional knowledge as well as grassroots innovations is discussed next.

Part One
Traditional knowledge, innovation, practices: Individuals, communities and local institutions

Nature of traditional knowledge

Conservation of biodiversity and other natural resources over a long period of time has been possible because of the cultural, spiritual and other social institutions that have guided the relationship of local communities with the resources. Even in a context where deforestation in some countries, such as Nigeria, is about 6 per cent per annum as against the global average of 0.2 per cent, there are forests, streams, old trees, and lakes, which have been conserved by the people extremely well. It is not just the resources but also the *knowledge* about these resources which have been conserved through practice and innovations. 'Resources'include not only those which are visible to the naked eye, but also those which are not visible, such as micro-organisms. Okagbue[10] (1993) provides an example of traditional knowledge systems around microbial diversity and its use for food processing. He observes, "Since microbes and their activities are often difficult to observe and appreciate, we are often unaware of their influences on culture. These facts notwithstanding, several cultural practices designed to preserve food and other materials such as leather, wood, etc., or to protect the health of humans, and crops, are directed towards relevant microbial agents. For example, the efficacy of certain herbs traditionally used in foods and medicines has been shown to be due to the activity of specific chemical components of herbs against some pathogenic and food spoilage micro-organisms". Downes (1999)[11] refers to a U.S. patent 5751,1986 granted on a purported variety of the ayahuasca[12] vine, *Banisteriopsis caapi*. He adds, "Many indigenous groups in the Amazon hold this plant to be sacred and therefore feel that it is inappropriate for private persons to have exclusive rights over any aspect of it. Within industrial societies themselves, certain activities or entities are typically excluded from market relations. For instance, a great deal of valuable, novel information -- such as scientific discoveries about the natural world -- is explicitly excluded from intellectual property protection" (Downes

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[10] Richard Okagbue, "The Scientific Basis of Traditional Food Processing in Nigerian Communities" in G.T. Emeagwali, African Systems of Science, Technology and Art, Karnak House,London, 1993, see at web site http://members.aol.com/afriforum/okagbue.htm#AFPT

[11] David R Downes and Sarah A Laird, 1999, Innovative Mechanisms for Sharing Benefits of Biodiversity and Related Knowledge: Case Studies on Geographical Indications and Trademarks**,** Prepared for UNCTAD Biotrade Initiative, Washington, D.C.: Center for International Environmental Law , draft paper

[12] Glenn M. Wiser,1999, PTO Rejection of the "Ayahuasca" Patent Claim: Background and Analysis, Washington: Center for International Environmental Law, http://ciel.org/ptorejection.html

Wiser sumamrises the case,"Loren, S. Miller obtained U.S. Plant Patent 5,751 on June 17, 1986. The patent granted Miller's rights over a purported variety of the Amazonian vine, *Banisteriopsis caapi*, also known as ayahuasca. Miller dubbed his variety 'Da Vine'. The patent was granted on the basis of Miller's claim that Da Vine represented a new and unique variety of *B. caapi*, which was distinct from other forms primarily because of the color of its flower petals. Miller stated that he had obtained a cutting of the plant from a 'domestic garden in the Amazon rain-forest of

South America.' He added that he was investigating the plant for its medicinal value".

1997:4)[13]. Recently, the US Patent and Trademarks Office (USPTO) has revoked the patent on this plant acknowledging that the inventor had claimed knowledge which was already in the public domain. The USPTO has written to the Director General of the Council of Scientific and Industrial Research (CSIR) assuring him that no such patent will be issued on traditional knowledge on which prior art exists. It has also requested DG, CSIR to provide a documentation on Indian herbs, drug formulations in ancient texts as well as recent research so that trivial patents can be avoided. Robert Saifer (Director, International Liaison Staff, US Patent and Trade Mark Office) comunicated in a letter dated August 27, 1999 addressed to Dr. R.A. Mashelkar, Director-General, Council of Scientific and Industrial Research, and Secretary, Government of India, Department of Scientific and Industrial Research:

> We should, however, address the need of creating more easily accessible non-patent literature databases that deal with traditional knowledge. Perhaps an office among the developing countries should suggest this as a project for the SCIT Working Group on Standards and Documentation, working in close cooperation with the International Patent Classification (IPC) Committee of Experts. With the help of the developing countries, traditional knowledge can be documented, captured electronically, and placed in the appropriate classification within the IPC so that it can be more easily searched and retrieved. This would help prevent the patenting of turmeric, as well as karela, jamun, brinjal and other traditionally used remedies[14].

This shows willingness of one of the major players in the field of intellectual property rights to respond to a persistent criticism of the patent system in that it did not pay attention to the rights of local communities. Obviously the above formulation only solves part of the problem which deals with issuance of unlawful patents on knowledge which is in public domain.[15] It does not deal with providing protection to the knowledge known only to a local community and/or individual experts/innovators whose knowledge is not ordinarily in public domain.

Functions of Traditional Knowledge: Traditional knowledge can serve several functions including (i) semiotic, i.e., communication through symbols, art forms, crafts, etc., (ii) institutional, i.e., providing rules coded in rituals and/or other cultural and social sanctions. Some of these rituals and cultural sanctions institutionalize incentive measures for the use of traditional knowledge just as IPRs do. These sanctions could be material such as fines or penalties or ethereal such as the fear

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[13] Downes, David R. 1997. *Using Intellectual Property as a Tool to Protect Traditional Knowledge: CIEL Discussion Paper*. Washington, D.C.: Center for International Environmental Law. November 1997 discussion draft.

[14] I am grateful to Dr. Mashelkar for sharing this letter with me and authorizing me to quote it so that the discussion on the subject moves forward rather than remaining locked in an old position. All those groups which are opposed to the patents on traditional knowledge *per se* would find above quoted formulation helpful in so far as it enables prevention of anyone getting a patent on public domain traditional knowledge. However, as we would argue later, such a position would not bring much economic or other benefits to the communities and also may not contribute to the continuance, growth, and vibrance of the traditional knowledge systems. It is certainly alright to prevent public domain knowledge being patented but unless value addition in this knowledge is protected, how would investment in product development take place and furthermore, how will the surplus to be shared fairly and equitably with the knowledge and resource providers be generated.

[15] The US PTO also agreed to correct the status of US Patent 5,401,504 issued on the use of turmeric for wound healing. All the six claims were cancelled after Indian government provided prior non-patent literature on the subject. Likewise, the patent issued on Ayahuasca, a plant used by Amazon community, has also been revoked.

of God; (iii) configurational, i.e., the arrangement of various life processes and stages are performed according to the traditional norms generating predictability about their social outcomes; (iv) utilitarian knowledge of certain plants or animal products being used for various food, nutrition or health needs; (v) situational, i.e., during emergencies or other contingencies, codes of conduct may be specified to maintain social order and responsibility towards other life forms, including wildlife. In addition, traditional knowledge may also have (vi) religious and spiritual functions which may or may not involve material objects. Since the society has to adapt to emerging situations from time to time, traditional systems of culture, technology and social exchange provide some scope for experimentation deviance and variation. Same instrument of incentives may not help in nurturing each of these functions.

Some groups demonstrate this innovative adaptiveness more than others, but the innovative spirit is evident in every culture to a large or small extent. Therefore, traditional knowledge systems are not just serving to maintain a *status quo*. There are also provisions for dealing with the demands of modern times. However, there are social, cultural and material forces which disrupt traditions and create either new traditions or leave a void. There are also cases where certain dysfunctional and socially repugnant traditional practices are outlawed by the State,[16] though these may not completely stop the outlawed measures. Likewise, traditional communities in some parts of the world have used dynamite to catch fish-a very destructive method of fish collection killing young and the old fish alike. One therefore should not romanticize traditional knowledge and take an empathatic but critical look at the knowledge system.

Generally, a community classifies the variability in a natural phenomenon on which it is dependant for its own survival into discrete categories so as to manage that resource efficiently. Since language is the means for expressing such a knowledge, the number of words for such variability in a given language tends to be higher when the dependence of the community on the same resource is high, than when the dependence is low. Therefore, a coastal fishing community may have a much higher number of words for waves, just as farmers in rainfed environments or mountainous regions have a higher variety of terms for explaining soil diversity. Traditional knowledge systems in such cases can contribute to a better understanding of the environment and underlying sources of variation. The inter-relationships between different components of eco-systems are also pursued differently in traditional knowledge systems compared to the modern ecological or other disciplinary studies. For instance, three indigenous communities in Alaska and four in Chukotka Russia were studied by Huttington and Myrin (1995)[17] to analyze their knowledge about beluga whales. They studied the timing, location and movements of beluga whales around each community. How the status of ice, fish, wind, and the presence of killer whales affected the belugas was described in detail. The researchers realized, during relaxed but intensive discussions with the local community members, that these discussions would veer towards some other subjects seemingly unconnected. The researchers tried to bring the discussion back to the topic but before they succeeded in doing that they discovered a new connection. A structured inquiry would have made accessing such data impossible. For example, one digression was about beavers. Beavers, a local respondent informed them, build dams in the streams where salmon and other fish spawn.

[16] The practice of *Sati*, i.e., a widow burning herself on the pyre of her husband or child marriage or taboos on women's participation in certain activities are some such examples.

[17] Henry P Huntington and Nikolai I. Mymrin, 1995, Traditional Ecological Knowledge of Beluga Whales, An Indigenous Knowledge Pilot Project in the Chuckchi and Northern Bering Seas, Anchorage: Inuit Circumpolar Conference-Alaska, http://nmnhwww.si.edu/arctic/html/tek.html

When the beaver population expands, the spawning habitat of salmon may be reduced. In turn, this affects the belugas, which feed on salmon. Hence, as these authors pointed out, traditional ecological knowledge cannot be preserved merely by documentation. This requires combining knowledge with experience, which in turn means conserving the way of life which produced the knowledge. (Gupta, 1999).

In another example, Merculieff (1990), Commissioner of the Sea Otter Commission, Alaska, raised a fundamental issue about the politics of defining resource boundaries and the legitimacy of the particular ways of local people in dealing with these. Distressed at the poverty of many of the First Nation peoples of Alaska, he decried the tendency of 'Animal First' activists to deny such peoples their autonomy in pursuing a sustainable coexistence in their ecological context.

Merculieff (in Gupta, 1991) observed:

> "They do not understand that in their desire to protect animals, they are destroying culture, economic and spiritual systems which have allowed humans and wild life to be sustained over thousand of years... Their's (Animal First activists concept) is based upon a belief that animals and humans are separate and they project human values into animals. Ours is based on the knowledge from hundred of generations which allows us to understand that humans are part of all living things - and all living things are part of us. As such it is spiritually possible to touch the animal spirit. In order to understand them. Our relationship with animals is incorporated into our cultural systems, language and daily lifestyles. Theirs is based upon laws and human compassion... Because we are intricately tied to all living things, when our relationship with any part of such life is severed by force, our spiritual, economic, and cultural systems are destroyed, deep knowledge about wild life is destroyed, knowledge which western science will never replace... I leave you with this last thought - we have an obligation to teach the world what we know about a proper relationship between humans and other living things" (see Gupta, 1991a)

In cases where the context of local knowledge and its functional or conservational advantages or relevance hinges on the associated cultural and spiritual beliefs, mere monetary compensation or reciprocity towards such knowledge systems may not provide sufficient incentives. This issue became obvious when US government issued an executive order (no.3206, 1997)[18] about the need for federal and state institutions to respect the religious and cultural beliefs of native communities in the reservation areas as well as in the federal or state forest areas. Similarly, the conflict that

[18] The American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act 1997, provides that the

> Departments recognize and respect, and shall consider, the value that tribal traditional knowledge provides to tribal and federal land management decision-making and tribal resource management activities. The Departments recognize that Indian tribes are governmental sovereigns; inherent in this sovereign authority is the power to make and enforce laws, administer justice, manage and control Indian lands, exercise tribal rights and protect tribal trust resources. The Departments shall be sensitive to the fact that Indian cultures, religions, and spirituality often involve ceremonial and medicinal uses of plants, animals, and specific geographic places. Indian lands are not federal public lands or part of the public domain, and are not subject to federal public land laws. They were retained by tribes or were set aside for tribal use pursuant to treaties, statutes, judicial decisions, executive orders or agreements. These lands are managed by Indian tribes in accordance with tribal goals and objectives, within the framework of applicable laws.

American Indian Tribal Rights, Federal-Tribal Trust Responsibilities, and the Endangered Species Act," and its accompanying Appendix , June 5, 1997, Washington, D.C.: Secretary of the Interior and the Secretary of Commerce. See http://conbio.rice.edu/nae/docs/order.html

took place some years ago on the border of USA and Canada on the issue of converting a burial ground of native communities into golf course by local developers highlighted the relevance of this issue. While state tried to make the objections of local communities into a law and order problem, the fact remains that mere use of coercive power of the state cannot subsume or suppress the underlying cultural and spiritual beliefs of communities associated with natural resources with or without human uses. In the context of this study, I must, however, caution that one should not try to resolve all kinds of conflicts by one or two simple solutions. The IPRs have obvious limitations in providing appropriate reciprocity for such beliefs and cultural rights.

Knowledge systems for survival and sustainable biodiversity management

It has been generally believed that the knowledge systems of local communities and indigenous peoples are holistic in nature. Centuries of association with an environment have produced a deep understanding of the inter-relationships among the different elements of a landscape or a habitat. Because fluctuations in the environment require adaptive responses, communities have developed a wide range of diversified survival strategies at intra and inter-household levels as well as at community level. However, local and indigenous knowledge systems, while generally holistic, have some reductionist elements. In order to cope with the complexity of ecological change, some people in the community specialize by knowing more and more about less and less. Such specialized expertise requires focusing, targeting and steering strategies on specific themes or aspects of nature. A good archer may be good because s/he does not look at all at the interconnections between target, the wind and the world around and instead focuses only on the target. This kind of reductionist approach helps in developing a sharp shooting skill.

So-called Western science is biased in favor of reductionist relationships, whereas local knowledge systems are biased in favor of systemic linkages and a holistic perspective on nature. Where efficiency of resource use has to increase so as to cope with increasing population pressures (where applicable), scarcity, fluctuations in the environment, or other contingencies, a blending of formal and informal science may be necessary. Achieving sustainability in resource use requires the fusion of sacred with secular, formal with informal, and reductionist with holistic views.

The production of knowledge and its application takes place in a given socio-ecological context, through innovations over a long period of time. It has been suggested that this context influences, and to some extent shapes, the world views of people, which in turn influence the heuristics used for generating new solutions and knowledge (Pastakia, 1995). The heuristics [19]are like decision making rules which are also accompanied with criteria of choice. Local and indigenous knowledge system are not static. They evolve, adapt and transform dynamically with time. New materials are incorporated, new processes are developed, and sometimes new uses or purposes are evolved for existing knowledge besides the acquisition of knowledge. Hence, there is a need for rewarding not only traditional knowledge but also contemporary innovations. The concept of Traditional Resource Rights (Posey et al., 1995), implying recognition of the primarily customary rights does not do full justice to the individuals who are responsible for contemporary creativity and innovation, although it does provide a useful way of looking at community rights in conjunction

[19] The heuristics as a concept is defined by Webster's Encyclopedic Unabridged Dictionary as, "serving to indicate or point out; stimulating interest as a means of further investigation". However, it is used here in the sense of thumb rules for taking decisions. The underlying thumb rules are simple ways in which complex problems are resolved.

with basic human rights. Depersonalizing the process of knowledge production and reproduction limits the type of incentives considered and results in concentrating the resources only in the hands of governments or, in rare cases, of local community leaders.

The conceptualization of indigenous knowledge as an autonomous subset of local knowledge evolved through interaction among local communities, individuals, and their environment over a long period of time, is problematic on two accounts: (i) there always are interactions with other knowledge systems through trade and other exchanges from time to time incorporating elements of these outside systems with or without their contextual incorporation, (ii) knowledge is not produced only collectively and is not only inter- generational in nature. I have argued (Gupta, 1980, 1984,1987,1988, 1989,1992-99) that knowledge is produced locally and sometimes indigenously by individuals without any interface with the community or outsiders. Just as it is also produced otherwise. The contemporary knowledge could build upon traditional knowledge but may also be developed autonomously. Merely because a particular innovation builds upon traditional reserve of knowledge produced within the community or outside does not invalidate or minimize the contribution of individual in the contemporary context. The possibility of such contributions being recognized by modern IPR systems is obvious, notwithstanding the transaction cost involved therein. The problem arises when (a) knowledge is produced over a long period of time by a community in isolation (a1) or in conjunction (a2) with other communities, (b) knowledge is produced by some individual experts in the community sanctioned, authorized, recognized or legitimized by the community formally or informally, (c) knowledge produced in long past and codified in some texts (c1) or retained in oral traditions having continuity through informal institutions or rituals (c2) or recalled by some individuals without any continuing tradition of practice in real life through rituals or otherwise (c3), knowledge produced over a long period of time but practiced and specialized by a few individuals (c4) and knowledge produced in recent past with author known (c5) or unknown (c6) with limited or wide diffusion; (d) knowledge produced in contemporary times by the community in the wake of some crisis or through some common institution and (e) knowledge produced by individuals (e1) or groups (e2) or associations or guilds (e3) based on some external resources introduced by state, markets, NGOs or simply through some individual exchange with outside world (for instance, local knowledge about use of neem developed in some African countries where it was introduced in mid 70s or similar knowledge produced by local communities to use tyres of automobiles as fish reefs or in the boats or as flower pots, etc).

There could be many other variations in production and reproduction of knowledge by individual or communities. For instance, knowledge produced by some individuals in past (a variety selected by some specific farmers) may be reproduced by a community (which grows this variety and provides/does not provide feedback to the original developer). Likewise, a landrace may be developed through collective effort of a community but may be reproduced by only one or two individuals for whatever reasons. The assignment of intellectual property rights in these varied situations will have to follow different kinds of modalities and institutional arrangements. Just as variations have already taken place in the evolution of Plant Variety Acts through acceptance by UPOV of new concepts such as, “wild discovered plants” having DUS property as the new variety (Gupta, 1999). There is a similar need for modifications and adaptations in the IPR laws to reward different kinds of contributions by individuals and communities in long past or recent times through improvement or innovations in local materials, knowledge systems, or external materials or knowledge systems or a combination of these. There is no purpose served by engaging in meaningless debate on the comparison or contrast among so-called indigenous or western science

or knowledge systems since each has drawn upon the other to varying extent in different places. In any case, the way forward lies, as has been the attempt by Honey bee to not only engage in debate occasionally about the 'stand alone' view of local knowledge and the supposed incompatability between `so-called indigenous science` and the western science. I have always believed that there is only one science. The variants are, good and bad science. On the other hand, the methods of developing scientific practices are quite different in some cases among various cultures and communities. Likewise, the critieria of evaluation of an experimental result are also quite varied. In addition, there is much greater tolerance among local communities, of empirical practices without knowing their scientific causes. Moreover, those communities that have kept local experts poor, by not valuing their knowledge systems adequately, are unlikely to pass on to them externally-generated incentives.

Current debates on IPRs and benefit sharing over TK assume a structureless homogeneity of local communities. They assume a convergence between the interests of local community leaders and those of local experts and TK holders, but this is difficult to accept. The asymmetry in knowledge systems and related power differentials are apparent in global discourses on incentives and consultations. These have been dominated by the so-called representatives of indigenous communities, though of Western origin, both in terms of numbers and ideas. For instance, in various consultations by UNEP and the CBD local communities are largely represented by the more articulate indigenous people from western countries. Many communities have suffered in the past and *they* should be heard. To anyone familiar with the miserable conditions in which most local communities live and strive to conserve biodiversity and associated knowledge systems, it should be obvious that their problems and concerns are very different from many of the problems articulated at most international fora. Moreover, the concerns of local experts and innovators within impoverished communities may be very different from those of the rest of the people. How can their concerns be heard and addressed?

Bridges between formal and informal knowledge systems: Many international consultations and studies on knowledge systems have identified a need to distinguish among different types of knowledge and recognize the need for building bridges between local or indigenous knowledge vis-à-vis formal scientific knowledge (e.g. Atte 1989; Gupta 1989, 1991a, b, 1995, 1997,1998, SRISTI, 1993, Honey Bee, 1990-99, Skolimowski, 1981, Berkes 1988, Brokenshaw, Warren, and Werner (eds.), 1980). Both formal and informal science are capable of producing abstract as well as practical knowledge, although the latter tends to produce more of the practical kind. Different incentives might nurture different types of knowledge. For instance, material-individual kind of incentives may include IPRs as one kind of incentive. Because of industrial application, these rights have a possibility of either being licensed or being worked to generate commercial returns. But, as I will show later, there are a whole range of other incentives (material, collective, or non-material, individual and non-material collective, portfolio of which may be appropriate in a specific situation).

However, the same knowledge systems can pursue different functions simultaneously, in various combinations. For instance, a fishing community might use classificatory skills to deal with variations in the movements of fish and locations of spawning sites. It might use indicators for spotting the sites where fish would be found in abundance at different times of the year. It might have to use systemic linkages to relate temperature, wind velocity, turbidity of the water and behavior of the fish, to decide how far to go in the ocean without courting too much risk or

uncertainty. One way to understand the complexity of knowledge systems is to link the functions of nature with processes of 'sense making' i.e. drawing meaning from empirical observations. Berkes (1988:18) provides a strong argument for sensitivity in 'sense' making. He observes,

> The traditional ecological knowledge of the Cree is empirical knowledge, as in the observations of the "disappearance of animal in extremely cold weather, the way black bears try to cover their tracks before denning, the sensing and the avoidance of (predatory) otters by the fish. However, the "sense" the Cree make of empirical knowledge is not scientific, mechanistic, or analytic (re:Skolimowski,1981). That is not to say that the Cree approach is either superior or inferior to the Western scientific one, but it is different [...]the Cree model of caribou cycles shows a better fit with the actual caribou population dynamic in Quebec - Ungava Peninsula than does the current scientific model.

Diversity, complexity, simultaneity and change in ecological systems are codified in knowledge and practices through language and culture (Gupta 1989). Just as Inuits are recognized for having the highest number of words for classifying snow, fishing communities have many words for distinguishing and discriminating different kinds of sea conditions, fish spawning sites, etc., (Johannes, 1981). Conceptually, any community, which is dependent upon a resource for its survival, has to develop a pattern or a set of categories to deal with variations in the availability of that resource. For example, farmers have a rich taxonomy for clouds and soils and, in some cases, for insects and other animals. Leather workers have taxonomy for leather, carpenters for wood and likewise fishing communities for water and aquatic life.

In the context of the CBD, it is very important to understand and to appreciate that different indigenous and local communities develop knowledge systems through a tradition of invention and also develop languages through which to articulate their knowledge systems. If a language dies, a knowledge system partly or completely dies with it. Hence, the conservation of language becomes a crucial factor for conserving taxonomies because each word, conceptually speaking in the context of a natural resource, is a category. Modern science will benefit a great deal and so will the ability of humans to understand their environment and cope with it, if the scientific basis for these categories is better understood. The etymological roots of different words might elucidate the process of codification of knowledge over time in languages, as influenced by exogenous knowledge systems, migrations, wars, and other social interactions. Palomares, Garilao and Pauly (1998) provide an interesting study of local names of the fishes in the Philippines drawing upon the FishBase database maintained at the International Centre for Living Acquatic Resource Management (ICLARM). They present the rather counter-intuitive insight that in subsistence fisheries fifty per cent of the species did not have Philippino names, whereas in the commercial fisheries as many as almost 90 per cent had such names. Since the number of species named by subsistence categories was only 34 as against 455 in the commercial categories, the difference may be explained by the possibility that subsistence categories of fish were not so crucial to the survival of a community. But the commercial categories were apparently very crucial and thus the variety of names.

Formal science, in its effort to generalize boundaries over large time and space, often masks finer categories. Local knowledge systems (LKS) often do the opposite. LKS help in distinguishing small variations in phenomena and do so within relatively small habitats. The better the resource management strategies in LKS fit with local environmental conditions, the lower the negative externalities on the environment may be. However, this local focus also means an inability or

limited ability of local communities to deal with wider connections. For the sustainable development of this planet, both telescopic and microscopic visions are needed: the ability to see connections among larger systems and to appreciate interconnections at micro levels; in other words, we need both reductionist science and a holistic vision.

Functional and causal knowledge systems are different. Farmers have been known to do right things for wrong reasons[20]. Their practices do not become invalid merely because a supposed causal connection has no known factual basis. Even in modern science, there are effective medicines for which the causal mechanisms came to be known only after a long history of use, e.g., the aspirin. A knowledge system should not therefore be downgraded merely because of such limitations. Rituals and some symbolic totems may be ways of constraining particular healing strategies lest they be used in inappropriate cases, doses or situations. For example, some medicines are suggested to work better when these are consumed with an edge of a finger slowly and slowly. Apparently, the intention is to suggest consumption of only as much quantity as the edge of the finger can contain. In a way, a ritual has incorporated a dosage. A marriage between local and exogenous knowledge and between formal and informal science will succeed only on the basis of reciprocal respect and a well-deserved restraint in exploring their logical bases. Hence, many local knowledge systems emphasize the questions that should not be asked rather than those that should be. Modern minds reject such boundaries to inquisitiveness, but the sacredness of certain kinds of knowledge rests on faith and its power. It is true that superstitions particularly those that cause definite harm to local communities as well as those that generate other kinds of social or ecological biases, have to be tempered with a scientific attitude. It is not easy to determine when faith becomes a source of superstition. Thus, there is a great need for exercising care in understanding and especially in attempting to influence local conservation practices. In their attempts to unravel the mysteries underlying local faiths, outsiders can erode the power of local experts and institutions without putting anything better in their place.

The local beliefs in the power of spiritual icons have helped conserve sacred groves, lakes, mountains, etc., all over the world. The sacred beliefs are linked sometimes to very basic functional needs. For example, the need to protect the mouth of the rivers. The points at which rivers originate are considered sacred almost all over the world. Not much will be gained by dismembering the sacred fibre from the profane one. The two are intertwined like the double helical DNA structure (Gupta, 1993). The conventional intellectual property rights can protect the folklore if national legislation for the purpose exists, they can also protect the uses of various biodiversity elements (even if out of the local context) and can protect the symbols, music, other icons considered sacred by the local community.[21] Reductionist knowledge by itself has rarely

[20] In a field study in Mahendra Garh district, Haryana, India in 1984, I observed that some farmers grew coriander around the field of chick pea. They believed that the coriander helped in repelling pests. M Pimbert at ICRISAT when informed about it did some studies at ICRISAT and found the coriander did not repel the pests. It attracted in fact the predators of the pests. The ultimate result about control of pest was correct, but the causal reason assumed by farmers was incorrect (Gupta, 1985).

[21] Perhaps just as we have trademarks and service marks, we may have to develop a category *of sacred marks* which will be restricted for use by specific communities or their representatives or the ones authorized by them. This provision can provide considerable psychological and spiritual solace to the communities which feel aggrieved by unauthorized and improper use of sacred marks. In the Australian case a native community felt aggrieved when a carpet manufacturer used their sacred signs authorized by an individual artist on the carpet. The community felt that the individual was not authorized by the community to contract the use of signs designed during spiritual ceremonies to anybody outside without communities permission. The court did not agree with this submission as

generated the social responsibility required to guide collective behavior towards conservation. The sacredness of certain sites, species and symbols must be respected even if modern minds find this incomprehensible or even irrational (Gupta, 1993).

The Production and Reproduction of Knowledge: The process of local knowledge production and reproduction may differ. Production of local knowledge can be through (a) discovery of problem-solving on a small scale or in an episodic manner and (b) through interaction with wider knowledge systems, ranging from networking with kith and kin to networking with external partners, for example.

In a dynamic knowledge system, some knowledge is lost when it becomes redundant on account of changes in access to resources, and changes in socio-ecological conditions, or changing perceptions of needs. In a vibrant culture, much of the knowledge that is passed down from one generation to another depends upon social structures and the needs of changing times. Knowledge related to livelihood strategies is embodied in practice. Once the livelihood strategies themselves undergo change due to reduced or modified access to the underlying natural resources, as has happened in most developing countries, the LKS becomes fragmented and also become inadequate to take care of a given resources in a sustainable manner. Cultural knowledge is embedded in rituals, folklore, art and other cultural and social artifacts and processes. Local experts may reproduce some other specialized forms of knowledge, such as making and retting nets or fish traps, individually rather than at the community level in a given community.

Knowledge that is embodied in practices usually takes the form of skills which are learned. Skills can be repetitive and non-repetitive. "Judgmental" skills are often scarce. Examples of such judgmental skills are weather forecasting, judging the quality of diamonds (diamond polishing using labor intensive methods has grown into an important off-farm employment in many of the villages of Gujarat, India, cattle judging, and diagnosing human and animal ailments and problems of soils, lakes, finding out potential sites with rich fish population, etc. Individuals who possess such skills may become recognized as local experts. Some skills are embodied in the practice and can be converted into specific know-how capable of being applied for industrial applications by anybody well versed in the art. Whereas there are other skills which are embodied in the persons as a kind of tacit knowledge. The latter can only be kept either as trade secret or as personalised knowledge. The former can benefit from application of different IPRs whereas the latter may be covered by trade secret protection only.

The Performance of Indigenous Knowledge

The performance of indigenous knowledge has been reviewed by Richards (1987). Performance from an indigenous perspective might include a number of criteria that are considered by formal science as less relevant: e.g., risk management, contributions to system maintenance, soil health, etc. The same practice could have different impacts on the natural resource base, depending upon the criteria emphasized by a community while deciding the appropriability of a practice in a given

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mentioned later in this paper (Blackney 1999, Also see (1995) 91-116, CCH Australian Intellectual Property Cases, 39,051 and
(1991), 2 Intellectual Property Reports 481 at 490.

cultural and spiritual context. The values underlying the choice of criteria serve as a guide for dealing with each other (social equity), with non-human sentient beings (i.e., other life forms capable of feeling and having consciousness), and with nature (ecological responsibility) and the super-natural (ethereal or spiritual beliefs). For instance, the bowhead whale, which was a protected species for 65 years, was allowed to be killed by the Canadian government in July 1998 for consumption as well as ceremonial purposes by Inuit communities. The Bowhead Traditional Knowledge Study coordinated by Keith Hay of the Nunavat Wildlife Management Board revealed the existence of 350 bowheads rather than a "few tens" believed to exist by scientists. This number made the permission to kill one whale a year for ceremonial purposes quite sustainable. Traditional knowledge embedded in a culture and embodied in practice serves as the mechanism to preserve and pass on sustainable livelihood strategies to future generations.

Communities give expression to their belief systems, norms, values, and ideologies through folk art, crafts and rituals, taboos, myths, symbols, etc. These values are reflected in their livelihood strategies, which are also closely integrated with local institutions, social networks, kinship networks and knowledge systems.

The ecological context in a given region or for a given community defines the nature of environmental risks or threats. A drought, a flood, erosion of biodiversity, or an increase in salinity levels are examples of threats. The regions that have low exposure to such threats are preferred by markets and are therefore at an advantage in land-based community strategies. Given the low transaction costs of exchanging resources in these regions, the adaptive responses of their households are fast. Their social structures are also different to those of disadvantaged regions that have higher perceived or real exposure to risks or threats. In Table 1, I have enumerated the key contrasts that characterize the advantaged (market-dependent and dominated) and disadvantaged (nature-dependent and dominated regions).

The market dependent communities are the ones in which most exchanges are mediated through markets. The commoditisation of labor, products, and skills is high. In contrast, the communities that draw their major sustenance through use of natural resources, often without much value addition, are defined here as nature-dependent communities. The regions where each type of community predominates are also contrasted here. The market-dependent regions are the high growth green revolution regions and commercial fisheries, while the nature-dependent regions are rainfed drylands, hill areas or forest fringe areas and small scale fisheries.

Table No 1

	Market dominated	**Nature dominated**
1. Communication system	Digital	Analogue
2. Pooling of resources	Very low	Very high
3. Reliance on common	Low	Very high

properties		
4. Settling of books of account	Very short term	Long term
5. The proportion of women headed or managed households	Very low	Very high
6. Women's participation rates	Very low	Very high
7. Reciprocities	Specific	Generalized

Source: Gupta, 1992, 1995

One particular dimension of this contrast between nature-dependent communities and market-dependent communities is like comparing analogue and digital systems. Analogic communication implies metaphorical communication. While digital implies very precise ways of communication suggesting what it is and what it is not. The redundancies are low in the latter while high in the former. Many local experts have a symbolic language through which they communicate their understanding of a problem. Many scientists and policymakers do not appreciate this basis of communications and jump to the conclusion that such expertise involves more 'mumbo jumbo' than actual skills. In some cases, this might be so, but to generalize this over entire bodies of traditional knowledge in contemporary institution contexts is quite inadequate. The persistent neglect of traditional ecological and technological knowledge as well as contemporary creativity of local communities and individuals needs to be avoided. Bridges built between knowledge that has evolved through generations of interaction between humans and nature on the one hand and the western scientific scholarship evolved over few centuries on the other only will enrich both. The fair trial of contemporary creativity by formal scientists will enlarge the repertoire of those institution builders who want farmers and fisherfolks to have low-cost, nature-friendly technologies, coupled with institutional structures restraining greed and maintaining respect for the rights of the unknown and unknowable (that is, perfect strangers like the future generations of a community). Many times the motivations for even a contemporary innovation are not entirely utilitarian from human point of view though the invention may be extremely useful for human beings. Amrutbhai Agravat, a farmer-artisan of village Pikhor, District Junagadh, Gujarat innovated a tilting bullock cart (see figure No..) in which the burden on the bullocks was reduced considerably because of the four wheels instead of conventional two wheel cart. The advantage of tilting mechanism was that one could pour the manure directly into furrows instead of putting it in one place. And then distribute the manure manually through baskets. Here the concern for the wellbeing of the bullocks may not be captured in the incentives for the cart per se and yet, this

concern has been an important driver of the invention[22].

Communities and individuals who have long conserved biodiversity have not done so entirely on the basis of utilitarian logic. The efficiency of ethics may sometimes be tempered by the inefficiency of technology which local communities use. That is, while the local communities may not like natural resources to be exploited beyond their sustainable limits, they may use non-sustainable and inefficient technologies. Use of such technologies in the wake of unfair competition with well equipped market forces may lead them, for example, to use unsustainable technologies for catching fish, such as fishing by the use of dynamite.[23] Extractive uses of biodiversity could be sometimes less conducive to the long-term conservation of a species, even though the norms and values guiding the extraction may be very noble. This happens when poachers combined with impoverished local communities may bring a species to near extinction even though local extraction by the communities may be much less than that by outsiders. Once ethical values, cultural norms and belief systems become weak, the inefficiencies of extraction methods may start generating negative feedback effects. That is, the restraint for extracting diverse resources within their sustainable limits becomes weaker. The important point to note is that improvement in technical methods may not necessarily lead to evolution or restoration of ethical norms. The challenge thus is to devise incentives that fulfill four conditions of sustainability: (1) access to biodiversity for local communities, so as to ensure their sustainable livelihood systems, should take priority over access for outside institutions or individuals; (2) assurance to individual healers or other local experts, communities, and other stake holders of sustained access to the resources and viable collective responsibility for using biodiversity; (3) blending traditional skills/abilities to convert biodiversity resources into investments with or without value addition; and (4) conservation of cultural lifestyles and value systems in such a manner that basic needs are met without impairing the life support systems of local communities.

Unless arrangements are made for sharing value added knowledge and benefits from value added gains (made possible by converting local knowledge into economically profitable investments or enterprises) the collectors have no ethical right to collect more of such knowledge. A second requirement should be that research results and lessons learned in the process of value addition should be shared with the knowledge providers in the local languages and in an easily understandable manner. Codes of conduct for genebank managers, researchers, funding agencies, and other development managers should provide for such sharing in an unequivocal manner. Local communities have already paid a heavy price because the designers of dams, hydropower projects, waterways, commercial prospectors of biological resources, and landfill programs that have damaged wetlands have ignored their knowledge and institutions. These communities must not be dispossessed of the only resource left with them; i.e., their knowledge.

The Honey Bee Database (1990-1999) was established ten years ago to scout, develop, sustain,

[22] The patent has been filed by SRISTI on behalf of the innovator for this cart, refer application No… dt. It is interesting to note that this innovation has been licensed to two entrepreneurs for about a 1000 and 700 USD for three and one district of Gujarat respectively. This is the first time in India when an easily copiable technology has been licensed by the entrepreneurs for small areas like districts just because patents have been applied for and there is a possibility of checking unauthorized imitation.

[23] In this method fisherman used dynamite explosion in the river stream such that all the fish – small or big are either killed or numbed in the process. The method does not discriminate between large and the small fishes and helps in maximizing catch in minimum time. In contrast, traditional practices where such nets are advised in which fish less than 4 x 4 inches cannot be caught are extremely sustainable since small fishes are not caught.

disseminate and reward grassroots innovators and experts in traditional ecological, technological, educational and institutional knowledge which was developed by local communities and individuals without any outside help. This database can be accessed by innovators and others who aim to empower them by adding value to their innovations and by sharing benefits with the knowledge providers and innovators in a fair and equitable manner. Members of the Society for Research into Sustainable Technologies and Institutions (SRISTI) and the Honey Bee Network have been involved in the documentation, experimentation, and dissemination of indigenous knowledge, innovations and practices in the agricultural and animal husbandry sectors for 16 years, working closely with farmers, and using a variety of methods to document about 7,500 innovations and practices from 3200 villages in Gujarat (SRISTI, 1996) and in other parts of India. In addition, innovations have been documented from local communities in many countries in Africa, Asia and Latin America. Through the Honey Bee Newsletter, grassroots innovations have been disseminated to more than 75 countries. This has produced probably the world's largest database on grassroots innovations having now about ten thousand innovations an doutstanding examples of traditional knowledge, with names and addresses of the innovators (individuals or communities) and communicators in most cases.

For example, this database has seventy one entries on the traditional use of fish and fish products, wastewater etc., for curing animal diseases, improving crop productivity (grape vines are supposed to particularly benefit from fish compost) etc. Such local knowledge about aquatic diversity and its uses has not been adequately appreciated and there is a strong case for launching a global drive to strengthen efforts in this direction.

Biodiversity, poverty and knowledge erosion: incentives for conserving diversity, and related knowledge, innovations, skills and institutions

Biodiversity cannot be conserved by keeping people poor even if, historically biodiversity survived largely under such conditions (Gupta, 1990). Our studies (Gupta, 1989, 1991, 1997) have shown that many communities which conserve diversity have remained poor because of their superior ethical values. This happens when many healers refuse to demand or accept any compensation or payment for their services provided to individuals within and outside their community. Further, when they decide not to pluck more plants than are necessary for immediate use they forego an opportunity of accumulating wealth by processing the herbal diversity in larger quantities and selling or dispensing it to others for consideration. There are others at the same time (including local people as well as large corporations - national as well as international) who have no hesitation in extracting biodiversity without taking care of regenerating the same. One of the challenges is to modify ethical positions that threaten biodiversity and, at the same time, to ensure improvements in livelihood prospects for indigenous peoples, through the implementation of the CBD and relevant IP conventions. These communities will then continue to conserve biodiversity along with their associated ethical and cultural values.

The rate of erosion of local knowledge about biodiversity has never been so high as it is in the current generation in areas which did not go through large scale annihilation of local tribal communities as happened in many Latin American and African countries through the influx of missionaries. There are several factors which explain this: the changing family structure from

extended to nuclear families, consequently weakening links between the grandparent generation (which holds much of this knowledge) and the grand children generation (the parents' generation is alienated from these knowledge systems already, due to the heavy influence of modernity), lesser esteem for this knowledge in primary school curricula, the transition from oral to written culture, and the inability or unwillingness of many older healers and herbalists to share their knowledge or agree to its transcription, or to transcribe it themselves. This unwillingness arises in many cases because outsiders (such as ethnobiologists) have extracted the local knowledge, commercialized it or published it without any attribution, reciprocity, or benefit sharing and thus have offended local communities. Knowledge erosion is a threat as serious as resource erosion itself. The reasons are obvious. If there is no knowledge about given resources, plants become weeds. It becomes not only difficult to locate what is useful or known, but also the incentives for conserving what is not known is much reduced. In ecological economic terms, the option values decline if the probability of finding something useful in the current generation is lower because of the loss of knowledge about the resources. Conserving biodiversity without conserving associated knowledge systems is thus like building and maintaining a library without a catalog. It is true that users of such a library might in fact develop a catalog over a long period of time but meanwhile the users would suffer. By analogy, biodiversity users, who are without a knowledge base, will not benefit from centuries of experimentation and knowledge accumulation by local communities and indigenous peoples. It is true that formal scientific knowledge of plants and animals is diverse and rich. However, the bases upon which different communities have classified and organized their knowledge as well as practices are similarly complex and dynamic.

There are three crucial assumptions underlying this perspective. First, not all knowledge, innovations and practices prevalent in a community are communal in nature. There are individuals who have great expertise in various aspects of local knowledge that is not known at all or known only partly to the local community. Second, not all the knowledge in use by a community is traditional in nature. There are many examples of contemporary innovations by local communities, developed collectively or individually. Third, local knowledge can be conserved perhaps in a more sustainable and dynamic manner if the associated cultural values and ethical institutions contributing to conservation of biodiversity are also conserved and/or strengthened. Sustainable and dynamic conservation would mean conservation in a manner that the knowledge grows through constant experimentation and innovation rather than just being maintained as a fossilized form of historical knowledge, produced at one point in time and carried forward by succeeding generations. The implications are obvious. Incentives for the conservation and sustainable use of biodiversity will have to be sufficiently flexible and diverse so as to provide for the growth and development of the traditional as well as the contemporary knowledge that is held by individuals as well as groups. The same or similar incentive structures or philosophical assumptions cannot provide adequate motivation to conserve what exists and restore what is lacking. Devising appropriate incentives is challenging because many local communities lack access to resources for some basic needs and are impoverished. Factors that have contributed to this linkage between high biodiversity and poverty are discussed by Gupta (1989, 1991a, 1993). SRISTI (1993) has noted the following factors (see also Gupta, 1990, 1992). These factors include:

(a) Biodiversity is high in rain forests, mountains, some arid and semi arid areas, humid areas, primarily due to diversity in soil, climate and other physical and social structures.

(b) Poverty is high because markets are often unable to generate demand for diverse colors, tastes, shapes and qualities of natural products. Products of mass consumption particularly

when processed by machines, have low variability because throughput by machines has to be of uniform quality and maturity level (for instance for processing tomatoes to make ketchup, local varieties will not be suitable because these are not synchronous in maturity, have uneven ripening status and thus, taste, color and flavour can not be standardized). The cost of inventory, transportation, display in shelves of large varieties of, for example, tomatos is obviously quite high compared to that of only one variety. Consumers who do not demand larger varieties either because they have not been exposed to the same or are unwilling to pay the extra costs also contribute to lower demand of biodiverse products.

(c) The regions of high diversity also have very poor public infrastructure (in tandem with weak private market forces), because the people have limited surplus to attract public servants and they are less articulate and organized to create political pressure (except through insurgent movements as is becoming evident in different parts of the world).

(d) The low demand for the ecological and technological skills of these communities characterizes them as 'unskilled' labor, fit for being a part of the urban slums, squatters, or other similar work force. Once the knowledge system is devalued, cultural and social decline follows. The tenuous relationship with nature is ruptured. Ecological degradation spurred by various external resource extractors is aided and abetted by many poor as well as not so poor people for whom survival in the short term seems possible only through eco-degrading strategies. Thus when the demand for local biodiverse products (main items for the communities to dispose off) is low, exchange value will drop, consequent purchasing power will decrease, and poverty is bound to follow. Supplies for basic needs also get constrained due to administrative and political apathy towards people in these regions where population density is low and thus the number of votes and other kinds of political pressures are lower.

Incentives for Conservation and value addition

To overcome many of these constraints, four kinds of incentives have been proposed (Gupta, 1991, 1995, 1997):

The matrix resulting from the interaction of two variables a) nature of benefit, whether material or non-material and b) target of benefit, whether individual (including group of individuals) or community provides the framework for designing these four incentives for rewarding innovations.

	Forms of Benefit	
	Material	Non-material
Target of Benefit Individual		
Collective		

I INDIVIDUAL -MATERIAL

These rewards are in material form such as royalties from patents, copyrights or trademarks, biodiversity user fees, monetary rewards, fellowships, land assignment or equipments, etc., to individuals. These could arise from those who license technologies of herbal- or animal-based recipes by local individuals or educational or research grants etc.

II INDIVIDUAL - NON-MATERIAL

Documentation, press coverage, TV and other media, public felicitation, invitation to lecture in schools, centres of learning and research. Invitation to conferences, workshops attaching the name of the innovator to the innovation (an incentive frequently used by the local communities themselves), photographs being placed in village or district councils, access to new skills. For example, SRISTI has been giving the SRISTI *Sanman* (honour) for the last five years to outstanding innovators at grassroots level.

III COMMUNITY - MATERIAL:

These are quite relatively important. The rewards in material form to communities or groups of people help to generate the right signals for mobilizing the collective action which is so important for conservation. The instruments of such rewards could include risk funds, trust funds, priority in the development or allotment of infrastructure such as schools, health care system, access roads etc. free or easy access to data banks, access to external expertise, community awards, community grants/ risk funds, external aid in developing common property assets, marketing intervention for organic produce, etc.

IV COMMUNITY - NON-MATERIAL

These are rather difficult to implement but may have quite an endurable impact particularly when the rewards change the values of the communities positively. Rewards include policy changes to ensure greater control over local natural resources, removal of perverse incentives (that is indications which encourage non-sustainable use of resources) for conservation, favourable policy environments for eco-friendly products, conservation practices, media attention, community awards, capacity building through transfer of technology, building up of negotiation skills, pedagogy changes, inclusion in the curriculum of lessons which raise social esteem for local, eco-friendly practices and innovations, etc.

The magnitude, manner and form of incentives or benefits may influence the degree of involvement of the local communities or individual innovators in future projects of biodiversity conservation.

- Incentives could be in cash or kind, conditional (linked to research) or unconditional.

- Community incentives could be of a direct nature or they could be indirect. They could be

provided at one point in time or over an extended period of time.

- Incentives could be provided by external agencies or by the local communities themselves. The improved status of the innovators on account of social recognition may or may not be associated with a greater say in decision making at the societal level.

- Incentives may focus on empowerment of local communities so that they may have better negotiating skills and better knowledge for conservation of local resources. Alternatively, the incentives may be targeted directly at conservation. Incentives targeted at the community may lead to action either at the community level or even at the individual level.

The concern for local knowledge has been there for a long time. As early as 1969, Verma and Singh raised questions about the continued relevance of indigenous knowledge in the context of animal husbandry. The modern health system for human beings was quite weak. For animals it was even weaker. Local communities in many parts of the tropical developing world rely on local knowledge of animal husbandry even today. This is indicative of the fact that mainstream education and public policy still do not give due attention to the peoples' knowledge system. One implication of this is the downgrading of those knowledge systems in the eyes of young people of the same communities. Once the esteem for local knowledge goes down, there are less incentives for young people to acquire that knowledge and to experiment and rejuvenate the same. This leads to serious discontinuities in the intergenerational flow of knowledge. Once the "local experts," the older generation, are gone and there are no successors, the knowledge held in trust by those individuals for future generations is lost forever. Young people are not acquiring the skills of local experts because of a lack of incentives. However, some of these skills might lead to new career options; for instance, the skills of restoring the health of degraded lands, water bodies or forests are becoming increasingly valuable as international conventions and their implementation gain momentum.

A Framework for Access to Local Biodiversity and Knowledge Systems

Access to biodiversity can be looked upon from the perspective of its uses as well as the methods of access.

- **Access Framework**

	Access	
	Extractive	Non extractive
Non commercial	1	2
Returns		
Commercial	3	4

1) Non-commercial / Extractive: The samples are extracted for taxonomic or ecological analysis without any commercial purpose in mind, e.g. for academic research and studies by different individuals, institutions, and public & government organizations. Recent examples of such studies include the Department of Plant Science, Oxford, UK, request to the Ministry of Environment & Forest for conducting field studies and collection of specimen Flora from South

India.[24] A similar request was made by the Royal Botanical Garden, Edinburgh, Scotland, conduct field studies and collect flora from Sikkim, India.

2) *Non-commercial / Non-extractive*: Access to biodiversity in order to describe eco-systems or local institutions. For instance, studies carried out by the Zoological Survey and Botanical Survey of India in order to document the biodiversity can be termed as examples of such access. The ethnobotanical studies documenting knowledge of ethnic communities about plants are another example of access to biodiversity and associated knowledge systems. It is true that this information may be put to commercial use or the sites described may become sites for economic extraction or eco-tourism later, but if, at the time of documentation, the intention was of a non-commercial nature, then the case will fall within this category.

3) *Commercial / Non-extractive*: The extraction of local knowledge systems of the local community about the biodiversity, rather than the diversity itself, falls in this category. This knowledge is later utilized for commercial gains in collaboration with pharmaceutical firms and other commercial prospectors. The access does not involve actual physical extraction of biodiversity. The use of the knowledge possessed by the Kani tribe to screen a therapeutic drug by Tropical Botanical Garden Research Institute (TBGRI) with benefit sharing agreements is a well known example in India. Databases, such as the Natural Products Alert Database (NAPRALERT), which contain a range of information including ethnobotanical data on selected plants, are accessed by different companies on payment as the data can help at several stages of medicinal development. However the service is provided free of cost to developing countries.

4) *Commercial / extractive*: The form of access where the commercial organization, local communities or cooperatives extract components of biodiversity for commercial purposes. This involves physical extraction of biodiversity to produce value added products or for direct use of the resource. The extraction of medicinal plants by firms to produce medicines, the working of bamboo forests by the paper industry for use in pulp production, are examples of this category. The Merck-INBio deal in Costa Rica is a classical example. Merck, a pharmaceutical company, received screened natural samples from INBio, National Institute of Biodiversity of Costa Rica, for further research and development. Similarly, the use of medicinal herbs and plants by an individual herbalist to treat patients may also be termed as an extractive and commercial access. Here the scale, purpose, and location of the user may make a further difference to the obligation of the extractors.

The commercial/extractive and commerical/non-extractive access (No. 3 & 4) can be pursued for different proposes by various extractors. The location of the user and the extractor may influence the respective entitlements and obligations.

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[24] The Ministry of Environment & Forest granted access to these Institutions on the following terms and conditions:

1) The accessor will collect only those species that are specified in the request.
2) The specimen or collection will be used only for the purpose listed in the request.
3) A scientist from Botanical Survey of India will accompany them to all the field visits made.
4) Before publishing the outcome of the research conducted the MoEF permission is to be sought.
5) In case the research has potential for commercial exploitation another agreement need to be signed.
6) Transfer of specimen or the research finding to third party without prior permission of MoEF is prohibited.
7)

The term , `local' refers to geographical limitation such that resources are extracted or used by the communities living around the resource. They may or may not have formal property rights on the resource. The external user or location would mean distant, farther and beyond the access and control of local communities. Thus local context would be a tribal community living in or around a forest and dependent on the locally available resources for its survival. The external agents could include companies or scientists or others located in the cities nearby or even outside the country. The difference is in scale and spatial distance. It is true that local communities may have institutional arrangement whereby the control, the mechanism of using a resource outside. For instance, a local cooperative unit for managing biodiversity resource may have a plant or trading centre in far off place. In such a case, the local user is only implying the relationship of the user with the resource. Obviously, the user may have external connections. The scheme presented here should be seen as a way of looking at contrasting situations to understand the underlying tensions.

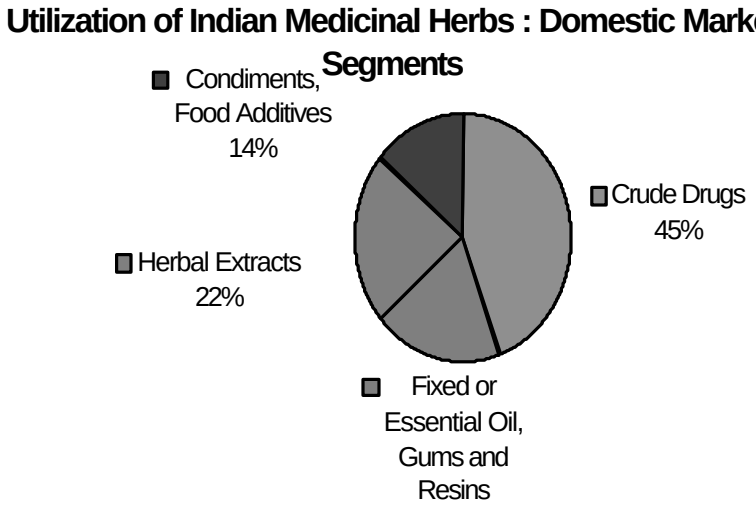
		User Location	
		Local	External
Extractor Location	Local	1	2
	External	3	4

1)Local Extractor-Local Use

The use of diversity by the communities residing near the site, or having property rights over it, for their own consumption, may constitute category 1. Collection of leaf litter from social forestry to be used as fuel by tribal communities in Orissa, India, or the use of bamboo available in the forest for construction of houses by local and indigenous communities are examples of such modes of access. An Exim Bank occasional paper estimates the local extraction and consumption of herbal plants to the tune of Indian Rupees (Rs.) 600 million every year.

2)Local Extractor-External Use

The economic significance of Indian biodiversity can be gauged by the fact that the domestic trade in medicinal herbs and its extracts is to the tune of Rs. 3 billion and is increasing. (Source: Exim Bank Occasional Paper No.54) The medicinal herbs are extracted by the local people and reach the industry, through middle men, to be utilized for production of value added natural products.



A recent World Bank study pointed out the poor returns on natural resources to India and its local extractors by citing the example of "*Tetu Lakda*" twigs. These twigs are available in India at Rs. 9/Kg ($0.26/Kg) while its extracts are sold in the international markets at Rs 500,000/Kg ($15,000/Kg).

The policy guidelines and protocols should look into these disparities in benefit sharing and enthuse and motivate the private sector to bridge these gaps. In some cases, if motivation does not work, sanctions may have to be called for. The current demand for medicinal plants is being met from cultivated and wild sources, however the wild remains the major source of medicinal herbs. The world trade in medicinal plants and related products is estimated at US $ 5 trillion by the year AD 2050. To meet the increased demand, cultivation of these species and use of tissue culture or cell culture techniques need to be promoted. This is a must, as even the current level of extraction from the wild is not sustainable. The private sector has to take the lead in this area and policy measures for biodiversity conservation should include incentives for such investments.

3)External Extractor -Local Use

A paper mill may collect and use "*sabai*" and "*bhabar*" grass for pulp making in India. The grass that is found fit for rope making is sold to the local people. The collection of long bamboo by paper mills operating inside the forest for sale to the local people via the forest corporation is another example of such interactions.

4)External Extractor-External Use

An external extractor, such as a paper mill or a non-timber forest produce contractor uses labor from outside the local communities to prospect biodiversity which is then transported to an external location for value addition or processing. The local communities have minimal or no role to play in such extraction though they may suffer the consequences of resource depletion and degradation.

A regulatory regime cannot be designed uniformly for different kinds of extraction options at varying scales for various commercial and non-commercial purposes. The tables below define the interaction of various types of biodiversity with different access regimes and governed under

various property right laws.

Table I : Modes of Extraction and Diversity

		Biodiversity Extractors biochemical	Fauna	Floral	Microbial	Genetic
Foreign	commercial					
	non commercial					
Domestic	commercial					
	non commercial					

Access to biodiversity *per se* should be distinguished from access to genetic resources, despite the difficulty to draw the line between both categories. This is because genetic access has never been regulated and genetic resources had been considered the common heritage available to everybody before the CBD came into being. Secondly, the monetary gains arising out of genetic resource use are significantly higher than those arising from physical access.

Glowka (1998) reviews various proposed legislations, agreements or executive orders (for example, in Philippines) on the subject of access determination processes. In the Indian Pact, Art. 37 provides framework for gene banks to enter into contracts with other partners and Art.36 provides access contracts with universities and recognized investigators. Philippines legislation is also quite flexible for institutional researchers in which case prior informed consent is taken only at local level. However, National Commission on Indigenous People (Administrative order No.1, 1998, Philippines[25]) provides several specific guidelines for Protection and Promotion of Indigenous Systems and Practices (IKSPs). The guidelines are:

a) The ICCs/IPs have the right to regulate the entry of researchers into their ancestral domains/lands or territories. Researchers, research institutions, institutions of learning, laboratories, their agents or representatives and other like entities shall secure the free and prior informed consent of the ICCs/IPs before access to indigenous peoples and resources could be allowed.

b) A Written agreement shall be entered into with the ICCs/IPs concerned regarding the research, including its purpose, design and expected outputs;

c) All data provided by the indigenous peoples shall be acknowledged in whatever wrings, publications, or journals authored or produced as a result of such research. The indigenous peoples will be definitively named as sources in all such papers;

d) Copies of the outputs of all such researches shall be freely provided the ICC/IP community; and

e) The ICC/IP community concerned shall be entitled to royalty from the income derived from any of the researches conducted and resulting publications.

[25]Office of the President, National Commission on Indigenous Peoples, Administrative Order No.1, Rules and Regulations Implementing Republic Act No.8371, otherwise Knows As "The Indigenous Peoples' Rights Act of 1997": Quezon City: Philippines

These guidelines do not seem to distinguish among national researchers and international researchers, as is the case in proposed legislation by Indian government. The issue of course is, as mentioned above earlier, whether similar constraints should operate on researchers with non-commercial and non extractive motives vis-à-vis researchers having commercial extractive or commercial –non extractive motives. In the absence of proper research and generation of preliminary data base how will external or internal prospectors assign values and enter into contracts assuring reasonable returns to local communities and other stakeholders.

Different kind of biodiversity occur on land and water governed by different kinds of property right regimes. The regulating authority has to differentiate the application rules and regulations depending upon the source and the extractors of the resource. (Table II)

Table II : Governance and Access

		Source regime					
		Terrestrial			Aquatic		
Extractors		Private	Public	Common	Private	Public	Common
Foreign	Non-commercial						
	Commercial						
Domestic	Non-commercial						
	Commercial						

The property right regime governing a resource influences not only the constellation of stakeholders but also the possibility of disadvantaged communities and individuals benefiting from a resource-centered benefit sharing mechanism. Further, benefit sharing need not be seen only among international users of resources and knowledge but among by the domestic users. After all a tribal community or individual healer gets no respite from the fact that the exploiter is from within the community or country and not from abroad. In most developing countries, the greatest damage to the biodiversity and greatest exploitation of local communities has been caused by domestic interest groups in relative terms, exceptions apart.

The Role of Intellectual Property Rights Regimes

The need for a low transaction cost system of intellectual property protection for TK is obvious and yet most global dialogues on intellectual property rights have not yet embarked upon such a system. Article 23.4 of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) provides for negotiations to be undertaken in the Council for TRIPS of the World Trade Organization (WTO) on the establishment of a multilateral system of notification and registration of geographical indications in the context of wines. There is no reason why such negotiations should be restricted only to wines and not include traditional knowledge as well as contemporary innovations of local communities and individuals.

There are many other policy and institutional modifications that are called for in existing IPR laws. It is not my argument that removing the imperfections of IPR regimes will by itself generate economic rewards and social esteem for local, knowledge-rich, but economically poor people. I realize that the role of non-monetary incentives may be sometimes more important. However, the biotechnology, drug, and other value adding industries have not yet shown any explicit interest as a

stakeholder in generating models of voluntary benefit-sharing. Does this imply that they believe that future gains in biotechnological products may be made only on the basis of public domain biodiversity?

Machlup, (1958) provides a succinct historical review of the debate on patents in the late 19th century in Europe and America. The anti patent movement collapsed after 1873 following the depression, the rise of protectionism and nationalism and the "willingness of patent advocates to accept a compromise". The rise of free enterprise and trade was accompanied by the acceptance of principal of compulsory licensing so that inventions could be used by getting them licensed to others at reasonable compensation. The idea of compulsory license evolved way back 1790 but became part of patent wisdom at the Patent Congress held at Vienna World's Fair in 1873. Machlup (1958) provides various arguments that were used to oppose patents among the developed countries including the ethical considerations.

The discussion on registration systems has taken place for about a hundred years now. Machlup reviews this debate and summarizes various considerations that were brought into the discussion. He observes:

> Under the registration system, the validity of a registered patent is examined only if an interested party attacks it in the court and asks that the patent be invalidated. Under the examination system, the patent is issued only after the patent office has carefully examined the patentability of invention. This examination may include so-called "interference proceedings", when the Office finds that two or more pending applications seem to claim, "partly or wholly" the same invention so that the priority of one inventions has to be established. The so-called "Aufgebotssystem", examination-opposition-system provides for an interval of time after publication of the specifications examined and accepted by the official examiner and before the issuance of the patent, in order to enable interested persons to oppose the patent grant……..*The registration system administratively is the cheapest. But may burden the economy with the cost of exclusive rights being exercised for many inventions which, upon examination, would have been found non-patentable.* In favour of the examination systems, it has been said that it avoid a mass of worthless, conflicting, and probably invalid patents, onerous to the public as well as bona fide owners of valid patents; that it prevents the fraudulent practice of registering and selling patents similar to the claims being patented by others; and that it drastically reduces the extent of court litigation (1958:8).

We will revisit the issue of registration system in the light of recent experience later. Machlup has reviewed several suggestions for reform of the patent system about four decades ago, some of which are still relevant, such as:

a) Rewards to the patentees of a sufficiently high level to give general satisfaction to the inventors and those who have invested in their inventions financially in lieu of making inventions freely accessible to all. The rewards will have to be fixed according to the "assessed values created by the invention" (Michael Polanyi, 1944)[26].
b) In this scheme "instead of making annual "participation payment" to the licensers (in addition to the reasonable royalties received by them from licensees) the government would

[26] Michael Polanyi, "Patent Reform", Review of Economic Studies, Vol.XI (1944) P.67

buy the patents outright and open them to all, free of royalty (Hamilton, 1957)[27] Another variant of this suggestion was the option to government to purchase any patent at a reasonable price if it was interested in making it available for general use.

c) The proposals for giving prices, bonuses are said to be as old as the patent system itself (it is important to mention that opposition to the monopolistic features of patents have not come from socialists but mainly from economists believing in free enterprise and free trade).
d) Government should finance the research and development work so that if society wants some innovations it must pay for them in the first place.

In different countries, combinations of incentives system have been followed. Even countries having strong patent systems have recognized the importance of government's investment in research, national awards and in occasional cases option of compulsory licenses. The examination system has been for disclosure rather than for invention or novelty as in the case of Switzerland. Their experience has been that percentage of patent which worked in the national system was not very different from the international patent system. Machlup quotes the famous analogy of the automobile brakes. These permit the motorists to drive it with greater speed. Unlike the real brakes in the motor, the patents put brakes on others regardless of "how fast or cautiously they proceed". He concludes that based on the evidence available till then, the implications for strengthening or weakening different features of patent law will not be same for a non-industrialized country or a newly industrialized country or US. In the post GATT phase, the consensus has veered towards harmonization of patent laws across the countries though some exemptions and more lead time has been given to the developing countries. The history only shows that the debate being witnessed now is not new and has never provided unambiguous answers.

Coombe (1998) reviews the interface between intellectual property, human rights and sovereignty in the context of indigenous knowledge and conservation of biodiversity. She reviews the universal declaration of human rights, International Covenant On Civil And Political Rights (CCPR) 1966, and International Covenant on Economic, Social and Cultural Rights (CESCR) 1966. In the context of IP, CESCR provides that an author can benefit from the protection of moral and material interest resulting from any scientific, literary or artistic production. Historically the civil and political rights, she observes, were believed to be absolute and immediate whereas the economic, social and cultural rights were thought to be more "programmatic" in nature such that these could be realized gradually. The former were considered justiciable while the latter were considered more political in nature. She quotes Scott Luckie who argues about the permeable nature of many of the human rights that, "should have long ago laid to rest sentiments divorcing, rather than merging, civil, cultural, economic, political and social human rights" (Luckie 1998)[28]. Despite the fact that most countries who are party to CESCR do not view the intellectual property rights same way as other rights enshrined in CESCR. When reporting to the committee on the realization of rights under Art. 15, the state is asked, she adds, to describe the steps it has taken to realize, "the right of everyone to take part in the cultural life which he or she considers pertinent and to manifest his or her own culture. All the 130 states, she adds, "are party to the CESCR have international human rights obligations to ensure that the intellectual property rights recognized in their jurisdictions are established, granted, exercised, enforced, licensed, and otherwise used in a

[27] Walter Hamilton, The Politics of Industry, New York: Knopf , 1957, p.70
[28] Scott Luckie, Another Step Towards Indivisibility: Identifying the Key Features of Violation of Economics, Social and Cultural Rights, 20 (1), HUM, RTS, Q 81, 82 (1998)

fashion that does not infringe upon the human rights recognized in the two international Covenants." Despite the fact that about 130 countries have ratified the convention of biological diversity, which mandates under Art.8j the use of local knowledge, innovations and practices through involvement and approval of local communities, the tensions on this account remain.

The application of IPR laws to traditional knowledge and innovations hinges on the conceptualization of the traditional or indigenous knowledge itself. Brush includes all folk of popular knowledge preserved in local and traditional practices as indigenous knowledge (Brush, 1996). Agrawal (1995) decries the tendency to view indigenous knowledge as a counterpoint to western or scientific knowledge. This has been very obvious to the readers of Honey Bee newsletter for over ten years. Honey Bee Network has questioned this dichotomy and has always argued for building bridges between formal and informal science. The assumption is that science is a post-industrial revolution western construction. Studies by Needham on the evolution of science and technology in China and the research work on plant science by Mazumdar (1925), and Singh and Verma (1969) clearly demonstrates that the localization of knowledge takes place through practice in different parts of the world. Likewise, the scientific principle of refutability, generalizability and falsifiability have been at the core of scientific knowledge produced by local communities. Mere abstraction or lack of it does not confer on a practice, a label of a superstition or a conjecture. Lack of causality, likewise, is not a limitation just of local knowledge. The use of aspirin for headache has been a modern scientific knowledge for a long time without our knowing till recently, how did aspirin actually reduce or remove the headache. So far as abstraction is concerned, there is much of agronomy and other plant sciences in which empirical knowledge is generalized without providing the entire rationale of a given practice. Farmers have produced such knowledge for ages. So long as this knowledge produced predictable, functional and context specific results (some of which were also context free), the scientific basis of the knowledge remained only to be articulated. This became essentially an issue of logic and language. Boiling milk at least three times till it comes to brim without spilling over by alternate heating and cooling has been an old practice for extending the life of milk. By doing that at frequent intervals of few hours, one could keep milk fresh for days without using refrigerator. Women farmers and the villagers who developed this method of keeping milk fresh for long did not articulate the underlying principle or the theory, as was done by Louise Pasture (adding a condition of pressure as well). The practice did not become unscientific because the underlying rationale was not articulated in the modern scientific language. Thus the issue is of generating vocabulary which helps connecting different knowledge systems recognizing in the process, the limitation and strengths of each. There is no question about peculiarities of method, some of which dissolve on careful scrutiny. For instance, many good breeders considered breeding as much an art as science in the sense that they always looked for plant/s that matched their selection criteria – a function that many traditional farmers also performed while selecting their varieties. Some methods of developing scientific information are common among local communities as well as formal scientific institutions. Grafting to improve the horticultural plants, selection to improve self-pollinated crops as well as some of the cross-pollinated crops, selection followed by bulking and again selection iteratively are also common methods of plant breeding, crossing has also been attempted by farmers, plant protection methods, agronomic practices, etc., share a great deal of commonality in approaches in the two knowledge systems. The criteria of evaluation of course differ quite significantly. Local communities may evaluate any technology on multiple parameters which may include concern for soil, water, long term sustainability, etc. However, in some cases, the shortsightedness of formal scientific systems is also seen in the local knowledge systems.

The issue is not that one is independent of other. After all, chilly, tomato, tobacco, potato and many other crops were introduced in Asia only about half a millennium ago. The local knowledge evolved around these crops in due course and with great cultural, socio-economic and socio-ecological variability. The point is that a local community whether settled from outside or evolved indigenously in a given region does not have any compulsion to test its technologies over a wide region. Therefore, given the closer fit between local technologies and the specific ecological conditions, generalizability across large spatial units may be poor by design. This does not make the specific practices any less scientific.

Coombe (1998) acknowledges, "that opposition between dominant and indigenous culture are often over-simplified, blurring the actual fluidity and permeability of knowledge and cultural boundaries. Just as dominant cultures appropriate knowledge from indigenous ones, indigenous knowledge itself contains knowledge shared between cultures, as well as information brought by colonists, settlers, and traders." This view, as I said before, has been the basis of our movement in Honey Bee network but also that of a few other attempts (Warren (1989), Varma and Singh, 1969). Dr. Y.P. Singh who guided some of the earliest post-graduate theses on indigenous knowledge in mid-60s had raised the issue, 'whether indigenous animal husbandry knowledge was relevant today (Ibid, 1969)'. He has guided another doctoral thesis(bu Dr Hira Nand) on indigenous dryland agriculture knowledge in mid-70s. The tradition of building bridges between different knowledge systems is quite old. Gaya Prasad Singh, (1915) had drawn attention to the practice of storing potato seed on the heep of coal in Frankfurt, Germany and compared that with the local practice of storing seeds under the cot in a diffused light and relatively cold environment. This concept was later popularized globally by International Potato Research Centre (CIP, Rhoades, 1984). There are many other researchers such as Mauris Iwu (1989), Atte, Paul Richards(1985), Hiranand(1979), etc., who have tried to pursue the same line of thinking.

DeWalt (1994) reinforces the notion that "those who use and develop indigenous knowledge systems (mutables immobiles) and those who develop and apply scientific knowledge system (immutable mobiles) are constrained by the way in which they have been trained to think and contexts in which they live. The key is to provide both knowledge systems with more opportunities in which they can inform and stimulate one another" (1994:128)[29]. Thurston (1992) has demonstrated the potential of doing so in the case of plant diseases. The TAPP database developed by him traces the local and ancient knowledge on plant diseases documented over last 500 years. Richards (1985) showed similar potential in case of rice, pests and many other agricultural practices. Warren (1991a, b) has also argued for similar need of complimentarity among formal and informal knowledge systems.

The tension on the issue of applying intellectual property right laws to local knowledge, innovations and practices also stems from the conceptualization of the local knowledge as essentially cultural and community construction. Posey and Dutfield (1996) conclude after a review of various IPR instruments and their applicability to different kinds of local knowledge that, "IPR laws are generally inappropriate and inadequate for defending the rights and resources of local communities. IPR protection is purely economic, whereas the interests of the peoples are only partly economic and linked to self-determination. Furthermore, cultural incompatibilities exist in that traditional knowledge is generally shared and, even when it is not, the holders of

[29] Billie R. DeWalt, 1994, Using Indigenous Knowledge to Improve Agriculture and Natural Resource Management, Human Organisation, 53, (2), 123 – 131.

restricted knowledge probably still do not have the right to commercialize it for personal gain". They suggest instead a concept of Traditional Resource Right (TRR) which recognizes, "the inextricable link between cultural and biological diversity and sees no contradiction between the human rights of indigenous and local communities, including the right to development and environmental conservation" (1996:95). It is obvious that intellectual property right systems never evolved to deal with various other rights that are included in the bundle of TRR. The contributions specifically dealing with intellectual capital are covered by the intellectual property rights. So far as the rights of the communities are concerned which are collective and deal with knowledge produced in past, these may have to be dealt with new instruments. The Community Intellectual Property Rights (CIPR) were articulated by Crucible Group (1994) to enable local communities to assert their "rights to seed" such that no outside company or institution could use their knowledge or resources without their permission – a proposition which is in line with Article 8J and some aspects of FAO's Farmers Right Concept. The Crucible Group also suggested a need for national legislation, an international database for tracing germplasm possibly through CGIAR system and appointing a `public defender' to mediate or act as ombudsman (1994). The Third World Network (Nijar, 1994) suggested a model Community Intellectual Right aimed at preventing the privitisation and usurpation of the rights and knowledge of the communities to be called as, "Community Intellectual Rights" (CIR). It was further proposed that local community leaders who would act as trustee of the community and the farmers rights would be held in perpetuity because knowledge and practice evolved over long period of time as the community evolved. A `registry of invention' was also suggested with which the community biodiversity register (Kothari, Ashish, Pathak, N, Anuradha, R.V., and Taneja, B., 1998, Gadgil, Ghate and Rao, 1999) could be linked. This knowledge would lie in public domain. Subsequently, Ghate, Gadgil, Rao (1999) have modified the concept to include only public domain knowledge in the community registers and mentioning the name of local experts (but not their knowledge or innovations) in the register. This was in response to the suggestion by Gupta (1998) that by recording the knowledge of experts in the public domain register, the intellectual property rights of the experts will be exhausted. So far as CIRs are concerned, the purpose of preventing others from patenting will be achieved by publishing the local knowledge and making such publications available to the patent offices.

Stephen Gudeman believes that IPR are another form of market forces which would further erode an already endangered commons (1996)[30]. He does not believe that technical essence of a local knowledge can be abstracted from the context of its use and tested in laboratory to develop something of common use. He argues, only partly correctly, that if scientists could not validate a particular knowledge, they might consider it faulty. He observes, "The scientists draw a distinction between *res cogitans* (thinking being without spatial extension) and *res extensa* (material things as extended substance) – between the mental and the material, intellect and emotion, knowledge and context (1996:112-13). Undoubtedly, what Stephen has argued has an element of truth. Large number of scientists (in fact majority of them) have treated local knowledge in such a manner. At the same time, the fact that 74 percent of the plant derived human medicines are used for the same purpose for which local communities discovered their use (Fransworth, 1981) proves that scientists have not hesitated in drawing upon the useful, valid, and abstractable local knowledge when it was appropriate. Obviously the evidence only shows how much great the potential is of using local knowledge even out of its strict socio-cultural context. To what extent the users of traditional and local knowledge have contributed to the growth of the very knowledge

[30] Stephen Gudeman, Sketches, Qualms, and Other Thoughts on Intellectual Property Rights, in VALUING LOCAL KNOWLEDGE : Indigenous People and Intellectual Property Rights, S.B. Brush & D. Stabinsky, eds., quoted in Coombs, 1998, Op.cit.

system which generated tremendous commercial returns, is a valid issue and we will revert to it later.

WIPO – UNESCO (1985), Model Provisions for National Laws on the Protection of Expressions of Folklore Against Illicit Exploitation and Other Prejudicial Actions, was supposed to help national governments in enacting laws to provide protection to folk knowledge and also folk varieties. However, the only reason one can speculate, may have been responsible for widespread neglect of these provisions even by the developing countries is the lack of willingness of most developing country governments to check the domestic exploitation of folk culture, art and varieties. In the post-CBD phase, many countries are trying to correct this distortion.

Coombs (1998:107) agrees with the proposal of Gupta (1997) that "every patent office in a Western country should insist that the patent applicant declare that the knowledge and resources used in a patent have been obtained lawfully and rightfully". The lawful acquisition will imply that the prior informed consent and approval and involvement of local communities and creative individuals have been ensured, assuming that the donor country has laws requiring such consent and approval. The rightful acquisition involves ethical enquiries into the corporation's compensation practices. She feels that Western governments who are party to the major human rights Covenants should ensure that "private parties subject to their jurisdiction do not violate the human rights of others, such a premise is congruent with commitments to rights of subsistence, to enjoy the fruits of one's labour, privacy, environmental sustainability, and cultural integrity (although not all of these rights are necessarily implicated in every such taking)". She feels that the lawful and rightful disclosure requirements may be awkward, if not politically impossible, to enforce particularly if it was to be imposed as an absolute barrier to the patent protection. She suggests that in the shorter term this requirement need not include any minimum criteria. For instance, she suggests, "a corporate applicant might simply disclose that the source country impose no legal consent requirements, and that it has made no arrangements for compensation. To the extent that this information is made part of the public record and published by member State governments, it would provide leverage for indigenous peoples, NGOs, concerned consumers, interested citizens, and the media to put political pressure on patentholders to improve their research and development practices congruent with developing human rights norms. Over time, some corporations might recognize the publicity values and goodwill to be accrued by greater transparency and might set increasingly higher standards to develop market distinctions" (1998:108).

Dutfield (2000)[31] in an extensive review of various initiatives including peoples biodiversity registers, community intellectual rights, SRISTI's local innovation databases, concludes that the relevance of international IPR regime to the CBD is beyond doubt (2000:125). The questions which he feels are unresolved include:

> (1) It is not certain that increased availability of IPR protection will automatically lead to greater levels of innovation in society. Innovation and creativity flourish in many parts of the world without any (western) IPR laws. [32] On the other hand, allegations are increasingly made that too much IPR protection of basic research is stifling innovation (see Heller and

[31] Graham Dutfield, 2000, Intellectual Property Rights, Trade and Biodiversity: Seeds and Plant Varieties, IUCN and London: Earthscan Publications Ltd.

[32] The knowledge, innovations and practices of indigenous peoples and local communities, for example, are rarely if ever protected by intellectual property rights.

Eisenberg 1998); (2) The role of intellectual property rights in the erosion of agro-biodiversity has been the subject of some polemical debates, yet we still do not know how far biodiversity is affected by intellectual property rights for seeds, plant varieties and/or agrochemicals. But it can be argued that we cannot afford to wait for conclusive proof one way or another before making decisions on the design of environmentally-sound intellectual property rights. It is vital to consider whether and how the precautionary principle may be applied in the IPR context to minimize the risks; (3) Some evidence suggests that most technologies supportive of biodiversity conservation are in the public domain. However, with respect to those which are not, it is unclear whether intellectual property rights hinder or encourage their transfer to developing countries; (4) It is widely accepted that the application of traditional knowledge and technologies can add value to genetic resources. While patents are clearly unsuitable mechanisms to protect the rights of traditional knowledge holders, the use of other intellectual property rights may in some circumstances be feasible.

So far as the issue of erosion of agro-biodiversity as a consequence of use of IPR is concerned, the evidence in the post-green revolution era in most developing countries is quite unequivocal. The erosion has been caused primarily by the public sector induced high yielding varieties, none of which have been protected by either the patents or plant variety acts since the same have not been applicable. In the Western societies, this supposition may have been valid. It is also true that large number of private seed companies and traders have used advanced lines as well as new varieties developed by public sector R&D labs without any reciprocity of compensation or payment of royalty. The result has been that public sector R&D institutions have had to depend primarily on government for resources and thus their creativity and autonomy have been adversely affected. The application of different kinds of intellectual property rights would have made these institutions recover returns on their investment in R&D and in due course have more dynamic and vibrant organizational culture. Obviously, so far as the right of communities and local farmer breeders is concerned, it would require specific institutional innovations to reduce transaction costs and at the same time enhance incentives for contributing their know-how and resources to the public and private R&D institutions where applicable. In many cases, farmer bred varieties can generate incentives for the individual farmer breeders provided they can protect their intellectual property and use it for commercializing their innovation or disseminating it without any cost to others[33]. The response to other questions requires adaptation of the current IPR regime which CBD and WIPO are currently exploring.

Blakeney (1999[34]) reviews various mechanisms for the protection of indigenous knowledge and seems to endorse the suggestion of Gollin (1993) to make it obligatory for any user of biodiversity to pay a fees to the personal group that discovered or traditionally used a particular specie through

[33] Whether the farmer innovators disseminate their innovation through commercial channels or non-commercial channels should be their decision. We have no right to impose our value judgment on them. There is no reason why when an author can copyright her books, a musician can gain from the sale of copyrighted cassettes, a company can benefit from the commercialization of patented technology, only farmer innovators should be expected to disseminate their knowledge and resources without any claims on the benefits that flow to users of their knowledge or innovations. The knowledge rich economically poor innovators cannot be expected to subsidize the society which on its own does not contribute anything either for conservation of agro-biodiversity or for ensuring that conservators of biodiversity do not suffer economic disadvantage vis-à-vis the cultivators of high yielding varieties.

[34] Michael Blakeney (Ed.), 1999, Intellectual Property Aspects of Ethnobiology, London: Sweet & Maxwell.

access legislation. Lesser (1998[35]) suggested that a registry of traditional uses of genetic material be maintained in sufficient detail to permit their identification. Koon (1998[36]) regrets that the current patent act of Malaysia does not have any special provision for protecting traditional knowledge, method of treatment in traditional medicine, products and processes. He has suggested a proposal to introduce a special provision in the patents act to protect the end-products of traditional medicine and treatment. However, he favours a *sui generis* system which should ensure that larger public interest must have precedence over commercial interests. He also suggests that traditional medicine and treatments should be available to society as these have been available for generations. In Brazil, Wolff (1998[37]) describes, the bioprospecting legislation no.1235 of July, 1997 of the state of Acre and law no.0388/97 of the state of Amapa. In the law of the state of Acre the bioprospecting was allowed subject to an Agreement of Access including the state, the applicant for access and the furnisher of traditional knowledge or the domesticated agricultural crop. The state was represented by the Department of Environment of the state of Acre. The law also provides that "no individual rights of intellectual property registered inside or outside the state which are universal knowledge held by local communities or which have been acquired without certificate of access and the state exit licence will be recognized" (1998:178[38]). The state law of Amapa forbids the utilization of genetic resources for research, conservation, or commercial or industrial applications that do not have the access certificate. Bill No.306/95 dealing with the recognition of the rights of indigenous person to intellectual property rights arising from bioprospecting activities was introduced by senator Silva. It was approved by the Senate on November 4, 1998 and is currently under evaluation by the National Congress. The Bill creates a Commission for Genetic Resources and provides for fair compensation among applicant, access agency, furnisher of traditional knowledge and other parties to access contract. Article 36 provides that a contribution would be made to a special fund from the compensation amount for strengthening conservation, research, and inventory of genetic resources. An interim ministry group offered a substitute bill in August 1998 which provided, "less stringent regulation so as to allow an exchange of information. It acknowledges the right of traditional knowledge holder in deciding upon access of third parties to the information regarding such knowledge, and assures the local indigenous communities' right of participation in the distribution of benefits arising out of the use of such knowledge" (1998:180). Williams (1998)[39] reviews the issues in New Zealand with particular reference to Wai 262 claim presented by multiple tribals about Maori knowledge systems and their protection of sacred wisdom. The Waitangi Tribunal established by an act of Parliament is hearing the claim and no decision reportedly as yet has been taken. Blakeney, while reviewing the position in Australia, cites two recent cases *Yumbulul v. Reserve Bank of Australia*[40] and *Milpurrurru v. Indofurn Pty. Ltd*[41]., in which intellectual property law failed to recognize the communal interests. In the first case concerning *Yumbulul*, the representatives of the

[35] W. Lesser, 1998, Sustainable Use of Genetic Resources under the Convention on Biological Diversity. Exploring Access and Benefit Sharing Issues, Wallingford:CAB International, 127-135.
[36] Ong Chui Koon, 1998, Intellectual Property Protection of Traditional Medicine and Treatments in Malaysia, in Blakeney (ed.), Op.cit. 155-172.
[37] Maria Thereza Wolff, 1999, Indigenous Peoples and the Protection of Genetic Resources in Brazil in Blakeney (Ed.), Intellectual Property Aspects of Ethnobiology, pp.173-182.
[38] Maria Thereza Mendonca Wolff, 1998, Indigenous Peoples and The Protection of Genetic Resources in Brazil, in Blakeney, (ed.) Op.cit., 175-181.
[39] David V.Williams, 1999, Traditional Knowledge Systems and Intellectual Property Rights "Talking Past Each Other": Current Issues in New Zealand in Blakeney, (ed.) Op.cit., 123-138
[40] (1991) 21, Intellectual Property Reports 481.
[41] (1995) 91-116, CCH Australian Intellectual Property Cases, 39,051

Galpu Clan located in north-east Australia tried to prevent Reserve Bank from reproducing the design of Morning Star Pole on a commemorative bank note. The Pole reportedly had been created by one of the member of the Clan, "who had obtained his authority and knowledge to create the Pole through initiation and revelatory ceremonies. In view of the Galpu, the individual artist was obliged to the community and thus the Clan could prevent the use of the design of the pole in a culturally offensive manner. The trial judge felt that the artist who had created the pole was within his rights to dispose off his intellectual property rights through a legally binding agreement. He lamented that, "Austrialia's copyright law does not provide adequate recognition of aboriginal community claims to regulate the reproduction and use of verbs which are essentially communal in origin"[42].

In *Milpurrurru* the damages were awarded by the court to a number of Aboriginal artists for breach of copyright by those who wrongfully reproduced their designs on carpets. The major problem in this context is that many indigenous communities do not view their heritage in terms of property but consider it as a community and individual responsibility. Further the ethnobiologists have put lot of knowledge of indigenous people in the public domain – a position which we have criticized separately. He views that collaboration of indigenous people with ethnopharmacologists may not qualify to be called as joint invention – a position which is not true in many cases.

David Downes, [43]Senior Attorney at Center for International Environmental Law (CIEL) recently communicated to the author for possible endorsement an appeal submitted to USPTO, December, 1999 which made several suggestions for reform at USPTO such as,

> (1) the PTO procedure should be amended to make clear that each patent applicant must disclose any knowledge they obtained from an oral tradition, as part of the general requirement that an applicant disclose any knowledge that is materially relevant to patentability; (2) In addition, the PTO should require patent applicants to carry out their own search of prior art embodied in traditional knowledge systems, and provide the results in their application. They should also disclose the country and exact geographical location from which the knowledge or resources were acquired, and certify that the knowledge or resources were acquired in full compliance with local laws of the source country; (3) Under the current rules, a patent examiner evaluating an application must perform a search of all the available prior art in the form of journal articles, databases or other publications in the relevant field of technology. Examiners should review all public sources likely to contain such information, such as databases and registries of traditional knowledge, to ensure that each aspect of an applicant's claims represents a truly inventive step. The comments will give examples of publicly accessible databases and journals that could help the PTO identify patents that claim to be new inventions but in fact are part of the prior art found in traditional or informal knowledge systems; (4) The United States is a party to the Patent Cooperation Treaty (PCT). The PCT gives more liberal treatment to traditional knowledge that is eventually recorded in written format than does the current practice of the PTO. Accordingly, we suggest that examiners more fully integrate PCT guidelines governing international and international-type searches into the normal examination process for domestic patents; and (5) CIEL, COICA, and the Amazon Coalition have successfully argued in their challenge of the ayahuasca (Banisteriopsis caapi) patent that the mounted plant specimens in herbaria of United States museums and universities accessible to

[42] (1991), 2 Intellectual Property Reports 481 at 490.
[43] David Downes, 1999, personal communication

researchers constitute "printed publications" and thus are prior art that can bar a patent. For plant patents based on specimens that originated in developing countries, examiners should routinely consult expert institutions to determine if herbarium specimens exist that may be materially relevant to the novelty of the claimed plant variety.

Many of these suggestions are in line with the earlier suggestion by us (Gupta, 1995,1998,1999) in terms of (a) requirement of patent offices to ask every applicant to certify that application for patent includes claims based on 'lawful and rightful' access to local /traditional knowledge and resources, and (b) non patent prior art available in data bases like Honey Bee or Biodiversity Registers or other forms of national registers is taken into account.

Sadjo (1992) suggests, drawing upon the work of property rights theorist Demsetz (1967) and Coase (1960) that the externalities generated through the inefficient market outcomes of access to genetic resources may be "corrected" through negotiations among the affected parties particularly if transaction costs are not very high. The contractual arrangements may be able to specify various concerns that each of the party to the transaction may have as distinct from the approach of deriving these concerns through property right laws. Swanson (1998)[44] looks at the property right issues in the same context and observes, "existing IPR system creates incentives to invest in R&D at the end of the industry (the plant breeding sector), but is not generating investments in the earlier parts of the industry (the genetic resource providers)". This happens, Swanson suggests, because (a) farmers in developing countries do not have property rights on their genetic resources and have no direct incentive to invest in diversity and (b) plant breeding industry located primarily in the developed world did not feel it necessary to justify their own independent investments in conservation of in-situ diversity in developing countries because of lack of control or rights over this diversity in developing countries. In an earlier study, he found that around 55 per cent of breeders felt that having an in-house collection of germplasm was better and gave more stability than investment in in-situ conservation. The remaining breeders considered cost to be important factor. And he considers lack of incentives for seed industry in developed country to invest in developing countries as a case of "property right failure". This formulation has obvious limitations because lack of property rights need not be the major barrier to investment in conservation of in-situ diversity. The contractual arrangements, as suggested by Sadjo above could to some extent achieve the same results, so long as the developing country governments provide legitimacy to these contracts and help in their enforcement. The argument that efficiency needs ownership, is valid but it can not be the argument that efficiency needs private ownership in each case. After all there is enough literature to show that common property right institutions can generate very efficient and viable outcome given three sets of appropriate rules that is dealing with (a) boundaries, (b) resource allocation and when conflict arise in implementation of both kinds of rules, then (c) rules for conflict resolution (Gupta, 1984, 1998). Ostrom (1993) elaborates this system of rules in much greater detail and considers clear demarcation of boundaries in addition of eight kinds of rules to be necessary concomitants of sustainable CPRs institutions. The point still remains that seed industry need to learn ways of dealing with local institutions having customary rights rather than well defined property rights. It is true that recognition of community rights in the national legislation will be a prior condition for legitimizing the contractual mode of agreements and possible investments by seed and other biotech industries in the in-situ conservation. For the

[44] Timothy Swanson, Property Rights Issues Involving Plant Genetic Resources: Implications of Ownership for Economic Efficiency, CSERGE Working Paper GEC 98-13, Norwich: University of East Anglia

sake of argument, one can even suggest that the users of biodiversity need to deal with current diffused status of property rights in developing countries with much greater responsibility and reciprocity rather than using this ambiguity as an excuse for not fulfilling ethical and institutional responsibilities towards conservators of diversity (given the provisions of CBD)

Ben-Dak (1999) prefers compensation at the enterprise level instead of general level of human infrastructure while looking at community compensation process. He suggests that licenser participates with the local partners in the production of value added products and shares or retains certain distribution rights with the licensee. He also suggests that product development assistance be provided as a part of initial compensation with the group providing knowledge and resources. He describes the experience of global technology group of UNDP in collaboration with Centre for Scientific Research into Plant Medicine (CSRPM) based at Mampong – Akwapim in Ghana. Initial phytochemical screening by the CSRPM in collaboration with HealthSearch Inc.,(HIS) a US based company of *Capparis erithrocarpos* reveal dose dependent analgesic and antipiratic effect. Through various contacts mediated by GTG, CSRPM entered into a licensing agreement and patent process with HIS. Finally the HIS applied for patents on Capparis derivative in US and as a result original CSRPM members became a stakeholder in a newly acquired company called as Ghana Industrial Holding Corporation's GIHOC Pharmaceutical Company Limited. The net compensation for the IPR were, "the capacity building in Ghana, the transfer of technology to Africa, the (soon) new availability of medicine continent wide and the fostering of local entrepreneurship (Ben-Dak, 1999:169)[45]".

Leisinger considers urgent evolution of binding national and international regulation as necessary for fair compensation to the gene-rich developing countries. He also recommends that in the absence of "binding national regulations, seed corporations should not take a free right but look at the issue in the way of tacit licensing agreement and set aside the usual percentages of sales for the support of agricultural research in developing countries (1999:143)[46].

Richard Gerster (1998) looks at the issue of intellectual property rights from the point of view of European NGO rejecting the further extension of worldwide patent protection. Likewise, he also argues for elimination of obligation under Art.27.3 of TRIPS agreement to provide protection for plant varieties[47].

Sherwood, Scartezini and Siemsen (1999) make several recommendations for increasing inventiveness in developmental countries. Those who pursue and inventions in developing countries should be able to access the international literature on the subject while planning their

[45] Joseph D. Ben-Dak, 1999, Rights, Compensation, Indigenous Knowledge Systems and the Strategy of Global Intellectual Property Management: The Challenge in Thomas Cottier, Peter Widmer and Katharina Schindler (Eds.) Strategic Issues of Industrial Property Management in a Globalizing Economy, AIPPI Forum Series , Abstracts and Selected Papers, Oxford: Hart Publishing.

[46] Klaus M.Leisinger, 1999, Ethical and Ecological Aspects of Industrial Property Rights in the Context of Genetic Engineering and Biotechnology in Thomas Cottier, Peter Widmer and Katharina Schindler (Eds.) Strategic Issues of Industrial Property Management in a Globalizing Economy, AIPPI Forum Series , Abstracts and Selected Papers, Oxford: Hart Publishing.

[47] Richard Gerster, 1998, Patents and Development: A non-governmental Organisation View Prior to Revision of the TRIPS Agreement in The Journal of World Intellectual Property, Vol.1.No.4,pp.605-619.

research, should have access to risk capital, and be able to get support of well trained patent attorneys. They recommend that (a) patent should be granted rapidly even before technical examination, (b) rely generally on examinations performed competently elsewhere, (c) add local technical information to existing global databases and (d) facilitate easy and early access to global databases for local inventors. The patent offices also should also postpone their fees under certain conditions to promote inventiveness. They feel that if these recommendations were accepted in developing countries, inventors would be able to reduce and postpone patent acquisition cost, will file high quality patents and will also be able to mobilize funds[48].

Merges and Nelson (1990)[49] in an extensive review on the economics of patent scope issues recognize the depressing effect of a very broad patent on other inventors to stay in the invention game. Their view is that the information disclose in the patent application should be matched with the claims being made by the examiners. This is an extremely important point given the tendency in recent past to have highly broadbased patents issued in European countries and US. It becomes relevant in view of the January, 19, 2000 ruling of US appeals court, which, "determined that seeds, as well as the plants grown from them, are patentable under 35 U.S.C. 101. Pioneer Hi-Bred International Inc. v. J.E.M. Ag Supply Inc., No. 99-1035. Although the patent office had been granting plant and seed patents, it was not until this ruling that patentability was firmly established.[50]" The breeders will not be able to use such patented plants for further breeding. This will also affect the rights of the communities which may have conserved the germplasm and thus may have provided 99 per cent of the unchanged germplasm of the patented seed. It will be useful to take this issue up during the negotiations under TRIPS in the next trade round.

The empowerment of local knowledge experts will require building bridges between the excellence in formal and informal science. Reform of TRIPS is thus a process involving reform of knowledge producing and networking institutions in any society. The process of producing or defining new knowledge having industrial applications is closely linked to the mechanism for its protection. The kind of growth that has taken place or is likely to take place in a given sector or field of technology, invariably influences the evolution of legal system to protect the property rights in that field. For instance, the emergence of biotechnology influenced the kind of protection researchers in the field have been able to obtain in US and other European countries. Likewise, developing countries will have to view their comparative advantage in various fields of knowledge, appreciate the mechanisms of recognition, reproduction and networking of this knowledge and provide appropriate incentives through intellectual property rights as well as other instruments. The collective intellectual property rights have a specific meaning in the context of developing societies where a large majority of people still survives primarily through access to natural resources. It is in this context that reform of TRIPS becomes a process of reforming the knowledge producing, reproducing and networking mechanisms.

The asymmetry in rights and responsibilities of those who produce knowledge, particularly in the

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[48] Robert M.Sherwood, Vanda Scartezini and Peter Dirk Siemsen, Patents for Third World Inventors: Proposals for 21st Century Improvement in Patent World, May 1999 (http://216.3.116.71/PW/artres.htm)

[49] Robert P Merges and Richard R Nelson (1990), On the Complex Economics of Patent Scope, The Columbia Law Review, 90:839.

[50] Victoria Slind-Flor, 2000, Plants Protected by Patents:Federal Circuit's ruling clarifies confusion in the law, The National Law Journal, January 31, 2000.

informal sector, and those who valorize it (in the formal sector) has become one of the most serious and contentious issues. There are possibilities of securing some of the interests of grassroots innovators and traditional communities within global trade regimes, provided the ethics of extraction can be factored into the calculation of respective incentives or disincentives for cooperation among different stakeholders. To do so, some of the fast-emerging and expanding technologies like information and communication technologies (ICTs) will have to be adapted to the needs of local communities and individual grassroots innovators.

Some of the issues in the context of benefit sharing are:

A) To what extent has the generation of awareness about rights of traditional communities and grassroots innovators among various stakeholders been effective in changing the way business is done? It seems that professionals like scientists and academics have been far more proactive than the corporations in this regard (Shaman pharmaceutical is one of the few exceptional companies). Most mainstream companies have so far shied away from making any bold attempt to tilt the scales in favour of local communities.

B) Have the norms of benefit sharing acquired the status of a professional value? For instance before accepting a PhD thesis, a certificate is generally taken from the student that s/he has acknowledged all the contributions in the research work. However, a similar declaration is mandatory for the researchers and commercial users of indigenous knowledge that they have made due acknowledgements and reciprocal arrangements with the innovators. The norm of acknowledgement of local knowledge has not become a professional value among germplasm collectors as well as ethnobiologists.

C) What combination of monetary and non-monetary incentive would be optimal for which kind of knowledge systems and innovations and under what institutional arrangements? Unless such a contingent framework is developed, it is unlikely that most users of biodiversity will be able to initiate benefit-sharing experiments.

D) We do not know what level of intellectual property protection will make local knowledge systems vibrant and buoyant. Is it possible that fears about the erosion of local knowledge increasing due to its valorization are unfounded?

E) What are possible reasons for such a dearth of information on experiments around benefit sharing? Why are so few people trying to pursue these experiments? Why aren't consumers of value added products in Europe and other Western countries as conscious of the rights of local communities and grassroots innovators as they are about the rights of animals?

F) What is preventing NGOs and Governments in developing countries from initiating benefit-sharing measures on their own among the various institutions within the country? Why should domestic arrangements of benefit sharing as attempted by Tropical Botanical Gardens Research Institute (TBGRI) and the Honey Bee Network not take place in many countries rather than await the resolution of North-South conflicts?

G) The consumers of herbal and other products have never demanded fairer contracts with the local community. This indifference stands in contrast to the boycott of beef burgers in the U.S.A. some time ago to discourage environment-unfriendly rearing of beef in Latin America.

H) What is the perception of local communities and innovators themselves on the issues of benefit sharing?

There are several ways in which indigenous knowledge, innovation and practices can be protected so that the informal knowledge systems continue to grow and symbiotically interact with modern science and technology:

a. Reforming IPR systems to make them accessible for small grassroots innovators.
b. Overcoming informational asymmetries in formal and informal knowledge systems through IT applications.
c. Establishing dedicated green venture promotion funds and incubators for converting innovations into enterprises.
d. Reforming the mandate and responsibility of CGIAR institutions to make it obligatory for international agricultural and natural resource management institutions to accord priority to adding value to local innovations.
e. Rethinking and redefining the role and responsibility of international financial institutions and United Nations agencies with respect to ethical, institutional and financial support for grassroots innovations and local knowledge systems.

Making IPR systems accessible to small innovators and local communities[51]

The debate on the relevance and appropriateness of the conventional IPR regime for plant varieties, products based on knowledge of local communities and individual informal experts, and the use of local biodiversity (even without use of associated knowledge systems) has become very emotive in recent years. Many NGOs and activists see no merit in the IPR regimes for providing incentives to local communities and creative individuals. They term the attempts of the large corporations (generally multinational corporations (MNCs)) to access biodiversity without sharing any benefits with local communities as 'Biopiracy'. Many others oppose IPRs because these are supposed to commodify knowledge which reportedly was `always' in the public domain for universal/local benefit. The high costs of hiring patent attorneys are also supposed to make the present patent system out of reach for grassroots innovators. The absence of any institutional framework in most developing countries to (a) provide information about IPRs, (b) extend help to obtain patents for individuals or communities and (c) oppose the patents by others on the knowledge traditionally known to local communities, have further alienated the moderates and hardened the attitudes of the conventional opponents.

The arguments of those who do not see any hope in the existing IP systems, and the provisions of the TRIPS Agreement in particular, can be summarized as follows:

a) All the knowledge held by the people about the use of biodiversity for treating various ailments of humans and animals, producing vegetative dyes, developing local land races, etc., is held in common by the local communities. This knowledge is supposed to have been transferred by one generation to another over very long periods of time with (or without) some value addition by successive generations.

51 Based on Gupta, Anil K , 1996, Rewarding Creativity For Conserving Diversity In Third World: Can IPR Regime Serve The Needs Of Contemporary And Traditional51 Knowledge Experts and Communities in Third World? a Paper presented in AIPPI Forum (September 10-14, 1996) on Ethical and Ecological Aspects of IPRs, Interlaken, Switzerland, on 13 September, 1996 since published in Cottier et al,, 1999.

b) The knowledge should be held in the public domain and should not be allowed to be monopolized by MNCs (though the behaviour of the public sector and of private, national drug companies is no different from the MNCs).
c) The relevant existing intellectual property rights regimes, in particular the patent system, evolved for the protection of industrial inventions and are therefore not suitable for biological processes and products.
d) Since the knowledge of various plants has been developed over several generations, why should the present generation be entitled to reap all the rewards if any?
e) Why should governments be entitled to any benefits from the commercialization of patented products when the resource and the knowledge were actually provided by individuals or communities?
f) While process patents can be provided, product patents impede research, generate excessive monopolies to one or a few inventors, make the technology or products out of reach of common people due to price increases, and discourage the expertise of successful reverse engineering in Third World countries.

There are many other arguments on ethical and efficiency grounds against the patenting of life forms and also against the products derived from common knowledge without any reciprocity towards knowledge generators or providers in one or more countries.

Dimensions of the role of intellectual property rights in benefit sharing among communities as well as individual healers.

1. Not all the knowledge held by people in biodiversity rich economically poor regions and communities is (a) traditional, (b) carried forward in fossilized form from one generation to another (rather it has been improvised by successive generations), (c) collective in nature, and (d) even if known to communities, is reproduced by everybody.
2. Knowledge of considerable economic importance is produced, reproduced, and improvised by individuals and also in recent times, i.e through contemporary innovations.
3. The traditional knowledge should receive certain kinds of protection if incentives have to be generated to conserve not only the knowledge but also the institutions of its reproduction and inter-generational transfer.
4. Given the high rate of success in formal research based on locally identified uses of plants and other components of biodiversity, the transaction costs of formal Research and Development (R&D) systems in private and public systems are reduced considerably. The R&D institutions should in turn share the benefits that may accrue from commercialization of derived and protected products. In some cases local communities or individuals, as the case may be, should be considered co-inventors of the new, value added products.
5. The newness and non-obviousness of a traditional knowledge should be seen in the light of available repertoire for that particular purpose. If the prior art in a given field of knowledge does not provide documentary evidence of a technology evolved by a local community as a part of its traditional knowledge system, should that knowledge having industrial application be not considered new and inventive for the purposes of patent protection?
6. The local knowledge should qualify to be considered new for the purposes of prior art since outside communities/companies may not have had access otherwise. The norms regarding the destruction of novelty due to publication of local knowledge should be reconsidered and modified so that incentives to share the knowledge by local communities

with outsiders are not affected adversely. A special grace periods should be provided. European Union has been discussing the issue of one year grace period given to inventions published in the preceding year. US already has such a grace period. What is being proposed here is that traditional knowledge published, say in last five years may be allowed to be protected so that the local communities do not feel betrayed by the researchers who documented their knowledge and exhausted their rights through publication without their informed consent. The period after CBD may be covered by the grace period.

7. Large number of local experts are extremely knowledgeable though very poor. They know far more than anybody else in their respective villages and have expertise to prepare various solutions. Others may know about it but they may not have contributed to it, except by giving an opportunity for testing. To that extent they should have a small share in the benefits and entitlements. But the entitlements of an expert could not be at par with the rest of the community. What kind of blending must be done among individual incentives as well as community rewards can not be specified in a generalized manner. It may vary and should be done on a case-to-case basis. More research is needed to specify the conditions under which one may need more emphasis than the other.
8. Every patent office should insist that the patent applicants declare that the knowledge and resources used in the relevant invention have been obtained lawfully and rightfully.

This implies a need for regulations in developed and developing countries requiring full disclosure by any corporation or an individual seeking patent protection on a plant-based drug or any other natural product. The disclosure should provide that the source material has been *rightfully* and *lawfully* acquired. 'Rightful' acquisition would involve moral as well as ethical issues in access to biodiversity. For instance even if a local community has not asked for any price for sharing the material or the knowledge about it, is the corporation bound by an ethical conduct to set up trust funds and other forms of reciprocity for local communities? Is it incumbent upon it to ensure that the superior ethics of local communities remaining poor despite conserving biological diversity and the knowledge around it does not become a reason for perpetuating their poverty, and thus endangering the survival of diversity itself ? The responsibility of the developed countries is higher and thus reforms should take place there immediately. In the developing countries given the poor infrastructure, the process of reform is bound to be slow.

'Lawful' acquisition implies that prior informed consent and approval and involvement of local communities and creative individuals has been ensured, provided that the biodiversity donor country has laws requiring such consent and approval. If a country does not have any such laws, as for instance India, then acquiring any material will be lawful or legal but may not be rightful.[52] Cottier (1999) has suggested the need for negotiating a concept of TIPS (Traditional Intellectual Property Rights Systems) in the next round of TRIPs review. In some parts it is similar to Community Intellectual Property Rights systems and in other parts it is akin to the conventional

[52] This argument has arisen in the context of Art 15.5 as well as Articles 8(j) and 10(c) of Convention on Biological Diversity CBD). Prior informed consent is required only of parties to the Convention i.e the contracting nation states and not of the knowledge and resource providing communities. Under Article 8(j) however, the approval and involvement of local communities and individuals is required for ensuring the equitable sharing of benefits. Whether that will happen at all will depend upon the legislative environment and local institutional capacity in each country. Whether the institutions, which deprived knowledge-rich, economically poor people of their basic rights and needs, would let any benefits trickle down to them will depend upon the access of such people to alternative frameworks of negotiation and mutually agreed terms.

patent systems except that it resolves the public domain and prior art issues by considering traditional knowledge new and inventive so long as it is known only to a small group of people.

Downes and Laird, 1999, acknowledge what many commentators feel are the inherent contradictions among the existing system of intellectual property rights with traditional cultural property rights and customary law[53]. They suggest, "geographical indications and trademarks have the potential to respond to some of these concerns more effectively than do other intellectual property rights. Rights to control trademarks and geographical indications can be maintained in perpetuity. They do not confer a monopoly right over the use of certain information, but simply limit the class of people who can use a certain symbol". Geographical indications and trademarks, they add, can be used by producers to differentiate their products, according to various criteria such as the sustainability or traditional nature of production, and thus create specific market niches and appeal to the consumers.

Downes and Laird (1999) look at the registries of knowledge as ordered collections or repositories of information. In view of the increasing use of registries by indigenous peoples and local communities "as tools to promote, protect, and either claim rights over or prevent appropriation of traditional knowledge in the form of of databases — "compilation of data," in the terms of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization (WTO). They recognise the problem that arises when oral knowledge of local communities and innovators is converted into electronic format through various mediations by formal scientists and others, such that the final text gets influenced by the culture and knowledge systems of mediators. They review the SRISTI's registery and also the one by the Inuit of Nunavik and the Dene in Canada while looking at IPR options for protecting the same. They summarise their concerns while suggesting future options as:

> Thus, any future steps to define legal rights relating to traditional knowledge in databases will need to respond not only to concerns about protection of database makers interests — and not only to concerns about protection of indigenous and local communities interests in their knowledge — but also to concerns about the broader interest of all social groups in access to and exchange of information.
>
> An additional problem is that the sui generis rights desired by database owners extend beyond the conventional scope of copyright, such that owners would have rights to prevent others from using information even when that information is not creative or new, simply because it is contained in the database. Similarly, indigenous and local communities' interest in traditional knowledge extends beyond protection of new information to encompass protection of knowledge that has been held for as long as centuries, simply because it is held by the given community. A corresponding expansion of intellectual property rights could take a great expanse of information out of the public domain. While specific database owners and communities might benefit from such protection, society as a whole — including indigenous and local communities — might suffer from vastly expanded restrictions on access to the growing amount of information taken out of the public domain. If nothing else, special measures to protect indigenous and local communities' knowledge

[53] See, e.g. Kari-Oca Declaration 1992; Indigenous Peoples' Earth Charter 1992; Mataatua Declaration 1993; Greaves 1994; Brush 1996; Posey & Dutfield 1996; COICA/UNDP Regional Meeting 1994).

should be designed carefully so that they respond specifically to the interests and values relating to such knowledge and communities, and do not go farther(Downes and Laird, 1999).

This brief overview provides a context in which the case studies presented in the next part may be appreciated. It is obvious that key actors in each of the case study have not been aware of all the implications of the IP laws as well as ethical and equity implications of different kind of institutional arrangements for benefit sharing.

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