

## Indicators for the Assessment of the local and indigenous innovation<sup>1</sup>

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The search for inclusive development indicators [IDI] through synergy between different ways of knowing and understanding the interface between natural and social resources, institutions, technologies and organizational arrangements is a very timely and relevant initiative of UNESCO. The increase in social aspirations, thanks to various ICT technologies and widespread democratic urge, has put tremendous pressure on the policy makers to make science and technology systems more and more responsive to the needs of common people. India has declared the current decade as the “Decade of Innovation”. The President of India, apart from conferring biennial awards for grassroots innovations, has also been hosting an exhibition of such innovations at President’s house for last two years. Chinese President has given a call for harmonious society through inclusive innovations. An MOU is being signed between the National Innovation Foundation of Malaysia and India this week to herald south-south cooperation for unfolding people’s potential for developing extremely affordable, accessible and accountable innovations for conservation of resources and economic self-reliance. Tianjin University of Finance and Economics [TUFEE] set up a twin centre on grassroots innovations at TUFEE and SRISTI (Society for Research and Initiatives for Sustainable Technologies and Institutions) to promote cooperation in this field.

Honey Bee Network started more than 23 years ago raised the question of linkage between formal and informal science, protection of intellectual property rights of the grassroots

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innovators, cross pollination of ideas through local language communication and sharing of benefits in a fair and just manner when their knowledge, innovation and practices became the basis of value added products by formal sector.

National Innovation Foundation (NIF, [www.nifindia.org](http://www.nifindia.org) 2000, at the last count, it had pooled more than 160,000 ideas, innovations and traditional knowledge practices –not all unique though- from over 545 districts of India)), Grassroots Innovation Augmentation Network (GIAN, [www.gian.org](http://www.gian.org) 1997), Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI, [www.sristi.org](http://www.sristi.org), 1993) and recently [techpedia.in](http://techpedia.in), (a portal by SRISTI pooling 104,000 engineering projects by 350k students from over 500 institutions) etc., are some of the initiatives of Honey Bee Network which are transforming inclusive innovation ecosystem of India. These 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 hands. Khoj Lab has been set up by Future Group (the largest owner of retail space in India) such that every idea will be labeled as India ka idea.

The questions that Honey Bee Network raised decades ago are relevant even today. I will first summarize what good indicators should do, then discuss how relevant indicators can be identified for achieving the goals of STIGAP and finally recommend the innovation policies which can leverage inclusive innovations for inclusive development.

### **Part one: Taxonomy of indicators:**

AmartyaSen [1980] stressed on the merit of good indicators versus accurate description of reality. The parsimonious choice always requires some sacrifice of detail. But, for policy makers, it is important to know the approximate trends quickly rather than get detailed statistics long after the event by when, the damage is done. The tradeoff between quickness and comprehensiveness should not lead to shortcuts and preference of methods like RRA/PRA which are not only unscientific but also unethical. Let me summarize some of the arguments I made

towards developing a theory of indigenous ecological indicators which may have a bearing on science and technology indicators [Gupta, 2001]. One of the first assumptions was that most systems boundaries were fuzzy in nature. The Honey Bee Network itself is a testimony to that and the recent open innovation movement further confirms that. Most organizations today recognize that new ideas and innovations will not necessarily emanate from the members of organizations. In fact, large number will come from people outside the organization. The fuzziness of the boundaries may be absorbed or dealt with through institutional, technological or social adaptation. The boundaries may be monitored by indicators of inclusion or exclusion [type one and type two error] whereas the fluctuations may be measured through multi step indicators and their impact on different sub-systems. The boundaries could be spatial, seasonal, sectoral or social. Scarcity of resources may generate new opportunities which may dilute the institutional norms about their use within sustainable limits. Thus, the indicators should reveal not only the state of system performance but also the way various scarcities are impacting institutional norms, values and belief systems. Too much of resilience can generate inertia and too little can lead to frequent breakdowns.

Recently in a paper on 'Ways of Knowing, Feeling and Doing', Gupta, (2010) observed:

Modern scientific systems will not generally accommodate location specific meanings or boundaries of the concept. Though in ecology, there is a greater flexibility in this regard. Whereas the local knowledge systems often combine specific and general aspect of knowledge with great ease. Therefore, some of the attributes that a cattle rearer takes into account while purchasing a bullock or cow are universally agreed to be good indicators of the performance. There could also be certain superstitious beliefs, which might guide purchase decisions in the community. The blend of rational and irrational provides even in our own lives, a way of being sane and humane. In modern science, conjectures are allowed as unproved propositions but rationality is supposed to be the underlying logic. Studies of sociology of science have often demonstrated that scientists do pass judgments about various uncertain problems using their intuition or political beliefs. And at that moment, their behaviour is no different from a supposititious cattle purchaser. In fact, situation may be worse. The consequence of wrong purchase or not making a right purchase are borne by only an individual. In the case of scientific advice, the consequences are borne by larger society. The case of climate change debate in northern America illustrates the point.

The classification can not only be on the basis of the manner of rendering (oral, anecdotal, tacit, folkloric, etc.) but also on the basis of source (scriptural or empirical), method (observation, deduction, analogical, phenomenological, etc.), consequences (effects on human, non-human, animate or inert materials, immediate or long term, proximate or widespread, certain or uncertain, etc.), motivations (curiosity, exploration, dominance, charitable, etc.), social processes (individual, collective, sustained or episodic, ), materials (endogenous, exogenous, blend of two), cultural (taboos, beliefs, motifs associated with the logic of pursuing investigation or explaining it or sanctioning it), etc. There may be many more ways in which knowledge is classified. Newhouse (2004) explains both the agency function of indigenous scholarship ('an ability to shape the world through one's thought, action and feelings') and the sense making function (integrating physical, mental, emotional and spiritual along with dialogical and not necessarily dialectic basis of arriving at complex understanding). The way of knowing can itself be classified in various ways independent sometimes of what is known. Though complete disjunction between the two may not be possible. The problem arises when we romanticize a particular way of knowing in preference to and in exclusion of other. Scientists select off-types of plants and develop varieties when these plants are found to possess desirable characteristics in heritable manner. Many farmer breeders also have done the same thing. The ways of knowing can thus be similar across formal and informal boundaries of knowledge institutions.

Having argued that 'a change not monitored is a change not desired' [Gupta, 1984, 87], I would suggest that indicators be also used to track the stress that local communities go through for dealing with their every day life. Indicators also require self-governing institutions to evoke appropriate social response. Validation of indicators requires their cultural embeddedness. While some indicators will be universal [etic], others will be culture specific [emic].

In the context of innovations, each grassroots innovation itself is an indicator of a stress that communities have been facing for which available solutions have not been satisfactory. Of course, the same socio-economic and socio-ecological stress need not trigger similar experimental effort by local communities in different parts of the world. But sometimes, it does. The comparison of innovations from China and India through Honey Bee Network partnership reveals many examples of similar problem triggering more or less similar innovations. Given

such a possibility sharing Honey Bee database widely is like to influence the search for sustainable solutions around the world, particularly when absence or presence of an innovation becomes an indicator of recognition of the concerned problem by formal or informal system. Studies have shown for instance that a large number of problems faced by women have not been addressed by the formal S&T system and also the informal innovation system. The system of indicators should thus track gender dimension as well. Reduction of drudgery in the tasks that women perform in farm as well as in non-farm sector has to be monitored through unambiguous and precise indicators. For instance, if most of the paddy transplantation is done by women and if almost all of it remains manual, then development of manual as well as motorized transplanters which are accessible and affordable becomes an important indicator of reduction of drudgery in this task. Enumeration of such tasks in each country and identification of effort made to make those tasks easier will be one of the purposes of good indicators.

Different kinds of social conflicts indicate a variety of stresses that people are no more willing to live with. Almost all over the developing world and in some of the developed countries, tribal or indigenous people living in the forests or regions around them have been facing acute difficulties in managing their livelihood. The degree to which the *in-situ* value addition takes place determines the share of benefits that accrues to the local communities. Higher the *in-situ* value addition, higher the benefit. If there are no devices or simple machineries which make *in-situ* value addition possible, then subsequent steps aren't likely to take place. The indicator in such cases would be the scale of relevant research and fabrication programmes and their outcomes in terms of available devices or proportion of *in-situ* value addition. Therefore, the policy, institutions, technologies and indicators are organically linked.

Not all indicators can be monitored at the same frequency and at the same level. The efficacy of certain indicators will increase if local communities are also enabled to monitor the performance of various policies in this regard. We need the institutional arrangements which enable local communities to monitor the performance of science and technology policies for inclusive development. The indicators can also be categorized on the basis of feedback they generate for

users at different levels. The plimsoll indicators, I have argued, can help in finding out the resilience of the institutions. As mentioned earlier, the degree of resilience should be just enough neither too much, nor too little. The range within which a value of an indicator can vary without adversely affecting the outcome is the plimsoll range. A proper taxonomy needs to be developed to help in classification of different kinds of indicators for different degrees of inclusiveness of development process.

The degree of inclusiveness depends upon the extent to which a policy directly targets the most affected social groups without getting derailed by the implementation dynamics. For instance, there are 100,000 post offices in India covering about 600,000 villages. A policy, which aims to impact all the villages, will have to use the channel of post offices through which one can ensure complete inclusion of all the villages. The channel to deliver a policy can thus indicate the degree of inclusion in terms of spatial, social, seasonal and sectoral dimensions. No one indicator is likely to provide sufficient information about various dimensions.

## **Part II: Indicators of local/indigenous innovations**

It is important to recognize that not all local innovations are necessarily indigenous in nature. There is always an exchange taking place between exogenous and indigenous information, resources and institutions. The degree of asymmetry may vary from case to case basis. Not all materials, ideas, resources and processes used by grassroots innovators originate from indigenous thought or practice. At the same time, there are communities and individuals to develop a complete indigenous solution. For all practical purposes, we will use the term, 'local' or 'grassroots' interchangeably.

The genesis of any grassroots innovation may lie in the identification of one's own or third party's need whether experienced recurrently or only episodically and localized or generalized in

nature. Not all needs are felt, and if felt, articulated or even aggregated. The question of being responded by oneself or others may thus arise only if such needs are registered formally or informally. In this paper, we deal with primarily the innovations *by* the people, though there is a legitimate place for the innovations *for* the people. Much of the literature is on the innovations for the people. Much less is available on innovations by the people. The user driven innovations are essentially those where users of a product or service developed by a corporation or a public service agency suggest improvements in the design or delivery of the same. In most of the literature on user based or user centric, it is assumed that users innovate to derive intrinsic pleasure. The corporations or the provider of the service or product are not required to share any benefits. Honey Bee Network framework does not therefore resonate with such asymmetrical attempts to harness peoples' creativity or innovation<sup>3</sup>. The knowledge or innovations by the common people have also been mobilized in the last few years under crowd-sourcing or mass-sourcing frameworks. In these cases, the benefits may be given though not always. There is also a concept of challenge award as a way of invoking peoples' participation in solving a mass problem which science and technology institutions may not have been able to solve for so long. Mahatma Gandhi had offered a prize of 7000 pounds in 1929 for improving the design of a spinning wheel according to the parameters defined in the challenge. There have not been many such awards in the developing world offered to solve persistent problems. The offering of such awards can itself be an indicator<sup>4</sup>.

The design of institutions to match the expectation of grassroots innovators can also be studied as influencing the process of inclusive development. If the institutional flexibility does not extend enough to enable local, often illiterate people to share their knowledge and innovations, get it registered, valorized, protected and diffused through commercial or non-commercial

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<sup>3</sup> Gupta, Anil K, *From Sink to Source: The Honey Bee Network documents indigenous knowledge and innovations in India*, in *Innovations / Summer 2006*, [www.mitpress.mit.edu/innovations](http://www.mitpress.mit.edu/innovations), p. 49 – 66

<sup>4</sup> Gupta, Anil K, *Empathetic innovations: Connections across boundaries "Timeless Legend of India, Gandhi"* [Ed.] Dr. R. A. Mashelkar in commemoration of 30 years of Gandhi National Memorial Society, Pune, 2010; also see, *Grassroots Green Innovations for Inclusive, Sustainable Development* in *The Innovation for Development Report 2009-2010, Strengthening Innovation for the Prosperity of the Nations*, Ed. Augusto Lopez-Claros, New York, NY: Palgrave Macmillan, pp. 137-146

channels, then no matter how progressive the policy is, inclusion will not take place. Indicators of policy and institutions have to be matched with indicators of technologies and culture.

The technological indicators deal with frugality, flexibility, affordability, accessibility, malleability, multi functionality and blendability with the existing resources and knowledge systems. The cultural indicators imply the processes by which women, minorities and other disadvantaged groups can access institutions and technologies so that their interest and innovations are matched by appropriate supply of goods and services. The cultural institutions also play a role when inclusive innovations are disseminated in the rural areas. Not always do women attend the meetings and therefore articulate their concerns adequately. The awareness about this matter has increased in the recent years although tangible results are still not noticeable enough.

Some of the questions which can help us assess the performance of S&T indicators for inclusive development through local innovations are:

To what extent a society is drawing upon the local and indigenous innovations adequately in its polity, nation building efforts, science and technology pursuits?

How many problems of common people remain unaddressed for more than a decade, century and millennia? Whether there is gender bias in the problems articulated and addressed? Studies have shown that even grassroots innovators seem to be negligent of the problems of the women in general. They are not able to solve their own problems many times because women were either denied access to blacksmithy or carpentry tools or had been enculturated to cope rather than transcend the problems.

To what extent the criteria of resource allocation in the formal s and t system leverages the innovations by common people and if so at what scale. Indian budget for scouting, spawning and supporting grassroots innovations remained frozen for a decade at 2000



level till last year. Even now, it has not reached a very significant scale yet. At such small scale, the impact may take place entirely through role model effect and self triggered steps of civil society. Such efforts are going to be small, sporadic and scattered.

The international community may also show similar indifference to this source of inclusive innovations, as evident from the resources allocated by many international development organizations in the last two decades. Does voluntary nature of activities, working against consultancy driven culture of large organization militate against the blend between global and national or local efforts?

What efforts have been made by different member countries to modify their national innovation systems to incorporate the learning from creativity and innovations of common people in the institutional research programme?

How much resources are allocated in S & T budget to add value to the unique traditional knowledge as well as green grassroots innovations to make development process more inclusive?

How many databases like the one set up by Honey Bee Network over the last 24-25 years exist around the world to systematically track creativity at grassroots?

What kind of incubation support systems have been created, how many papers have been published in science journals expanding upon the leads taken from the ground? How often have the knowledge providers and grassroots innovators been acknowledged or included as co authors in the scientific publications based on the lead provided by them?

How many patents have been filed by public or private institutions in the name of grassroots innovators with the property rights assigned to them? To what extent the IP system has been modified to enable people to people sharing of information while people to firm being mediated on the licensing basis?

How many experiments or research programmes have been started, stopped or modified on the basis of feedback from grassroots innovators? Whether the list of programmes initiated on the basis of grassroots innovations have led to new partnerships across sectors and institutions to reflect the new priorities of inclusive development?<sup>5</sup>

Whether challenge awards have been announced to address Millennium Development Goals through inclusive innovations at grassroots.

Whether science and technology students are required to do a final year undergraduate or post graduate project on a problem affecting disadvantaged communities and/or their innovations to solve the same?

How many post graduate theses have been done blending formal and informal science? Are there any special awards for such theses to incentivize engagement of young minds with the problems of masses?

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<sup>5</sup> NIF (National Innovation Foundation) has signed MOU with Indian Council of Medical Research and Council of Scientific and Industrial Research. Similar effort is on with Indian Council of Agricultural Research. At international level, MOU with Malaysian Innovation Foundation is being signed and is already under progress with Tianjin University of Finance and Economics, China. Earlier, a global Grassroots Innovation Augmentation Network (GIAN) was being set up involving Brazil, China and India. Efforts are on to bring several African countries also on board.

Are there any lessons based on green grassroots innovations included in the school text books and curriculum of higher education?

Are grassroots innovators allowed to use the workshop facilities available in the formal S&T system to experiment on their ideas?

How much fund is allocated for investment in the development of ideas and innovations at grassroots by themselves, R&D institutions and private sector?

Are there any dedicated labs mandated to add value to peoples' unique knowledge and if so, what has been the outcome?

How much time is allocated on the public media for creating awareness about grassroots innovations?

Since risk capital plays an important role in generating entrepreneurial opportunities for the common people, how many micro venture innovation funds [MVIF] unlike micro finance funds have been created for different sectors and spaces?

How much subsidy/investments have been allocated for large scale trial, demonstration and on-farm use of grassroots innovations?

Have mobile or stationary multimedia, multi language exhibitions of innovations been created to help people learn in their own mother tongue, even if they are illiterate and not just from local but also exotic innovations. Three barriers to learning, i.e., language, literacy, and localism can be overcome only through multimedia, multi language interfaces and databases.

Given the widespread problem of nutritional deficiency among the children [50 per cent children in India under the age of five are malnourished], special focus is needed, traditional foods, innovations in food processing, storage and blending to overcome this problem apart from taking care of clean water and many other associated factors. The indicators that point attention to specific interventions in promoting innovations dealing with as widespread a problem as this need to be developed by looking at inter-sectoral S&T investments, programmes and messages.

Indicators of involvement of young scientists in addressing the social problems through knowledge networks crossing the boundaries of sectors, institutions and levels are needed to ensure an agile response to the problem.

The research programme to address the problems of physically challenged people by themselves and others to provide fair opportunity through innovative inclusion have to be specifically monitored.

The indicators have to be both internally and externally valid. This will require action research to ensure that the right kind of indicators is used for the relevant purposes. The capacity to use the indicators and interpret them for adequate policy response will also need to be developed. The multimedia, multi language content on developing and using indicators will need to be developed on the web for widespread testing. The local communities, civil society organizations and grassroots administrative functionaries will have to be involved in the development,

validation and use of indicators for self-design changes at community level. Not all changes have to be top down. Some of the innovations are best spread from people to people. The only role of public institutions is to avoid or eliminate negative influences that may inhibit people from trying these out. In some cases, people just ignore all impediments and go ahead with the solution.

### Part III: Some Policies for promoting local innovations for inclusive development<sup>6</sup>:

The journey of over two decades through Honey Bee Network has taught several lessons which may be useful to promote grassroots innovations around the world. The Shodhyatras [learning walks] every summer and winter for last 14 years have revealed a tremendous richness of human ingenuity and experimental ethic for generating local solutions to local problems. After walking for around 5000 kms., one can say that there is no dearth of individuals and in some cases communities which are willing to try things out. If there is a major impediment, it is the availability of tools and technologies that can empower local farmers, artisans, fishermen and women and other small scale mechanics to let their imagination get fuller expression. In many cases, the technologies local communities use to process local forest products have remained unchanged for thousands of years. For instance, early civilisational journey must have begun by human efforts to use stones to peel nuts for extracting kernel for food or edible or non-edible oil. There are communities which still use the same process for mahuwa seeds or many other non-edible oil seeds. Just as innovations have eluded certain activities [those which involve women in particular], they have occurred more often in other cases [such as plant protection, crop varieties, post harvest processing, animal health, agronomy, food processing, transportation, energy and other utilities]. Lot of examples of the awarded innovations is given at [www.nifindia.org](http://www.nifindia.org) and about public domain open access is available at [www.sristi.org](http://www.sristi.org). The linkage between technology students and problems of small enterprises and informal sector is being pursued through a SRISTI initiative viz., [www.techpedia.in](http://www.techpedia.in). So far Honey Bee Network

has helped NIF mobilize more than 150,000 ideas, innovations and traditional knowledge practices from more than 500 districts of India. In addition, large number of innovations were mobilized from many Asian, African, Latin American countries and China by SRISTI. To motivate young technology students, more than 100,000 projects by 350,000 students have been pooled at [www.techpedia.in](http://www.techpedia.in) by SRISTI. Such a database can easily be analyzed to see the connection between the young minds and the problems of masses.

- Creation of platforms that can pool the minds on the margin [which are not marginal minds] along with the modern R&D youth can provide the most effective way of tackling the unsolved problems of society where local innovations may not yet be there or may need further value addition.
- The innovators need to know other innovators [just as the honey bees do cross pollination] through local language networks. This is a very important because language, culture and innovation get linked in this policy goal.
- The value addition through research, design, testing, calibration and real life testing requires dedicated funds, network of R&D labs with mandate to respond to the aspirations of grassroots innovators and accountability towards the innovators to protect their knowledge rights.
- Most grassroots innovators are very generous in sharing their knowledge and innovations. But their generosity should not become a reason for their poverty. There is a need to develop further the concept of *Technology Commons* evolved by Honey Bee Network so that people to people learning is not affected by the intellectual property rights at all. At the same time, firms cannot usurp the rights of local communities and innovators without proper attribution and reciprocity. Policies that enable fair engagement between formal

and informal sector to harness the full potential of grassroots innovations have to be put in place. One such policy is establishment of Technology Acquisition Fund through which individual innovators can be rewarded and compensated so that innovation can be disseminated as a public good. This can meet the twin goals of incentivizing creativity and at the same time creating public goods.

- The access to materials, tools and techniques is very important if the potential of local/grassroots innovations has to be harnessed fully. Recently, in a meeting of American Society of Mechanical Engineering and US National Science Foundation at Ball university ( march 18-18, 2011, <http://www.i-m-a-d-e.org/rimmea/> ), in my key note lecture on, "Frugal, flexible and friendly innovations for extreme affordability: Engagement with Honey Bee Network", I argued the following:
  - a. The trade off between affordability and accuracy may make a significant difference to the issue of accessibility and effectiveness. More accurate solutions need not always be more effective.
  - b. Many of the innovators use very old materials and design products using old tools. The library of materials and publication possibilities has not been ever provided to grassroots innovators. If Virendkumar Sinha, a mechanic from Bihar can develop a pollution control device for capturing about a kilogram of carbon a month from the exhaust of 12 HP diesel engine and at the same time reducing the sound by half, it was not too much a tribute to the material as to the design. If his repertoire of material was richer, he could have developed even more efficient solution.
  - c. The human-powered fabrication tools are a need of the hour given the uncertainties of power supplies and inability to afford a diesel engine. We have several pedal-powered woodcutting, drilling and shaping machines, which can be improvised even further. A library of functional tools, which can help transmit energy from one form to another, will be very useful. Large number of hydro turbine, biomass gasifier, terrain-induced energy powered bicycles, etc., need such solutions. NIF has more than a half a dozen compressed air vehicles and engines where the innovators don't have access to carbon fibre tanks or other such technologies for generating more efficiency than what normal tanks make it

possible. The central issue is to create a kind of periodic table of materials for different functional and fabrication needs. People at the grassroots level may find such a matrix extremely helpful in narrowing down their search. *There is little that modern science and technology has done for knowledge rich, economically poor people. But it can do a lot more.*

d. One of the possible gains that NSF/ASME and larger scientific community can draw from the partnership with creative people at grassroots is access to new heuristics for frugal thinking, flexible fabrication and multi functional designs. Nature is frugal, resilient, diverse and multi-functional. Getting close to people who are close to nature, and depend on it for meeting major needs may imbue in us a sensitivity, a perception, a compulsion to know, feel and do what we must.

The deviant research<sup>7</sup>, I have argued will need to be tracked, nurtured and made mainstream for larger inclusive development. I am sure that STIGAP initiative of UNESCO will prove to be a landmark step in the socially inclusive science and technology for future so that development process does not have to treat the ‘minds on the margin are not marginal minds’<sup>8</sup>.

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<sup>7</sup><http://www.newscientist.com/article/mg19526222.000-the-word-deviant-research.html>, Sept 22, 2007

<sup>8</sup> [http://www.ted.com/talks/anil\\_gupta\\_india\\_s\\_hidden\\_hotbeds\\_of\\_invention.html](http://www.ted.com/talks/anil_gupta_india_s_hidden_hotbeds_of_invention.html) my TED talk that makes this point forcefully.