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The unmet needs of disadvantaged people living in developing countries pose a complex challenge for development planners, but like many challenges, it also provides an opportunity for creative communities and individuals to develop alternative approaches. One such approach, which I have been intimately involved with for more than two decades, is leveraging grassroots innovation.

The traditional approach to helping disadvantaged people is a top-down one, in which government, NGOs, or businesses create solutions and provide them to the poor. Many large corporations, for example, have convinced themselves that they can serve the poor by producing and delivering goods and services at an affordable price—the bottom-of-the-pyramid approach.

These businesses, governments, and aid organizations seldom consider acquiring ideas or innovative products and services designed at the grassroots by the people they are trying to assist. The question of reciprocating what those people have shared with them seldom arises. Despite the billions of dollars spent on developmental aid, we still do not find many databases, either online or offline, of innovative solutions developed by disadvantaged people themselves.

We should not discount completely the merit of providing certain goods and services to the people at the bottom of the economic pyramid, but the fact remains that poor people are not at the bottom of the knowledge, ethical, or innovation pyramids. Unless we build on the resources in which poor people are rich, the development process will not be dignified and a mutually respectful and learning culture will not be reinforced in society.

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The search for inclusive development has become imperative because social tensions and disquiet among marginal communities have been increasing. Many governments spend more resources fighting their own people—often considered to be rebels or extremists—than on investing in the ideas and imagination of local communities and individuals.

Instead of treating economically poor people as a *sink* of public aid, assistance, advice, and corporate goods and services, we should treat them as a *source* of ideas, innovations, and institutional arrangements with which formal public and private institutions can engage.

Many triggers can push an innovative idea to evolve into a full-fledged solution. Sometimes an accident leads to a new discovery. Innovations can also emerge when an idea in one field is applied in a totally different field, which I call analogue innovation. For example, Yusuf, an innovator in Rajasthan, developed a groundnut digger that is pulled behind a tractor. As it is pulled along, the digger picks up the soil and the uprooted pods, agitates the soil and pods, drops the soil, and keeps the pods in a sieve. An entrepreneur from another part of India heard about the digger, licensed the technology, and adapted it as a beach cleaner. The principle was the same but the domain was very different.

Engagement between the formal and informal sectors can take place if we recognize, respect, and reward creative grassroots knowledge systems. Enabling local communities and individuals to convert their ideas into products and services—by blending modern science and technology, design, and risk capital—constitutes the heart of grassroots innovation.

Building on People's Knowledge

Taking a grassroots approach to innovation is not easy. Before embarking on this approach one must first understand and reconceptualize the interface between natural, social, ethical, and intellectual capital. *Natural capital* was the first capital to come about when societies began to enclose resources and started asserting individual or collective property rights. The boundaries around a resource or the limitations on its extraction gave rise to the value of natural capital. It can be saved, exchanged, or consumed with or without renewability.

Respect for group norms gave rise to *social capital* that required a reliance on trust, reciprocity, and third-party sanctions. For example, if a person used a gill net with a small mesh, he could catch small fish, something that might benefit him but hurt the community. To prevent that, the community could sanction this behavior and penalize the offender.

When a person regulates his own behavior from within, it is called *ethical capital*. When we restrain ourselves from fishing in the spawning period because it is not the right thing to do from the perspective of fish population dynamics and sustainability, our restraint gives rise to ethical capital. There are no external sanctions, only internal guilt or a sense of responsibility.

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Knowledge about the various ways in which people regulate their own behavior or that of others in managing resources (natural or otherwise) constitutes *intellectual capital*. Only a small part of intellectual capital is governed by intellectual property rights.

Entrepreneurial outcomes may be guided by individual or collective access to resources or the ability to convert resources into investment with or without keeping social and ethical capital in mind. Grassroots innovators typically employ an enormous

amount of social and ethical capital, and their innovations often reinforce the renewability of natural capital.

But not all innovations or innovation-based enterprises need to be sustainable or pursue a larger social good. In some instances, innovators can do the opposite by ignoring or harming social and ethical capital. For example, using dynamite in a lake to stun or kill fish, which are then scooped up, is a non-sustainable act.

Creating Grassroots Innovations

Grassroots innovations emerge when existing systems and practices fail to serve people's needs. They can arise through serendipity, systematic experimentation, trial and error, or combining solutions in new ways. In some regards, the methods of problem solving in the formal and informal sector are similar. Formal plant breeders, for example, look for odd plants that have desirable characteristics and either through recurrent selection or back crossing incorporate those characteristics in established plant varieties. Farmer breeders in the informal sector also do this. To illustrate these processes, it is useful to look at examples from the Honey Bee Network's work.

In India and other countries with large populations of underserved people, one of the greatest social problems is the plight of marginal farmers. More than 100,000 Indian farmers committed suicide during the last decade in parts of Maharashtra, Andhra Pradesh, Punjab, and other regions of India. Their suicides were attributed to excessive borrowing to grow Bt cotton and their inability to pay those debts. When we visited the homes of affected families in Maharashtra and inquired whether they knew about non-chemical (and less expensive) ways of controlling pests, the unfortunate answer was "No." This isn't because there aren't any alternatives—there are—but because the information about the alternatives is not widely available.

Take cotton, a crop that consumes 40 to 50 percent of the total chemical pesticides used in India. A farmer from Haryana, Harbhajan Singh, discovered that by irrigating cotton in alternate rows, he could reduce his irrigation costs by half and his pest control expenses substantially without affecting the yield adversely. Growing lady's finger around a cotton crop is another economical solution for controlling pests. The flowers of lady's finger are similar to that of cotton. Lady's finger belongs to the same plant family and blossoms earlier than cotton. By attracting pests, it can reduce the impact of pests on cotton.

In the course of my work I have also learned that farmers can do the right things for the wrong reasons. I discovered that some farmers grew coriander around a field of chickpeas, apparently to repel pests. At my suggestion, a friend at the International Crops Research Institute for Semi-Arid Tropics researched the practice and found that coriander did not repel the pest, but instead, being nectar rich, it attracted the pests' predators. The outcome was the same.

but the underlying logic was different. This example demonstrates the positive role that formal or institutional scientists can play in grassroots innovation, by validating or adding to people's ideas.

These and other solutions can easily be shared as open source ideas, which may even be relevant worldwide. There are many examples of farmers who have benefited by the Honey Bee Network's open-access database of innovations, but many more can benefit if the database gets translated into different languages and is shared widely through social media channels.

Creating the Honey Bee Network

Almost a quarter-century ago, it became clear to me and others that inclusive development could not be imagined without incorporating diversified, decentralized, and distributed sources of solutions developed by local people, on their own, without outside help. We started the Honey Bee Network, an organization that seeks out innovations developed at the grassroots, organizes them in a readily accessible way, and provides them to people at the grassroots who can use the innovations to improve their lives and their communities.

Since its founding, the Honey Bee Network has mobilized more than 170,000 ideas, innovations, and traditional knowledge practices from 545 Indian districts. Most of these ideas, innovations, and practices were gathered by volunteers reaching out to people where they live and work. A very small number of these ideas reached us by people taking the initiative to do so on their own. Many times, grassroots innovators don't even know that they have innovated.

The Honey Bee Network is so named because it is based on the behavior of honeybees: We should cross-pollinate ideas by promoting people-to-people learning, whenever possible in the local language; like flowers (which attract honeybees for their own good) we should not let people feel shortchanged because their knowledge is being taken without their consent or involvement. Furthermore, the knowledge providers should not remain anonymous. Instead, their identity should be acknowledged and their intellectual property rights should be protected. If one of the only resources in which people are rich is taken away from them without acknowledgment,

attribution, or reciprocity, then little remains with them. Hence the need to protect people's knowledge rights. And if any income is generated from the commercialization of their knowledge, we should return a reasonable share back to the people who developed the innovation (honeybees, after all, don't keep all the honey for themselves).

To provide institutional support to complement the work of the Honey Bee Network, we have created several formal organizations: the Society for Research and Initiatives for Technologies and Institutions (SRISTI) was established in 1993; the Grassroots Innovation Augmentation Network (GIAN) was established in 1997; and the National Innovation Foundation (NIF) was set up in 2000 at the initiative of the Indian Ministry of Finance as an autonomous institute under the Department of Science and Technology (DST).

In 2009 SRISTI created a Web portal (www.techpedia.in) that now has summaries or titles of more than 150,000 engineering projects pursued by 400,000 students from more than 500 institutions. The goal is to put the problems of the informal sector and small-scale industries on the agenda of students so that more inclusive development takes place.

The Honey Bee Network has spread to more than 75 countries. The strongest network outside of India is in China, followed by Malaysia. China already has a database of about 3,000 grassroots innovations. An international congress on grassroots creativity and innovations was held the first week of December 2012, at China's Tianjin University of Finance and Economics.

The Honey Bee Network does not restrict itself to technological innovations alone. There are common-property institutions in which communities develop innovative rules to manage natural resources, and there are many inspired teachers who dedicate themselves to innovative approaches in education. Similarly, there is a great deal of folk cultural creativity that deserves to be recognized to maintain the experimental and creative traditions. For each one of these, one needs to create avenues for documentation and entrepreneurship development.

Building upon grassroots innovations as a fundamental building block for societal transformation is a valid and practical strategy. Many countries have not yet resolved to scout, spawn, and sustain such innovations. But I hope that as income disparities increase and social tensions mount, the policy and institutional space for grassroots innovations will expand. Inclusive development requires harnessing the minds on the margin that are not marginal minds.

Creative Ways to Foster Grassroots Innovation

After more than two decades of experience creating organizations that foster grassroots innovation, a great deal has been learned about how to do this successfully. What follows are seven creative ways to foster grassroots innovation.

1. **Encourage the growth of micro-venture finance.** Venture capital is critical in providing risk capital for funding the entrepreneurs who arise from grassroots innovations. In 2003, the NIF, with the help of the Small Industries Development Bank of India, established the first full-fledged venture capital fund for grassroots entrepreneurs, the Micro Venture Innovation Fund. This fund has enabled 186 grassroots entrepreneurs to develop and spread their innovations.

2. **Expand the public pool of innovations by providing financial incentives to innovators.** In 2011, the Honey Bee Network and NIF created the Grassroots Technological Innovation Acquisition Fund. Patent rights to dozens of technologies were acquired from innovators by paying a notional amount to create a public pool of innovations for licensing at no or low cost to small entrepreneurs within and outside of India. Providing this kind of financial incentive helps attract innovators to the program and reduce barriers to diffusion.

3. **Recognize, respect, and reward innovators where they live.** It is important to honor innovators at the grassroots level—where they live. One way we have found to recognize them is to organize learning walks (what we call shodhyatras) that go from village to village, visiting the homes of outstanding knowledge holders to honor innovators at their doorstep. During these walks we also organize other activities that draw ordinary people in, such as biodiversity and idea competitions for children and recipe competitions for women.

4. **Create community fabrication workshops in the homes of innovators.** To encourage innovators to share their work and to get budding innovators involved in creating new things, we have built fabrication workshops inside the homes of innovators. These shops, which are open to the community, have machinery and tools that would otherwise be unavailable, particularly in rural areas. The workshops also foster a spirit of cooperation that helps further grassroots innovation.

5. **Build partnerships between formal and informal science.** A natural product laboratory, Sadbhav-SRISTI-Sanshodhan, was created more than 10 years ago at SRISTI through a grant from a private philanthropist in Mumbai. It is now supported by DST and other institutions. It works on the ideas, innovations, and traditional knowledge of people in four areas: agricultural, veterinary, human, and microbial diversity.

6. **Invest in children's ideas as part of an inverted model of innovation.** Because children approach problems unencumbered by experience, they can sometimes find ingenious solutions to problems that bedevil adults. One child, for example, suggested a modification to the walker used by the elderly or people who cannot walk without support. Instead of all of the legs being the same height, the modified walker had height-adjustable front legs so that people could use it to climb stairs.

7. **Mobilize university students to address unsolved social problems.** Undergraduate and graduate students can be encouraged to tackle real life social problems as a part of their final year project. By creating a platform that is open and facilitates collaboration, problems that were only partially solved one year can be taken up by students in the following year. This strategy allows the students to work on long-term projects, not just short-term ones.