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From Sink to Source The Honey Bee Network Documents Indigenous Knowledge and Innovations in India

India has a natural wealth of biodiversity, thanks to variations in its climates and soil conditions and its geographical features, including rain forests, arid lands, and mountains. Yet many of India's most biologically rich regions are prone to drought and floods or distant from the amenities of urban life. Many in these regions live in poverty and relative isolation: their local products are unfamiliar in most of the world, their public infrastructures are weak, and their skills are unrecognized. Subsistence in these regions is a constant challenge. Local individuals and tribal communities have long met those challenges by drawing on their local environments, inventing effective agricultural techniques, and learning the medicinal and nutritional value of nearby plants. Harsh conditions have done as much to induce individual creativity and innovation as to limit them.

Such local knowledge, in India as elsewhere, is in danger of disappearing, not just in high-risk environments but also in developed regions in rural and urban areas. Traditionally strong links between grandparents and grandchildren are weakening as mobility increases. Few mechanisms exist for documenting indigenous innovation. Those that do exist may be rightly viewed with suspicion: for decades whenever outsiders have "discovered" local knowledge, they have often commercialized or published it without attribution.¹ Yet at the same time, traditional knowledge is increasingly valued in the global marketplace, as illustrated by the dramatic worldwide growth in demand for herbal remedies over the past two decades.²

Increasingly, the issue is not whether, but how, traditional knowledge and innovations should be documented and recognized. How can those who seek to document local inventions ensure reciprocity between the innovators and those who may later seek to use and perhaps even commercialize documented ideas?

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What mechanisms would help inventors to further develop, share, or commercialize their inventions, when they are so inclined? How can this work be accomplished without undermining the communities from which the knowledge originates?

In 1988-89, I established the Honey Bee Network to help address these very questions. A honey bee connects one flower to another through pollination, removing the nectar without harming the flowers. Similarly, the Honey Bee Network consists of a database plus members who scout out, develop, sustain, and reward grassroots innovators, without diminishing the value that the invention has for the inventor. Rather than looking at inhabitants of poor regions collectively as a *sink* for aid and advice, we to recognize their contributions formally as a *source* of inventions and innovations.

In the 18 years since its foundation, Honey Bee has documented 50,000 innovations and traditional knowledge practices in a database of ideas. While we do not have the resources that would let us fully evaluate the effectiveness of all of the knowledge we have documented, much of it is currently being assessed or has survived more detailed scrutiny. A handful of inventions have resulted in patents. *The Honey Bee Newsletter*, which includes information on inventions and discoveries, now reaches people in over 75 countries. My parent institution, the Indian Institute of Management in Ahmedabad, provides editorial and logistical support while the Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI) helps print it in seven different Indian languages. In the last year, an affiliated organization responsible for the business development of ideas, the National Innovation Foundation (NIF), has received 166 inquiries from 33 countries for 54 technologies documented by the network.

Despite the growth and reach of our current activities, it is evident to us that we are only beginning to build awareness of the potential value of indigenous innovation in India—we are far from realizing its full value to inventors and users of the inventions. Yet the experience of the Honey Bee Network over the past decade and a half has established how critical it is to document traditional knowledge as a first step in such a process.

RETHINKING OUR APPROACH TO HELPING THE RURAL POOR

Two decades ago I spent a year in Bangladesh working with the Bangladesh Agricultural Research Council and Institute. My task was to help the council orient its research more towards the problems of disadvantaged farmers, many of whom had nothing more than their homestead.

Our work succeeded. My scientist colleagues discovered many on-farm innovations. We began to see the potential of learning from such “grassroots” creativity. I completed several studies on participatory learning in various dry and tribal regions. Yet after a time I began to notice that, while I had benefited personally and professionally, the local people who had shared their knowledge with us had not. My studies, written in English, had no prospect of connecting these local people

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and their knowledge with one another. The way I had reported on their innovations had rendered them anonymous.

Rather than give up on the work because of this evolving ethical dilemma, I set about creating an organization that could overcome the asymmetries in knowledge, recognition, and reward to which I was newly sensitized. The Honey Bee Network is the product of that initial effort. The premises behind the network's activities are the same now as they were at the outset. First, people must be given credit for whatever knowledge they share with the network; they should not become anonymous. Second, the shared knowledge should be used only after the inventor has given his or her Prior Informed Consent; inventors have a right to know what we do with their knowledge. Third, inventors should be able to dip into the network's shared knowledge through their own language; we should not require inventors to learn English in order to participate actively in the network. Finally, if we get any income, including a consultancy or award, through exchanging or disseminating the knowledge, some reasonable share of that income should go back to the source.

FORMING THE NETWORK

When Honey Bee printed its first newsletter in May 1990, it had 44 subscribers, including scientists, public aid workers, financiers, farmers, and craftsmen. My colleagues and I had collected information on a handful of innovations through our own previous work, plus letters and word of mouth; it took us another year to gather enough information for a second newsletter. By May of 1991, the network had become more tangible. We had produced our newsletters in English and Tamil and had plans to do so in Gujarati and Hindi. An Oriya version was in the pipeline. Most importantly, the work of those early years was emblematic of Honey Bee's core activities: scouting and documenting grassroots innovations and traditional practices and sharing this learning with a wider audience.

As one means of scouting, we had organized several community workshops and had surveyed the arid region of Saurashtra in Gujarat, in southwestern India. Through this survey, Honey Bee members and participating students of Gandhian rural institutions collected a hundred innovations and planned another survey the following year to learn more. We did not verify the practices experimentally, though we did try to collect plant and other material samples wherever possible.

We published these ideas along with their sources in the hope that each would be worth pursuing or might provide new concepts or new ways of using known materials. By communicating the innovations, we created a dialogue between farmers, scientists, researchers and others with a wide range of other backgrounds. Maneka Gandhi, the former Indian Minister of the Environment, was and is still a regular reader. Army officers and highly paid professionals began to participate, sometimes by assessing an idea or acting as mentors, and later, as the network matured, by providing venture capital. More recently, the Honey Bee Network has attracted the attention of government officials in Brazil, South Africa, and China.

Among the many traditional practices we published during the summer of 1990 in Gujarat were 14 cures for foot and mouth disease, a highly contagious virus that causes ulcers in the hooves and mouths of infected animals. Farmers are reluctant to use vaccines and medicines to prevent and treat the disease; they may balk at the high cost or mistrust the medication.

One farmer, Maganbhai Hirabhai Patel, forced his infected animals to walk on hot sand. The farmers who practice this technique believe that the hot sand kills the organisms responsible for the disease. Others, such as Ambavibhai Gokulbhai Dubaria, treat hooves and mouths with brine, sometimes pouring brine directly into the hooves.³

The publication of these and other innovations captured the attention of several scientists. In our April 1992 newsletter, we published the reactions of a few scientists who tested or analyzed the effects of some of the local traditions. For example, Dr. D. V. Rangnekar commented on the value of several foot and mouth disease practices. He noted that making animals walk on hot sand, and rubbing their mouths with jaggery, a form of unrefined sugar, were both helpful in healing ulcers while brine, an anti-viral treatment, helps animals by preventing a secondary infection.⁴

Not all of the scientific analysis was positive, however. Most scientists were skeptical and dismissed the ideas out of hand. Scientists approach problem-solving differently than local experts. Often, local experts have a symbolic language through which they communicate their understanding of a problem. Many scientists and policymakers do not appreciate this style of communication because they are accustomed to more precision. They often jump to the conclusion that such informal symbolic knowledge involves more “mumbo jumbo” than actual skill.⁵ In some cases, this might be so, but it would be unfair to generalize this over entire bodies of traditional knowledge.

Consequently, this first step in evaluating the performance of indigenous knowledge stirred up quite a debate within the network. Word had circulated that scientists had dismissed many of the innovations, though they had actually tested very few. Some network members felt that the network should not make modern science seem superior by using it to validate or invalidate farmers' practices.⁶ One member holding this view was my colleague T. M. Mukundan, a graduate of both the Indian Institute of Technology, Madras and the University of California, Berkeley who has studied Indian techniques for harvesting rainwater.

I agreed that it is not scientific to dismiss a farmer's innovation without experimental validation or explanation. At the same time, my colleagues and I recognized that we needed both to create dialogues between institutional scientists and farmer innovators and to somehow combine reductionist, experimental science with holistic practices.⁷ These combinations have been key for us ever since. The *Honey Bee Newsletter* fills an important need because so few journals focus on the knowledge and creativity of local people. Scientific input is valuable because farmers can benefit from external validation of their ideas and from scientific insights that might improve their innovations. Together, both sides learn about new

resources, new methods and new applications from one another.

Through this debate, we made some progress. Scientists participating in our network began to look differently at the innovations, gradually viewing them not as folklore to be dismissed but as hypotheses to be tested. A few partner universities responded by hosting seminars about farmer innovations that included as participants both farmers and members of the scientific community.

THE SHODH YATRA: FINDING INVENTIONS

In March of 1998, Honey Bee members conceived of a novel way to gather local innovations. A group of farmers interested in encouraging organic farming techniques gathered in their village in the Junagarh district and wondered how they might connect with far-flung farmers to exchange organic farming techniques. At around the same time, in Ahmedabad, participants discussed the same subject in a workshop on how to develop interactions between experimenting farmers and scientists.

One farmer, Gafarbai Kureshi, attended both meetings and proposed a solution. He invited the group on a Shodh Yatra, a “journey of exploration,” starting at his orchard in Junagarh. The journey, which started on May 15 of that year and ended on May 23, took 18 members of the Honey Bee Network on a 250-kilometer walk. The “Yatris,” as we call ourselves, traveled by foot in heat up to 43 degrees Celsius (over 100 degrees F.) through 47 different villages.⁸

Our aims were to meet farmers, learn about their experimental techniques, and share what we learned. We also aimed to get children interested in creative farming techniques and to educate those we encountered along the way. To inform the farmers about our activities and objectives, we distributed Honey Bee publications and displayed some of the agricultural implements our members had invented. To carry our luggage and the audio-visual equipment during the entire Shodh Yatra, we used inventions that Honey Bee had scouted out: a three-wheeled tractor developed by Bhanjibhai Mathukia of Junagarh and a tilting cart developed by Amrutbhai Agrawat of Gujarat.

Shodh Yatras have become a Honey Bee tradition now. They typically follow a route away from any regular roads or transport lanes, making the yatra more challenging. Shodh Yatris meet the villagers, farmers, and artisans individually; collectively they prepare a report on their experiences in both Gujarati and English. The Yatris look for the oddball—anybody doing something differently—and try to understand the logic behind it. We also seek out new methods of crop protection and cattle rearing and any villagers’ improvements in implements. When we share the Honey Bee database with the villagers, we ask them for their feedback and we all benefit from the resulting discussion.

The Honey Bee Network uses the Shodh Yatras to promote informal learning among children. We have arranged biodiversity contests, where young people can show off their knowledge of local plants and their medicinal and nutritional applications. Prizes and certificates are granted on the spot. Through these competi-

tions, more knowledge is transferred from grandparents to grandchildren in a few days than would normally occur in years. We have come across children who know more than 500 plants and their uses. Yet most such children eventually drop out of school only to become part of a pool of unskilled laborers.

More formally, during Shodh Yatras, we hold evening meetings with villagers, which provide a forum for mutual sharing of creativity and innovations. We hold recipe contests where women compete to cook the most nutritious meal from local ingredients. We also reward prominent villagers—those who have helped publicize the Shodh Yatra, those who have developed new methods, those involved in organic farming, and the oldest members of the community—by presenting them with a variety of publications.

The tractor that proved so useful on our first Shodh Yatra also became one of our technology transfer success stories. Grassroots innovator Bhanjibhai Mathukia, who has the equivalent of a 4th grade education and comes from a small village in the Jungarh district, developed the 10 horsepower tractor out of various readily available components. He used the gearbox and rear wheels of an old Mahindra jeep, and the front tires of a Fiat Padmini, a miniature car popular in India, along with a fixed-speed “stationary” engine normally used to pump water. Since his village was located close to Rajkot, a major foundry hub, he was able to get some components and parts manufactured.⁹

The resulting invention, a small, low-cost and highly efficient tractor, fills a vital demand gap in this and other local Indian markets. In the Saurashtra region of western India, where this tractor was developed, the soil is light, the land holdings are large, and there is little rain, except during the monsoon season. Farmers need a way to work large amounts of dry land very quickly. The smallest tractors currently available on the market are in the 24 horsepower range and cost over 225,000 rupees (about US\$5,000). Since annual farm incomes in the most productive regions average only 37,000 rupees (about US\$800)¹⁰, farmers cannot afford these tractors and must use bullocks, which are becoming increasingly expensive because of fodder shortages. Their other option is to use power tillers, but their small wheels have low clearance, and their poor traction and few attachments make them inappropriate for the volume and type of work required in this region.

This tractor was so promising that the Honey Bee Network developed a technology transfer agreement for it. In this work it was joined by its recently formed and more formalized institutional counterparts: the Gujarat Grassroots Innovation Augmentation Network (GIAN) and the Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI). The agreement gives M/s Pramal Farmatics Pvt. Ltd. exclusive rights to manufacture and market the tractor in the states of Gujarat, Maharashtra, Rajasthan, Madhya Pradesh and Uttar Pradesh under the “Vanraj” brand in a deal valued at over 10,000,000 rupees (about US\$220,000). M/s Parman Farmatics acquired the technology for an upfront transfer fee of 300,000 rupees (about US\$6,600). Mr. Mathukia will receive a 2.25 percent royalty and has a 20 percent equity stake in a proposed marketing company that will have exclusive dealership and distribution rights for two dis-

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tricts in Gujarat. Mr. Mathukia has already received 125,000 rupees (about US\$2,700) for producing the first tractor to order. Since its inception in 1997, GIAN has successfully undertaken 13 such technology transfers of grassroots technologies to entrepreneurs.

Since that first Shodh Yatra in 1998, we have traveled 17 more, and have discovered many other successful inventions. During the third Shodh Yatra, through the Bharuch district, we discovered a promising agricultural sprayer. We scouted out other sprayers from Gujarat through a statewide contest for innovations. The winners were Arvindbhai R Patel, Gopalbhai Surtiya, Khimjibhai Kanadia, and Lalit Surana. Though none of these innovators have much formal education, they all show great creative spirit.

Each sprayer has a unique design and application. Mr. Patel designed a knapsack sprayer in which a spring-loaded dead weight taps into the user's natural body movements to generate the compression needed for spraying. The innovative design makes the user more productive by lowering his or her fatigue. Mr. Surtiya's sprayer uses the rotational energy of a wheel to power the spraying. Mr. Kanadia's lightweight backpack sprayer is designed to suit the needs of small farms, nursery owners and women. Mr. Surana devised a motorized micro-sprayer. Patents are pending for the first three of these technologies.

Satasiya Industries in Ahmedabad has signed a national and non-exclusive license to manufacture the three patent-pending sprayers. It has paid a few hundred thousand rupees so far (about US\$5,000), and has agreed to pay a 2.5 percent royalty on sales turnover for five years, with the possibility of renewing the agreement. The inventors have received half of the license fee and have agreed to donate nearly an equivalent amount to the Western Indian Grassroots Innovators Alliance for Nurturing Creativity (WIGIANiC). They also will be donating 5000 rupees (about US\$110) to activities in their regions related to community welfare and environmental conservation.¹¹

A LONG TAIL FOR INVENTION? IDEAS AS PROPERTY FOR PEOPLE IN POOR PLACES

Of the inventions documented by the Honey Bee Network, the overwhelming majority are not of types that can be readily and formally protected as intellectual property. Still, a few inventors have been awarded patent protection with support from the network. The Aruni-tilting bullock cart, which we towed behind the Vanraj tractor during the first Shodh Yatra, earned a patent from the United States Patent and Trademark Office (USPTO). Invented by Amruthbhai Agrawat of Gujarat, the four-wheeled cart has a rope and pulley mechanism that tilts the cart, allowing farmers to more easily distribute manure and other loads by dumping them en masse, drastically reducing the manual labor required.

Another invention patented by USPTO has also been a commercial success: a motorcycle-based tractor developed in Amreli, a rain-fed but dry region of Gujarat. The few tractors that are available in Amreli are expensive to rent.

Box 1. Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI)

The scope of the Honey Bee Network expanded in 1993 with the founding of SRISTI. While the network does not receive outside funding, in the past SRISTI has received limited funds from the International Development Research Centre of Canada, the World Bank, the Global Environmental Facility, the International Fund for Agricultural Development, India's Department of Scientific and Industrial Research, and the Government of India.

The SRISTI Mission:

- To expand space in society for building upon sustainable technological, institutional and educational initiatives and grassroots innovations and traditional knowledge.
- To document, analyze and disseminate innovations developed by people themselves.
- To validate and add value to local innovations through experiments (on farms and agricultural stations) and laboratory research to generate nature-friendly sustainable technologies.
- To conserve local biodiversity through in situ conservation and experiments with markets and community-based institutions.
- To protect the intellectual property rights of grassroots innovators
- To generate monetary and non-monetary incentive models for recognizing, respecting and rewarding grassroots creativity and associated ethical values and norms of individuals and communities.
- To provide support including micro-venture capital to the local innovators to scale up products and services based on grassroots innovations through commercial and non-commercial channels.
- To embed the insights learned from grassroots innovations in the formal educational system in order to expand the conceptual and cognitive space available to these innovations.

Traditionally, farmers have relied on bullocks to pull plows, but fodder there has also been scarce. These farmers asked a local mechanic, Mansukhbhai Jagani, for help. He created a multi-use machine out of a motorcycle by developing removable attachments. Now farmers have a machine to use for sowing, plowing, and, with a quick changeover, for transportation. Other patented inventions include a device for climbing coconut trees, and a cotton stripper.

One of the network's most pivotal and challenging roles has been our effort to act as advocates for grassroots innovators and help them benefit as owners of intellectual property. We have made progress in this area, particularly in helping inventors get their innovations recognized and commercialized. Much remains to be done, however, to help indigenous people gain access to international patent systems. Box 1 describes efforts related to intellectual property issues.

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While protecting inventions has been difficult, an even greater challenge is protecting traditional knowledge. For instance, knowledge about the medicinal and agricultural value of plants is often considered prior art, though that designation is the subject of debate. Prior art is information that is already known to the public and therefore knowledge that cannot be patented. For innovators in developing nations, this creates a distinct disadvantage because they rarely document their ideas or communicate them in any way beyond speaking about them. Innovators become vulnerable to outsiders coming in, extracting their knowledge, and publishing it without crediting them. We see the need for a mechanism to protect local innovators and their oral knowledge in cases where outsiders have not yet documented the knowledge in public journals and databases.

The economic significance of Indian biodiversity underscores the importance of this dilemma. Domestic trade in medicinal herbs and extracts has reached US\$66,000,000 and is increasing. Many of these plants and exports bring in great profits on the international market but Indians see little of that income. One example is “tetu lakda” twigs, a source for anti-cancer drugs.¹² In India, these twigs sell for 9 rupees per kilogram; on the international market, their extracts sell for 500,000 rupees.¹³ If we assume that knowledge about the benefits of these twigs is a prior art, the holder of that idea cannot collect compensation from others who use it for commercial purposes.

The few patents that have emerged from the work of the Honey Bee Network are not likely to have a major impact on the broad array of challenges that face the communities from which the inventions originated. Those challenges are great, and will not be easily solved. They are significant because they show that creativity is subject to the same sort of “long tail” phenomenon that has recently been noted in consumer markets.

Clearly, the global distribution of inventiveness is dominated by a few corporations and institutions of learning, if we quantify it by patent counts or other conventional measures. On the other hand, what if we could count the innovators and document this phenomenon? It is at least possible that if we added up the small number of inventions per capita among the many people in the world’s poorest places we would get a number comparable to the output of the presumed “invention leaders.” The “long tail” in the distribution of creativity is a statistical way of expressing the notion that a very large number of small-scale efforts can add up to a major contribution. We have found that even children can add to the list of valuable inventions, as described in Box 2.

HOW SCIENCE ADDS VALUE

Local knowledge diffuses throughout the Honey Bee community in several ways. SRISTI, the institutional extension of Honey Bee, has a help line that people can call to get answers to questions. It also publishes local language newspapers. Collaborators have organized training programs to educate youth and others about animal treatments and ways to make herbal pesticides. New plant varieties

Box 2. The inventive capacity of children

Remya Jose from Palghat, Kerala was very bright; in the tenth grade she had achieved marks of almost 90 percent. She had earned distinctions in several extracurricular contests, including recitations and writing an essay and a one-act play. But to get to school, Remya had to take two busses each way. Then, while she was in eleventh grade, her mother, a teacher, became ill; her father was already being treated for cancer. Her household chores increased, squeezing her already tight study time.

Among her many household chores, washing clothes took a great deal of time. It occurred to her that she could design a washing machine operated by the same kind of foot pedals used in a bicycle. Her father helped her by taking her drawings to a local mechanic. She also interacted with the mechanic and soon her washing machine was ready. Because it involved cycling, it let her do the wash and also get some exercise. The total cost of her machine was under \$40. She submitted it as an entry at NIF's national competition for grassroots innovations and traditional knowledge and got a Presidential Award in the Student Category. NIF now receives business queries about this machine not only from India but also from abroad, as many poor people are searching for ways to reduce the drudgery in their lives.

Vishnu Bhachubhai Dumania was 10 years old when he left school because his family needed him. His family was involved in salt making in Surendranagar and they needed young Vishnu to monitor the level of water in the tank and switch off the pump when the water supply ran out. The water

developed by farmers have diffused mainly through the farmer-to-farmer network, and sometimes through locally branded seeds sold by commercial dealers.

Over time, these activities evolved and Honey Bee now focuses on developing the herbal formulations derived from grassroots practices into viable, user-friendly and marketable products through conventional research and development. We have gathered information on approximately 30,000 herbal and biologically-based innovations and traditional practices for aiding plant, human and animal health. Now Honey Bee has formed a partnership between scientists and the traditional knowledge base with the dual goals of adding value to traditional practices and helping pool the best ideas. That partnership has matured beyond our initial debates in the *Honey Bee Newsletter* and has been formalized into the National Innovation Foundation of India (NIF), established in 2000 with a budget of US\$5 million. In 2004 the NIF signed an agreement with the Council of Scientific and Industrial Research to support four areas of research: herbal, mechanical, food processing and nutraceuticals (engineered foods with added health benefits) and energy. NIF formed a similar partnership with the Indian Council of Medical Research in 2006 to add value to non-codified, folkloric traditional herbal knowl-

source is located about a kilometer from the place where the salt is processed. Someone must constantly monitor the water level because the pump will break down if it runs without water in the tank.

Because Vishnu dearly wanted to pursue his education, his challenge was to find a way he could go to school like other children and yet not neglect his family duty. He had to design a system that could monitor the water level, indicate when the water level dropped beyond permissible limits, and then automatically switch off the pump. His solution was to attach a box with a rope to the pipe that discharges the wastewater. On the other end of the rope, he attached a stone that weighed as much as the box when it was full of water. He attached a red flag to this stone. When the water level decreases, the flow of water into the box slows down. The box becomes lighter and moves up and the stone at the other end moves down. The flag attached to the stone also drops. When the flag moves out of the visible range, it is a signal that the pump is about to exhaust the water in the reservoir. Vishnu attached a mechanism that would switch off the motor as the stone moved down.

With his invention in place, he no longer needed to spend time monitoring the water level. Moreover, the design was so popular that most salt making families in the area began using it. It is an effective labor-saving device. More importantly, for Vishnu, it freed him from his daily chore and let him pursue his studies.^{*} Many children in India face similar challenges. Immediate family needs pull them out of school early and, even if they do remain in school, their local knowledge and innovations count for little in the academic world.

^{*} Anil Gupta, "When Necessity Calls and the System Fails," *Honey Bee Newsletter*, 16 (3).

edge through medical research.

One example of how science has added value to local traditional practices comes from recent research into the tradition of using milk to manage diseases in crops. Farmers and scientists alike have described milk as a natural inhibitor of plant viruses; it also sticks well and spreads well. It has proven effective against viruses and fungi in various plants, including winter wheat, tomatoes, peppers, tobacco, potatoes, and sugar cane.¹⁴ In 1992, the *Honey Bee Newsletter* published an editorial about a farmer's practice of dipping his hands in milk before sowing tobacco seeds. In 2005, researchers in Jodhpur examined two other specific applications of milk and shared their results in the newsletter. In one study, they compared the effectiveness of two treatments to prevent downy mildew in pearl millet plants: soil treatment with *Gliocladium virens*, a biological pesticide, versus seed treatment using raw cow's milk. They found both treatments to be equally effective.

In another study, the scientists investigated using raw cow's milk to prevent chili crop damage and loss from leaf curl disease. Pesticides alone have not been an effective treatment for this problem. The researchers found that a combination of both milk and a pesticide, what they called an "alternative disease management

technology,” worked well. When they soaked seeds and treated the ground with milk and a pesticide, rather than solely using pesticides, the amount of pesticides required dropped, resulting in lower costs, and the yield increased by 25 percent. In turn, 12.5 percent more jobs became available.

Because our network has collected such a variety of valuable practices, one of its underlying activities is campaigning for and promoting public awareness of traditional knowledge and sustainable practices. We have done so through a variety of avenues. We have installed experimental computerized networked kiosks, called Gyan Manthan Kendra (Knowledge Churning Centers), in different villages, allowing local people to browse for innovations in multiple languages. We have also set up on-farm experiments and formed local innovators’ clubs. And we have collaborated with a major national television channel to air a series called Avishkar India (India Innovates) in addition to extensive radio and television coverage on the BBC World Service and the Discovery Channel.

Members of Honey Bee also spread their knowledge at local festivals. Sattvik, a food festival focusing on traditional and organic food, has proven to be a unique and successful way to encourage people-to-people learning. The two-day festival provides an opportunity for organic farmers to show urban people the benefits of diverse crop varieties and to emphasize the importance of organic farming.

Organic food shows real promise. A recent market survey by *Business Standard* reveals that the global market for organically produced food is US\$26 billion and is estimated to increase to US\$102 billion by 2020.¹⁵ However, the organic business has not yet taken off in India. Sattvik helps address this problem by bringing farmers and urban consumers together to collaborate and share best practices and novel ideas for tapping into this growing international market.

Our second Sattvik, in December 2004, attracted 18,000 people from nine Indian states; we hosted sixty stalls, a 50 percent increase from the first Sattvik held in February 2004. During the festival we held a meeting to discuss organic certification and marketing and agreed that all involved should pool their knowledge and expertise. Some attendees suggested developing a website or helpline to provide information about organic produce. As part of an ongoing research effort by SRISTI to understand organic and traditional food issues, business and journalism students at various local colleges conducted a survey to gauge people’s understanding of organic farming. They found that 90 percent of people wanted to read more about organic food to deepen their understanding of it. Over half said Sattvik festivals should be held more often, and over 70 percent were willing to pay a premium for organic food.

We organized a third and even larger Sattvik in December 2005. Farmers not only sold their produce at the festival, but also connected with urban markets and urban consumers and learned about the market potential for their products. According to Arvind Paramar, who brought 18 farmers to the festival, “all of the grains were sold, and we also got a lot of contacts at the festival.” One farmer, Khimjibhai (first name unknown) said, “The festival has provided an opportunity for me to understand the market for organic produce. I have used this knowledge

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and set up a shop for organic produce in the village. Not only do I sell my produce, but I also procure it from other farmers and sell it if the demand is high. The festival has helped me become an entrepreneur.”¹⁶

The Honey Bee Network has also tapped into inventors addressing other pertinent issues, such as energy efficiency and renewable energy. Over 70 percent of Indians live in rural areas, and nearly 90 percent of the total energy that rural people consume consists of non-commercial fuels such as firewood, cow dung and agricultural waste, according to the Gujarat Energy Development Agency, an organization focused on promoting and developing renewable energy. Still, many rural poor must purchase kerosene for their cooking stoves, and its price is rising. Thus people are looking for new fuels and innovative ways to make cooking more efficient.

Honey Bee has documented several responses to these problems. One day a farmer, George David Raj of Kanyakumari District, stumbled on the idea of cooking with the gas that emanates from cow urine. He had made a pit into which he could drain cow urine and covered it with a concrete slab to contain odors and keep out insects. When he opened the pit, he was overwhelmed with a strong odor and as he placed his cigarette on a nearby pile of straw, the straw burst into flames. If the fumes were that flammable, he reasoned, they might work as cooking fuel. Now he drains urine from the yard into a tank 11 feet deep. He keeps the tank full to 9 feet, draining the excess into the garden as fertilizer. The gas that forms from the urine occupies the top 2 feet of the tank and he pipes it into the kitchen through a regulated valve mechanism.¹⁷

BEYOND HONEY BEES: EXPANDING THE SCOPE

SRISTI, the institutionalized extension of the Honey Bee Network, has evolved into a very forceful voice to protect the intellectual property rights of both individuals and communities. SRISTI has discussed many policy reform proposals at meetings of the World Intellectual Property Organization, and has campaigned for an International Network for Sustainable Technological Applications and Registration (INSTAR). Such a registry has yet to evolve. If implemented, however, this registry would allow people in one part of the world to learn from creative people in another part and would provide a low-cost clearinghouse for connecting innovations with investment and entrepreneurial support.

More importantly, such a registry would be one way to provide innovators with a means of protecting their ideas. Historically, property has provided a foothold for poor people to gain power. Governments have denied voting and other basic rights to people who lack title to property. Today, intellectual property rights are the modern foothold to the global marketplace. Developing nations are making the transition from nature-based economies, with local knowledge based on local resources, to market economies, where knowledge and products have value beyond their immediate use to a villager. As they do so, individuals in these developing nations need the title to their unique knowledge in order to have the

Box 3: Preserving Traditional Knowledge Sources

Five kinds of change can protect indigenous knowledge, innovations and practices so that informal knowledge systems continue to grow and interact symbiotically with modern science and technology:

- Reform intellectual property rights systems to make them accessible to small grassroots innovators.
- Use modern information technology applications to overcome information asymmetries in formal and informal knowledge systems.
- Establish venture funds and incubators dedicated to converting innovations into enterprises.
- Reform the mandate and responsibility of the institutions in the Consultative Group on International Agricultural Research (which apply science-based solutions to global food and nutrition problems) so that these institutions are obliged to place a priority on adding value to local innovations.
- Rethink and redefine the role and responsibility of international financial institutions and United Nations agencies with respect to ethical, institutional and financial support for grassroots innovations and local knowledge systems.

right to profit from it.

Gaining that title isn't simple, however. Part of the problem is the perception that traditional knowledge is old and common. That is, some believe that local people hold in common all the knowledge about the local use of biodiversity to treat various ailments of humans and animals, to produce vegetative dyes, and to develop biological pesticides, for example. People suppose that people have transferred this knowledge to successive generations over very long periods without much change or improvement.

On the contrary, not all such knowledge is traditional. Villagers do not carry all of it forward in fossilized form from one generation to another. Rather they have improvised it over successive generations. Not all of it is collective in nature, and, even if communities know certain traditions, they don't all reproduce all of it. Moreover, these communities produce knowledge of considerable economic importance.

Because the external perceptions are so disconnected from the internal reality of individuals, the intellectual property community considers much of the local, traditional knowledge that Honey Bee has collected to be prior art. For this reason, powerful corporations can use the knowledge without crediting those who developed it. They can extract the knowledge and the plants, in a form of "bio-piracy" in which the original creators of the knowledge gain nothing. In fact, they may lose in the end as corporations extract their local plants and inflate the value of these resources beyond their reach. Box 3 suggests some ways to counter this problem.

BOX 4. Building Incubators

While SRISTI and NIF have made great progress in expanding and formalizing the work of the Honey Bee Network, after an international conference on Creativity and Innovations at Grassroots held at the Indian Institute of Management, Ahmedabad in January 1997, we realized that a link was missing. We had no venture capital in the chain that SRISTI was building. We proposed a venture fund; the Gujarat state government came forward to collaborate with SRISTI and IIMA to set up the first Gujarat Grassroots Innovation Augmentation Network (GIAN).

GIAN plays three roles:

- Incubate promising grassroots ideas and knowledge into marketable technologies.
- Protect the intellectual property of inventors.
- Help innovators take their ideas to market.

Along similar lines, to strengthen the support for innovations, the Small Scale Industrial Development Bank of India (SIDBI) joined hands with NIF after Yashwant Sinha, the Finance Minister, announced in Parliament that a Micro Venture Innovation Fund of about \$1 million would be set up in October 2003. While micro finance is not new, micro venture finance is a novel idea. It recognizes the creativity that exists at the grassroots level and acknowledges that if these innovations are to reach their potential as products or value-added technology, the innovators need the support of venture capital.

ENGAGING THE GOVERNMENT AS A PARTNER

By 1998, the Honey Bee Network had documented about 10,000 innovations and examples of traditional knowledge. We had been lobbying the government to scale up Honey Bee in a more formalized structure with dedicated funding. After considerable effort, in December 1998 we finally met with Dr. E.A.S. Sarma, then the Secretary of Economic Affairs. As a scientist, he could appreciate the merit of the Honey Bee database. He invited Dr. Vijay Kelkar, the Finance Secretary, who also found the idea worth scaling up. The result was the National Innovation Foundation (NIF), to be chaired by a champion of innovations in India: Dr. R. A. Mashelkar, FRS, Secretary of the Department of Scientific and Industrial Research. In February 1999, Yashwant Sinha, the Finance Minister, announced the foundation's formation in his budget speech in Parliament; on February 28, 2000, NIF formally came into existence with a budget of approximately US\$5 million. Box 4 describes the funding and objectives of an affiliated innovation incubator organization.

NIF has mobilized an additional 40,000 innovations and examples of traditional knowledge, bringing the total database to more than 50,000 practices from over 400 districts. One key accomplishment has been to strengthen ties between

villagers and the scientific community through its formal research agreements with the Council of Scientific and Industrial Research and the Indian Council of Medical Research. It has also helped file 77 patents; among these were six filed in the United States and three granted in the U.S and 14 in India. Other organizations formed by NIF include chapters of the Student Club for Augmentation of Innovations at Grassroots (SCAI), individuals at universities who provide technical and business assistance to the grassroots innovators. NIF has also established Grassroots Innovation Design by Students (GRIDS) clubs, which encourage students of engineering, agriculture, and pharmacy to undertake projects that support grassroots innovations.

NIF has organized three award functions and has planned a fourth. Abdul Kalam, the President of India, has given the awards at the last two functions. Having the head of state honor grassroots innovators and traditional knowledge holders makes a powerful statement. Never before had extremely common people pursuing uncommon distinctions imagined that they would receive such consideration from the president of one of the world's largest democracies.

ON THE HORIZON: A NETWORK WITHOUT BORDERS

SRISTI organized the first international scouting contest in 1999 through the International Fund for Agricultural development (IFAD). Several criteria were used to evaluate the entries: uniqueness of practice, novel use of ingredients and their apparent effectiveness, use of locally available material, prospects for research and development and wide applicability. SRISTI honored the award winners, who came from three different countries, at a Global Knowledge Conference held in Malaysia in March 2002. A second international contest included Central, South, and East Asia and the Pacific Islands. The awards were presented in Bangkok in July 2003, to a traditional community representative from China, a Maharashtrian village community for local management of forest resources, and an innovator from Vietnam. SRISTI is planning to hold similar competitions in Brazil and China.

Other efforts to internationalize our grassroots network have evolved. Students from IIMA designed a web site, www.indiainnovates.com, to assist the grassroots innovators in developing and testing their products for a global market. Already, some of these technologies have been commercialized in the USA, Singapore, and Pakistan.

Several countries are coming together in what may eventually amount to a global GIAN, or global innovation incubator. Brazil and China have made connections with SRISTI and Malaysian and South African science and technology departments are in touch with Honey Bee to explore extending these networks into their countries. Their goal is to make commercialization less expensive for entrepreneurs by attracting investors from around the world. Such a unified network may evolve into a virtual global incubator for green grassroots innovations.

More recently, SRISTI has further expanded its scope. It now includes

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women's knowledge systems, educational innovations, and a natural product laboratory for adding value to traditional knowledge, set up with the help of the private Sadhbhav trust in Mumbai. SRISTI continues to organize the Sattvik traditional food festivals, which have helped generate demand for organically grown and diverse foods made by using local crops and recipes.

CONCLUSION: TENDING OUR ROOTS

The Honey Bee Network started with a simple revelation: creative individuals at the grassroots level can be a source of valuable innovations. We have attempted to help these creative individuals on many levels—from the grassroots level itself to the national political level and extending into international law. As we look forward, it is critical that we not forget our roots.

It will take a substantial, distributed effort to foster these roots so that a tradition of creativity and invention continues in future generations. Those of us involved in the Honey Bee Network are committed to contributing to this effort by encouraging curiosity and collaboration among children. The biodiversity competitions, for example, instill a sense of appreciation, care and concern among children towards the environment and nature. A “concrete school project” has established several alternative schools in areas that lacked any kind of schooling infrastructure. And SRISTI has helped to set up a separate Academy for Augmenting Sustainable Technological Inventions, Innovations and Traditional Knowledge (AASTIHK) to provide innovators an opportunity to do research into their own network and strengthen their cooperative ways of learning.

We must also continue to forge links between local university researchers and local innovators so that we can help ourselves become leaders in traditional knowledge and innovation. Gandhian rural *vidyapeeths* (colleges) in Gujarat agreed that each year three students studying agronomy, extension and veterinary science should focus their dissertations on themes such as organic farming and understanding traditional practices. So far they have produced over 100 dissertations.

In terms of technology and invention, similar opportunities exist in our pool of approximately 400,000 technology students in India. Each one conducts one project each year. No mechanism yet exists to link their projects with local innovations, traditional knowledge or current local or regional problems. But if only one per cent of these projects were based on innovations that have already been scouted out and documented, in order to improve and standardize them, this would be a great achievement. By extending the practices of Honey Bee, perhaps by creating a web-based database of information on such projects and a correlated list of urgent local or regional problems, we might make another set of connections that will further propel our local innovations forward from within.

We invite reader comments. Email <editors@innovationsjournal.net>.

1 Examples abound. In the 19th century, for instance, when outsiders discovered Assam tea, they took over its production and export. Then, as today, few of the local people who work long hours on tea plantations can afford to drink Assam tea themselves.

2 In the early 1980s, research showed that 80 percent of modern plant-based medicines are used for the same purposes that were discovered by native peoples (N.R. Farnsworth, 1988, "Screening Plants for New Medicines," in: E.O. Wilson, and F.M. Peter eds., *Biodiversity*; Washington DC, National Academy Press.) More recently, investigators focusing on a part of Nigeria calculated that the correlation between claims of local communities and the evidence from modern pharmacological science was more than 85 percent. (Maurice Iwu, 1999, *Traditional IGBO Medicine*; Report of a project sponsored by the Institute of African Studies, University of Nigeria, Nsukka).

3 Anil Gupta, "Animal Husbandry Practices," *Honey Bee Newsletter* 2 (1) p. 20, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad.

4 Anil Gupta, "Scientific Comments on Farmers Practices," *Honey Bee Newsletter* 3 (2).

5 Anil Gupta, "Rewarding Traditional Knowledge and Contemporary Grassroots Creativity: The role of intellectual property protection,"

<http://www.cid.harvard.edu/cidbiotech/events/anil_gupta_paper.htm>.

6 Anil Gupta, "Editorial," *Honey Bee Newsletter* 3 (3 & 4).

7 These colleagues include Kirit Patel, Riya Sinha, Vijay Sherry Chand, Hema Patel, Mahesh Parmar, Dilip Koradiya, Ramesh Patel, Srinivas Chokkakula, and Shailesh R. Shukla.

8 Society for Research and Initiatives for Sustainable Technologies and Institution, "1st Shodh Yatra," undated, http://www.sristi.org/cms/en/1st_shodh_yatra.

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10 Consultative Group on International Agricultural Research, "Watershed Projects Aim to Improve Farmers' Incomes," *cgiarNews*, September 2006.

11 National Innovation Foundation India, "GIAN announces a first-of-its-kind Grassroots Innovations Technology Transfer in India," August 14, 2004 press release, http://www.nifindia.org/bd/pressroom_item_2.

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13 Anil Gupta, "Rewarding Traditional Knowledge and Contemporary Grassroots Creativity: The role of intellectual property protection,

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14 Arun Kumar, et. al, "Validating People's Knowledge: The Role of Formal Sciences," *Honey Bee Newsletter*, 16 (4).

15 Arati Menon Carroll, "How green is my bazaar," *Business Standard*, October 15, 2006, <http://www.business-standard.com/bsonline/storypage.php?autono=202986&leftnm=11>

16 Anil Gupta, "Sattvik 2005," *Honey Bee Newsletter*, 16 (4).

17 Anil Gupta, "Honey Bee Hums," *Honey Bee Newsletter*, 16 (4).