Indigenous Knowledge and Innovations for Managing Resources, Institutions and Technologies Sustainably: A Case of Agriculture, Medicinal Plants and Biotechnology

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Abstract

Communities living close to nature invariably evolve a language to understand and interpret the variations and discontinuities in nature. A flower of new colour, an unusually tall plant, an unseasonal germination or an extraordinary fruiting have attracted human attention in every part of the world. Some of these odd plants got selected either for curiosity or for a purposive characteristic and became a local crop variety. Some got analysed for their therapeutic property and became a medicinal plant. Some were combined with other plants, insects, fungi or other materials such as animal urine, milk, minerals or other compounds to develop various kinds of biotechnological products useful as drugs, dyes or derivatives. It is not surprising therefore that civilizational societies whether in Latin America or Asia or Africa have had a tremendously rich knowledge base drawing upon local resources.

In this paper, I first discuss the framework in which indigenous knowledge systems for agriculture, medicinal plants and biotechnology can be analysed. In second part, I suggest ways in which policy makers can try to blend the formal and the informal institutional contexts of technological knowledge. Lastly, I suggest some areas for further research, action and policy interventions through cooperative Indo-Brazilian and S African dialogue.

Indigenous knowledge and innovations for managing resources, institutions and technologies sustainably: A case of agriculture, medicinal plants and biotechnology [1]

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Communities living close to nature invariably evolve a language to understand and interpret the variations and discontinuities in nature. A flower of new colour, an unusually tall plant, an unseasonal germination or an extraordinary fruiting have attracted human attention in every part of the world. Some of these odd plants got selected either for curiosity or for a purposive characteristic and became a local crop variety. Some got analysed for their therapeutic property and became a medicinal plant. Some were combined with other plants, insects, fungi or other materials such as animal urine, milk, minerals or other compounds to develop various kinds of biotechnological products useful as drugs, dyes or derivatives. It is not surprising therefore that civilizational societies whether in Latin America or Asia or Africa have had a tremendously rich knowledge base drawing upon local resources.

But, the indigenous knowledge base does not restrict to only the local resources. Migrations, transportation of goods and services and wars or curiosity cross cultural travel have often led to introduction of new species in different parts of the world. A new plant, subjected to traditional ways of knowing becomes part of local knowledge system. In many parts of Africa, neem was introduced when Indian Prime Minister gifted neem plants in early 70s. Within few years, local communities discovered that the soap made by the oil of neem kernels was in great demand because of its properties to cure skin diseases – a knowledge which had existed in India for millennia. Many cultures have had

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to rediscover the knowledge that existed long time ago which because of various reasons including colonial rule got eroded. If erosion of local knowledge was explained only by external factors such as colonialism, the problem was simpler to solve. Most countries have achieved self-rule in the last thirty years. But the rate of knowledge erosion has increased in the post independent societies. Obviously, there must be endogenous reasons which are responsible for the erosion of knowledge as well as biodiversity.

In this paper, I first discuss the framework in which indigenous knowledge systems for agriculture, medicinal plants and biotechnology can be analysed. In second part, I suggest ways in which policy makers can try to blend the formal and the informal institutional contexts of technological knowledge. Lastly, I suggest some areas for further research, action and policy interventions through cooperative Indo-Brazilian and S African dialogue. The importance of strategic triangle of South Africa, Brazil and India in this area can be understood by the fact that all the three societies place extraordinary importance on transforming their polity in favour of the concerns that the common people have.

There is a personal reason why I feel very optimistic about this cooperation because the Brazilian Presidential office invited me in October, 2004 in a conference on Social Technologies, to give a keynote lecture on the experience of Honey Bee Network in mobilizing grassroots innovations and traditional knowledge for social development. Subsequently, I received a request from the Brazilian government to become member of the Honey Bee Network. This is a very fortuitous development which I hope will become a basis of enduring engagement. The Science and Technology Minister of South Africa who was also Chair of the Commonwealth Science Council invited me to present a proposal to transform CSC into Commonwealth Innovation Network to the conference of Science and Technology Ministers of Commonwealth countries. Prior to this conference, grassroots innovators from India were invited to share their knowledge, innovations and practices with their South African counterparts. Not only, did South African government send more than a dozen delegations to study our experience in building a value chain around grassroots green innovations but also the Minister wrote to all other Ministers mentioning Honey Bee Network as a model for blending formal and informal science. Within India, Department of Science and Technology helped in institutionalizing the Honey Bee Network philosophy by setting up National Innovation Foundation (NIF) in

February 2000 under the chair of Dr. R.A. Mashelkar, a worldwide champion of innovators, with a corpus of five million dollars – likely to be augmented with similar additional amount this year.

Having scouted more than 60,000 innovations and traditional knowledge, 70 per cent of which deal with herbal knowledge for human, animal and plant health, NIF and Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) have laid the foundation for people's knowledge to become a viable basis for socio-economic transformation. There is no doubt that much more remains to be done than what has been achieved. But it is certain that blending of indigenous/local knowledge with institutional knowledge, science and technology can unleash tremendous creative power inherent in human ingenuity. This paper, therefore, summarizes a very painstaking journey through the minds and hearts of people in thousands of Indian villages. Literally speaking, we have walked more than 3400 kms., as a part of Shodh Yatra i.e., journey for exploration on foot, every summer and winter during last ten years. These walks have reassured us about the dynamism of the living knowledge systems. But these have also made us conscious of the alarming rate at which indigenous knowledge is getting eroded. My submission is that never before in the human history, so much knowledge has been lost in such a short period as in the current generation. Several reasons are responsible for this erosion. The changing lifestyles and the disconnect between the grand parents and grand children generation, restriction in the access of communities to the biodiverse regions due to various governmental regulations, depiction of traditional healing practices as superstition or sign of backwardness in the school and college text books, lack of consumer preference for biodiverse products, given the marked based promotion of uniformity in colour, taste, size, shape and appearance, etc. In addition, there are many other factors which are responsible for the erosion. For instance, most of the traditional healers did not charge for their services and the communities could not evolve mechanisms of providing sufficient incentives for these healers. The younger generation saw this profession as a profession of penury and lack of economic opportunities. Given the popular culture diffused by the public and private media, why would young people like to follow a path of penury. During our Shodh Yatras for thousands miles, we did not find many young healers. Once the catalogue of creative knowledge remembered by the local traditional healers is lost, lot of medicinal plants would become weeds. In agriculture, we define weeds as plants out of their place. A wheat plant in paddy field

may become a weed. In nature, there is no plant which is ever out of its place. But, when the knowledge of its ecological, therapeutic or other cultural significance is lost, then we cannot generate incentives for conservation of that plant. Indigenous healing traditions are extremely important if they have to be rehabilitated as a part of contemporary creative strategies for survival, conservation in a sustainable manner. The challenge for public policy is really to get the young people become curious, concerned and committed to explore the value of these knowledge systems. They will not do it unless the incentives for doing so become sure and certain and substantial in nature.

Part I

Framework for analyzing indigenous/local knowledge system

Several studies have shown that worldwide awareness and interest in herbal medicine and nutraceuticals often derived from organically grown crops is increasing almost exponentially. And yet, unlike in China, the average shelf space allocated for herbal products in a modern chemist shop is not very substantial in all three countries. That is a market based indication of how much economic space this knowledge system occupies in the three societies. But this should not detract our attention from the potential that this knowledge system has.

How does this knowledge get produced?

The knowledge domains can primarily be divided along private, community and public dimensions. None of these domains by itself can produce conditions for production and reproduction of knowledge. For instance, if a community does not conserve the biodiversity in a given patch of land or lake, then individual healer would not have an opportunity to screen different plants for various purposes. At the same time, public policy may come in the way or promote the interface between private community and public managed resources. The three domains of knowledge intersect with three domains of property rights governing these resources. As illustrated in the discussion below, an individual scholar can go to an individual healer, record his or her practice and publish it to bring it in public domain without Prior Informed Consent (PIC) of the knowledge holder or even without acknowledging the source. Within the society, not everybody may

have same amount of knowledge about different plants or other materials and even among those who know, not everybody will be equally skilled to practice the knowledge. The asymmetry in access to resources and local knowledge may become an important determinant of the way local communities organize themselves for conserving resources and associated knowledge systems. Public policy can exacerbate the asymmetry or reduce it depending upon the way it increases or decreases the transaction cost. Sometimes, for developing a distributed value chain, some of the transaction costs will have to be absorbed through subsidy or public investments. In a liberalizing world, subsidy is a bad word but we seldom realize the subsidy that state provides in the form of infrastructure to the privileged sections of society (who does not notice the absence of cycling lanes in most developing societies as an evidence of this bias).

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.

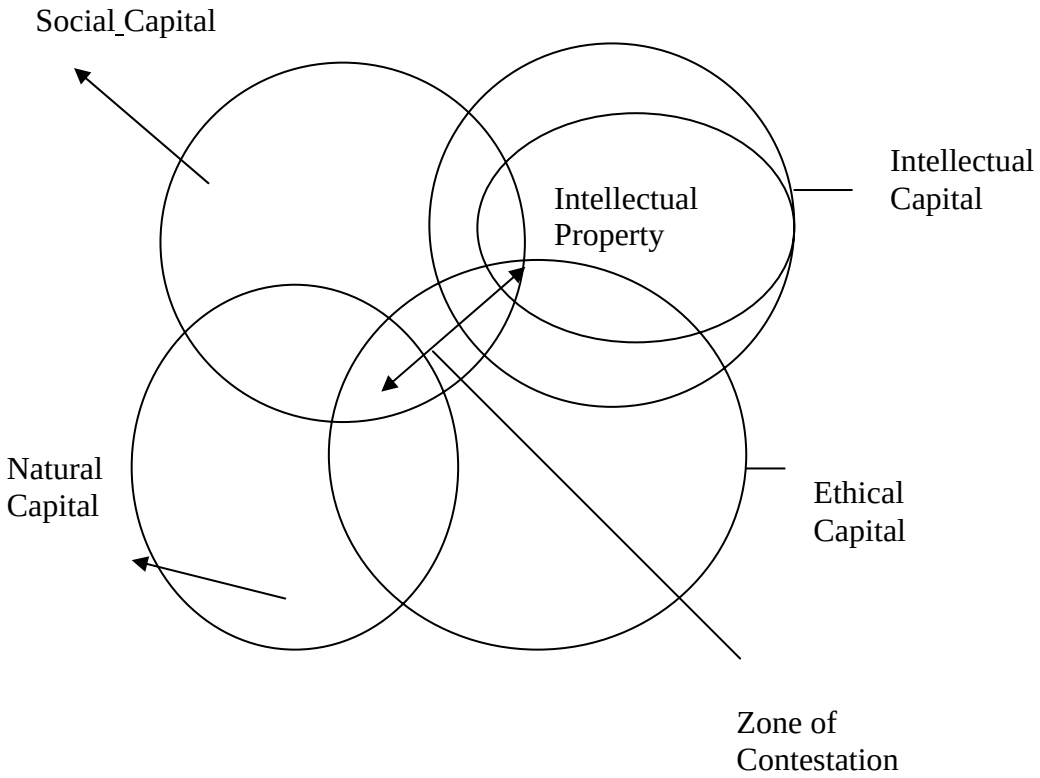
The values guiding these solutions also differ from some of the dominant values in the modern system. For example, most innovators generously share their knowledge, innovations and practices whether based on local resources, traditional technologies and tools or modern materials or tools. Because of 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.

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).

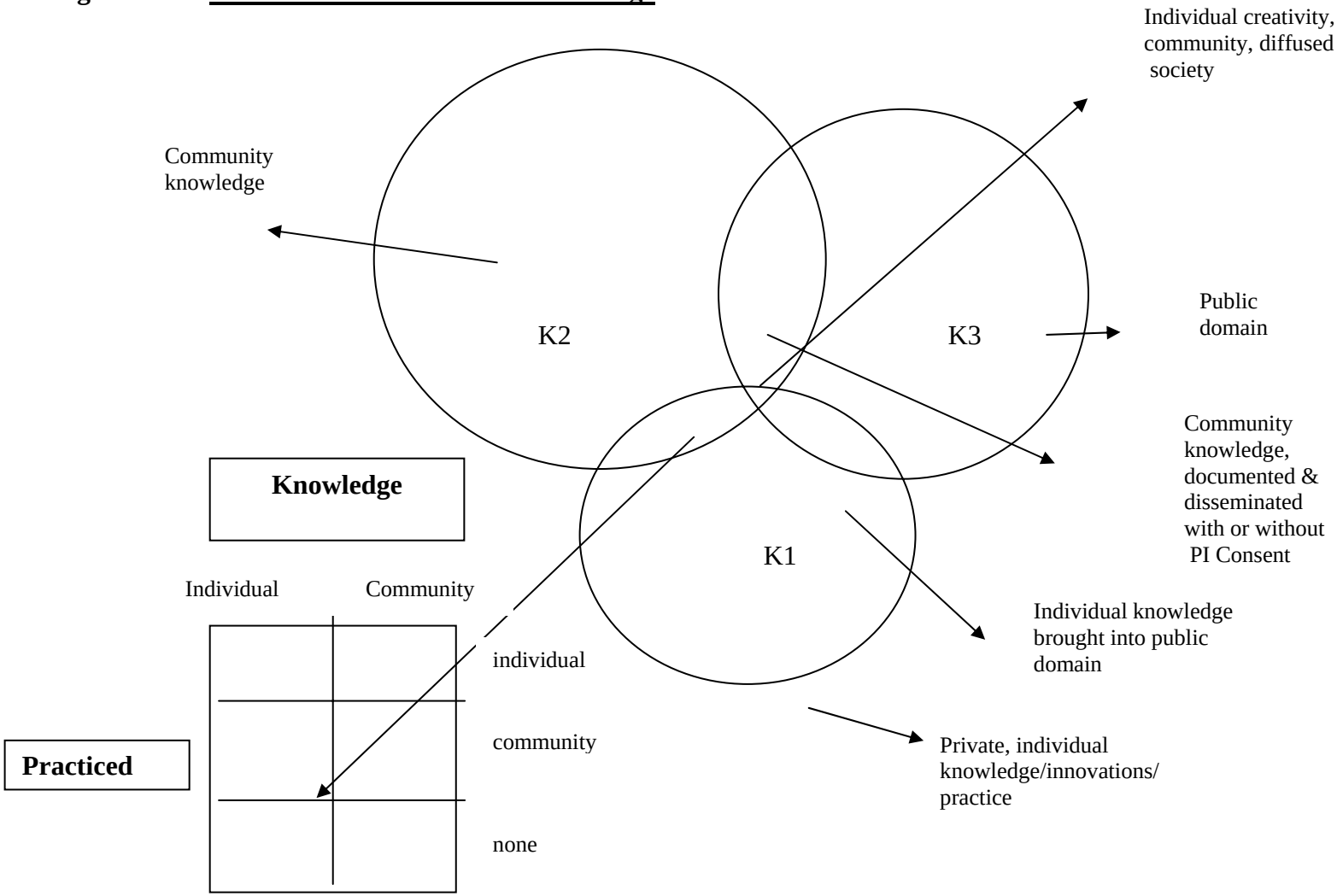
[2] For instance if radioactive minerals such as uranium or precious metals are found underneath the private property land than state has a right to claim property rights on those resources in certain countries like India with or without compensation. Likewise an individual has a right to grow sandal 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.

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 (Gupta, 2004 own compilation)

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. Likewise, the implications of other subsets can be studied.

Part II

Blending formal and informal science, technology and design: The model of SRISTI, GIAN and NIF

Large number of agricultural, herbal healing and indigenous biotechnological practices require scientific validation, value addition and possible commercialization or non-commercial diffusion. In India, an agreement was signed last year between CSIR and NIF which has now been operationalised through four task forces dealing with herbal agricultural, animal and human health practices; nutraceuticals and food processing; energy and mechanical technologies. Ten innovation fellows from among the innovators and traditional healers and professionals will be hired to steer the cooperation and mentoring process. Separate funds have been allocated by CSIR for various CSIR labs to add value. Given the size of database, amount of 250,000 USD for value addition may be very small. But, a good beginning has at least been made.

There are several issues in the research on medicinal plants, agriculture and biotechnology that have to be taken into account.

Medicinal plants:

a. Scientists often prefer single plant based formulation whereas most indigenous formulations have two, three or more ingredients.

b. Local communities often pay attention to the location, timing of the lunar cycle, stage of flowering or maturity, sometime the presence of specific companion plants or other ecological features (such as lake, ridge, or shaded valley), aspect, etc. Scientists do not consider these variables as very important.

c. The validation of any practice also depends upon the carrier, bio enhancer, suppressant of the side effect and the curative agent included in the formulation. The local systems of medicine recognize the strikingly important role that any of the non-curative constituents can play. For instance, psyillium husk, if given with milk is likely to be laxative whereas same husk with curd will help in controlling loose motions. Likewise, different carriers can alter the effect of the medicine, something which is not recognized very well in the allopathic system of medicine.

d. While screening the herbal medicine, the method of application or intake can also make a difference to effectiveness. As a member of evaluation panel of International Cooperative Biodiversity Grant Programme (ICBGP) of NIH, USDA and other organizations in USA, I once asked examples of the cases where local medicine when tried by the scientists did not work. In one case, the scientists mentioned that they repeatedly went to the healer when medicine did not work and found that healer was very annoyed on their negative report. Finally after getting exasperated, the healer asked them as to how did they give the medicine to the patient. The scientists explained that they gave it by injection. The healer said that he gave it orally and not by injection. Scientists found that it worked when given orally.

e. Any knowledge system has its own internal rules and organizing principles. When validation is done without paying attention to these principles, then there can be problems. National Cancer Institute of US screened 35000 plants against cancer and found hardly seven or eight to be effective, *taxus bachata* was one of them. Why was it hit so low? The reason was that the particular pathway through which a screen is set up may not be applicable to every plant which is used by the healers for that purpose. Therefore, the need for multiple screens using different heuristics for validating the local knowledge. This is a difficult task because scientists are often used to doing things in a particular manner and may not appreciate such constraints. But to improve efficiency, we will have to try validation protocols as close to the original setting as possible.

f. It is not that only certain plants have medicinal properties. Almost any plant can be used as a medicinal plant depending upon the dose, method, proportion, timing, etc. The increasing importance of nutraceuticals is highlights the role indigenous food can play in curing diseases. Many of the uncultivated plants used in the food could have and in fact do have medicinal properties. This requires a systematic effort to document, inventorise and analyse the role of such foods. A socio-economic and political implication of such an approach would be that the demand for such foods will help in providing incentives for *in situ* conservation of diversity and also provided additional income to the conservators. In any case, the ever increasing proportion of expenditure on health requires alternative approaches to be given a fair trial.

One of the most unfortunate realities of all the three countries is that the amount of budget allocated to indigenous systems of medicine is much lesser than the so called modern system. Within indigenous systems, the role of folkloric knowledge is ignored almost completely. The public policy in India unfortunately focuses only on codified classical knowledge about use of medicinal plants and ignores the folkloric knowledge. How important this neglect is can be judged by the fact that all the classical codified texts put together have less than 2000 plants (out of 7000 assumed constituents) explaining all the formulations. India has more than 43000 species and

thus there exists huge lot of folkloric knowledge, which if given proper incentives and support can not only transform the health management profile of the country but also help in developing a knowledge based approach to poverty alleviation.

Agriculture:

g. The role of chemical intensive agriculture in sustaining the agro eco systems as well as the general well being of society is being questioned all around the world. The productivity of the various external inputs has gone down drastically over the last three decades of green revolution. One has to apply far more pesticides, fertilizer and other inputs to get the same amount of output. The research on sustainability is a priority. However, without building upon the local knowledge that farmers have of their environment and the limits of its ability to tolerate disturbance, it is not possible to pursue sustainable alternatives.

h. Sustainability requires understanding eco system properties and the role human interventions play in modifying these properties. The models which are taught to the science students in agriculture are often drawn from temperate environments. We have to develop such models in tropical conditions. Without longitudinal research for several decades on the same site in a multi disciplinary perspective, such models cannot be developed. How many such sites exist in India, Brazil or South Africa?

i. Farmers' innovations and traditional knowledge documented by Honey Bee Network over last decade and a half demonstrate the potential these innovations have in not only providing low cost solutions across regions and sectors but also in extending frontiers of science in a few cases.

j. Much of the additional income in a growing economy is spent on goods in which taste plays an important role. That is how the contribution of processed food increases in the convention basket as the income increases. But, the

indigenous food processing technologies are seldom documented, pooled, evaluated and incorporated in the modern food chain. Their nutraceutical properties provide additional reason for strategizing their role. However, the catalogue of germplasm in the national gene banks has not incorporated indigenous knowledge for food processing, nutraceutical applications or other such local uses. This is an urgent task if western domination of our diets, nutrition and health has to be reversed along with reduction in the cost and enhancement of the sustainability outcomes.

k. In the area of farm machineries whether for production, processing, storage or transportation, the small modular, multi functional innovations have an important role for small farmers. But, the institutional research is focused on larger machines, specialized machines and difficult-to-maintain machines.

l. The curricula in agriculture, health and biotechnology sectors seldom incorporates the insights from people's creativity and innovations system. Unless curricular reform takes place to incorporate learning from people, their technologies, institutions and culture, how would the professionals ever develop respect for the wisdom of common people.

Biotechnology:

m. The transformation of biological properties for pursuing cultural ends has been part of almost every culture. Lord Ganesh symbolizes the fusion of elephant and human forms. Indian culture did not conceptually prevent the transition of life from one to another form or blending of different species or even genius. However, the transgenics have not received favourable attention from most civic organizations. Same organizations have seldom protested when the continued adverse consequences of chemical pesticides have manifested in the environment, the life of the workers who spray these chemicals and the consumers of toxic residues. Awareness of ecological consequences of different technologies has to be created in every society.

n. There is no doubt that ideal arrangement would be when farmers can see and evaluate the performance of chemical, biotechnological, herbal and biological ways of managing agriculture or controlling pests. Such experiments have not been done in any of the cooperating countries. Why should public support for any one alternative. I submit that sustainable alternatives have to be made so efficient that they can compete with the non-sustainable ones on merit.

o. Local communities have used fungus, bacteria, yeast, etc., in their food, medicine and other natural resource processing activities. We have not inventorised such knowledge systematically in any of the countries. There is a need to blend modern biotechnology with traditional biotechnology to produce sustainable technologies.

Part III

Policy implications:

To summarize, what I have tried to argue in this paper is that the knowledge systems evolved and refined by people are in dynamic tension with the influences from the modern world, some at their terms and many at the terms at which outsiders determine the pace and direction of the interaction. The result of this interaction among the people, rest of the society and with nature manifests in different coping strategies that people use to survive under stress. Sometimes, the stress triggers creative solutions in the form of innovations and sometimes the traditional solutions are modified or adapted and it becomes part of traditional knowledge systems. If these solutions were sufficient to solve contemporary moral problems of democratic and civilized society, one would not need to devise institutions for interaction with the people. In many cases, these solutions are sub optimal and yet worthy of attention as heuristics for more optimal and sustainable solutions. There are occasions when some of these solutions really surpass the limits of modern knowledge systems. Simple solutions of complex problems in a frugal, multi functional and recombinable manner generate an ethics or generosity. The tragedy is that this generosity become the reason for continued deprivation and poverty of the people.

We need a world in which people are not penalized for being generous, frugal, economical and simple. The institutional arrangements and policy alternatives for future growth for economists must be measured on their ability to provide incentives for such behaviours that are compatible with above hope.

Some specific suggestions for policy dialogue are:

1. While each of the three countries is very eloquent about the need for developed countries to reciprocate their responsibility in dealing with traditional knowledge particularly about herbal drugs, and yet within each country the protocol of prior informed consent (PIC) has not been institutionalized for corporations, colleges and other collective efforts for commercialization of products based on local knowledge and/or resources. How to resolve this anomaly within a time bound manner?

2. SRISTI has argued for over last ten years that every patent applicant in developing and developed countries must be asked to declare that the knowledge and /or resources used while making claims for protection has been obtained 'lawfully' and 'rightfully'. The 'lawful' access implies compliance with the laws of the country from which the material and/or knowledge has been obtained. It includes PIC. The 'rightful' access implies that even if a country either does not have a law or does not have the machinery to implement the law, the explorer of biodiversity and associated knowledge system seeking patent protection should declare that he/she has followed the model guidelines compatible with lawful behaviour. Before a case can be made internationally, each country should make this requirement obligatory in their own boundaries. WIPO has referred to our work in this regard in the June 2005 meeting of the inter-governmental panel on the disclosure requirement. But, the real success of this initiative of Honey Bee Network, SRISTI and NIF would be when no student, scholar, public servant or commercial and non-commercial corporation would ever be able to access or use knowledge of people without acknowledgement, informed agreement and assurance of fair and just benefits.

3. There has to be a consortium approach to development of herbal health kits for human, animal and plants using traditional knowledge and contemporary grassroots innovations by pooling the best practices of each country for improvement mass health and livelihood. The millennium development goals oblige each country to cooperate and use some such radical approach to achieve the targets even before the due dates. Whether for AIDS, diarrhea, diabetes, malaria or other such disorders we need to combine the modern science with the indigenous knowledge of not only technology but also institutions.

4. The intellectual property rights of local communities and individual healers, farmers and other innovators need protection through an international registry such as INSTAR (International Network for Sustainable Technological Application and Registration) proposed by SRISTI way back in 1993. Such a registry will reduce the transaction cost of investors and entrepreneurs as well as innovators.

Unless forces of globalization are harnessed for empowering grassroots people, we will be only serving the interests of those who are already served by markets and states in a privileged manner. The civil society initiatives and professional discourse have to change the language and the tenor if we have to be accountable to those whose knowledge has brought us together.