Farmers Innovations for Sustainable Resource Management

and Conservation of Biological Diversity[1]

Anil K Gupta,

with
Jitendra Suthar, Muralikrishnan, Srinivas, Kirit Patel, Vijay Chauhan, Dileep Koradia, Alka Rawal, Astad Pastakia,
Shailesh Shukla and Vijaya Sherry Chand

Growth rates in chemical inputs, use of irrigation water (ground as well as surface), electricity etc., have increased at a pace far higher than the growth rate of food production. The reasons are not far to seek and were not difficult to predict. Yet, planners in developing countries as well as developed countries still seem to be convinced about more of the same.

But a silent revolution has been going on, unnoticed and uncelebrated. This has never been seen as a source of healing the sick soils, souls and spirits. But can the technological and institutional innovations by small farmers in disadvantaged regions provide spur for such a revolution? We believe that these can, and our faith stems from thousands of innovations that we have already documented in Honey bee network already. But will these innovations be able to rescue the spirit of non-sustainably used resource on their own? Perhaps not, and hence our argument for blending the two knowledge systems, the formal and organized one with the informal and unorganized one.

We narrate in part one of the paper the diagnoses of the problem. What can formal science do and cannot in the context of meeting challenge of sustainable natural resource use. In Part two we discuss the context in which farmers' Innovations emerge and evolve at individual as well as collective level. In part three the problem of knowledge erosion is discussed and the case of Honey Bee network is presented which aims at stemming this erosion. In part four, I present some suggestions for rewarding creativity and some lessons for rethinking the mainstream technology generation and diffusion systems.

Part One: Where have we gone wrong?

The crisis of food production and geo political considerations created conditions in many developing countries particularly in India to strive for food self-reliance. The possibility of using high yielding varieties (more appropriately highly responsive variety) brought about what is popularly known as green revolution. Simultaneous changes in the banking institutions, price support, procurement and distribution infrastructure and extension machinery along with subsidized inputs made the

[1] Published in the proceedings of the International Symposium on Food Security & Innovations: Successes and Lessons Learned at University of Hohenheim (Eds.Franz Heidhues/Andrea Fadani), Frankfurt, Berlin: Peter Lang, pp.97-112, 1997

transition to high growth agriculture possible. It is well known that this growth took place primarily in well irrigated, good soil and level land areas. A large part of arid and semi arid regions and mountain areas were left nearly untouched by the green revolution technologies. The non-sustainability of different inputs can be understood by looking at the condition that became limiting with passage of time.

In case of fertilizer, several factors have contributed to declining productivity such as: (a) imbalance use of chemical fertilizers, (b) excessive mining of native soil fertility leading to micro nutrient imbalances, (c) changes in the soil physical and chemical properties because of absence of or low quantities of farm yard manure (FYM) applications, (d) the modification of soil microbial diversity due to excessive nitrogen application and also other chemical inputs, etc.

The case of water is even more serious. In case of ground water, excessive mining of water led to (a) increase in the cost of energy for extracting water (b) ingress of the sea salinity in coastal regions, (c) toxicity of fluoride and some other elements due to creation of cavity and oxidation processes, etc. In case of surface irrigation, excessive irrigation, irregular supply, lack of complimentarity between surface and ground water, lack of on-farm development, high seepage from canals leading to water logging and rise of salinity, influx of weeds, etc.

The declining water table also meant increasing cost of energy which further affects the viability of the returns to the investment. Both increase and decrease in the water table in different areas have made the respective farming systems non-sustainable. In some areas water is being mined from as deep as 1000 mts. or more. In a few cases, the water being extracted could be called as fossil water which is not going to get recharged and while stored when the earth was being formed.

The case of pesticide is the most obvious and at the same time most pathetic. Not only large number of pesticides which are banned in the European countries are exported to developing countries. But within the ones which are not banned, the information provided to the farmers is totally inadequate leading to considerable ecological and human health damage. Excessive use of pesticide has led to (a) elimination of useful predators and other beneficial insects including pollinators, (b) toxic residues in the soil, water as well as products affecting human and eco system health, (c) deleterious effects on the soil microbial diversity, (d) resistance among the pests and diseases leading to tread mill effect, etc.

There are several other areas where we have made costly mistakes. The declining crop biodiversity is an important one. Studies by Hargrove (1991) and others have shown that as many as one third of modern varieties of rice had a common parent for important trades leading to very high risk of diseases or pests spreading on large scale. The uniformity of crops and varieties has also meant tremendous increase in the weed infestation and consequent application of chemical weedicides. What are the lessons from all these mistakes and how can one see their social and political implications:

a. The modern agriculture as conceived and operationalised under green revolution strategy is not sustainable. There has to be a change in the strategy, structures and the processes of understanding inter relationship between different parts of the eco system.

b. The dominance of large corporations and big scientific establishments generated a false hope that ‘Lab to Land ‘ model will not only sustain green revolution model but also provide spur for continuous innovations.

c. The institutions emerging as a consequence of chemical intensive subsidized agriculture could not generate a worldview which will easily help in restoring eco-compatible resource use systems. The barriers in making a transition to an alternative system should be recognised and faced with squarely.

d. The increasing imbalances among regions, commodities, and social classes would endanger the social amity and intensify struggles for greater control over natural and other resources among deprived sections of society. Some times these struggles will dissipate lots of creative energy of a society and generate false identities including rise of fundamentalism of various kinds.

e. The public sector science and technological systems which delivered the most goods so long may be squeezed of resources and thus market forces may further accentuate the technological imbalances unless small scale, alternative technological innovations can find space for their expression.

Part Two: Survival in Bypassed Regions-Towards Alternative Indigenous Ecological and technological knowledge systems

But with all these constraints, some system or pattern has to be developed to reduce complexity in nature. These patterns constitute the basis of indigenous ecological knowledge system. Within these patterns, some occur with greater regularity than others. The language and folk culture generates symbolic or other means of memorizing these patterns. It is not surprising that communities which depends upon a particular natural resource often are reported to have many more words to capture the variability in that resource compared to communities which are independent of this resource. For instance, a coastal community dependent upon offshore marine fishery resources may have far more words to classify waves in the sea than a fishing community dependent upon inland sources. Eskimos similarly have been reported to have large number of words for snow.

The taxonomic basis of soil, clouds, waves, winds, plants etc., thus constitutes the bedrock on which edifice of indigenous creativity and innovation is built. An artisan who would like to economize on the use of wood in replacing a worn out shoe of a plough, has to find a suitable material to replace or repair the shoe. In a workshop of innovative artisans in south India, a blacksmith reported the outcome of a material science research that he pursued for some years. He found that the iron of scrap leaf springs or suspension of automobiles was most suitable for making shoe caps for the shear of the wooden plough. The precious wood used for this purpose was thus saved through a creative blending of traditional technology with a modern material.

It is this process of blending that I intend to discuss next to illustrate how coping strategies imply combinations of materials, methods, products to generate or improve options for survival in high risk environments.

a) <u>Combinational heuristics:</u>

The search for innovative solution can be through several routes. In this case various combinations of old and new methods, materials, products generate a whole range of choices of which sustainability can be determined on the basis of renewability of resources involved.

Materials

Old New

Old

Method

New

Old

Products

New

i) Old methods, old material and old products signify the traditional wisdom which may have relevance even for contemporary context. For instance, Virda is an age old technology for conserving rain water in a saline arid region with saline ground water. In an otherwise flat land region, the rain water temporarily gets stored in some minor depressions or tanks. Within these tanks, the pastoralists dig shallow wells lined with frames of wood of *Prosopis juliflora* having grass layer between different square wooden frames as well as between the earth column and the frames. Hardly ten inches rainfall provides sufficient storage of fresh water in these wells above the saline ground water. These Virdas are covered with silt and sealed. Depending upon the need one Virda is opened at a time and the water remains sweet for two to three months after which it turns saline through upward movement of saline water.

This technology has enabled the pastoralists in Banni pastures to survive for several centuries. Even ten inches rainfall in this area may fall within a few days and hence the need for a robust, efficient and adaptive strategy.

In such a case, the modern science does not merely help explain the functional viability of the technology but also provides basis for abstraction and generalization. For instance, once the properties of wood and grass are analyzed, the pressure for wells to collapse given the dimensions of storage is worked out, the infiltration rate and functions of saline soil in holding the salts is explained, possibilities of searching other materials with modified methods for similar or modified outputs can be developed. There is very little advantage that the prior art of knowledge in modern science provides in dealing with such complex questions of survival in difficult regions.

ii) <u>Old methods, old material and new products</u>

The wool on the mane of the camels is known to be very hardy and resistant to corrosion. Traditionally the pastoralists make different kinds of ropes, carpets, bags etc., out of wool on different parts of the camel's body. Once somebody figured out the use of these carpets as oil filters in oil refineries, a new product got developed out of old method and material. Similarly sisal rope has been used in various activities both for commercial and domestic purposes. It was found these ropes could withstand corrosion better than any other material in sea. Thus a new use for old material made by old method generated a new opportunity for value addition and income generation in some of the most economically depressed regions. The sisal grows in poor soils in semi-arid regions.

Processing of sisal is very painful because of various tannins released in the water tank in which sisal plants are immersed for sometime. While taking the fibre out, the

tannins cause blisters on the hand. Simple technologies have been developed to take the fibre out without having to go through painful process. An old material can be used using new method for old products or uses. Modern science can blend with the method leaving other choices intact.

iii) New method, old material and old product

In many of the cumin growing regions, farmers had observed that the plots on the roadside had better productivity than the interior ones. They figured out that the dust which settled on the plants saved them from certain pests and fungal diseases. Some other farmers observed similar pattern near the brick kilns. Dusting with ash or fine soil became a new method for controlling pest and fungal diseases in this crop. In many other crops, the use of ash has been well known as a dusting material for a long time.

Similarly, in the case of termite control in the light soil areas, farmers had known that moisture keeps the termites under check. However, they had also known another seemingly unrelated phenomena that sorghum plants when young were not eaten by the cattle because of some toxic compounds (Hydrocyanides). One farmer in a dry region thought of cutting, chopping and putting the sorghum plants in the irrigation channel. The assumption was that toxic compound in the plant would mix with the water and help in overcoming termite problem in this field. This is what actually happened. In this case a whole new field of research has been identified. So far the sorghum breeders were looking for land races with low hydro-cyanide content. This innovation opens the opportunity for selecting high HCN content sorghum lines. In case this technology works in different parts of the world, dry farmers could grow a small patch of high HCN lines to be used for pest control purposes.

(iv) Old methods, new materials and new product or use

Some innovative farmers have used a drip of castor oil organized through a tinbox with a wick hanging over an irrigation channel. The castor oil drops into the water and spreads into the soil. In a crop of banana, this oil adds to the lusture of banana by making its skin shining. Apparently, consumers like such bananas more and pay a better price. This drip i also used in other crops for soil based pest control.

Similarly examples can be found for other cells. What these examples show that farmers can be extremely creative in solving local problems. But issue is whether this knowledge systems will survive the onslaught of iniquitous markets and big science?

Part Three: The Danger to Localized Knowledge:
The Case of Honey Bee Network

Erosion of knowledge is as much if not, much more serious problem than the erosion of natural resources. We can probably reverse the declining productivity of natural resources like soil through watershed projects or other resource conservation strategies. However, erosion of knowledge can not be easily reversed once lost. The regeneration of resources and knowledge associated with these resources have to be seen in a single as well as multiple generation framework.

Consider first the single generation situation. The ideal sustainable situation occurs when both resources and knowledge have been conserved, but what happens when one or the other is eroded.

When the resources are conserved and the knowledge becomes eroded (as in the case of state-controlled conservation of resources through parks or sanctuaries keeping people out of the resource), the sustainability of the system becomes endangered. If knowledge is eroded, the erosion of resource can't be far behind.

When the knowledge is conserved but the resources are eroded, the sustainability of the system is more likely if local knowledge is incorporated in strategies of regeneration. The knowledge will also be eroded, however, if it is not used.

The least sustainable single generation situation occurs when both the resources and the knowledge become eroded. This is so because the knowledge may only be available in old book shops or waste paper markets, or pavement stores. The folk knowledge once eroded may be almost impossible to reconstruct or rejuvenate. Erosion of knowledge was never so rapid as in our generation because of declining inter-generational communication.

As bleak as the single generational picture is, consider now, the multi-generational situation. Again, the ideal situation occurs when both knowledge and resources have been conserved.

The situation where knowledge has eroded and resources have been conserved is not a likely scenario. This is so because a resource cannot be sustained over generation without drawing upon local knowledge at all. Under conditions of no human intervention or access, certain resources like forests may be conserved over generations without incorporating local knowledge. But with the increasing influence of human-made factors on the survivability of forests through acid rains, global warming, and erosion of upper catchments etc., as well as increasing population pressures, we doubt such a situation could occur.

The case of erosion of resources and the conservation of knowledge over several generations leads to a possibility of sustainability if knowledge has been documented through efforts like the Honey Bee network and is available to people, regeneration of resources is possible within a long time frame.

The worst case of all occurs when both knowledge and resources have become eroded over several generations. Only rare repositories of knowledge may exist among some bypassed communities.

Whether the analysis is performed in a single or multiple generational setting, the key is the same. The conservation of knowledge is as important as the conservation of resources, if not more so. Thus, any system of conservation should be directed not only at rewarding communities for the conservation of resources, but also at rewarding them for the valuable knowledge they hold, create and recreate.

In the context of the biologically rich, low-mean/high-variability income areas discussed earlier, emphasis is placed on providing short-term relief, employment, and other means of subsistence in high-risk environments in order to alleviate poverty. The economic stress on the community erodes their self-respect and dignity. The will of the people to struggle and innovate gets subdued. Both the resource and, the knowledge around this resource get eroded.

The Case of Honey Bee

In order to stem knowledge and resource erosion, the Honey Bee network, a global voluntary initiative was launched six years ago. Its purpose is to network the people and the activists engaged in eco-restoration and reconstruction of knowledge about precious ecological, technological, and institutional systems used by other people.

This network aims at identifying the innovators (individuals or groups) who have tried to break out of existing technological and institutional constraints through their own imagination and effort. What is remarkable about these innovations is the fact that most of these require very low external inputs, are extremely eco-friendly and improve productivity at very low cost.

It is necessary to note here that organizations of creative people, which take the form of networks or informal cooperatives or just loose associations, would generate a very different kind of pressure on society for sustainable development. The spirit of excellence, critical peer group appraisal, competitiveness and entrepreneurship so vital for self reliant development, may emerge only in the networks of local 'experts', innovators and experimenters. It is true that every farmer or artisan does experiment. But not every one is equally creative and not in the same resource-related fields. The transition of the developmental paradigm from 'people as victim's *perspective to that of the people as potential victor's* is the answer. Former may generate patronizing and externally driven initiatives where as latter may spur endogenous initiatives by people themselves.

Honey Bee network newsletter is brought out in six languages in India (English, Hindi, Gujarati, Kannada, Tamil, and Telugu) and Zonkha in Bhutan so that dialogue with the people takes place in their own language. The creative people of one place should be able to communicate with similar people elsewhere to trigger mutual imagination and fertilize respective recipes for sustainable natural resource management. The Honey Bee network is headquartered at SRISTI (Society for Research and Initiatives for Sustainable Technologies and Institutions c/o Prof Anil K Gupta, Indian Institute of Management, Ahmedabad),an autonomous NGO.

It is realized that the technological innovations cannot survive without institutional innovations and support structures. Hence we have been documenting the ecological institutions, which have been evolved by the people to manage knowledge and resources as common property.

Honey Bee insists that two principles are followed without fail: one) whatever we learn from people must be shared with them in their language, and two) every innovation must be sourced to individuals/communities with name and address to protect the intellectual property rights of the people.

It is possible to take the current global debate on biodiversity and peasant knowledge beyond rhetoric. Our network extends into 75 countries at present. Some of the colleagues have started similar documentation in their respective regions. Offers have been received from Nepal, Sri Lanka, Uganda, Paraguay and Mali for local language versions.

Honeybee also appeals to fellow researchers, activists and planners in other developing countries to identify native wisdom both to inspire and also to provoke the young minds to explore. In every country a very strong oral tradition of knowledge

generation, validation, scrutiny and diffusion exists. Honeybee strongly believes that boundaries between formal and informal knowledge systems may often be false. The informal system may have formal rules waiting to be discovered. The formal system may have informal beliefs, accidents, or conjectures providing impetus for further enquiry.

Honey Bee has already collected more than five thousand innovative practices predominantly from dry regions to prove that disadvantaged people may lack financial and economic resources, but are very rich in knowledge resource. That is the reason we consider the term 'resource poor farmer' as one of the most inappropriate and demeaning contributions from the West. If knowledge is a resource and if some people are rich in this knowledge, why should they be called resource poor? At the same time, we realize that the market may not be pricing peoples' knowledge properly today. It should be remembered that out of 114 plant derived drugs, more than 70 per cent are used for the same purpose for which the native people discovered their use (Farnsworth, 1988). This proves that basic research linking cause and effect had been done successfully by the people in majority of the cases. Modern science and technology could supplement the efforts of the people, improve the efficiency of the extraction of the active ingredient or synthesize analog of the same, thereby improving effectiveness(Gupta, 1991).

The scope for linking scientific search by the scientists and the farmers is enormous. We are beginning to realize that peoples' knowledge system need not always be considered informal just because the rules of the formal system fail to explain innovations in another system. The soil classification system developed by the people is far more complex and comprehensive than the USDA soil classification systems. Likewise, the hazards of pesticides residues and associated adverse effects on the human as well as entire ecological system are well known. In the second issue of Honeybee out of ninety four practices thirty four dealt with indigenous low external input ways of plant protection. Some of these practices could extend the frontiers of science. For instance, some farmers cut thirty to forty days old sorghum plants or Calotropis plants and put these in the irrigation channel so as to control or minimize termite attack in light dry soils. Perhaps hydrocyanide present in sorghum and similar other toxic elements in Calotropis contributed towards this effect. There are a large number of other plants of pesticidal importance found in arid and semi arid regions, hill areas and flood prone regions which can provide sustainable alternatives to highly toxic chemical pesticides.

It is possible that private corporations may not have much interest in the development and diffusion of such alternatives which pass control of knowledge into the hands of people. However, an informed, educated and experimenting client always spurs better market innovations as is evident from the experience of computer industry. Therefore, we do not see that there is a basic contradiction between the knowledge systems of people and the evolution of market rules to strengthen and build upon it. However, such a model of market would be highly decentralized, competitive, open and participative.

Honeybee in that sense is an effort to mould markets of ideas and innovations but in favor of sustainable development of high risk environments. The key objectives of SRISTI thus are to strengthen the capacity of grassroots level innovators and inventors engaged in conserving biodiversity to (a) protect their intellectual property rights, (b) experiment to add value to their knowledge (c) evolve entrepreneurial ability to generate returns from this knowledge and (d) enrich their cultural and institutional basis of dealing with nature.

Of course no long term change in the field of sustainable natural resource management can be achieved if the local children do not develop values and a worldview which is in line with the sustainable life style. Thus education programs and activities are essential to perpetuating reform. That is also the reason why we have organised biodiversity contests among school children to identify little eco-genius.

Part Four: Rewarding Creativity of the Farmers, Tribals and Pastoralists

The issue thus is: how do we go about compensating or rewarding indigenous or local communities for their valuable knowledge and conservation contribution. For the first time that the communities and individuals who conserved biodiversity despite remaining poor have a chance of overcoming their poverty by being compensated/rewarded for their traditional as well as contemporary creativity. Even more promising possibility is that this can happen without any need for patronizing protection from the state (which kept them poor and illiterate for so long). That is not the only promise. We could even hope that the polity of this country for once could get out of the hands of self seeking rent extracting class of non-competitive, non-creative and non-inventive industrial, trading, professional and farming elite. The game thus is very clear. Those who have faith in the inventive capabilities of the economically poor but intellectually rich communities and individuals would like to exploit the opportunity offered by GATT and Rio agreement. On the other hand, there are those who still live under the illusion that a patronizing and protective regime is what poor are looking forward to.

Those who are opposing the protection of intellectual property rights are doing so perhaps because they have no confidence left whatsoever in the native genius. Their argument seems to be very simple, “since we have never won in past in any global struggle, what is the guarantee that we will in future when odds are against us”. A mentality of failure, cynicism and defeatism is unlikely to generate any hope even with best of the circumstances and all odds favouring us.

Congressional Research Service of US Congress went into the question of people’s knowledge and its protection recently (Axt, Corn, Lee and Ackerman, 1993, henceforth, The Report). The report noted an increasing awareness that plant and animal species in the tropical rain forests and elsewhere were disappearing at an accelerating rate due to human activities destroying or affecting their habitat. The Report further noted the resurgence of interest among pharmaceutical companies and government research agencies in screening plant and animal species for medicinal properties useful in treating various diseases (biodiversity screening). The Report stressed that the destruction of habitat had “proven fatal not only to the numerous plant and animal species but also to many indigenous peoples dependent upon that habitat, and continues to threaten many that still exist”.

The search for local germ plasm or new plant sources for deriving herbal pesticides, veterinary drugs, or other products is done globally by multi-national corporations as well as national and inter-organizational associations. Among the issues that must be addressed in bio-prospecting are:

a) Whether those who want to access this kind of biodiversity have the capability of doing so on their own (INBio felt otherwise and thus entered into a deal with Merck) ?

b) Whether the external organization can access the same material or knowledge about it from other sources? In many cases the knowledge may be available from other sources though not the entire material. In such a case, the bargaining position of

the provider is weakened compared to the one holding a monopoly.

c) Even in the cases of monopoly, whether the external organization could have accessed the material through alternative legal or illegal routes? Any material obtained without due process of law, transparency, and prior informed consent of the communities and the national institutions designated for the purpose, should not be granted patents. Where a local community supplies local knowledge or natural resources from their region, they should be entitled to a share in the value addition. The reason for this is that the people dependent on this resource could suffer losses in several ways, for example, their access to plants, sites, or habitats could be reduced when outsiders find some new uses for the same. It seems ironic that because the people shared their knowledge, they could lose access to the habitats which helped them generate the knowledge in the first place. They could also suffer losses because the plants which they conserved have been selectively harvested (through so called 'scientific forestry'), thus, disturbing the ecological balance thereby endangering their life support system.

d) Even if the scientific knowledge exists in some developing countries, it may not be possible for that nation to commercialize the products based on biodiversity prospecting. The skill and capital trade-offs thus have to be made recognizing the respective strengths of the different partners.

e) Should patents be granted on plant products traditionally used by third-world people if specific improvements have been brought about. The case of Neem is interesting. Neem's use as a source of pesticide could not and has not been patented. Among the three of the important patents (for derivative uses) for the use of Neem are, one for extracting a purer form of azhadirichtin, a second for a more storage stable form, and a third for the use of this compound for cancer treatment. None of these forms of the compound were reported to be similar to the ones found in nature. Also, the use was different from the ones known hitherto. Since these patents do not inhibit use of this compound by anyone extracted through any other method of more or less purity or stability, compensation to the local communities is not due for such inventions. The fact that this lead was given by people who had used this plant and compound for pesticidal purposes is beyond doubt. Thus, the case for compensation can be made. But compensation to whom? In all such cases of patents on a specific improvement in well known recipes or botanicals, a cess or tax should be levied for a global, regional or national funds for research and development grants to people dependent upon the source plant. Global fund because this plant, for instance Neem, is found in many countries and the knowledge about its use may have been discovered in each of this country.

The Rio treaty suggests that free access to germ plasm should continue despite whatever mechanisms are created for compensating communities responsible for the protection of such plasm. In fact some have argued that the national sovereignty granted under the Rio treaty does not grant property rights to nations over the germ plasm that they have. It is difficult, however, to see how this resource can be considered different from a coal or a petrol reserve in so far as sovereignty is considered. Unlawfully acquired germ plasm for developing varieties or drugs would not confer property rights superior to those of the original providers. This implies need for regulations in developed countries requiring full disclosure by any corporation seeking patent protection on a plant based drug or any other natural product. The disclosure should provide that the source material has been *rightfully* and *lawfully* acquired. 'Rightful' acquisition would involve moral as well as ethical issues in access to biodiversity. For instance even if a local community has not asked for any price for sharing the material or the knowledge about it, is the corporation bound by an ethical

conduct to set up trust funds and other forms of reciprocity for local communities? Is it incumbent upon it to ensure that the superior ethics of local communities remaining poor despite conserving biological diversity and the knowledge around it does not become a reason for perpetuating their poverty, and thus endangering the survival of diversity itself ? The 'lawful' acquisition will imply that prior informed consent and approval and involvement of local communities and creative individuals has been ensured provided that the biodiversity donor country has laws requiring such a consent and approval. If a country does not have any such laws, as for instance India, then acquiring any material will be lawful or legal but may not be rightful.

The Rio treaty thus provides for compensation in the form of providing countries (i.e. which provide genetic resources) an access to and transfer of technology which makes use of those resources, including technology protected by patents and other intellectual property rights at mutually agreed term. This should happen through involvement and approval of these communities ensuring an equitable sharing of the benefits. Article 15.5 requires Prior Informed Consent (PIC) to be obtained from the contracting parties for obtaining access to genetic material or associated knowledge in countries which have enacted legislation requiring PIC.

The practices documented by Honey bee and SRISTI network should be considered eligible for registration in the joint name of SRISTI and the concerned farmers or communities where we can convince ourselves about the genuinity of innovation. The registration system should not discriminate on the basis of obviousness to a small group of farmers in a village or a taluka. The point to be noted is that the practice could not have been discovered or invented by a lay person with average knowledge in the field.

To summarize, we present a scheme in which four kinds of incentives for rewarding creativity and conservation of biodiversity can be generated.

A. a. Material- Specific
b. Material -Non Specific
c. Non Material- Specific
d. Non Material- Non specific

a. Material- Specific: In cases in which specific individuals have contributed to conservation of land races or wild plants with specific economic and inventive uses, their rights to receive licensing fee or royalty must be recognized.

In case of (b) i.e. material -non specific i.e. community or a larger group, the compensation would flow to a group through trust funds, risk fund or insurance funds to encourage inventive communities to take more experimentation and perhaps progress on the path of entrepreneurship. Insurance funds should also ensure that communities or farmers growing land races get price advantage compared to the high yielding varieties.

There are several ways in which revenue can be generated for providing various incentives to individuals or collectives :

(i) a cess or tax on the sale of seeds or crop varieties using the given germ plasm conserved or contributed by the specific individual or community,
(ii) share in the turnover from commercializable plant derived product such as herbal pesticides, veterinary medicines, vegetative dyes, anti-oxidant compounds, nutritional

supplements etc.

(iii) A tax on the market arrivals in grain markets in green revolution regions or high yielding varieties of different crops (including various other cash crops) to be used for conserving diversity and providing incentives to communities and individuals conserving diversity.

(iv) license fee to be collected from public as well as private sector companies for using germ plasm still conserved by communities in backward regions even if available in national or international gene banks.

(v) the license fee could be supplemented by larger investments in infrastructural development in these regions particularly in education and other minimum needs,

There are several other ways in which the revenue can be generated. The important point to be understood is that people would not conserve biodiversity while remaining poor for too long.

One can innovate in many ways to identify the precise areas and communities that are conserving rare germ plasm. The primary school children and teachers can be involved in country wide documentation of the bio-diverse regions, races, wild plants of economic importance etc., in the form of a campaign led by some committed NGOS and professionals apart from community leaders. State department of agriculture and revenue staff can also be involved in urgent inventorisation of knowledge, materials and claimant communities and individuals.

Farmers growing local varieties particularly under threat will need to be compensated for not shifting to high yielding varieties in selected areas. Mechanisms can be worked out for in situ conservation through the involvement of state agricultural universities and other conservation bodies.

(c) the non material-specific rewards deal with honor and recognition of individuals and specific groups of people who have contributed most in conserving biodiversity.

(d) the non material and non specific instruments deal with changes in policies, curriculum at different levels, institutional norms for providing credit and other support systems. Banks would not consider financing a herd of local well bred Gir cows, or bio-diverse farm at the same scale at which they would finance input intensive farm. Students are not taught any thing inspiring about the contribution of communities which conserve biodiversity. On the other hand they are shown as backward.

B. A scheme needs to be developed for supporting all those panchayats which will undertake systematic cultivation of local land races in every season in large enough areas for enabling some seed exchange. Villages which have conserved local varieties like Jackrana variety of pearl millet or Khirchia of salt tolerant wheat need to be provided some funds for local development linked to the contribution these land races are making in breeding on an ongoing basis. This will give a signal to other communities as well. Funds under this scheme also may be allocated by an auto-nomous body rather than bureaucracy.

C: The Patent act must provide for recognition of indigenous innovations. Data base like that of SRISTI can provide a valuable beginning point. Scope can exist for defensive patents in which certain innovations valid for larger social use can be patented not to prevent their diffusion but to prevent their being patented by some third party.

Creativity at grassroots can indeed spur a new paradigm for development, which builds upon what people know, excel in and have pride in.