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Cradle of Creativity:

The case for in situ conservation of agro biodiversity and the role of traditional knowledge and IPRs

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Anil k Gupta[1]

Agro-biodiversity in any specific ecological context emerges trough the interaction among human preferences, natural selection pressures and larger social and institutional considerations. There are major catastrophic events such as droughts, severe floods and other natural calamities which might lead to not only extraordinary changes in the agro biodiversity conditions or the local agro ecological characteristics but also to major migrations. The intermingling of agricultural biodiversity from different regions has gone on for millennia. Human preferences have played a prominent role in selection but many times in highly ecologically stressed regions, the selection was made by nature and human beings adapted to whatever seeds or plants which survived. It will be useful therefore in any study of agro biodiversity to look at the pattern in the use of agro biodiversity within the variable field conditions as influenced by medium or long term agro ecological changes. Such studies would require a longitudinal or a long term monitoring of agro biodiversity for which we have not had any institutional infrastructure created in the country. This is perhaps the only study where we had the opportunity to revisit the same region after a interval of 10 years to see the changes at plot and sub plot level in the preferences of farmers as influenced by agro project conditions.

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The agro biodiversity is influenced by several factors operating at different levels social, cultural and institutional factors. It is well understood that taste is a major driver of human choice in some of the crops more than in others. But taste itself evolved out of social cultural practices influenced by the survival strategies. For instance in high altitude Himalayan regions, most Buddhist communities eat meat though Buddhism is one of the most devote religion to non-violence and preservation of life. Social institutions have emerged which permit for instance, eating of meat but not hunting of animals. Special social groups are allowed to hunt or rear animals for meat purposes. The selection of crop varieties in such regions is obviously influenced by the agro ecological conditions but also by the compatibility between food of crop or tree origin vis-à-vis that of animal origin. Need for high calories in a cold temperate environment further influences the human preferences. Just as lack of preference for milk influences the selection of varieties in which fodder may not be an important concern in some of the South Indian regions. The coastal communities relying on fish express different preferences for plant and animal origin food because of obvious compatibility implications. Therefore social factors are also shaped differently in various geo physical and agro ecological conditions. The coastal community on Western coast of India vis-a-vis eastern coast of India have contrasting practices and preferences in many regards.

Ecological Factors:

Micro agro ecological factors: The agro climatic and micro ecological factors are influenced by the natural or human made infrastructural modifications in the physical conditions. For instance making a road without culverts for cross drainage may influence the water holding capacity of a specific niche and thereby change the local ecological conditions. Similarly the changes in the drainage profile because of construction within the village or around it may change the area and velocity with which water may drain. I remember an example in an East Indian village where a particular variety of rice was grown in a specific low line pocket because water drained at high speed from this region. Only a variety with the strong root system capable of withstanding high speed water would have survived in this pocket. There was no choice but to grow such a variety.

Modification of cultivation conditions:

Conservation through modification of agronomic practices: However, one should get an impression that farmers only cope and adopt and adjust with the constraints so created in the environment. They constantly modify the environment itself to making cultivation possible of different kinds of varieties. One of the most famous example is ridge and furrow system in Central India where there are heavy clay soils. Given high rainfall in the region, without providing for drainage, cultivation would not be easily possible. Likewise in Saurashtra dry land region with light soils and low rainfall, permanent set and furrow system has been developed for groundnut in which the moisture retained in the furrows and crop is cultivated on the slightly raised beds. Similar physical arrangement with characteristics variations in different kinds of agro ecological conditions provides a rich understanding of the context in which agro biodiversity has evolved.

Modification of Soil Properties: The modification of the soil topography and other properties due to various natural and other human induced factors also influence the micro ecological conditions for conservation. These modifications can take place through public policy for land leveling or watershed development or through natural factors such as land slide, siltation through flooding or tidal waves or erosion. In Southern Bangladesh in Barisal region it was observed by the author during 1986 and that due to siltation, the flooding level had changed. The rice varieties requiring higher level of inundation could no more be cultivated. Similarly, the tidal waves influenced the movement of water during day and night as well as during different phases of lunar cycles and accordingly interacted with the soil level and other properties. In some of the eastern Indian plains large scale deposition of sand and or silt through flooding or changing of the course of the river as also influenced the conditions for conservation of germ plasm.

Socio-economic and cultural factors:

Dis-entangling the class and eco-specific factors in choice of technology: Modification of human preferences can take place sometimes according to class and at other times ecological considerations. In a study (Gupta 1985, Nadira et al. 1985) effort was made to disentangle the class and eco specific factors in the choice of technology in this case of crop varieties by different social groups. Cultivation of sweet potato on rivarine lands, *chaur* lands (small islands in the river) was eco specific. That is rich or poor both would cultivate the same crop given the agro ecological suitability for the given conditions. However, in the upland conditions around the homesteads, it was generally cultivated only by the most poor people. In fact the nursery for sweet potato was grown on the homestead often less than 20 or 30 cents with the understanding that if land on lease became available, it will be cut and transplanted in the given plot or else one would try to get some food out of the vines in the homestead. For such poor people in Bangladesh who could not afford even rice in the lean season, sweet potato was the only food they could afford.

Social status of low economic value dry land crops: The conservation of agro biodiversity is also influenced by the mindsets, values and socio psychological context of the self-esteem. Some of the local crops and varieties (for instance minor millets, also called as inferior millets) are going down in consumer preference because these are not the foods, the rich and better off people in society consume. Dr. Geerwani, an eminent nutritionist and home science scholar once mentioned that only way one could conserve many of the local varieties of dry land crops was by putting these crops and their products on the table of the elite. There may be some truth in it. The curriculum in primary and secondary education also includes references to such crops in a manner that generates disdain towards them. The lower status of a crop or a variety may have nothing to do with its nutritive quality, fit with the agro ecological condition or its role in overcoming hunger and conserving environment.

Paying attention to etymological roots of the local name of varieties: As mentioned elsewhere local names provide useful clues in some cases to the most important

characteristics of the farmers variety which may have led local committees to select that variety. For instance *'sathiya'* variety of paddy indicates a maturity period of 60 days. Similarly tolerance to flooding level, colour of the grain, storability, tolerance to floods or drought or salt etc. suitability for early sowing or late sowing or for poor or rich fertility conditions, mixability with the other crops for growing as inter or mixed crops, vulnerability to birds being high or low etc. or some of the characteristics which may be indicated by the local names. While systematic studies of such names have been done for fish biodiversity, author is not aware of many studies for agro biodiversity. Lack of attention to such selection criteria may prevent breeders from improving the suitability of local germ plasm through improvement for modern market needs. It is not that breeders have not pay attention at all. The important characteristics such as high salt tolerance, flooding, level or drought tolerance etc., are indeed taken into account while developing breeding programmes. However, some of the final characteristics which may have much more important role in developing niche markets have not been given enough attention.

Cultural mechanisms for conservation: Certain rituals, festivals and traditions play an important role in conservation of agro biodiversity. For e.g. the tradition of eating Echnocloa colonum (popularly known as *sama* or *samo*) on a particular day of fast in North Western India has generated an institutionalized demand for a grain of this plant. It grows as a weed in rice crop but in some areas it is grown as a crop also. Likewise, there are several other similar rituals which require specific varieties of crops for specific functions or on particular days. During various *shodh yatras* (journey on foot for eight to ten days for exploration and celebration of grassroots creativity) we have discovered many uncultivated plants which are used by women in various recipes. Apart from providing the source of stress foods i.e. food during stress periods when other grain or vegetable crops are not available, these are provide specific nutritional inputs. Sometimes these are grains or vegetables required for ceremonial purposes or for health reasons.

Consumer preferences:

Consumer preference and crop characteristics: It is interesting to see how sometimes farmers are unable to modify the genetic characteristics of a land race but they modify the cultural practices to generate the output needed by them. Once while walking through farmers homestead in Tangail region of Bangladesh during 1985-86 along with a young bright researcher viz. Nurul Alam, we observed a lady (unfortunately I don't recall her name) who was de-rooting the vines of sweet potato before readying them for transplantation. When asked, why was she doing it, she provided a very interesting insight which plant breeders and agronomists have persistently ignored. She said that if all the rootlets at each node of the vine cuttings were allowed to stay and grow into sweet potatoes after transplantation, the sweet potatoes would be long, thin and have thinner skin. The consumers in the market preferred round potatoes which would be the case if she left only a few rootlets in place. Further the round tubers would have thicker skin, increasing in the process, storability of the tubers. She did not have to sell these faster and even at low prices. Also she could store these for longer period for self consumption or for sale. The factoring of consumer feedback takes place even by the poorest agro biodiversity conservators but only when consumer demand and preference is a motivator for the same. There are many cases in which absence of consumer demand acts as a great disincentive for conservation.

Consumer demand for bio diverse crops: In an earlier paper exploring the question 'why regions of high biodiversity have high poverty?' (Gupta 1990), I had pursued this issue. Among various reasons for high poverty in such regions, the fact that consumer demand for irregularly shaped, variously colored fruits and vegetables was much lower than the uniformly shaped and colored fruits and vegetables made a difference to the incentives farmers had to cultivate diverse land races. There were also structural reasons behind the consumer demand. How many different kinds of tomatoes or gourds would a vegetable vendor be able to display on a small vending lorry or roadside shack. Of course if there was a strong consumer demand, vendors with different kinds of tomatoes would find it profitable to specialize. Such a demand has unfortunately been going down with increasing popularization

of aesthetically pleasing, even if taste-wise poorer, high yielding varieties of fruits and vegetables. There are other reasons for consumer lack of preference for diverse agro biodiversity products. The improved varieties are often grown in better endowed agro climatic conditions. These are provided chemical inputs particularly pesticides. Consumers apparently prefer pest free products though the ones eaten by the pest are likely to have no pesticides residues or low residues.

Suitability for food processing: It is well known that taste and preliminary characteristics of food have been a major influence on the evolution of selection criteria of particularly women who often select and store the seed. Sometimes even the local names of variety signify suitability for such purposes. However, gene banks generally do not record the local food processing properties for which a particular farmers variety is preferred or known for. In the absence of such characterization the ability of food processing industries to generate demand for specific varieties is very limited. The lack of demand, as is obvious, acts as disincentive for conservation.

Policy Induced disincentives for conservation:

Implications of Price, Procurement and distribution support: Public policy for food procurement and distribution is another factor that contributes to the erosion of agro biodiversity. The public requirement has mainly proposed on wheat and rice in India and accordingly the public distribution system (on which many poor people rely) has also provided only these grains for consumption. Under food for work programme for generating employment in lean season wheat and rice are mainly has been given as wages in coin. For last almost thirty years distribution of wheat and rice, has generated demand and taste for wheat and in some cases for rice. The market for local grains gets suppressed particularly in rainfed regions which is where the agro biodiversity is found in abundance. Improved varieties of sorghum though yield higher, yet do not have enough storability and thus are not suitable for procurement. Government has not developed procurement system to other local crops and their varieties. Thus on one hand taste for wheat and rice has been developed

even in the regions where these crops are not grown at all or enough and on the other, lack of procurement support depresses the demand for local grains. In some of the states such as Andhra Pradesh where rice distribution at Rs. 2 per kg has seriously depressed the demand for sorghum and many other millets. Once the demand goes down the erosion of agro biodiversity inevitably follows.

Neglect of storability criteria: The crop breeders have also neglected storability has a selection criteria or one of the breeding objective in crops. Some years ago in a meeting on conservation on agro biodiversity I had asked Dr. Mangesha, then chief of Germplasm Conservation, ICIR, Hyderabad, whether they had characterized their germplasm on storability criteria. He replied that storability was not an issue in sorghum. However, earlier studies in Maharashtra had shown that hybrid sorghum grains when distributed under employment guarantee scheme has part wages for work, this was rejected by the farmers because of quality deterioration during storage. At the same time some other participants in that meeting in Chennai informed that one of the local variety of sorghum had a name called as Irangu Chollam. I had asked a question as to whether there was any Sorghum variety known for its storability. I was informed that '*Irangu'* is derived from '*Erumbu',* a tamil word which means iron. This variety is known for its storability and supposed to last long as an iron piece does and is red in colour similar to the rust on the iron. Such gaps between the objectives of the breeders and public policymakers on one hand and farmers on the other who have to survive in these difficult regions illustrate an institutional impediment for conservation of agro biodiversity.

Organic agriculture as a means of promoting agro biodiversity condition: Much of the cultivation an extreme arid or semi arid some of the high altitude mountain regions or deep flooding regions is organic. Certification of these regions and crops growing therein as organic would help in getting the producers and conservators of agro biodiversity, incentive in the emerging market place. The constraint of these producers in affording inputs or in having input responsive varieties will in fact become an opportunity for conservation as well

as income generation. Lack of certification facilities is a serious disincentive for such producers in marginal environments.

Incentive for agro biodiversity enhancers: The Role of Farmer Breeders: Honeybee network has documented large number of examples of farmer breeders who have made selections, in natural diversity or artificially introduced diversity through crossing and developed new varieties. Protection of intellectual property rights of farmer breeders either as defensive protection or as an aid to potential commercialization, can be an important incentives. The fast track testing of such varieties at no cost to the farmer breeders in the countrywide varietal testing programme can be another incentive. Venture capital support to such farmers or licensees of their varieties for setting up seed companies could also help in dissemination of these varieties and thereby enrichment of agro biodiversity. In some cases farmers' varieties can be an important source of genetic traits. For instance a groundnut variety earlier called as *Morla* (peacock beak like) was developed by Thakershibhai in Saurashtra. It had two unique properties, namely strong peg and lack of ridges on the groundnut pod. Because of this, the general problem faced by the farmers at the time of groundnut digging of several pods remaining in the ground while uprooting the plants became less severe in the improved variety. The scientist of the National Research Centre of groundnut rejected the variety on account of lower yield but failed to use it as germ plasm for the two characteristics mentioned above. In an International Crop Science Congress held in 1988 at Delhi, ICRISAT scientists had acknowledged that they did not have good germ plasm for these two characteristics. Because of lack of ridges the soil did not get attached to the pod and thus digging of groundnut was facilitated. In another case, Dhulabhai had developed a pigeon pea variety which had a red or pink flowers, apart from high yield and early maturity. Unlike the conventional varieties with yellow colour flowers, this new variety did not attract many pests. And thus saved the cost of pesticides. Likewise there are large number of other varieties developed by the farmers reviewed elsewhere. These indicate the potential farmer breeders have for enhancing agro biodiversity. It may be added that farmers varieties are not always based on improvement in land races. Many times they select mutants from improved variety population also.

Part two: The case for IPRs as one of the many incentives:

Generally when we deal with the issue of traditional knowledge three aspects have to be kept in mind:

a. Traditional knowledge as evolved by people to cope with various stresses and challenges around them. In many cases, institutional norms, ethical values and cultural codes also evolve along with traditional knowledge. While some of the knowledge bits perform very specific functions of solving health, conservation or production problems, others help in shaping the broader worldview. With passage of time, some of these knowledge, innovation and practices survive in their functional forms and some as part of belief systems, in fact, even as superstitions. Not everything in the tradition need either be functional or even morally desirable. A healthy skeptic approach provides answers to the constant struggle, which takes place between traditional technologies and contemporary consumer needs. Not everything, which is rejected by the consumers, need be wasteful and likewise not every part of tradition carried forward by community members need be synergistic with demands of a modern rational and communitarian society.

b. Traditional ways of solving problems will always remain a powerful means of generating grassroots innovations and improvised traditional knowledge. Trial and error, keen observation, experiments and eye for detail contribute to many innovations at individual or community level. The tradition of invention is a continuing one. Though given the colonial history and defeatist mentality it might have spawned, many people may not recognize this tradition. The problem thus arises when many of these innovations developed recently or long time ago at grassroots level are not recognized or rewarded. Diffusion of such innovations

may not take place and people may struggle with the same problems that might have been solved in another part of the society. Farmers men or women might select an odd plant which eventually generates a new plant variety, or develop a new machine, or develop anew drug or use fat of fish for killing pests etc. These solutions might even be seen as contemporary grassroots innovations.

c. Traditional technologies many times involve modern materials, scientific concepts and tools. In many ways these innovations are quite similar to the innovations generated in the formal scientific and technological systems except the process by which these solutions are evolved. Fishing community develops a new use of dynamite for catching fish (a non sustainable means), farmers use soap solution (soap made of new chemicals and different from old natural oil soaps) for controlling pests, or potter uses concrete to make tiles for roof etc.

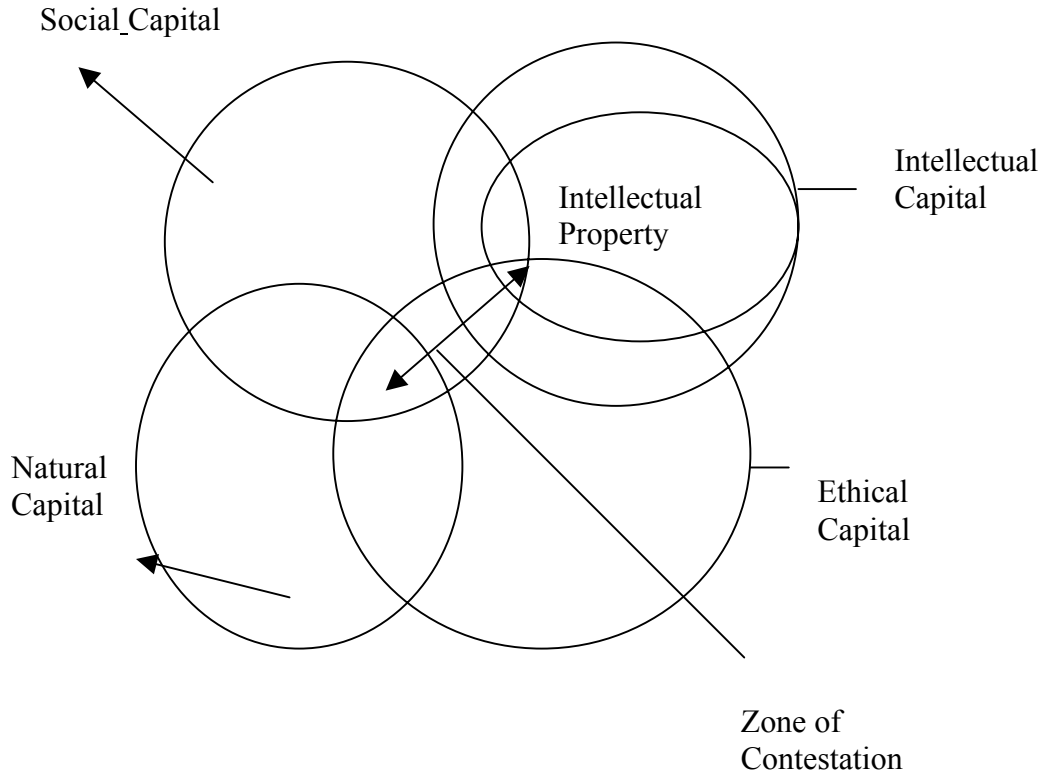
The values guiding these solutions also differ from some of the dominant values in the modern system. For example, most innovators generously share their knowledge, innovations and practices whether based on local resources, traditional technologies and tools or modern materials or tools. Because of this sharing, the users may benefit but the producers of knowledge do not, except in spiritual sense. However, that is the reason also perhaps why many of them remain poor. The children do not want to pursue the knowledge path, erosion of traditional knowledge takes place, and society loses a very valuable source of local solutions. May be, giving creative people their due will restore the respect for traditional knowledge and help in blending it with modern science and technology and produce valuable intellectual property.

Historically, natural capital was the first to be created when domestication of species began. Human kind used several approaches to define the property rights in natural resources. (a) Earmarking territories within which one group claimed rights for hunting food gathering or fishing etc. (b) evolving norms, values and rituals restricting the use of various species over time, space and social categories (c) Developing technologies for harvesting storing,

distributing or exchanging natural produce to extract economic and social rent (d) cultivation of crops, rearing of animals or managing fishing grounds through common property institutions or common poor resources (e) privatization of rights in land, or water or biological species reared on common property or open access territories (f) private assignment of rights in land and water and the natural resources found or grown in them (g) multiple layers or rights over same resource varying over time and/or space[2] etc. Given various ways of generating natural capital as shown in figure 1 some of it may overlap with social and ethical capital. The social capital involves evolution of norms, trust and reciprocities such that private transaction cost of using resources or internalizing the externalities go down. The ethical capital is the subset of social capital where institutional norms govern the way natural and social capital are used within the ethical framework evolved by the communities. The intellectual capital is the sum total of knowledge produced while generating natural social ethical capital. Only a small part of intellectual capital is governed by intellectual property norms, whether formal or informal or customary in nature.

[2] For instance if radioactive minerals such as uranium or precious metals are found underneath the private property land than state has a right to claim property rights on those resources in certain countries like India with or without compensation. Likewise an individual has a right to grow sandal wood trees on private land but does not have a right to cut them without government permission. In Bhutan individuals have right to kill an animal if it strays into the field and damages the crop but they do not have the right to kill the animals in the wild. Problems arise when an animal moves after having wounded on private land into the public land. There are communities which allow private rights in trees growing on community lands and vice versa. In Rajasthan, individuals having private water wells cannot refuse to give water to someone for drinking purposes. A private well becomes common property or open access for drinking water purposes.

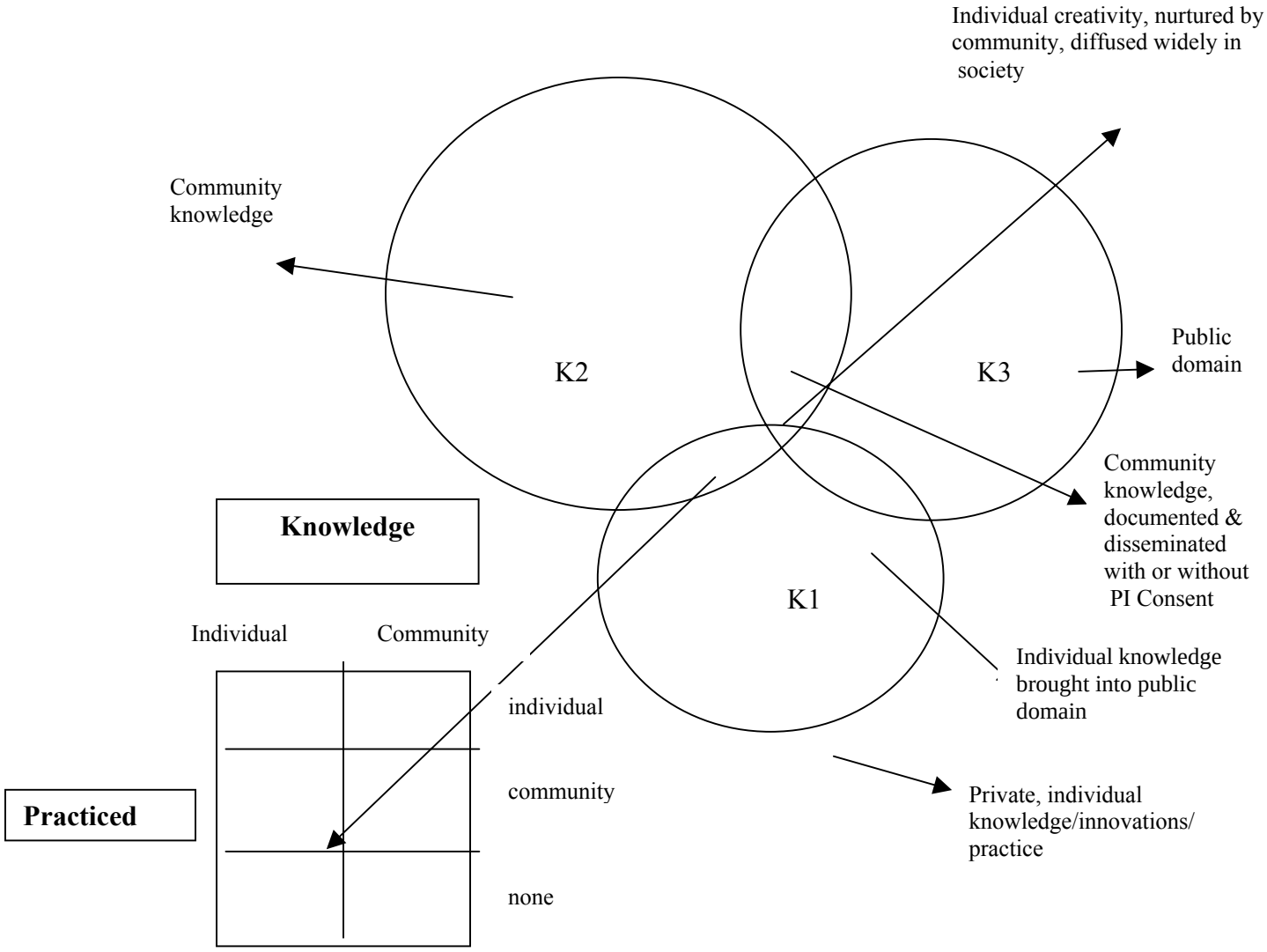
Figure 1: Relationship between natural, social, ethical and intellectual capital and intellectual property



Source Gupta,, 2001.

The evolution of intellectual capital can be understood through the interface among the private or individual driven production of knowledge, community based knowledge system and pubic domain knowledge systems (see figure 2). Various kinds of pathways through which knowledge systems can interact are given in Table one (Gupta and Sinha 2002).

Figure 2: Contested domains of local knowledge



Source: Gupta, 2001.

The three subsets in Figure 1 refer to the three overlapping domains of knowledge. Contestation emerges when the producers and users of knowledge have unequal access, ability and assurance about the resources and the benefits emerging from commercial or non-commercial usage of the resources with or without value addition (Gupta, 1995).

One of the issues which we intend to develop now is the relationship between property right regimes governing resources vis-à-vis the knowledge associated with these resources (see figure 3)

Resource right regime

		Private	Community	Quasi Public	Public
Knowledge right regimes	Private	PKPR	PKCR	PKQPR	PKPUBR
	Community	CKPR	CKCR	CKQPR	CKPUBR
	Public	PUBKPR	PUBKCR	PUBKQPR	PUBKPUBR

Figure 3

PKPR: Private resource and private knowledge right: If an individual has proprietary knowledge about the use or application of a particular plant or variety found only in her land, then the right to exclude from the physical property and intellectual property are privatized. It is possible that such a case may be very rare because single plant may not exist in one habitat alone. However, in Latin American and African context there may be individuals owning large tracts of land or water bodies having endemic biodiversity around which proprietary knowledge might be developed.

PKCR: Private knowledge around community resource: A healer may develop specific knowledge about the use of a plant or a fish or any other natural resource found in common property land or tank. The right to disclose, dispense or disseminate the

knowledge developed by this individual may be governed by customary knowledge rights such as trade secret or contemporary protection under INTELLECTUAL PROPERTY RIGHTS laws. Community may or may not demand any rent from the income generated by the concerned individual through use of this knowledge and the resource. It is also possible, as is generally the case, the concerned individual may not disclose the knowledge but dispense the medicine or any other service associated with community resource free of cost.

PKQPR and PKPUBR: Individual may likewise produce private knowledge about resources governed by quasi public (neighbourhood resources) or public resources such as public forest or public lake or public grazing land. The nature of right and its legal derivations may not vary much from PKPR except in the case when public authorities may govern the right of extracting resources from public properties. In such cases the right to use proprietary knowledge may be circumscribed by the access to public resource.

Iikewise, the implications of other subsets can be studied.

Part three: Incentives for *in situ* conservation and crop breeding by farmers

Farmer breeders make different kinds of contributions towards conservation, augmentation and development of agrobiodiversity such as (a) selection of landraces and their conservation in specific land use niches and for particular purposes, (b) identification of new agronomic and management practices which provide favourable conditions for the conservation of landraces and retention of specific characteristics of the crops, (c) identification of mutants and other off types which may have advantages in the changed micro ecological conditions, new consumer preferences or other market or infrastructural conditions for possible development of new varieties, (d) crossing of existing landraces with each other or improved varieties to develop new varieties, (e) introduction of landraces from one region into another to develop niche-specific varieties and in the process, developing or amplifying new characteristics expressed in the new introduced environment through recurrent selection, (f) modifying management practices

such that existing varieties of crops or fruits become competitive and thus survive against other competing crops and/or varieties and (g) developing new ways of propagating existing or improved varieties so that their survival in the stressed conditions becomes viable and thus those varieties get conserved. In addition, farmers have started in recent past even bolder experiments. The GM varieties of cotton released in an unauthorised manner last year in Gujarat have been crossed by enterprising farmers (oblivious of the environmental considerations) with existing hybrids and other cotton varieties hoping to introduce Bt. gene in the process.

Different kinds of breeding contributions require different kinds of incentives f(or disincentives, as in the case of gm crops) or individual and/or communities. Protecting intellectual property rights whether through patents, plant variety protection, geographical indication or a combination of these will be one amongst many incentives. The role of communities is predominant in the conservation of landraces except when only one or two farmers grow these varieties. Likewise, the role of individuals becomes paramount when specific crosses are made or individual selection criteria is used. Sometimes, the interaction takes place between the individual preferences and community institutions to influence the final outcome of agrobiodiversity. Only in a few cases, this interaction gets embedded in the technology, i.e., when a variety of this kind is grown, community cooperation becomes necessary. A case in point is when community develops norms for particular crop or variety to be sown on a particular date or after that date. It has implications for crop maturity, harvesting synchrony or absence of it, weed and pest infestation, etc. Scientists have discovered that some of these constraints may have become dysfunctional over a period of time, threatening the conservation prospect of specific varieties. For example, preponement of sowing some of the sorghum varieties was found to be an effective way to control striga in Andhra Pradesh by the scientists of Central Research Institute of Dryland Agriculture. Early sowing helped in better vegetative growth which did not let striga set flowers due to shade and thus no seed setting. In the next season striga seed load in the field was reduced. This is an example where institutional change is called for, to help in conservation of agrobiodiversity. Institutional Incentives may be necessary for technological innovations and vice versa.

a. Protection for Landraces:

The Plant Variety and Farmers' Right Act 2001 provides for the protection to extant varieties. Farmers, local communities or NGOs on their behalf can file application for protection. The Act also provides for compensation from the Gene Fund in the cases where the local varieties have been used for developing improved varieties or hybrids ought to be protected under the Act. The Authority administering PVFR Act has been authorised to pay the compensation, even before receiving any payment in the Gene Fund and then later recover it as an arrear of land revenue from the company concerned. Therefore, this provision does not merely deal with the protection of intellectual property rights of the local communities and farmer breeders but also provides for a compensation mechanism.

b. Filing Claims for Protection:

It is obvious that generation of data for fulfilling DUS requirements for PVFR Protection will not be possible for majority of the farmers and local communities. It was submitted before the Parliamentary Committee set up to discuss the draft bill that the Authority should be made responsible for generating the data and enabling the communities to seek protection for their varieties. This problem will remain with the farmer breeders all over the world. And accordingly, the solutions have to be found for generating this kind of information.

c. Fulfilling the DUS requirements for composite varieties:

It is well known that in rainfed regions farmers may grow composite varieties which require optimisation under varying environmental conditions. Uniformity may not be a preferred characteristic in such varieties nor can stability be checked in shorter term. Unlike the conventional approach of testing stability over three years, in such varieties

one would need to test the stability over six to nine years because of the inherent variability in environment. This is one of the major stumbling blocks in the way of conserving heterogeneous multi line varieties selected to cope with wide variety of conditions. The stability parameters are further influenced by the crop mixture or inter crop combinations. Testing these varieties under sole conditions would be self-defeating. Literature on plant variety protection has ignored these factors at national as well as international levels. As a consequence, public policy for intellectual property protection is not responsive enough to the needs of communities conserving evolving populations or various landraces in marginal environments. In mountain regions as well as in flood plains, same family of variety may include several eco types, i.e., sub-populations suitable for specific niches. One has to develop a cluster approach for characterizing such varieties. Because of obvious adaptive advantages, a few characteristics may vary within different sub populations of a variety selected for specific niches.

d. Duration of Protection:

Communities have conserved landraces over centuries and every subsequent generation may have made improvements in the given landrace. Question has been raised whether the current generation should reap all the benefits and secondly for how long should the benefit accrue. Just as copyright benefits are provided for fifty to seventy years after the death of the author, there may be a case for longer duration protection of plant varieties so that at least two generation may have incentives to continue to protect the variety and receive benefits through incorporation of these varieties in the improved seeds or horticultural plants. Since IPR rights are national sovereign rights, it does not matter whether multinational seed company has obtained a local Germplasm from an international gene bank or a CG centre. So long as this landrace is from within the country as in India, communities will have right to claim a share of benefits. It is a different matter that more and more plant breeders eschew the use of landraces in breeding programmes. Instead they use advanced lines improved at various CG centres or in private breeding farms. Identification of the contribution of landraces in the

pedigree of improved variety and their share in the potential benefits is not an easy task. A way to overcome this problem would be to generate funds through various means described herein later and use these to generate incentives for conservation. However, till the general problem is resolved, a specific problem of providing incentives through IPR protection will remain.

e. Protection of Farmer-bred Varieties:

Farmers make selections from the released varieties as well as from landraces, natural crosses and human made crosses. These crosses and/or selections are typical to the crosses followed by the mainstream breeders. The difference is that farmers may not be able to statistically analyse the genetic advance and also may not be able to systematically plan gene transfer. However, through their intitutive selection criteria and deep understanding of long term evolutionary processes they are able to blend the desirable characteristics. Honey Bee Network and National Innovation Foundation have large number of example of farmers bred varieties in annual as well as perennial crops. The problem of data generation and filing claims is as much relevant in these cases as in the cases mentioned above. SRISTI has submitted seeds of more than 400 landraces in a national gene bank at NBPGR, New Delhi for eventual characterisation and protection under NPVFRA. Other countries will have to evolve similar mechanisms for locating, recognising, rewarding and protecting of such innovations by farmer breeders.

f. National and International Technology Acquisition Fund: Expanding the Public Domain

There is no doubt that much of the economic changes as a consequent of green revolution have accrued because of the public domain nature of the technology and involvement of large number of seed distributors in popularising technologies. At the same time, it is also true that public sector R&D institutions more and more dependent on the state and central level bureaucracies for generating resources, some of which they could have easily earned through the licence fee from small and large seed companies and seed

corporations. Private sector seed companies have never shared even a part of their profit with the public sector R&D institutions. Given the possibility of protecting their intellectual property, it is hoped that public sector R&D institutions will generate more revenue and become less dependent on state bureaucracies. It is obvious that more autonomy will also promote greater creativity and proximity to the clients. There is a justified fear that too much emphasis on generating revenue can come in the way of development of self-pollinated varieties in which the seed companies may have limited interests. Earlier studies have shown that Farm Superintendents at research campuses have tended to stint while allocating land for conservation and augmentation of minor crops and other seeds for which market demand may be limited. Therefore, the goal of seeking autonomy through generation of revenue has to be matched with the goal of conserving minor crops and providing seeds of crops for which markets are weak.

Expansion of public domain is very important for crops and varieties grown by poor people and in marginal environments. However, the experience shows that state seed corporations and public agricultural departments world over have neglected the procurement, storage and distribution of seeds as well as grains of rainfed crops leaving the peoples in these regions vulnerable to the vagaries of market and environment. Public interest need not be served axiomatically by the public sector. This is a hard realisation which many NGOs and social activists have failed to realise despite availability of abundant empirical evidence in this regard.

Other Incentive measures for conservation:

g) Traveling grants or fellowships: selected conservators can be provide opportunity to visit research institutions, gene banks, other farmers in different regions to compare notes and select material. They could also use these grants for doing market research in different regions for their varieties.
h) Creating awareness: Festivals can be organized where different farmers (men and women) can be invited to show case the food preparations, varieties for sale and

other products to generate awareness, create demand and to promote lateral learning.

i) Mobile exhibitions of agro biodiversity, its preparations, unique properties small samples of seed and folk lore about these varieties, are shared through mobile exhibitions Profiles of the conservators are displayed in the form of posters. For individuals conserving diversity, this is a non monetary incentive but for those promoting conservation, it may be a monetary incentive.

j) Insurance funds can be set up either to pay the premia on behalf of the conservator of designated biodiversity to existing insurance companies or new insurance fund may be created specifically for this purpose.

k) Venture capital funds for investing in getting new product developed through partnership between public and private sector on one hand and farmers whether individuals or groups on the other. The venture of the risk capital would support enterprises at different scales which add value to local germplasm and thereby generated demand locally, nationally or globally. For instance, buck wheat grown in Bhutan has demand in Japan.

l) A small cess or tax be imposed on market arrivals of high yielding varieties in marketing committees or market yards to generate funds for providing incentives for conservation in non green revolution regions. Greatest erosion of agro biodiversity has taken place through pubic interventions through promotion of modern varieties. Given the low seed replacement ratios in most developing countries, a tax on seed may further affect the seed replacement ratio adversely. In any case the volume of seed sale is much lesser in most crops then the volume of crop harvest sold. Therefore the tax on seed will have to be much higher than the tax on market arrivals of high yielding varieties to get the same amount of revenue.

Other Policy Issues in protection of intellectual property rights

(A) National Level Policy

1) National Technological Innovation acquisition fund

There are always a few inventions and innovations which the concerned innovator (in private, public or informal sector) may not have wherewithal to scale up. Some of these innovations may need to be diffused for larger social good. For instance, improvements in design of kerosene stove which saves energy may be very vital for national interest but the concerned innovator (as is indeed the case with some of the innovators with NIF who have improved stove design) may have neither the incentive nor the capacity or both, to diffuse the design among large number of small scale manufacturers. Likewise, self pollinated crop verities improved by specific farmer breeders may need to put in public domain. But then who will invest in the diffusion of such technologies and why. A National Technological Innovation acquisition fund may be created to acquire the licensing rights of such innovations and inventions for eventual out licensing these at low or no cost to small scale manufacturers or seed companies under technological upgradation program.

2) Protection of Traditional Knowledge

Traditional knowledge systems help a very large section of our society not only survive against all odds but also generate in the process, some of the products, which might have national and global markets if properly developed. Within the Traditional knowledge systems, there are innovations and improvements by individuals and communities which need protection so that potential investors can have incentives to invest and recover one's investments. It has to be appreciated that if TRADITIONAL KNOWLEDGE is assumed to be in public domain, then there is no reason for any exploiter of this knowledge with in or outside the country to have obligation to compensate or reward the knowledge provider. Further, the TRADITIONAL KNOWLEDGE systems in many cases when blended with modern science and technology can generate immensely valuable solutions for societal problems and opportunities for improving livelihood

opportunities for knowledge holders. *Another very important ethical, moral and institutional issue is as to why should traditional knowledge holders be expected to disclose their knowledge with National Innovation Foundation if NIF can not protect their rights?*

Proposal: Systems of protection may require that any community or individual disclosing their knowledge for National Register on green Grassroots Innovations and Outstanding traditional knowledge may get provisional protection for say, ten years with maximum of five claims per innovation or traditional knowledge subject to the conditions:

(i) ***if any other community also claims the similar knowledge, then that community will be considered the co***-holder of the rights
(we will not like to encourage inter -community fights about this matter). We will also make assumption that unless there is some thing very unique, it is quite possible for similar solutions to emerge across communities over time and space for similar problems particularly when base resources, say same plants, exist in those regions.

(ii) ***The duration of protection may be extended if any further improvements have been made and disclosed***

(iii) ***It may be considered whether a small tax on every herbal and ayurvedic product and forest product import as well as domestic trade above a particular scale, be levied to collect the revenue for conservation, reward and information dissemination to traditional knowledge holders***

(iv) Local language databases (of such disclosed innovations and traditional knowledge as well as of patents issued on herbal knowledge) be developed of such claims which should be made available at district level for scrutiny by the traditional knowledge holders and tribal communities. Such a service must be insisted upon at international level also.

(v) All university and research institute scientists working on Traditional knowledge must be advised to use PIC form (see nifindia.org) with

whatever modifications MHRD may consider relevant so that they do not publish the results of their research without (a) sharing it back with the knowledge holders and providers, (b) consent of the traditional knowledge holders, and (c) ascertaining uniqueness of their results so that intellectual property rights protection opportunities are not missed. They must be obliged to share part of their pecuniary gains if any, through the licensing of such technologies produced through value addition in traditional knowledge, back with the specific communities or a national fund. This fund may be managed by non-bureaucratic body responsible for sharing it fairly and without much transaction costs with traditional knowledge holders.

(vi) All commercial organizations (such as Dabur, Zandu, Procter and Gamble) must be obliged to share part of their profits with the National Biodiversity conservation fund since they draw upon wild biodiversity (on which local communities depend and survive) without any reciprocity and responsibilities for conservation. This is important because traditional knowledge systems cannot survive and grow if the resource base on which they rest itself does not survive.

(vii) A national fund needs to be set up to promote filing of patents by grassroots innovators and TK holders internationally. NIF has facilitated five patents for innovators in US of which one has already been granted with the help of SRISTI and THT, a Boston based law firm without any fees to be paid.

3) Disclosure requirement in patent applications

The following suggestions need to be pursued at international level also. Every patent applicant is obliged to disclose whether the resource and/or knowledge obtained from third parties for developing the patent claims have been obtained lawfully and rightfully. The 'lawful' access would imply that whatever laws exist in the source countries, have been complied with. The 'rightful' would

imply that the prior informed consent of the knowledge providers has been obtained. It is obvious that India can plead for this change only if it brings it about within its own territory.

India should consider developing laws requiring such consent and disclosure by any domestic or international party proposing to work on traditional knowledge.

4) Product Patent

Product patents are must if traditional herbal knowledge system has to be valorised for generating new products and services for increasing social welfare as well as providing a new knowledge-intensive model of poverty alleviation and employment generation. It may be mentioned here that in a study of herbal patents done a few years ago, I had found that China had about 45 per cent share of the total herbal patents followed by Japan, about 20 per cent and Russia about 16 per cent. Most of the inventors were individuals and not corporations. The concentration of patent was very low and most people had protected only in one or two countries. Two other observations make this point even more important. One in five Americans has used Chinese medicine and in China, Chinese herbal medicine finds a place of honour in the chemist's shop unlike India where such medicines would generally be kept in an obscure corner. Without product patent, we cannot protect herbal knowledge in any significant manner. The TKDL provides only a defensive protection through disclosure so that patents on public domain Indian traditional knowledge are not issued by various patent offices in the world. This is a very useful purpose being served in a pioneering manner, but it obviously is an answer to a limited but important problem. The larger problem of protecting the rights of traditional knowledge holders remains unadressed by TKDL.

(B) International level Policy

5) International registry of sustainable technological innovations and traditional knowledge

SRISTI (Society for Research and Initiatives for Sustainable Technologies and Institutions) had made a proposal for INSTAR (International Network for Sustainable Technology Applications and Registration) in 1993. The purpose is to provide a low transaction cost system to innovators and traditional knowledge holders to obtain worldwide protection and have incentives for disclosure. Traditional knowledge holders in many developing countries which do not have capacity to set up such systems in next decade or two would suffer if such a registry was not there[3].

In TRIPS there is a provision for an international registry to be negotiated for wines and spirits. There is no reason why such a negotiation should only concern itself with the interests of a particular European country at whose behest, this clause was incorporated in the TRIPS.

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[3] National and international registry systems have been proposed to incorporate the elements of innovation patent system so as to provide incentives to local communities, herbalists and developers of plant varieties to share their knowledge without forgoing the benefits possible through intellectual property protection. The issue still remains as to whether knowledge produced over a long period of time through cumulative contribution of communities in a given region should get only a short duration protection and that too with limited claims. There are several other reasons why a registry may help the innovators and TK holders even if with shorter duration protection:

a) the possibility for potential investors, entrepreneurs and R and D partners to seek collaboration with innovators and TK holders would be very low if they did not have access to registry which would reduce transaction costs (TC) in the process,
b) the possibility of willing partners filing joint IPRs for longer duration may also be low if the registry was not there,
c) the technological obsolescence factor being high, many leads might not have much value if not explored within ten years any way,
d) the possibility of learning from one another might increase if there was a registry. Many times this goal gets neglected in the debate and to us in Honey Bee network, lateral learning among the local innovators and communities is a central concern. Surviving collectively is some thing that registry can facilitate.

The cost of filing patent can be very high. For example, a US patent application in 90s could be about 20,000 USD while in EU, it could cost twice that amount. However, this cost varies a great deal and in thirty two countries it was found to vary from USD 355 to 4772 in 1990s (Helfgott, 1993). We need to devise ways of reducing these costs for small innovators and traditional communities. INSTAR, an international registry might offer one way.

6) Geographical Indications and service Marks

The collective marks could also be utilized by association of healers, seed producers and others to provide guarantee about quality as well as authenticity of claims. Accordingly these could improve the prospect of market returns and consequent benefit sharing. These provisions can go a long way in safeguarding the traditional habitats and lifestyles without constraining these by non-sustainable livelihood strategies and poverty. It is obvious that if a particular production process and output does not derive any specific advantage from a given region, this might move to the locations where it is cheaper and more profitable to make it. Accordingly the local producers might have to emigrate to these regions where production now takes place or may have to become unskilled labourers in the other urban and rural regions. Patan silk is a good example, only three families are left in north Gujarat and one on Baroda which pursue authentic 750year old patan silk tradition. Rest all is unauthentic.

Lot of traditional knowledge and products have disappeared precisely through such erosion of opportunities associated with geographical regions. Most developing countries have not yet taken, steps to provide protection to the locally distinct and characteristic products and process based on value addition in local knowledge and bio diversity.

7) Sacred Marks registry at International Level

There have been many cases where sacred signs and marks of one culture have been used by another culture in an irreverent manner causing hurt and disrespect to other cultures. India should plead strongly for an international registry of such marks and also a general agreement that names and signs associated with God and goddesses venerated by any culture would not be allowed to be used in a disrespectful manner (some years ago, a US company had put such pictures on

toilette seats and in another case on chappals). Of course such respect should be shown domestically also.

8) Intellectual Property Information System

The ability of the local communities to avail of the existing intellectual property instruments depends considerably on their ability to access existing IP information in their own language and in a manner that is accessible to them close to their place of residence. Granting that much of the traditional knowledge is available in the ecologically rich regions where market forces and administrative support systems are weak. One has to recognize the complexity of providing IP information system in a widely accessible manner.

The essential elements of IP information system in such a context would include following institutional and technological arrangements:

a) A very wide information technology based communication network in some of the remote regions enabling community leaders and educational research institutions to scan prior IP existing on the plants, animal products or other associated knowledge or innovations innovated by these communities. In the absence of prior experience and training many of these communities would find it difficult to make sense of the IP information even if available in local languages.

b) Capacity building among the educational research community local NGOs and public service legal agencies for providing support to the local communities in searching and interpreting existing IP on the biodiversity, genetic resources and associated knowledge system.

c) It is to be expected that there would be many cases where traditional knowledge and or genetic resources have been obtained without prior informed consent, or developing mechanisms for sharing of intellectual property or any kind of benefits. Many of such cases could relate to periods

before CBD came into being and also before national sovereignty on biodiversity was recognized. It will be difficult for the local communities to recognize and appreciate chat they should not object to the violation of their ethical and intellectual property rights simply because the legal system was not in place to defend their claims in the absence of such rights. There could also be cases where the opposition could not be filed even if the patents have been issued in such cases using prior known TK of some specific communities, as was the case in ayahuasca (***Banisteriopsis caapi***) patent. The conventional legal constraints of the period within which opposition can be filed may have to be reviewed so far as it relates to the knowledge of communities.

d) The legal help to local communities to file objection in cases where intellectual property has been obtained on prior traditional knowledge could pose two problems: (1) if local community knowledge is considered prior art then it might facilitate questioning of some of the existing patents but it also might prevent seeking new intellectual property on the unclaimed intellectual property of the local communities, (2) it will be difficult to make the case that a plant found in many places could not have been identified as a source of a particular compound or use independently for which a particular local community had found the use. Therefore this issue of prior art is very complex. My own preference in the matter is that communities have more to gain by accepting that much of the local knowledge is considered outside the prior art definitions unless it is well known, and is in public domain through widespread practice. For all other cases
where knowledge is restricted only among a small localized community otherwise inaccessible to outside scholars or corporations, it should be considered a patentable subject matter.

e) The information system will have to have a national and international hub in such a way that national and international IP support organizations can play a role in educating as well as empowering local communities in dealing with a whole range of issues affecting their rights. In other words IP help desks

capable of handling queries from local communities in local language would need to be created to provide the support.

f) It is obvious that current capacity of WIPO and also national IP systems is grossly inadequate compared to the need of large number of communities all around the world. This has led to the widespread feeling of violation of rights among these communities. Many communities which do not support the concept of IP on their community knowledge would also like to make sure that others not authorized by them do not seek private individual IP rights on their knowledge. The IP information system which could be administered by WIPO should take care of the needs of such communities as well
Pilot projects for providing access to IP information system with the help of NGOs and willing national agencies need to be started to learn first hand various complexities involved in the task.