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Changing Paradigms: Designing for a Sustainable Future

Anamika R Dey & Anil Gupta

22 Empathetic climate resilient frugal innovations for sustainable communities

22.1 Introduction¹⁴

For more than two decades, Honey Bee Network has been trying to scout, spawn and sustain grassroots green innovations and outstanding traditional knowledge. Several institutions were created to link formal and informal science, technology and policy institutions. India is the first country, which has made unleashing the potential of grassroots innovators an essential part of the National Innovation System. Ideas, innovations and institutional initiatives for turning around economic development and fair distribution of wealth generated will not depend upon actors in formal sector alone. Lessons from Honey Bee Network are also influencing corporations both national and international besides public policy makers with in India and abroad. Many companies like Volvo, GE, HP, Philips, Microsoft, JSW etc. have also tried to learn from the insights gained from grassroots innovators. However, given the increasing uncertainty in the environment and the need for frugal quick time solutions, there is no choice but to learn from the communities for whom this kind of adaptation is the only choice.

In part one, creative and innovative coping strategies of knowledge rich-economically poor people are summarized. Part Two deals with the contours of emergent inclusive innovative ecosystem in India over the last 25 years of Honey Bee Network. Part three lists emerging inclusive models of innovations having bearing on creativity at the grassroots level. Trends in innovation literature, particularly from an open innova-

tion perspective are reviewed in part four followed by a summary of key points at the end.

22.1 Part One: Creative and innovative coping strategies with Climate risks

Dealing with risk and uncertainty has contributed to the evolution of local knowledge, institutions and culture among farming, pastoral and artisanal communities at grassroots level. The traditional institutions, practices and ways of finding contemporary innovative solutions to emerging problems still remain relevant even if some of the indicators or specific practices may have lost their relevance (Leonard, Sonia, et al 2013, Corinne Valdivia, D. Green and G. Raygorodetsky, 2010, Coleen Vogel et. Al., 2007). Institutional adaptation plays no less important a role through collective action (Daivi Rodima-Taylor, Mette F. Olwig, Netra Chhetri, 2012, also see www.sristi.org/cpri). The resilience requires not just actor based study but also the role of entire socio-ecological system (Gupta, 1984, Donald R. Nelson, W. Neil Adger and Katrina Brown, 2007). This paper focuses more on technological adaptation and innovation (Gupta, 1992, 1995, 1989, 2006, 2012). The grassroots innovations emerging in a materially constrained environment invariably leverage knowledge, ingenuity and local resources in a very frugal and empathetic manner. Not all innovations at grassroots are designed to solve one's own problems. Many of these are inspired or triggered by internalization by the innovators of some third party's problem including community unmet needs (through *samvedana*). The adjustment with risk at a time and adaptation over time may take place thus through collective institutions, individual responses and market and state level interventions. Studies have shown that among various household risk adjustment (HHRA) strategies for 'survival under risk' (Gupta, 1989), local communities can cope at intra and inter household lev-

¹⁴ Authors are grateful to Prof Gurdeep Singh, ISM, Dhanbad, for very useful suggestions and Pooja Tole for bibliographic help, R Baskaran for processing the text. The insights presented here are entirely due to the lessons learnt from green, grassroots empathetic and frugal innovators.

el, community and common pool resource institution level and though public interventions (see Table one, Gupta, 1984, 1995, Dey, 2015).

Intra-HHRA includes reordering existing plans for managing natural resources such growing eco specific crops, varieties, managing drainage, etc. When stress increases, households may take recourse to non-farm, socio economic adjustment strategies such as disposal of assets, migration or even modified consumption. When either intra-HHRA does not work enough, or some times depending upon the strength of kinship or social network structure, households may resort to exchange or borrowing or purchase of natural resources, seeds, seedlings, or other inputs to tide over the climate change induced crisis. But these exchanges may also involve borrowing loans in cash or kind, labor contracts, or tenancy, land being leased-in or leased out to adjust with risks. There are very few communities, which can really manage the risks without some collective measures. These could be reliance of indigenous common

property resource institutions (see sristi.org/cpri), common pooling of resources, or labour to manage a lake, pond or grazing land, community nursery, weeding, water management etc. Public interventions become imperative when the crisis is so deep that HHRA fail or prove inadequate. At such juncture government and some times philanthropic organizations create public support for affected population. The availability, accessibility and affordability (Gupta 2014), of these strategies lone or in combination influences how the new innovations are triggered and what combination of private, public and common resources they draw upon.

Technological innovations can emerge through collective need identification but may be pursued both individually as well as collectively. Double decker tree Root Bridge across a river in Nogreat village of Cherapunji distt, Meghalaya, north eastern India is a good example of how technology, institution, and culture mediated the evolution of a sustainable, frugal innovation. Thats why, Gupta (2009), has argued that *if technology is*



Figure 1: Risk Adjustment Strategies

like words, institutions are like grammar and culture is like thesaurus. Climate change induced risks require access, assurance, ability and attitudes of both, the local communities and institutional support providers, towards ecological resources, technologies, institutions and cultural norms in a given region to be modified to enhance resilience. Unless these changes are circular in nature, that is cradle to cradle, these will not be sustainable.

One of the drivers of frugal innovations is the use of second hand parts for mechanical innovations. These parts have a lot of material strength and life left though the main machine or the vehicle of which these were part originally may have exhausted their useful life. Thus frugal innovations are circular in nature and reduce, delay or slow down environmental footprint.

22.2 Part Two: Towards inclusive Indian innovation ecosystem

Tapping green grassroots knowledge from different parts of the country was not easy task. A journey begun 25 years ago through the new social movement, viz., Honey Bee Network paved the way for combining eight Es, “Ethics, Equity, Excellence, Empathy, Efficiency, Environment, Entrepreneurship and Education”.

The National Innovation Foundation (NIF, www.nifindia.org 2000), Grassroots Innovation Augmentation Network (GIAN, www.gian.org 1997), Society for Research, Initiatives for Sustainable Technologies and Institutions (SRISTI, www.sristi.org, 1993) and recently techpedia.in, (a portal by SRISTI pooling 187,000 engineering projects pursued by 550k students from over 600 institutions) etc., are some of the initiatives of the Honey Bee Network which are transforming the inclusive innovation eco-system in India. NIF has mobilized more than 200,000 ideas, innovations, and traditional knowledge practices, of course not all unique, from over 500 districts in India. More than 745 Patents filed for these creative students, innovator, mechanics, farmers and others institutions have triggered and supported a social movement with the help of volunteers in which many private sector institutions, such as intellectual property protection firms, marketing companies, designer firms etc., are coming forward to join forces.

Several models of innovation have emerged which either reduce risk, improve access or provide support to take risk (ecological, climatic, economic and social).

Empathetic innovations are triggered when an innovator internalizes the pain of others, by considering a third party problem as one’s own. The Inverted Innovation model applies when children ideate, and innovate; engineers and fabricators design and large companies commercialize these innovations. Deviant (New Scientist, 2007:56, Gupta, 2006) researchers in the formal and informal sector are joining hands to transcend new frontiers of affordability and accessibility through what Prahalad and Mashelkar (2010) call, Gandhian Engineering i.e. getting more from less for many, MLM). Grassroots innovations are unaided, developed by people having no formal training and often no experience from, or affiliation with the organized sector. Given scarcity of material resources, it is inevitable that most grassroots innovations leverage local knowledge resources, which is what they may have in abundance.

When household portfolios are characterized with low mean-low variance (vulnerable) or low mean (or average) income – high variance (most vulnerable) due to inherent socio-ecological characteristics and climatic uncertainties (Gupta, 1981, 1984,1989), they have to compulsively innovate because survival otherwise seems so difficult. The hope is that large and small corporations, public policy makers and R and D institutions will learn new heuristics from the distributed, diversified and developmental nature of such innovations at the grassroots level and trigger, what we call, a G2G (Grassroots to Global) model of reverse globalization.

New pedagogies in management education have to emerge such as courses like ShodhYatra, taught at IIMA for over a decade, reinforcing learning from *within, each other, nature and common people*. A paradigmatic change is in the offing when many large corporations are recognizing that the majority of ideas for the future will come from outside organizations through mass sourcing or crowd-sourcing processes. Forbes made this evident when it used Honey Bee Network’s experience to crowd-source content for its January 2011 issue and thus created a new journalistic tradition. It is for this reason that the search for the so-called Fortune at the Bottom of Pyramid (by selling things to poor) was a misplaced paradigm, since it did not consider the Innovative potential at the Tip of the Iceberg. Unless we expand the purchasing power of the poor through this inclusive innovation model articulated by Honey Bee Network, we may continue to sow the seeds of social instability through the

systematic exclusion of creative communities from the market (Gupta, 1992, 1995, 2012, 2013).

22.3 Part Three: Emergent Models of empathetic and frugal innovations

Among various motivations and triggers for innovations studied by Sinha (2009), one of the important drivers is empathy (Gupta, 2010). An innovator does not generally take initiative to solve a problem because they personally suffer from it. It is the internalization of problems faced by somebody else, as one's own that becomes a prime driver for an empathetic innovation. Amrutbhai, an innovator who began his life as a farm labourer developed several innovations such as a wheat sowing plate or box, a blade for groundnut harvesting and later a tilting bullock cart to distribute manure in the fields (Honey Bee, 1992). Similarly, Khimjibhai from Sabarkantha district, Gujarat was approached by women tired of carrying water on their heads and thus, having pain in their neck to find a solution. A device to shift a load from the head to the shoulders was developed as a result. Later, he developed a device for scraping gum from thorny acacia plants, which used to cause tremendous inconvenience to the women (Honey Bee, 2000).

Amrutbhai also developed a pulley that drastically reduces the risk of buckets falling into the well while lifting water due to loosening of grip or fatigue. Virendra Kumar Sinha (2009) had a mechanical welding and repair workshop situated opposite a primary school. The noise and the air pollution caused by the 12 HP generator used in his workshop disturbed the children in the school. Neither the school nor his workshop could be relocated. He therefore, invented a pollution control device to improve the learning environment for the children and reduced the smoke and noise pollution for neighbours. Gupta, Patel and Patil (1992) have reviewed more than hundred plants which have been used by local communities for pest control without using chemical, thus making solutions open source, extremely affordable, without negative externalities and highly climate change resilient.

Empathetic innovations can be mediated by several triggers such as articulation of the problem by the people suffering, noticing the third party oneself or, feeling responsible for those affected. Sometimes, a teacher or other intermediary can impress upon an

innovator to recognize the need to solve a problem. I had been sharing the problem of tea leaf pluckers in tea gardens for many years. Not many got moved until this problem was posed to the students of CEPT University in Ahmedabad, where students were, a part of their course taught by Astad Pastakia, a former student of mine, required to develop a solution to an unsolved local problem. Later, two groups got motivated through the internalization of the tea worker's problem and developed interesting prototypes. There is a widespread realization that the classical innovation system, based on R&D in the organized sector (corporations and public systems) has failed to take note of many unsolved problems of common people. With rising aspirations and increasing media exposure, a lot of local communities are becoming restive and are not willing to wait indefinitely for their problems to be solved either by local innovators or an external agency. Inclusive or harmonious innovation models require considerable stress on empathetic innovations, although several other motivators may have to be mobilized where empathy alone does not trigger action.

The *Inverted Innovation Model* builds upon the imagination of children to become intolerant with the myriad of problems around them. They may not have the technical competences to solve a specific problem but they can imagine a creative solution. Such ideas have been mobilized by Honey Bee Network for a long time but specifically focus in recent years under the IGNITE Competition. NIF has developed a new model in which children imagine and innovate, engineers and designers fabricate and corporations commercialize. For a long time, the task of innovation has been far too systematized and thus relegated to a professional and specialized group or set of individuals. The experience of triggering innovations not only in India but several other countries such as UK and Malaysia has revealed numerous examples of the Inverted Innovation Model. Let us illustrate. Mayank Walia, a grade nine student thought of an innovation which should have occurred to the specialists in the field years before. The problem was how to expand the reading potential for visually impaired people. A technology of pen-based scanners, which convert printed text to digital text, already existed. So did a public domain technology for converting digital text into speech. Mayank thought of combining these two technologies to enable blind people to read practically any book. This sweep of imagination shows

an element of empathy but also a very clever juxtaposition of available solutions. Eighth grader, Nisha Choubey noticed many that, due to overcrowding, there are often not enough places for travelers to sit while waiting at bus stops, airports and railway stations. She thought of integrating a folding seat into a stroller and thus gave rise to a multi functional stroller.

There are numerous other examples where children of class one and higher levels have imagined solutions to the problems with which, we the adults have learnt to live with. This is a trend, which portends well for the future. There can be nothing more reassuring for a society than to have children who are no longer willing to live with inefficiency or inadequacy. Much, of course, depends upon the favourable eco system required for nurturing such ideas. In Malaysia, a similar quest led us to visit a school along with the officials of the Ministry of Science, Technology and Innovation. On the spot competitions for ideas generated numerous examples of children developing new ideas to solve contemporary social and personal problems. Likewise, through a teacher who was walking with us in Shodh Yatra (learning journey), we talked to the young kids in her class who all invented one or another peculiar solution and surprised everybody with their creativity. While children's ideas have long since been scouted, treating kids as potential inventors and innovators for solving social problems is a recent development.

Deviant research (Gupta, 1984, 1998, 2007) has been argued as the process of breaking out of the boundaries of conventional research paradigms both in terms of methodology as well as purpose. Innovations emerging from deviant research follow unconventional methods and approaches. This has now become popular as crowd sourcing, mass sourcing and user driven innovations were conceptualized initially as deviant research by practitioners who realized the limitations of then available methods for discovering new ideas. Honey Bee Network itself began as deviant research more than two decades ago. The importance of deviant research as a precursor for innovations lies in recognizing the limits of disciplinary and sectorial boundaries of innovation organizations. Many large corporations today are acknowledging that majority of the new leads for innovative products and services are likely to emerge from people outside the organization. These may be users, non-users, just observers, supply chain members or even those excluded from the use phase. The concern

for frugal, flexible, friendly and extremely affordable innovations arises on account of majority of the poor people having remained excluded from the purview of various commercial and developmental policies, programs, products and processes. The concepts of *reverse globalization* (or g2G, Grassroots to Global) and *innovation insurgent* are offshoots of concern for the excluded.

The much abused term profit at the bottom of the pyramid (BOP) triggered a mindset in which the little savings and purchasing powers available to economically poor people had to be tapped by the large corporations by selling things to them, as Prahalad famously said, even if it meant a one rupee ice cream. Whether the children born in the poor families needed milk to meet their nutritional gaps or eat ice cream became a moot point. It is not surprising such a mindset has led to a situation where almost 40 per cent of children in one of the fastest growing states of India, i.e., Gujarat are found to be malnourished as per the official surveys. This approach did not consider that economically poor people could be at the top of pyramids dealing with ethics, knowledge, institutions or innovations. As we well know, language shapes the habit of thought. By using the BOP framework, we will inevitably discover only the inadequacies of economically poor people and not their strengths. Honey Bee Network was a departure in this context. It focuses on the ideas, institutions, initiatives and innovations in which economically poor people were rich i.e. at the base of economic pyramid (BoEP). That is how a huge database of innovations and traditional knowledge emerged in the last two decades. The fact that thousands of these practices and innovations could help in climate risk adaptation and resilience at individual and community level was ignored. For instance, Harbhajan Singh, a farmer from Hisar, Haryana was recognized by NIF for developing an innovative climate resilient practice of alternate row irrigation in cotton. The water requirement was reduced by half without reducing productivity. The reduced succulence in the plant also led to reduced pest attack and thus the cost of pesticide application.

Reverse globalization and g2G (grassroots to Global) imply creating global markets for grassroots products. Fair trade organizations and companies like the Body Shop did try to pursue such a path with various limitations and potential. In most cases, the poor were the provider of raw materials and seldom of knowledge and ideas. Instead of treating poor as receivers of aid,

assistance and help, thinking of them as provider of new ideas, traditional knowledge and creative institutions can change what I refer to as from Sink to Source (Gupta, 2006, 2013). NIF has facilitated the commercialization of several grassroots innovative products around the world. SRISTI has filed patents for such innovators in US with pro bono help from patent firms. If proof of the potential of reverse globalization was needed, it has been provided in abundance. The performance of this potential however remains to be fully tapped. The model of reverse innovation (Govindarajan, 2009; Trimble, 2009; Immelt, 2009; Prahalad, 2009) suggests that innovations developed in resource-starved conditions in developing countries may find applications and market in developed countries as well. Reverse globalization not only implies that innovations developed in the informal sector in developing countries have relevance in global markets in western countries, but also other developing countries.

Within developed countries, there is a scope of grassroots innovations by common people outside the formal sector and this is one potential, which has not been tapped in most developed countries. There are examples where attempts were made to learn from the margins within developed countries. Hiscox and Connor (1939) wrote a book, "Fortunes in Formulas for Home, Farm & Workshop" illustrating numerous examples of local knowledge in grassroots innovations made by farmers, fishermen and women, artisans, etc., for solving local problems. Unfortunately, this did not continue in most developed countries.

The concept of *innovation insurgent* (Gupta, 2007) implies harnessing the qualities of an insurgent for a positive transformative end. The insurgents are irreverent, don't respect the order, establishment or a dominant paradigm, are risk takers, courageous, and do not often care about social approval (though peer approval is still relevant) before embarking upon a new mission. In most developing countries, where the development process is not inclusive enough, youth in marginalized communities become influenced by extremists and may resort to violence prone leftists ideologies. Their choice of violent means is wrong but their ends, i.e., desire for fair and just social order may be valid. It is in such a context, that an eco system for supporting social and economic entrepreneurship based on local creativity and innovation can translate the concept of

non-violent, *collaborative innovation insurgents into a peaceful order*.

The socio ecological model of transforming organizations through innovative self-design also needs to be taken forward. Ecological conditions define the range of enterprises whereas the access to factor, product markets, kinship and other non-monetary exchange relationships determine the scale and scope of economic activities. The inherent risk in various enterprises generates the portfolio of choices having high risk - high return, high risk - low return, low risk - high return and low risk - low return (Gupta, 1981, 1984, 1989, 1992, 1995). The implications of household choices for the design of resource delivery system are obvious. Stationary organizations will not be able to serve mobile communities such as pastoralists, fish workers, forest workers, etc. Similarly, organizations designed for high population density regions will inevitably fail to serve the communities in low population density regions. Such fundamental disjunctions in the theory of organizational design and creative aspirations of local communities have begun to receive attention lately (Kate Hanisian & Shiloh Turner, 2015). It is time to ask questions about innovations in the research on innovations. Anderson, Dreu and Nijstad (2004), in fact after reviewing research during 1997-2002, suggested need to "Study innovation as an independent variable, across cultures, within a multi-level framework, and use meta-analysis and triangulation." Most of the studies are focused on innovations in organizations at different levels that occur due to varying motivations. The triggers could be stress, conflicts or hope of positive outcomes. The authors are focused on distress related triggers, which motivate individuals to innovate so as to alleviate distress in the organizations.

22.4 Part Four: Open innovations for enhanced resilience

The review of research by Anderson, De Dreu and Nijstad (2004) also revealed that more than 80 per cent of studies dealt with the replication of extension of existing lines of research and only about 13 per cent could be said to be theory driven. The majority of these studies were field based and not lab based and relied on questionnaire survey. The authors did not find any intervention study during 1997-2002. The search for in-

ducing climate resilience through bridging knowledge of formal and informal sector in open innovation literature poses even a bigger challenge.

22.4.1 Incentives for innovations

The role of prize as a motivator for innovation has received renewed interest in the recent past. Lohr (2011) reviews the experiences of X Prize Foundation, famous for announcing a prize for a low cost private space flight, and Qualcomm for announcing a 10 million dollar competition for a smart phone that could diagnose human health problem as accurately as medical doctors. The US Federal Government passed the America Competes Act in December 2010 authorising government agencies to sponsor prize competitions valued up to 15 million dollars. The US government had listed various challenges at www.challenge.gov with and without prizes to tap the innovative ideas of common people. This is a natural extension of the concept of crowd sourcing and open source softwares within the broad domain of an open innovation model. Lohr recalls a prize of 20,000 pounds being offered by Britain in 1714 (today approximately 4.5 million dollars) to anyone who could develop a device to accurately determine the longitude of a ship. That is how the marine chronometer emerged as an invaluable tool for sea navigation. In 1929, Mahatma Gandhi announced a competition with a 7,700-pound prize to anyone who could improve the design of the spinning wheel. He outlined six criteria of efficiency and cost. The winner was supposed to assign the intellectual property rights of the improved design to the organizers. It is a different matter that such prizes have not subsequently been offered for solving social problems. There is very little research on how different incentives work to promote innovation by common people.

Terwiesch and Xu, 2008 suggest that the potential of an open innovation system generating appropriate solutions through a promise of reward is linked to the type of innovations to be generated. When potential solvers are many, there could be some under investment of effort but with appropriate incentives and multi level or multi round screening systems, effort can be maximized. Mahatma Gandhi set the bar far too high by offering one of the best prizes at that time to intuitively eliminate the chances of under investment of effort. He had also specified the output parameters to prevent frivolous entries. Even without a multi round screening effort, one can offer a substantially large award and get

challenging problems solved. In the recent past, a private space flight came about through such an award system. The irony is that such awards are seldom offered for persistently unsolved socio-technical problems.

22.4.2 Open innovation model

In a recent review of users as innovators, Bogers, Afuah and Bastian (2010) built upon the work of von Hippel (1988) about the role of users as innovators. They referred to the earlier example of this kind given by Adam Smith (1776/1999: 114-115) illustrating how a boy who was employed to run a fire engine tied a string from the handle of engine to automate the system and thus got *time to play around*. Enos (1962) illustrates user driven innovation in the oil sector, Freeman (1968) in chemical industry. And Shah and Tripsas (2007) explore the potential of user innovators becoming user entrepreneurs. There are various reasons why users innovate. However, none of the paper indicates the producers of the products sharing the benefits derived from the deployment of user driven innovations in their products with the innovator users. The role of acknowledgement, reciprocity and respect has remained grossly under studied. The issue of intellectual property rights of the users has also been ignored. The authors suggest that the theoretical underpinnings of why users innovate has not been systematically articulated. The role of tacit knowledge triggering user-based innovations is also not adequately discussed. Incentives through enhanced performance are suggested as one of the major drivers of user driven innovation (Riggs and von Hippel, 1994: 459 - 460 in Bogers, Afuah and Bastian, 2010).

There are several questions that this literature review leaves unanswered: Why has the role of non-users but passive observers in generating innovations not been studied? Will the role of a user who continues with the usage vis-à-vis the one who discontinues the use of original device or practice be similar or different in triggering derivative innovations? Why should benefit sharing with the users not be pursued on the grounds of ethics and efficiency? The process of seeking innovations from common creative people who may not be users of the manufactured goods or services but identify the need gap among available technologies has been ignored almost completely. Honey Bee Network tried to bridge this gap since the late 1980's and has spawned a whole new framework of seeking innovations

from untrained, often unschooled minds in rural and urban areas with varying motivations.

22.4.3 Crowd sourcing

The concepts of crowd sourcing and mass sourcing were part of outsourcing in open innovation models emerging in the west (Howe, 2006, Chesbrough, 2003, Piller and Ihl, 2009, Hippel and Jong, 2010). The literature, however, remained focused on the need of a corporation or an organization to seek ideas for improving existing products and services. Piller and Ihl (2009) gave an example of the Danish government using user-centered innovation as a national policy (2005). The Indian government had announced the establishment of the NIF (National Innovation Foundation) in the budget speech of the Finance Minister in the 1999 parliament. The Foundation was actually established in 2000. In 2010, it became an integral part of the Government of India's Department of Science and Technology as an autonomous institution. India is perhaps the only country where grassroots innovations and outstanding traditional knowledge practices are part of the National Innovation System since then. With the help of volunteers and institutions such as SEVA (Sustainable – agriculture & Environment Voluntary Action), SRISTI (*Society for Research and Initiatives for Sustainable Technologies and Institutions*), Hitalgida, etc., by 2000 Honey Bee Network had mobilized about 10,000 innovations and ideas. Over the next decade and a half, supported by a strong volunteer network, NIF (National Innovation Foundation) established a database of 200,000 ideas, innovations and TK practices. While not all of these are unique, a large number are very distinctive and extremely affordable. The Memorandum of Understanding NIF has with the Indian Council of Medical Research and the Council of Scientific and Industrial Research, Indian Council of Agricultural Research etc., facilitate the blending of formal science with informal technologies developed by common people.

Gemunden, Salomo and Holzle (2007) extend the works of Schon (1963) and Howell and Higgins (1990) to stress the role of innovation champions in projects or programs possessing different degrees of innovativeness. They conclude that more than the champions, the open innovators willing to learn from outside the organization, take risks and identify valuable options play an important role in promoting innovations. However, these cases focus primarily on the organized sector.

Wiggins (2010) narrates an interesting model of research collaboration. He referred to it as citizens' science, in which people are involved in scientific research to deal with real world problems. Millions of volunteer participants from around the world can be motivated for distributed knowledge production, as witnessed in open source software. Schenk and Guittard (2009) continue the discussion on crowdsourcing from an organizational perspective using web2.0 and other social network platforms. In fact, in 1998 Eli Lilly company had used the concept of crowdsourcing at InnoCentive drawing upon the knowledge of the crowd for offering solutions to the corporate problems.

Minin, Frattini and Piccaluga (2010) describe the process of open innovation helping a firm during and after the downturn. Laursen and Salter (2005) linked the degree of openness of a firm to its absorptive capacity. By implication, there could be occasions when people's knowledge does not get recognized by public and private organizations because of their lack of absorptive capacity and perhaps ability to share benefits and win trust of the knowledge providers.

Bughin, Chui and Johnson (2008) noticed tension in open innovation model and asked the question as to who owns the intellectual property in the co-created products and services. The McKinsey research suggests that a variety of incentives would be needed for co-creation with customers. Trust in the company is a vital factor. They recognized that the limits of individual voluntarism might be reached sooner than later. A whole variety of licensing models emerged. Earlier work by Honey Bee Network (Gupta, 1997, 2000) advocated a portfolio of incentives combining material or non-material benefits targeted at individuals and communities to fructify in the short- and long term, upfront after commercial realization.

Terez-Luno, Medina, Lavado and Rodriguez (2011) analysed the effect of social capital and the tacitness of the knowledge on the emergence of medical innovations. By itself, social capital does not guarantee higher radical innovations indicating an important role for trust apart from reciprocity.

Dahlander and Gann (2010) look at the openness of the open innovation model. They traced much of the literature beginning with von Hippel's 1988 book but noticed far more citations for Chesbrough's (2003) publication. They recommend that the cost of openness needs to be figured out more thoroughly. The

incorporation of external actors for generating innovations within the firm needs to be studied in terms of various processes used to cope with openness as well as competitive environments. They also suggest that management of relationships with variety of sources from which ideas are taken needs to be factored while conceptualizing the open innovation model. A variety of combination of openness, offers seal will need to be evaluated for their respective effectiveness. Gupta (2010) discussed this issue from a slightly different perspective of accessibility of knowledge and opportunity to common people who may only communicate in local language and sometimes only through oral means. In such cases, their participation in the innovation chain will be contingent on the availability of multimedia and multi language tools as articulated by Honey Bee Network at the first Global Knowledge Conference in Toronto in 1997.

Schaffers, et al., (2007) and Marita Holst, Anna Ståhlbröst and Birgitta Bergvall-Kåreborn's (2010) share the view that Openness in Living Labs—Facilitating Innovation deals with the concept of the users, researchers, companies and other stakeholders engaging in voluntary agreements for solving problems. This represents an early stage collaboration for generating systemic innovations involving people in rural areas in a specific domain. It is still an engineered process highly purposive in nature and this purpose is not always autonomously decided but could be steered by specific stakeholders.

Dean [2011] traces the sources of technological innovations in China and highlights the role of mass innovations in the early years of industrialization, particularly in agriculture and decentralized industries. The role of workers for suggesting improvements was clearly identified. The innovations by workers were focused as a legitimate mode of improvement in productivity. The role of design in improving processes and product features began to be stressed in the late 1960's. Currently, innovations by grassroots workers are again being stressed and the design is no longer focused on adaptation but also the local generation of solutions suitable for Chinese conditions (Li Hua, Yu Jiang, Ye Lin, 2010, Zhang Liyan 2013). It is useful to mention that the China Innovation Network [CHIN] was modeled on the basis of the Honey Bee Network based out of the Tianjin University of Finance and Economics [TUFE]. In China, there is a renewed emphasis on harmonious

development, which in India is labeled as inclusive development. The exact degree of inclusion or harmony may remain a matter of interpretation but there is a conscious attempt.

The research on knowledge and innovative potential of workers in and out of organizations has remained grossly understudied though various authors have drawn attention to this lacuna from time to time. Yanow (2004) articulated this very sharply:

In principle, these workers develop knowledge in interaction with clients and customers that could be valuable to the organization, were it but to learn from them. Instead, the 'local knowledge' they learn in acting across these peripheries is *discounted, if not disparaged (emphasis mine)*, by more centrally-located managers and executives. The article theorizes about the nature of translating local knowledge concerning organizational practices and about the structural character of local versus 'expert' knowledge.

She sums up the tension as:

The problem appears to be old, recurrent, and structurally entrenched. Given the extent to which the language of 'organizational learning' has caught on in recent years, it is possible that describing the problem of the disparagement or disregard of local knowledge in these terms may work to change the nature of management practices in this regard. If the problem is located in the societal value attached to expertise, changing the situation will require a change in the working definition of 'expert' and expertise and a re-privileging of local knowledge. Such an approach would engage questions of power and the hierarchical structuring of work and the workplace, a source of potential resistance. If the problem is located in the societal value attached to 'Science' and technical rationality made through rhetorical argumentation, then change may require a counter-rhetoric of value. Here, perhaps, is where there might still be a role for 'culture' in talking about organizational learning, in that it enables an argument for the values of experience and local knowledge as sources of expertise.

Earlier, Nilsson [1995] highlights the process through which the scattered knowledge accumulated by the workers in the process of solving local problems, often learning-by-doing, was organizationally neglected but informally networked by the workers themselves. It was so vital for their continued efficiency. It is argued

that in several specific circumstances, “skill innovations by workers can be an important source of technical advance.”

It is apparent from the review that there are several factors which have led corporations to look outward in seeking solutions to their problems. The fact that most of them did not explicitly involve workers in the solutions seeking process implies continued neglect of the potential the workers have for developing ‘expert knowledge’. Many times, this expertise evolves through innovations. Stuart McDonald [1983] had shown through a study of sales notices of slaves during the 19th century England that some owners of slaves highlighted their highly skilled status and innovative potential while advertising them for sale. It is ironic that when workers were treated as a commodity, their creativity found value but after their incorporation as colleagues, the explicit attention towards their creative potential declined. Open innovation models have improved the ability of corporations and public systems to seek ideas and innovations far more easily and in a more diverse manner than before. But the limitations of such models are: [a] attribution, reciprocity and benefit sharing with the idea providers remain a contentious issue; [b] while looking outward, the degree of openness has been subject to access to tools, techniques, platforms and other kinds of knowledge domains.

The asymmetry in access invariably makes the so-called open systems less open; [c] the methods of incentivizing the common people and experts to share their solutions has yet to be empirically tested so as to produce a body of knowledge that can link formal and informal systems of knowledge productions, exchange and augmentation; and [d] the focus is far too much on seeking solutions to the predefined problems instead of treating open source or proprietary solutions developed at the grassroots level as indicators of problems being faced by the society [and thus worthy of solution]. The design of similar platforms for sourcing climate resilient grassroots innovations has led SRISTI to collaborate with UNICEF around UReport (as HoneyBeeReport) and RapidPro platform, to promote horizontal real time interactions among knowledge producers innovators, children, students and eventually other commercial and non-commercial organizations. It is hoped that corporations and other formal sector systems will see in open innovation system, a need for

reciprocity towards the common people from whom climate resilient innovations are sought and learned from.

22.5 Summing up

Grassroots innovations have triggered several fundamental changes in the way national systems of innovations are viewed, articulated and conceptualized. It is no longer possible to characterize national systems of innovations as dealing with formal sector Research & Development only.

Open innovation models influenced by early models of user driven or user centric innovations still retain focus on problems defined by the organizations at its managerial level. The involvement of workers as problem solvers or as mobilisers of social insight might have brought about greater connect between organizational strategies and the ideas of unorganized workers. Similarly the idea of involving climate change affected people in generating new solutions has not picked up a great deal though attempts in that direction have started¹⁵. But this has not happened as yet to a significant extent. Several models of innovations have emerged which warrant further work to test their empirical validity in different cultural and institutional contexts. The available evidence from Honey Bee Network’s activities in China and other countries indicates some potential

15 <http://www.wfp.org/climate-change/innovations> downloaded on Nov 3, 2015, provides the efforts of world food program but one can not find many examples of technological or informal institutional innovations at the site. Rockefeller Foundation issued a call launched in 2014 for livelihood innovations for building resilience. If it had built upon the learning from Honey Bee Network, the results could have been not only more extensive but also achieved more frugally. <https://www.rockefeller-foundation.org/blog/exploring-innovative-solutions-to-resilience-building/> downloaded on Nov 3, 2015. USAID launched a partnership with three NGOs including SRISTI to share the experience of grassroots innovators from India to enable Kenyan farmers to cope with risk better and use resource more efficiently; see www.sristi.org/cms/sristi-usaid and ‘USAID announces three partnerships for low cost agricultural innovations’, <http://timesofindia.indiatimes.com/business/india-business/USAID-announces-three-partnerships-for-low-cost-agricultural-innovations/articleshow/24982827.cms>, Oct 31, 2013

for these ideas and philosophical foundation to work cross culturally.

The inverted model of innovations, particularly empathetic innovations generates a new idea of involving young children as a source of ideas about the world they want to live in. Sustainability is likely to be higher in models that take into account the aspirations of future leaders of our society. The empathetic innovations emerge in socio-ecological contexts and can be a powerful source of generating climate resilient solutions for communities prone to risk. A model of inclusive or harmonious development in which the focus is far too much on one's own problem as a valid trigger for innovations needs to be tempered by a samvedansheel dimension so that innovations are triggered by internalizing others' problems as one's own.

The slowdown in economic growth in the recent past has further underlined the need for rethinking developmental approaches. The conventional models of corporate social responsibility or philanthropic approach to address problems of social iniquity, continued drudgery by women and other workers and lack of fair opportunities for developing one's talent will not work any more. It is borne out by the fact that there is almost total disconnect between the largest database of green grassroots innovations and such pursuits of larger organizations and public policy makers in various fields including climate change resilience at local level.

Absence of certain linkages speaks volumes about the chasm between philosophies of dominant foundations/bodies and policy structures and their accountability and assimilation of the perspectives from the grassroots. I have argued that linkage between formal and informal science and organizations of knowledge, innovation and practices can spawn a huge new ground of creativity, compassion, and collaboration for dealing with increasing climate, market and institutional risk and uncertainty in the lives of economically-poor but knowledge-rich poor people.

22.6 References and further reading

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Changing Paradigms: designing for a sustainable future is intended for designers, design students and design educators, who want to understand why and how to integrate Sustainability into design education and practice. It consists of five parts; Part One presents why we must design for a sustainable future, Part Two describes how to design for a sustainable future, Part Three presents student design projects exemplifying sustainable design, Part Four is a glossary of 120 terms and concepts about Sustainability and design, and finally, Part Five includes three appendices: The Cumulus Kyoto Design Declaration, and guidelines on how to green both school campuses and conferences. This book has been edited by Peter Stebbing and Ursula Tischner, who have invited internationally renown experts to contribute chapters. Changing Paradigms offers a comprehensive survey of essential knowledge for designers and other creative professions to shift their focus to the new design paradigm for sustainable production, consumption, and life styles.

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