

Draft For comments

Learning from the minds on the margin: Towards a new social contract for responsible science¹

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Innovations are imperative in the way agenda for inclusive and responsible science is evolved and pursued. Many of the problems that affect marginal environments, people and occupations have been ignored for a long time. Consequent alienation invariably generates anger and sometimes anomie among the bypassed communities. The struggles so caused further debilitate the will of formal sector to engage with the knowledge, wisdom and insights of the people in the informal sector. Such a chasm needs to be bridged for science to become responsible for addressing the neglected needs of the society.

My contention is that when formal system leaves certain social problems unaddressed for decades and sometimes centuries, people do not just wait passively. They try to solve some of them through their own genius in a frugal, flexible and often friendly manner. By engaging with such frugal innovators, we can learn new ways of solving problems in partnership with local communities. Honey Bee Network has been engaged both with the creative communities and also the scientific institutions to build a bridge between formal and informal science, technology and other institutions. It is inevitable that traffic on a bridge need not always be equal in both the directions. It is also not necessary that both sides should have equal eagerness to connect. However, the lessons from the linkages forged so far are very encouraging. In some cases, it is the individual scientists who have made a significant difference. And in other cases, it is the institutional policies that have facilitated the interface. There are also instances where institutional commitment is quite weak but, individual support from the scientists is strong.

I am privileged to speak as a part of Dr P N Srivastava endowment lecture series because among other things, one of the most innovative, inclusive and pervasive institutional change he brought about was the setting up of Navodaya Vidyalayas and of course IGNOU. I have seen Navodaya schools during our umpteen shodhyatras in different parts of the country and also interacted with the students drawn from various villages of the district. But for these institutions, which provide a very high quality education, many of the rural children would never have made it to the top of various professional fields.

I will like to share the experience of Honey Bee Network in forging the linkages between formal and informal sector in the first part. The lessons that can be drawn for possible wider application are discussed in the second part. And finally, the policy and institutional implications are drawn for forging the new social contract for responsible science.

¹ Prof. P.N. Srivastava Endowment Lecture delivered at JNU, New Delhi, 11th April 2013

Part I

Making a Bridge:

One of the reasons, we set up Honey Bee Network 25 years ago was to forge linkages between formal and informal sector, particularly of science and technology but also other sectors. It was realized that the approach of formal sector in dealing with the ideas, innovations and traditional knowledge practices was not always respectful of the knowledge rights of common people. The Convention on Biological Diversity echoed this concern in article 8J and 15C. However, in practice, the policies and institutional structure of science has not changed much. The guidelines of various academies of science [natural and social science] still have not overcome their ambivalence in this regard. The norms of citation and acknowledgement with regard to insights learnt from people have not evolved to the extent that knowledge providers in informal sector feel assured that their contributions will be dealt with in most rigorous and responsible manner. A fear of being shortchanged still persists.

However, more than hundred thousand people have somehow felt assured in sharing their knowledge [not always unique] with National Innovation Foundation [NIF], an Institute of Department of Science and Technology [DST], Society for Research and Initiatives for Technologies and Institutions [SRISTI] and Grassroots Innovation Augmentation Network [GIAN] and other members of Honey Bee Network. This faith is further cemented through collaborations that NIF has forged with over 200 labs and scientists in the last few years, in public as well as private sector. The fact that almost all the scientists have contributed their time and energy in validating people's knowledge either without cost or at very low cost demonstrates a new sense of collective responsibility emerging in Indian science and technology institutional network. The knowledge rich, economically poor people of this country can, of course, not thank the scientific community enough. This bridge of responsible science could not have been built by any one institution or individual. There is a long legacy of scientists working for the social good in India and around the world. We have to salute this legacy and hope that younger generation will only advance the social, ecological, industrial, cultural and ethical connect between formal and informal sector of knowledge, institutions and values.

The first issue of Honey Bee Newsletter deliberately began with a communication from two scientists of Gujarat Agricultural University [Dr. Kalyanasundaram and Dr. B.T.Patel] to highlight the fact that despite all the asymmetry and neglect, the formal sector had scientists who not only learnt from people but also acknowledged it. In fact, the pioneer in this regard was Dr.Y.P.Singh who had taught me at HAU, Hisar and had been a mentor even later when he was at IARI. Prof Kuldeep Mathur later honed my understanding of the socio-political context in which institutions work or refuse to work for disadvantaged sections of the society. There are many others who have continued this connection in different fields of science and technology and if I am not able to acknowledge them all here, it is only because the list is too long and I may miss the key story I want to share. For the first twelve years of the Network, the linkages with formal S and T institutions were more in the nature of comments and voluntary research by the scientists.

Dr. Arun Kumar, CAZRI did research on effectiveness of whey and milk on diseases of pearl millet and published several papers, acknowledging its effectiveness compared to the well-known chemical pesticides or other treatments. There has been worldwide program of using milk for controlling viral and other diseases in various crops. Post doctoral research on elucidating the exact mechanisms is still going on in Australia. It is a different matter that

Ministry of Agriculture and several universities and state departments will still take some more time before including such low cost, high effect sustainable practices in their advisory for the farmers. Incidentally, Department of Ontario in Canada does not have hesitation in putting this advice on their web site. Which protein or enzyme in milk or whey interacts with which pathway of the insect, bacteria, virus or fungus to prevent these from replicating and thus affecting the crop is not a trivial question? Why are not we asking such questions more often? Why do our priorities in many cases [obviously not all] continue to be guided by colonial structures of thought where priorities of western journals become the valid and appropriate priorities?

Good science is also responsible science

The effectiveness of NIF in the last 12 years to forge linkages with individual scientists and institutions such as Council of Scientific and Industrial Research [CSIR] and Indian Council of Medical Research [ICMR] reveal a changing mindset in the formal scientific establishment. In the agricultural sector, the ICAR may not have formally entered into any understanding but individual institutions and scientists in most universities and labs have been most cooperative. That testifies to the decentralized nature of governance and the autonomy that most institutions enjoy to forge partnership with institutions like NIF.

There are also institutions, which expect the Honey Bee Network to pay same cost of validation as would be applicable to a large national or international commercial company. The fact that *we don't have national guidelines* in the matter *making it mandatory* for public institutions to use differential norms without sacrificing scientific rigour shows the long way we have to still walk. The debate on social justice has been dominated far too much by affirmative action in terms of basic need and other entitlements of disadvantaged sections. We have still not recognized that in knowledge economy, ignoring the outstanding knowledge of the communities and individuals is even a greater injustice than ignoring their menial contributions. The bias against engagement with mental and not menial contributions of the people on the margin runs through several aspects of public policy. For instance, under MGNREGS [the largest public employment programme in the world] providing 100 days of employment to 250 million people, the documentation of ecological, occupational, cultural and other technological or social knowledge specific to a place is not considered a valid work. Thus, if climate scientist wanted to look at culture and space specific indicators of climate perception, change and impact from all over the country, this programme will not lend any helping hand. Similarly, if Ministry of Water Resources wanted to make an atlas of water quality and quantity in different seasons of the year by collecting samples from each well of the country, the programme again would not cooperate.

One can find so many other examples where sanitation through locally made soap or low cost water filters or roof top water harvesting, etc., will not be pursued through knowledge-based employment. We will not map biodiversity and soil diversity through this programme and thus continue to make our assumptions for public policy and institutional interventions on extremely limited information. We could have built knowledge registers and updated them every year in just five days of employment around the country. Each panchayat could find so many opportunities of learning from each other through such registers available on their village websites. The scientists could engage with the specific communities to study certain patterns in the socio-ecological interactions. So many innovations will emerge from such mapping of minds that cannot be fully imagined today.

Some other lessons learnt and challenges identified are:

Institutional: In general, most institutions appreciate examples of creativity and innovation in the informal sector. However, given their own agenda and mandate, not most feel empowered to take up projects on their own or suggested by outsiders involving interface with informal sector. In a few cases, the top leadership encourages independent linkages and does not either monitor or reinforce the same through annual planning and review mechanism. Some leaders have create institutional framework of cooperation with an independent oversight mechanism (comprising outstanding scientists) so that linkages endure changes in the leadership. There are cases where individual scientists encourage their students to work on the ideas of the people as a part of their postgraduate research and only seek supplemental resources since most of the students get their own fellowship. The budgets in which NIF could get validation done are extremely low (see Table 1 herein later).

There have also been some discordant notes in this cooperation. A particular faculty member took financial support for developing ideas of children into prototype but failed to acknowledge the idea providers in the research paper he co-authored with his students. Subsequently, it required considerable discussion to persuade him to at least mention the names of children in the body of the paper and not just as footnotes. Ideally, they should have been the co-authors. There are other colleagues who mentioned the source of the practice in the first publication and then in the subsequent publications based on the same lead forgot to acknowledge the original contributor of the idea. These problems are not very rampant. These are also not very unique.

Knowledge rights of the creative people:

The very genesis of Honey Bee Network lay in correcting the existing asymmetry in norms and practice of acknowledgement and attribution in formal sector about the knowledge of people in the informal sector. We are all familiar with the literature on ethnobiology, much of which does not ever acknowledge the knowledge providers by their names, even in the cases of community knowledge. The question of prior informed consent does not even arise. I resigned from the editorial board of one of the CSIR journals precisely on this ground. I had tried to suggest three guidelines which the editorial board could not accept and practice. The *first* was that we should insist on acknowledging the knowledge provider /innovator/ traditional knowledge holder in the research papers or publications based on their knowledge, *second*, we should share the findings with the knowledge providers in local language and *third*, the unique knowledge of the communities and/or individual should not be published, lest their intellectual property rights are eroded. After protection of the IPRs, it can be published as is the practice in the academic world. An undertaking to this effect was suggested from the authors. I am sure sooner or later, such guidelines would become the only way the knowledge exchange between formal and informal sector will take place.

Technological: One of the persistent challenges faced by the Network is the design of experiments which should mimic the conditions of original use as closely as possible. Be it the water extract, or processing herbal lead exactly as the knowledge provider does or dispensing it the way he does. It is not proper to invalidate a particular local practice because of inappropriate protocol. Slowly and slowly, we are achieving convergence on this account. There are some scientists who are in fact, taking the trouble of visiting the knowledge provider/s to observe how exactly he/she makes the preparation and dispenses it to the

patient. Some scientists have invited the local innovators to their labs to understand how the formal sector pursues research on their ideas.

When regulations fall behind the innovations:

In the case of mechanical technologies, we face many regulatory challenges. A large number of farm machineries are made by using old parts of automobile or other devices. This is done to keep cost low and also to harness the unused potential of a second hand components. We all know that not all components of a machinery fatigue at the same rate. It makes no sense to junk all components at the same time when many of them have life left for many more decades. The local grassroots innovators know this and accordingly harness the potential of such second-hand components. The problem arises when regulatory and testing agencies do not approve machineries having second-hand components. A large part of rural machineries will thus remain *illegal* even if these are highly *legitimate* for meeting local needs. The Regional Transport Officer is bound by the law which requires all traction vehicles to be certified for their road worthiness. The motorcycle based ploughing machines and various subsequent improved versions numbering more than 10000 are crucial for farming operations in Saurashtra. But, none of these will be tested or certified. So far as safety is concerned, slow moving vehicles invariably may be safer than the fast moving ones. In any case, proper safety features must be incorporated and that is an issue on which formal and informal sectors can cooperate. The search for frugal solutions will require less entropic ways of innovation. Naturally, using a material to its fullest potential life without compromising safety and energy efficiency must be the prime goal of a policy for sustainable inclusive development. In the absence of engagement between those who set the standards and the ones who innovate, the standards become an inhibitor instead of promoter of innovation. For many innovative machines, there are no standards yet. Hopefully, the situation will change, the dialogue will begin and the inclusive innovation policies will draw upon the genius of creative communities and individuals.

Socio-cultural:

Most of the innovators may not know that they have done an innovation. It requires an appreciative peer group or an eye for detail of the outsider or greater awareness to get this realization. It is for this reason that almost 90 per cent of the knowledge that NIF has received comes through the voluntary contribution of the Honey Bee Network collaborators and members. Hardly ten per cent reaches us directly. If we do not go out and scout, we wouldn't be able to find so much of hidden talent of our country. Even among the children, same proportion of ideas is collected through idea workshops. Keeping this in view, Hon'ble President during his address to the Vice Chancellors of the central universities suggested three steps to promote innovations in society:

- a. Organization of innovation exhibition during his visits to central universities and facilitation of his interactions with the innovators in the hinterland in different fields of social development.
- b. Setting up National Innovation Clubs which will aim at *searching, spreading, sensing and celebrating* the innovations all around. Unless young students get involved with innovation movement and faculty bring the experience of creative communities and people in the classroom, the courage to overcome inertia and attempt new heuristics for solving problems may not emanate.

- c. Interaction with inspired teachers who succeed in triggering extraordinary curiosity in the minds of students and thus motivate them to ask the unconventional questions.

Leveraging of grassroots innovations through exhibition at the President's House for last four years has given a very important message nationally and internationally. When the Head of the State honours common creative people, a new idiom of engagement gets evolved. Likewise, when former President recognizes the young children during IGNITE award function held every year at IIMA organized by NIF, once again an important message is conveyed about the significance of sourcing creative ideas from younger generation. One of the most remarkable things we have learnt through the ideas submitted by children is that they are far less patient with the problems of society than has been the case with our generation. This is the most redeeming thing that we can say about our country. Once this culture becomes pervasive, we would be able to overcome the widespread inertia and the tendency to live with the problems unsolved indefinitely.

Jugaad is a misnomer for majority of the grassroots innovations :

Tremendous experimental ethic is evident among people while attempting local solutions. Some of the lazy intellectuals have tried to turn all frugal solutions as 'jugaad'. A 250 USD ECG machine by GE, low cost health care by Naryan Hrudalaya, clay refrigerator by Mansukhbhai, etc., are all supposed to be 'jugaad'!. Surely, a term used so loosely becomes meaningless to characterize any systematic aspect of frugal innovation. The tinkering, i.e., makeshift arrangements for solving problems are tried everywhere in the world. When water leaked from the radiators of the car, people would use soap to plug the leak. If the wire has to be put in a socket and plug is not fitting properly, using matchstick to create a tighter grip has been done by almost every electrician [regardless of safety]. Using diesel engine for transporting people and goods has worked as a makeshift arrangement and may indeed be a 'jugaad'. But, Mansukhbhai Prajapati has developed seven different machines to make clay refrigerator and non-stick pans. He has circular kiln and large sized vertical kilns. None of these can be called as 'jugaad'. We should be discreet in using terms which make sense and do not denigrate the experimental and innovative ethic of common people. It is true that many times people may do right things for wrong reason. But then, identifying the right reason and feeding it back to the people is the responsibility of the scientists. Sometimes, people know the right thing but do not abstract the principle underlying it. Local communities have preserved milk by periodic heating and cooling for long periods without using refrigerator. They may not have isolated the scientific principle underlying that. They have known how to prevent spoilage of pickles for many years without any artificial chemical preservative. The science of the same may not have been isolated systematically. The socio-cultural context of grassroots innovations and outstanding traditional knowledge needs to be understood more empathetically.

Part II

Learning from the bridge between formal and informal sector

There are several strategies Honey Bee Network has used to build bridges between formal and informal science. Inviting scientists to serve on the review committees and then hoping that some of them will get motivated to take up validation and value addition research is one way. Writing to the research institutions directly with a request to help in validation has helped in many cases. Sometimes, the informal interaction in various meetings and lectures

like this also opens opportunities for cooperation. Formal agreements with scientific bodies have been tried in a few cases and generally there has been a positive outcome. At the end of the day, it is the interest of the concerned scientists that makes the maximum difference. Institutional agreements can only facilitate the linkage but actual bond gets formed when a scientist finds ideas of creative communities exciting enough to pursue. Preliminary research is done in several cases at Sadbhav SRISTI Sanshodhan Natural Product Lab at SRISTI. These results create conditions for congruence with scientists who would like to receive scientific leads rather than information about claims of common people. SRISTI Lab works on herbal technologies for agricultural, veterinary and human applications besides microbial diversity. In every Shodhyatra, we collect soil samples from which microbial diversity is isolated and further used for screening against different pathogens.

Frugality in science:

I would not argue that frugal innovations would invariably require frugal research. Sometimes, one needs to spend considerable amount of financial resources to get a solution which may be extremely affordable. But, when an organization has limited funds, frugal budgets can take those resources very far. In Table 1, we can see the amount spent by NIF in validation and value addition during last three years. The average cost of validating engineering technologies is about ₹ 2.21 lacs. Most agricultural universities and some of the research institutions have helped in validating agricultural, veterinary and farm machinery technologies. The human health practices have been taken up for validation in ICMR labs or other public and private labs. The average cost of validation ranges from ₹ 18,666 in SRISTI Lab to ₹ 2,44,125 in agriculture. In addition 32 community fabrication workshops have been set up at the site of mechanical innovators in different parts of the country at an average cost of ₹ 2.87 lacs. Such an economical outcome could not have been achieved if scientists had not been extremely responsive to the cause of promoting grassroots innovations and outstanding traditional knowledge. The journey from proof of concept to prototype, prototype to product development, product to utility and eventually to its widespread diffusion is a long one. Most of the validation activities have only meant crossing the first hurdle. For the subsequent stages, one would need far more resources. Generally speaking, one should begin with 2000 leads so as to produce 200 products, out of which 20 may diffuse widely. Another 20 or 50 may diffuse locally. It is apparent that with the available resources, NIF could only handle much smaller number of technologies. At this rate, it would perhaps take a few more centuries to do justice to the expectation of tens of thousands of knowledge holders who have already shared their knowledge with the NIF. The proposed so-called Inclusive India Innovation Fund by National Innovation Council will not address the needs or early stage risky funding. It will only be invested in the companies providing goods and services for the common people. The fact that it is the early stage where private sector investments is almost absent, has been ignored and thus the innovation ecosystem continues to exclude the ideas of informal sector, children and young technology students. All the students awarded with Gandhian Young Technological Innovation Award [GYTI, see techpedia.in/award] would not be eligible for any support at all. It is for society to judge whether such a conception of so-called inclusive fund does justice to the aspirations of creative youth and other communities of our country.

Engaging technology students: www.Techpedia.in

SRISTI realized that one of the most potent force in our country for addressing the unmet technological needs of informal sector as well as MSME is the technological youth. A

platform was designed by SRISTI by drawing upon youthful energy of Hiranmay, (then a third year student at SVNIT, Surat and now a part of SRISTI team, coordinating this platform) which now has titles of abstracts of about 150,000 engineering projects by about 400,000 students from 500 institutions. Idea was that no body should do what has been done before. Originality quotient should go up. The third year students in the summer should visit MSME clusters and villages and slums to identify technological problems in search of solutions. They should be given credit for the same. They should try to attempt a solution of one of these problems in their final year and get academic credit for the same as well. Gujarat Technical University joined hands with SRISTI. Quite extraordinary results have been achieved through this very fruitful cooperation supported by DST and led by the Dr Akshay Agarwal, VC of GTU. Should not this experience be replicated in other parts of the country and other disciplines and universities?

How do we learn from innovations?

There are four levels at which we can learn from the innovations whether in formal or informal sector: [a] artefactual, [b] analogic, [c] heuristic and [d] gestalt or configurational.

[a] Artefactual: One learns from the material characteristics of the innovation, be it in terms of form, feature or function of a mechanical or electronic technology. Or it could be method, material and applications in the case of biochemical or physico chemical or herbal innovation. If at least any one of the three dimensions out of material, method or application/use is new, one can learn from the novelty and develop further modifications for incremental or substantial innovation. In this case, the domain of the technology generally remains same though functionality may significantly vary because of improvements.

[b] Analogic: The innovation in this case is not drawn upon in its functional property but we try to learn from its metaphorical property. One can apply the technology even in a different domain using the original technology as an analogy. For instance, a farmer looked at the hook in a balance used by vegetable vendor by which he could use one of the pans for delivering the vegetables to the customer. Using this detachable pan hung on the hook, he developed a similar mechanism for a tilting bullock cart in which without removing the harness from the shoulders of the bullock, he could tilt the cart to unload its content. Similarly, a large number of innovations have been developed by applying a technology in a different domain by mimicking the properties of the original innovation.

[c] Heuristic: Here one does not learn necessarily from the physical form or from its analogic implications. Instead, the focus is on the principles or the thumb rules underlying the innovations. Let me take the example of bamboo windmill, the principles underlying the original innovation were drawn upon while replicating the idea in another context. Two brothers viz., Mehter Hussain and Mushtaq Ahmed in Assam designed a bamboo windmill in about USD 100 to irrigate a small paddy field with the help of a hand pump. This was later on modified to be used for pumping brine water to make salt in Gujarat. The cost went up to USD 1200 but the basic principle remained same. The brothers asked two questions, which a trained mind would probably not have asked. First, does it matter whether a paddy field is irrigated in four hours or forty hours? Second, does it matter whether water goes to the field in spurts or smoothly? The answer to both the questions was no. In fact, the slower irrigation is better because less nutrients are leached and plant absorbs more nutrients. In fact crop often needs moisture and not water. Once an interesting heuristic of not maximizing output per unit of time and not preferring smoother flow over regular flow was developed,

further innovation in terms of not fitting a gearbox became possible. The gearbox is the most vulnerable part, difficult and costly to maintain. This heuristic can be applied in so many different domains and across so many applications.

When a farmer listened to a long discussion that I had with him during Shodhyatra on the advantages of herbal pesticides instead of chemical ones, he summarized it in a sentence. He said, ‘whatever I had said implied that any plant which was not eaten by cattle or other animals, could be a source of potential pesticide’. He had captured the heuristic underlying various examples I gave of herbal pesticide. He could see a pattern in them. The reason why animals don’t eat a plant could be because of its toxicity. Since one needed toxicity for killing pests, there was no need to buy it from outside. Of course safety and other issues will have to be taken care of but the heuristic is very powerful and can be generalized almost universally.

[d] Gestalt or configurational: This is an institutional aspect of innovation. One does not learn only from the about three dimensions of innovations but also looks at the context in which innovations emerged and were nurtured. One cannot separate the institutional and cultural aspect from the technological dimension of innovation. That is why I have argued that *‘if technology is like words, then institutions are like grammar and culture is like thesaurus’*. One cannot make a meaningful sentence without combining all the three. Same way, an innovation cannot generally be understood without looking at its institutional and cultural context. The constellation of the factors or what is often called as ecosystem of innovation has to be learnt from rather than looking at an innovation in isolation. When we want to diffuse an open source onion planter, nationally awarded innovation by Pandharinath Sarjerao More. District, Ahmednagar, Maharashtra (<http://www.youtube.com/watch?v=z0WYreYP-B0> <http://www.nif.org.in/oniontransplanter>), we can not just share the design of this machine with small mechanics and entrepreneurs, we have to also share the spirit, the values underlying the decision of Shri More to make it open source. The culture of inclusiveness embedded in it will also need to be diffused. Institutional platform linking such mechanics who will learn from each other and keep cost low, so that affordability, accessibility and flexibility are integrated in each solution. The configuration of technological, institutional and cultural context of innovation needs to be learned form for more sustainable applications.

As one can observe, higher the level of abstraction, greater is the degree of generalizability and more diverse are the domains in which lessons can be learnt.

Should scale be the enemy of sustainability?

One of the challenges Honey Bee Network often faces is the criterion of scale by which the so-called success should be judged. No doubt, to some extent, any innovator would wish more and more people to benefit from his or her innovation. However, there are problems which are limited in scope, space or social segments. During the Shodhyatra in Dhemaji district, Assam, we came across a serious problem of high iron content in the water. The local communities did have water filters made from local sand and clay. Even the filtered water, clean as it seemed, when filled in bottles turned brown after we walked for some distance. Obviously, not entire iron had been filtered. If special filters have to be designed,

then their market may be restricted to a district or a few more districts, where such problems exist. Given the poverty and limited size of market, large private companies manufacturing filters may not see this as a viable opportunity for either solving the problem or commercially launching the solution, that is specifically designed water filter. The state will have to play an active role. If the incentives in the scientific and technology institutions were to be determined only by the scale of diffusion of their solutions, then they may also not address the problems limited to certain niches. In the *long tail of innovations*, while some innovations diffused widely, large number of innovations remain localized. Should such niche-specific needs be served or not? If the dominant ideology disincentivises the generation of solutions for small niches, then people in these regions or sectors will feel alienated. If local solutions are not optimal and if formal institutions are not willing to engage, social alienation and unrest are inevitable.

Alienating marginal people, fueling unrest:

Take the case of forest based products. Almost entire material from the forests where some of poorest tribal live is drawn out as raw material. Not even one per cent of local produce is valorized *in-situ*. In the absence of value addition, there is a limit to which even the most compassionate contractor or employer can pay more than a limited amount of wages, keeping aside the corruption and exploitation. My argument is that even with the best intentions, we cannot remove poverty and generate sustainable livelihoods, maintain ecological balance unless we ensure that no material goes out of the forest region without some value addition. If one looks at the nature of the technologies, some of them may be a few thousand years old. How does one join hands with local knowledge rich, economically poor people and create conditions for experiments to take place and innovations to emerge? Naturally, the engagement between formal and informal sector cannot just be left to the random chance events. It is not that the tribal communities don't have lessons to teach us. In certain regards, they may have extremely rich knowledge system. While in other cases, because of lack of tools and other facilities, they may not have been able to develop more efficient ways of processing forest products.

Learning from Tribals: In Naryanpur, Bastar, we came across an interesting sight. While there were no Christians or Muslims there, but there were some graves outside the village. We were intrigued. When we asked the reason, we learnt something extraordinary. When a healthy person died, they buried the body. When a sick person died, they burnt it. It is difficult to surpass the elegance and wisdom of such a practice. Does it matter how widespread this practice is? Will we value it less if it is prevalent in only one village? Similarly, we found another village in the same region, where people had built some sculptures on the top of graves. On closer scrutiny and discussion with the community, we realized that whenever an outstanding person died, the community made his clay sculpture on the top of his grave/Samadhi.

During Shodhyatra in Purulia and Bakura, West Bengal, we came across a very interesting practice. In a potters' village, some of the most beautiful terracotta horses were kept under a tree. When we enquired why had they kept such beautiful horses under a tree, the local potters replied, they had not kept the just the beautiful ones, they had kept the best ones. We were still intrigued. Looking at our inability to understand the logic, they explained that when the children walked by this tree, they could see what the current standard of designing best terracotta horses was. They had to do better. We had never come across such an outstanding example of *open source standards of excellence*. Even if we found only one

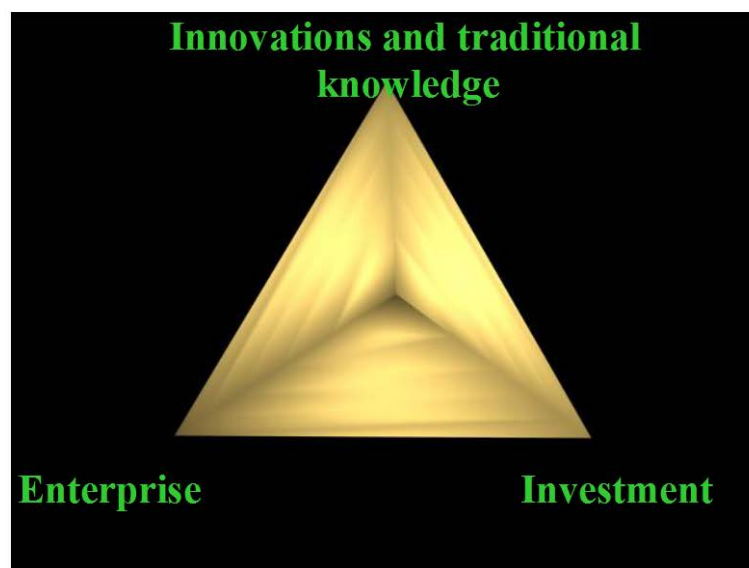
village, where such a practice existed, it was still worth learning from. Niches-specific innovations can change our entire perspective of life. No point in ignoring them.

From incubation to sanctuary model:

The scaling up of innovation depends upon how well we mentor an idea, help in forging the appropriate linkages and try to convert idea into viable product. India has many incubators, some of which have done very well in terms of converting ideas into practices. However, in a society where a large number of middle class or lower middle class innovators have to take care of multiple responsibilities, it may not always be possible for such innovators to leave their filial responsibilities and shift to an incubator. That is why, a large number of incubators don't have many incubatees. When GIAN was set up 1997 to link innovation, investment and enterprise, the golden triangle for rewarding creativity, the principle was to provide incubation support at the doorstep of the innovators (Figure one).

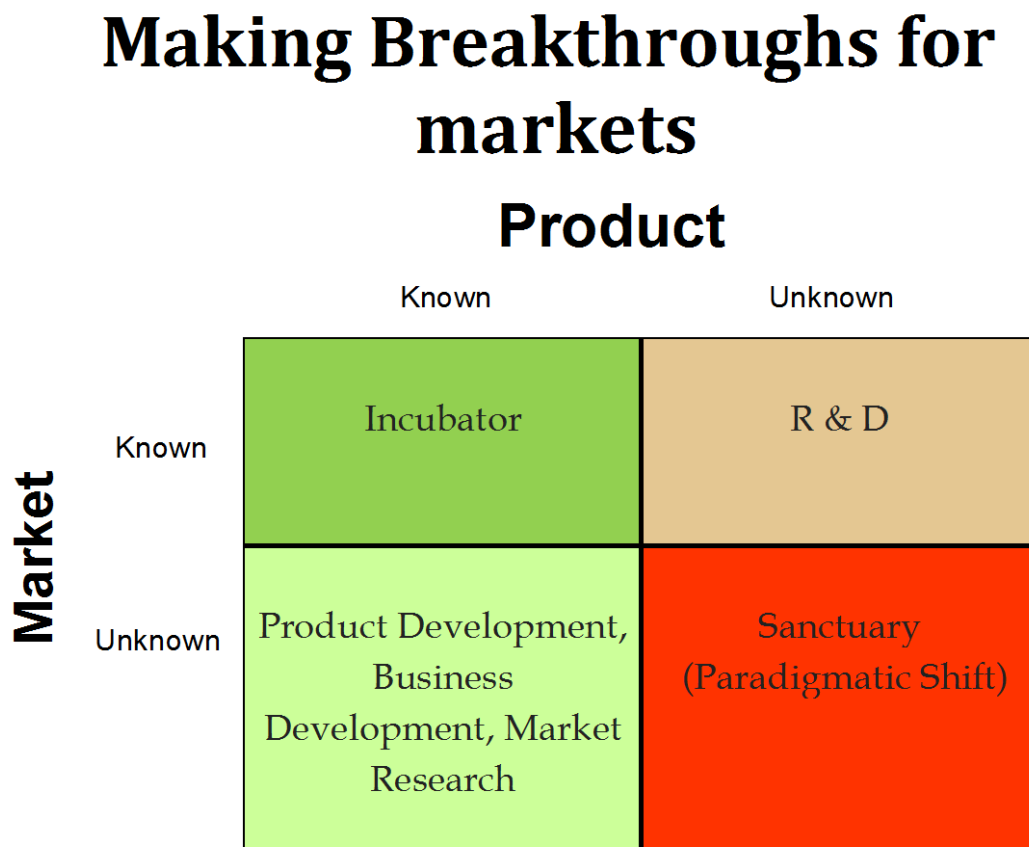
Figure one

GOLDEN TRIANGLE OF CREATIVITY



While redesigning the mechanisms of incubation, it may be useful to look at emerging challenges in nurturing incremental innovations vs. breakthrough innovations. As shown in figure 2, there are known and unknown products and known and unknown markets. Four combinations are: [a] known product, known market, [b] known product, unknown market, [c] unknown product, known market and [d] unknown product, unknown market.

Figure two



In the first case [a], incubation model may work well. While both are known, the greater fit between the customer needs and technology features has to be achieved. One can mentor and maneuver the journey from product to utility through better market linkages and design support. In the second case [b], one needs to do business development, market research and reconfigure the product to suit the market needs. In the case [c], market needs are known and one has to do R&D for developing a solution. In the fourth case [d], when both are unknown, one needs a very flexible, playful environment for innovation, which I call as sanctuary model. In the case of incubation, there is a *chaos* outside and *order* inside. In the case of sanctuary [like a wildlife sanctuary], there is a *chaos* inside and *order* outside. Breakthrough innovations will seldom take place in a context where institutional condition are overbearing and may stifle highly risky and diversified approaches.

When we look at the grassroots innovations, which have transformed the local conditions, extreme degree of stubbornness and unwillingness to take too much feedback into account has helped the fortitudinous spirit of innovators to thrive. It may look counter intuitive but we found another instance where many centenarians, particularly grandmothers showed similar attributes. Just as headstrong and autonomous women of their own mind often live very long, perhaps the innovators with similar characteristics can also come out with irreverent ideas leading to sustainable solutions.

There are many more lessons that we have learnt over the years from our engagement with grassroots innovators and the bridges that we have tried to build with the formal science, technology and innovation systems. Before I conclude, let me recall an incident about why large corporations feel hesitant in joining hands with grassroots innovators at an early stage. I was invited by Ludhiana Management Association chaired by Mr. Munjal (son of the senior Munjal, famous for a worldwide brand of bicycles) to talk about innovations. Having so many bicycle manufacturers in the meeting, I made a special effort to show many examples of bicycle based innovations in our database. As usual, there was appreciation and applause but I was not very happy. At the dinner time, I asked Mr. Munjal, whose wife was also present as to why did he not select any specific innovation related to his own industry (manufacturing largest number of cycles in the world), for further value addition, he replied, “Prof. Gupta, we are doing very fine”.

I then realized that if large corporation continued to do very fine, where is the need for them to innovate or learn from common creative people? While I don’t wish a bad time for such corporations, so that they pay attention to grassroots innovators, the fact is that they had begun to take note only when economy has begun to squeeze. Never before, so many large corporations had shown interest in open innovation platform as they do now. Honey Bee Network was one of the first open innovation platforms started 25 years ago. And yet, it has taken such a long time for corporations to begin to understand that not all good ideas can come from within. R&D is not equal to innovation. Innovations may require more freedom and flexibility and even frugality than the systems of large corporations often permit. Hence, the need to look out.

Summing up:

The tide is slowly turning. Many more public and private actors are taking interest in finding out how can they learn from common people. Deviant Research is getting legitimized slowly and slowly. At the same time, the norms of acknowledgement, attribution and reciprocity have not yet been adequately internalized in the formal sector. The informal sector, unorganized as it is, does not feel sufficiently reassured about the intentions of the formal sector. It is not surprising that if we leave aside the Honey Bee Network, despite billions of dollars having been spent by the international and national agencies, there are not many databases on the web demonstrating even a few thousand or a few hundred unaided innovations by common people. There must be something fundamentally odd in our approach! Why else would we share so much? Perhaps the demand for open access extremely frugal and affordable solutions to improve one’s life is going to increase. The Gandhian principle of self-reliance and self-help may not be entirely obsolete. Decentralised and diversified solutions provide diversity of thought for which cultural, institutional and even biological diversity are concomitants.

Let me conclude this paper with four recommendations. [a] every public institution of R&D must allocate at least 10 per cent resources for validating and value adding people's knowledge; [b] when validation is pursued, the conditions followed by the people must be carefully simulated and abstracted, lest a good idea is invalidated because of bad protocol. [c] The criteria of evaluation should also be carefully developed keeping in mind that people make tradeoff between accuracy, affordability and urgency all the time and [d] enriching people's own capability to solve problems using modern scientific tools and techniques is necessary to democratize science, technology and innovations. The new social contract would require significant investments not just in creating scientific temper but in

making scientific tools accessible to village and slum communities to understand the significance of science and technology based social transformation.

Table 1 - Average cost of validation/value addition: 2009 - 2012

Sr. No	Category	Total Amount Sanctioned (Rs.)	Total Number of practices/technologies	Amount/Practice (Rs.)
1	Engineering	2,03,25,000	92	2,20,924
2	Human Health <i>In vivo</i>	7,26,57,000	98	74,140
3	Human Health <i>In vitro</i>	13,53,500	31	43,661
4	Agriculture <i>Field</i>	18,95,580	48	39,491
5	Agriculture <i>In vitro</i>	9,76,500	4	2,44,125
6	Veterinary <i>In vivo</i>	83,40,693	97	85,987
7	SRISTI Laboratory <i>Field</i>	72,98,272	26	18,666
8	SRISTI Laboratory <i>In vitro</i>		365	
9	Community workshops	91,93,563	32	2,87,298