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Mobilizing from appropriate technologies to sustainable technologies based on grassroots innovations

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ABSTRACT

The paper focuses on the evolution of Appropriate Technology (AT) movement in India touching upon its ideological contours developed by thinkers like M.K. Gandhi, E.F. Schumacher, JC Kumarappa and others. It stresses that AT movement as a discursive one is not about mobilizing activities and people but is about academic discourses on AT. Hence it articulates the AT movement in India in the framework of 'Mobilization to Institutionalization'. And the paper presents an empirical case study of a social movement organization named Honey Bee Network, emergent of the said movement that does not represent the original discourse of the movement any more rather represents the later turning point of the discourse, i.e, the drift toward sustainable technologies in India. Noteworthy, that this case study of the Honey Bee Network at Ahmedabad is in fact a network of three organizations namely, Society for Research and Initiatives for Sustainable Technologies and Institutions (SRISTI), National Innovation Foundation (NIF), and Grassroots Innovation and Augmentation Network (GIAN) which are to scout, document, register, and incubate the grassroots innovations that are based on traditional and indigenous knowledge systems and lastly to transform these grassroots innovations into commercialized technologies. The Honey Bee Network as a social movement organization has been analyzed from the vantage of the well known resource mobilization theory of social movements. Lastly the paper brings out the socio-cultural embedded character of the grassroots innovations and their resultant technologies. And it is further argued that, this bottom-up approach of technological development is to pave the way for sustainable technologies.

1. Introduction

The arrival of the 20th century heralded great optimism for mankind that technology and science would provide solutions to almost all human problems, particularly those associated with poverty. However, these optimistic expectations had already begun to be undermined in the mid-20th century due to the long term adverse effects of technological innovations-for example, the introduction of extensive and capital intensive agriculture causing soil degradation, water scarcity, etc and indiscriminate industrialization causing ecological degradation and climate change, use of labor intensive technologies and use of steam engines causing environmental pollution, etc. The technology which has benefited us with the marbles of economic development and comfort is being countered by its own misgivings, i.e. by unleashing serious ecological crisis, environmental degradation, value crisis and economic inequalities. Great technologies have failed to provide solutions to many of world's major problems in particular to mass poverty. The global attempts to alleviate poverty in the developing world, which houses 75% of the

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global population, also facilitated a shift in the global thought process towards emergence of appropriate technologies. It had been natural to suppose at the outset that the best way to bring economic development was to facilitate in developing countries the kind of technologies that had led to the development of the developed countries. But in due course of time owing to the inaccessibility of developing countries to developed technologies and the built in dependencies there as well as growing unemployment and income disparities in developing countries led to the emergence of concepts like appropriate, intermediate, and alternative technologies to be taken with increasing seriousness to solve human problems in a more human manner. India like other developing countries has experienced the rise of this great intellectual debate in the context of its development.

Hence in this context, we take the opportunity to put forward a new epistemic strategy, as a development alternative which is in a way futuristic. The AT movement in India has gradually been transformed into a movement of sustainable technologies which is now catching-up. Two fine examples of this are; (1) Centre for Sustainable Technologies (CST) at the IISc, Bangalore (which is a transformation of the Unit for Application for Science and Technology to Rural Areas, ASTRA) and (2) the HBN. The HBN is being empirically studied here to represent this new epistemic strategy. The grassroots innovations that the HBN indulges in are often based on the informal knowledge/practices of creatively potent ordinary people (craftsmen/artisans, etc.) the non-formal innovators. That apart these grassroots, innovations are also often based on traditional knowledge systems and traditional practices that represent alternative epistemology to modern western science and technology. These two bases of the indigenous knowledge systems never acquired formal status, continued as folk/ethnic sciences and survived through informal practices of communities, but always required a touch of formality of modern science and technology to get recognition. May be such knowledge systems were not as developed as the modern western science and technology, of course because of historic reasons and their epistemic limitations (bound by socio-cultural embeddedness and limited amount of objectivity in the sense of transpersonal replicability). But such knowledge systems before facing extinction, could always be called upon to supplement the modern technological regime, that is making development un-sustainable, particularly in developing countries, in many ways.

1.1. Objectives of the paper

The objectives of this paper are: First, to understand the conceptual framework, debates on AT both from the standpoints of developing and developed countries; Second, to bring out the intellectual heritage and historical antecedents of the AT movement in India; Third, to study empirically a social movement organization, i.e, case study of the Honey Bee Network (HBN): Ahmedabad (which subsumes three organizations, such as the, SRISTI, NIF and GIAN) and to articulate the shifting thrust of the AT movement in India.

1.2. Methodology

The study is based on both (empirical) primary and secondary data. In order to study empirically the organization, the relevant information regarding the functioning of the network were collected through interviews among a few of their personnel. And secondary data were collected from various sources like, annual reports, documents, and publications of the network. HBN although believes in the Gandhian philosophy of technology is a more recent organization with nuance, where grassroots innovations are registered and at times developed into sustainable technologies, which are also some sorts of appropriate technologies, as these are often socially and culturally embedded and based on local resources & skills. Never the less HBN is a unique organization of its own kind that represents the emerging new thrust of the movement shifting toward sustainable technologies.

2. Appropriate technology (AT): a concept

AT is a concept that denotes a set of ideas or a framework within which we are to think and act for the development of society. The aim of this concept is to provide a basis and method for the choice of technology. It is intimately connected with the concept of development whereby development meant development of people. It has led sociologists, economists, philosophers, technologists, planners and environmentalists to contribute towards its definitive descriptions. It is directly linked to major developmental issues like unemployment, population growth, rising inequality in society, urbanization, environmental pollution, ecological degradation, etc. in many ways. The concept of AT hence endeavors to eliminate the adverse effects of modern technology by devising the same to retain its organic link between man and nature and to sustain growth by making units as small as possible. It also tries to change the life-style of the world by bringing mankind back to a life of simplicity which is in harmony with nature. The concept of AT is also closer to the operation of small scale industries. It advocates for smaller technologies dispersed in various areas with a bias against sophisticated large scale capital-intensive technologies. The concept can be used in terms of engineering designs and consultancy groups that have the necessary socioeconomic-cum-engineering expertise and have familiarity with the situation in the country [35]. The concept of AT reminds us that alternative technologies are available or could be developed for many tasks. AT as a concept, is a set of diverse and engaging explorations of the linkages between technological choices and social values [19]. Hence AT as a line of thought and action is being increasingly accepted and diffused due to the fact that it offers solutions to a world facing serious problems of inequality, injustice through loss of livelihood and resource crises because of resource intensive character of modern industrial technologies as well as their capital intensive character [2]. The best can be said that it is about the appropriateness of the technology which is the touchstone of the concept. And the appropriateness is defined in terms of environmental and climatic suitableness, capital or labor

intensiveness, use of local resources, energy saving character and resource intensive character of the technology.

Once 'Appropriate technology' was on its way of becoming a household term also. The proponents of small, affordable, human-centered technologies have found a Bible of sort in E. F. Schumacher's book 'Small is Beautiful'. Common examples of such technologies are solar heat collectors, wind mills, recycling of waste to produce methane and compost, composting toilets, urban greenhouses and rooftop hydroponics' gardens, etc. In sum, AT is a technology which can satisfy the basic human needs starting from the needs of the neediest. It creates a sense of being endogenous and self-reliant through social participation and control. Further it promotes a sense of participation, labor maximal utilization, employment generation, capital prohibitive and cost effectiveness, reduced dependence on imported technology and foreign exchange savings, etc. It is greatly resource saving and energy saving too. In addition to these of late it is found to be physically non-displacing as modern industrial technologies are.

3. Debate on appropriate technology

In the past, 'Appropriate technology' concept was generally used in the context of developing countries only. But of late, the concept of AT has gained currency in both developing and developed countries. Originally, the concept had emerged in response to employment creation and poverty elimination in developing countries. But large number of developing countries today rely on 'heavy' industrialization path to economic development and the technologies they chose do not necessarily reflect local factor endowments and their socio-economic relevance in these countries. On the contrary developed countries are now worried about green and energy saving technologies under the rubric appropriate/alternative technologies.

3.1. Appropriate technology for developing countries

The major problem developing countries face even today is of mass poverty. There is shortage of food and nutrition, little access to medical care and education, no clean drinking water facilities and very poor housing. It is here with such problems, arise a question of choice for AT. The form of alternative technologies developed for use by, 'developing country family' is generally referred to as Intermediate or low-cost technologies. It is the technology which selects or develops methods which are compatible to local economies, and which are intermediate in cost and their sophistication being placed between simple and complex technologies. The concept of 'Intermediate technology' which was coined by E.F. Schumacher concerned itself with technical solutions to certain of the development priorities of the developing countries, and has concentrated upon finding ways to combat high unemployment and poor community services on low budgets and low technical inputs. On the other hand, 'Alternative technology' concept emerged in response to the issues related to developed nations. Both alternative technology and intermediate technology qualify as appropriate technologies, because both relate to the issues of socio-economic development. Both seek to work with the natural systems rather than against them.

3.2. Appropriate technology for developed countries

'Industrialized country family' comprising the developed nations of the West started to develop AT in response to a growing concern for the protection of the environment and more recently to escape a mounting energy crisis. The ' industrialized country family' is currently using AT to assist itself in the search for new and renewable sources of energy and in developing programs for the reduction of environmental damage caused by industry. The form of AT developed in the ' industrialized country family' is generally referred to as Alternative or Soft technology; which seeks alternative approaches to present methods which are considered by many to have pressed too hard on the limits of existing resources (financial, natural/material, and human) [18].

3.3. Exiting literature on appropriate technology in developed and developing countries

Many groups and scholars in the last three decades have been critical of modern technologies, and have advocated changes rather than forsaking it. Their diversities of interests and philosophies are reflected in the variety of labels they have chosen to describe their proposals: appropriate, intermediate, alternative, radical, self-help, democratic, people centric, progressive, low cost, autonomous, soft, utopian, liberatory, non-violent, convivial and the like. There were some whose prime concern was with the problems of developing countries, and others whose concerns were about the 'quality of life', environmental, and energy problems of developed nations.

3.4. Developing countries

In developing countries, a few decades ago, there was a debate on the issue of AT. The kind of technology which [30] coined was 'intermediate technology'. To him, 'it is a technology which is vastly superior to the primitive technology of bygone ages, but at the same time much simpler, cheaper and freer than the super-technologies of the rich'. Nicolas Jequier (1978) (in Ref. [13] pointed out that inappropriateness or appropriateness is a quality which can be engineered into particular technology. He further claims that 'appropriateness lies less in specific design features of particular piece of hardware than in the broadness of the evaluation criteria which underlie its development and application. Ken Darrow and Pam (1977) (in Ref. [13] stated: 'AT is a term which represents a particular view of society and technology. It suggests that technology is neither neutral nor does it evolve along a single path. It recognizes that different cultural and geographical groups will have different technologies that are appropriate to their conditions; that technological self-determination is essential to cultural identity (and political independence). To him, the key element of appropriateness in the development context is generating innovation and self-reliance at the village level rather than importing mass producing

gadgets. M.M. Hoda (1980) (in Ref. [13], the then head of the ATDA, Lucknow has noted: 'disaster may follow if multi-national organizations take up to produce small machines in stainless steel package for the rural areas of the developing countries. This would be an end of appropriate technologies'. This dispute is related to- but not identical with-the question that whether appropriate technology should be an end in itself or stepping stone to modern western technology. The concepts associated with the former view are essentially those of groups concerned with the ills of western industrial societies.

3.5. Developed countries

The term 'alternative technology' has been used mainly in the context of developed countries and implies a rejection of modern technology whereas 'appropriate technology' permits discrimination between desirable and undesirable aspects of it. Prominent among those who promoted the concept of AT in developed countries were: Refs. [5,12,14,20,22,29].

Harper (1976) has pointed out that 'alternative' has the connotation of a counterculture in the West: not controlled by dominant institutions, cheap, improvisatory, personalized, and accessible to amateurs. He talked of 'Radical technology' which has its origins in the alternative life style movement and utopian socialism. The word 'radical' literally means 'going to the root', and accordingly 'radical technology' implies a fundamental reexamination of the role of technology in modern societies. It also implies a commitment to the ideals of the political left. Ref. [5] contrasted 'hard' modern technology with 'soft technology' using 35 characteristics, many of which overlap. In essence, he espoused an environmentally benign technology that is frugal in its use of resources; relatively labor intensive, produces in small-scale, and anchored on craft-based decentralized, village based industries. It is suitable to community life style that encourages cultural diversity and is based on participatory democracy; a steady state economy with a local system of exchange and trade; satisfying work and reducing the distinction between work and leisure; and demystifying modern science and technology.

To Ref. [20]; 'soft' energy technology uses renewable energy flows; involves many modest and diverse renewable energy sources matched in scale, quality, and geographic spread to end-user needs; and is flexible as well as easily understood. Rybczynski (1980) argued that an absolute nonviolent technology may not be achievable. Technologies do differ on their degree of disruptive effects. As [22] puts it 'Non-violent technology refers to mode of production that respects ecological principles and strives to work with nature instead of attempting to force their way through natural systems'. The concept of 'convivial tools' was introduced by Ref. [14] who was careful to state that he was using ' convivial' as a technical term to designate a society of 'responsibly limited tools'. The meaning of the term 'tool' also covered more than just technology, and included its use in factories and social institutions involving education and health care. He has cited the telephone as an example of a convivial tool, since (provided he has the money) the user can call anybody for as long as he likes and communicate anything he chooses. Thus there are many differences in approaches and opinions, on AT but all these enable to build a sufficiently coherent view of society.

4. Appropriate technology: a discursive movement

The problem of inappropriateness of technologies has resulted in an international social movement operating under the rubric of 'appropriate technology' movement. AT movement places emphasis on 'appropriateness' as a key issue and acknowledges the positive value of technology. It is an approach to technology which may provide for the preeminence of human concerns in an increasingly technological world. 'Appropriate technology' is a useful concept of central importance to technology studies and technology policies. The AT movement has acted as the harbinger of technology choice as a policy matter in India and has provided the main source of literature on the subject [38].

The 'AT' movement, while failing in some respects, has opened pathways for helping individuals gain better lives through simple, effective designs, said Amy Smith. In particular, AT has a new focus on helping people earn money from savings or efficiencies, said Smith. The pot-in-a-pot, for example, allows farmers selling food at the market 'to earn money because they do not have to reduce the price of their crops at the end of the day because they will still be good the next day.' This is a fabulous example of AT where a little bit of science and physics ends up creating device that is very useful [32].

The origins of the movement can be traced much further back into history and in particular to the industrial and technological experiences of three major countries: India, China and the United States. In India, the interest in AT, even if it was not defined in such terms goes back, as we shall see later, to the early mid-20th century. In China, the philosophy which underlines Mao Tse Tung's ideas about technology could be traced back not only to the civil war of the 1920s and the reaction against the big capitalism of the Kuomintang society, but also to the peasant rebellions which have always been one important element in China's history. As for the United States, its industrial history illustrates the problems of industrialization in an underdeveloped country and also the fact that all the modern large-scale technologies of today were originally small-scale, inexpensive and in certain respects appropriate technologies. To national policy makers and aid-giving organizations in the industrialized countries, AT was progressively entering into the mainstream of development aid. The transition from marginality to acceptance is most conspicuous in the United States, Canada, and the United Kingdom. Ref. [28] noted the rise and fall of AT movement in the Unites States during 1965–1985. His findings indicate that, there is a steady decline of those centers working on the development of AT due to rise of large private utilities, multinational constructions, and military–industrial complexes. In symbolic terms Pursell concluded that with the rise of Reaganomics (of Ronald Reagan) and cultural masculinity through Rambo (Hollywood marcho-man) there was a re-masculinization of American technologies

in the late 1980s implying the decline of ATs that were symbolic of the softer feminine principles. In a similar study on alternative technology movement in UK based on the cognitive approach [31] analyzed the advocacy of alternative technology in UK. Smith mainly explored two issues like, (i) the relation between conceptualization of environmental problems and the kinds of technology solutions promoted and (ii) the interplay and compromises environmentalist must make with other actors (social) important in technological development. Smith concluded reflecting upon how social actors advocate and construct technologies based on prioritization of their multiple values. Thus the interest in AT was spreading to other aid-giving countries too. AT is primarily an aspect of development aid. But the philosophy underlines that AT should first and foremost be an indigenous creation of the developing countries themselves and the central problem they have to face is that of building up an indigenous innovative capability and not that of importing more foreign technologies [16].

4.1. The early ideological mobilizations for appropriate technology movement in India

4.1.1. M.K. Gandhi and his efforts for appropriate technology development in India

Gandhian workers and independent voluntary associations had taken the leading part in AT development in India. M.K. Gandhi made it a movement, because he believed that 'If villages perish, India perishes too'. He organized the All India Spinners' Association and All-India Village Industries Association. He made 'Charkha' (the Spinner's wheel) a symbol of new village technology and started a systematic study of all the village industries with a view to improving their technology and to give them a new dignity. Gandhi was instrumental for the appointment of many experts to develop village technologies, which would help artisans and craftsmen to improve their productivity and efficiency. As a result of M.K Gandhi's efforts, there are at least one thousand such units that were set up in various parts of the country. In fact, the village development program had become an article of faith for the Gandhian movement in India.

4.1.2. Low-cost technology as a post-modern technology (liberating effect)

The meaning of appropriate technology had been aptly implied by M.K. Gandhi [9] when he noted that it provides work and also dignity to work even can have a liberating effect. This he pointed out in the context of 'Chamars' who were traditionally scavengers (earlier untouchable castes in India). They had to do the dirty works of removing dead bodies of the animals, disposing of the flesh, flaying and tanning their skins, and making various articles out of the skin, bones and horns. To him if some improved technology is provided to them, for instance pulley blocks for lifting and loading (instead of carrying the carcass on their shoulders), wheelbarrows for carrying, gloves and gun boots to deal with the dirt and filth, it would immensely raise their dignity in addition to making their difficult task easier. AT represents a sort of converging point for rich and poor countries and also for a quality of life, peace and permanence in the whole world. In this sense we might view it as a post-modern technology as it came into the conception after the arrival of modernity [16].

Within a few years of independence, however, the ideas of Gandhi were ignored not only by our planners but also by our scientists and technologists. Alienation from the rural poor, the equating of modernity with westernization, the submission to western criteria of excellence, the development of vested interests in large scale technology-all these factors were perhaps responsible for putting in the Gandhian ideas in deep cold storage. Little later it become imperative to move along with many elements of the Gandhian approach, because alternative technologies are the only ones compatible with the Pro-poor programmes like *Garibi Hatao* of the then Congress government in late 1970s. However people like Jamnalal Bajaj, Maganlal Gandhi, M.M. Hoda, Vinoba Bhave and Sarvodaya workers followed Gandhi's approach and contributed significantly for the AT development in India.

4.1.2.1. E.F. Schumacher and his efforts for appropriate technology development in India. In 1963, E.F. Schumacher, a British economist and former adviser to the British Coal Board, visited India at the initiation of the planning commission and Jayaprakash Narayan. He was deeply influenced by the Gandhian ideas of industrialization and technology, adapted them to modern needs and converted into the notion of intermediate technology which further turned into a worldwide movement. His books, *Small is Beautiful*, *A Guide for the Perplexed* and *Good Work* carrying the ideas of intermediate technology and principles of Buddhist economics made waves across the world. In 1966, he had set up with other like-mined people the Intermediate Technology Development Group (ITDG) in London to collect information on such technologies which would be really beneficial to the rural areas of the developing countries. This was the first organization of its kind in a developed country which advocated cheap, inexpensive and labor-intensive machines and equipments for the developing 'countries, instead of sophisticated, modern and highly capital-intensive machineries. The ITDG voiced its concerns and new ideas through its journal named *Appropriate Technology*.

Schumacher's movement of intermediate technology gave a new lease of life to the concept of village development and the Gandhian movement, reinforced as expected by Schumacher's ideas, took a lead in giving a new meaning and a scientific backing to the rural development programmes in India. The Gandhian Institute of Studies, Varansai had taken an active interest in intermediate technology, organized many seminars on the subject. Later on, it decided to establish an Appropriate Technology Development Unit in the voluntary sector. This dream was eventually realized late in 1972 when such a unit was set up at Varanasi in co-operation with the ITDG of London [16].

4.1.3. JC Kumarappa and AT development

The other influential protagonist of AT in India was JC Kumarappa who being influenced by M.K. Gandhi's philosophy has expanded the notion of AT. To him Gandhi was

successful in propounding an alternative economic system and vision that would ensure permanence and harmony with nature by using smaller and softer technologies as opposed to economic principles and values that compelled the west into a consumerist and imperialistic technology culture. Kumarappa invented the most effective way of conveying the ideas of renewable and non-renewable resources. He expanded Gandhi's vision of Khadi to a wholesome framework of rural industry and thus became a profound practitioner of AT. Kumarappa's legacy lives on the AT movement unleashed by Schumacher, of course greatly by the virtue of his celebrated book *Economy of Permanence.*

4.1.3.1. Appropriate technology: beyond Gandhi and Schumacher. Technology and science definitely have a role to play in shaping up a society. Integration of traditional technologies in modern socio-economic systems, in certain cases at least, can radically enhance the resource use efficiency and minimize the ecological impacts.

Ref. [16] noted that *swadeshi* movement in India lead by Gandhi and the revolution lead by Mao in China to 'walk by their own legs' were aimed at self-reliant development of these countries. And hence are also part of the AT movement. He had made it clear that AT is not merely some tools or artifacts (Hardware) but it can also be ideas, knowledge, management, practices, etc (software). Ref. [8] held the view that AT is an integral part of the alternative development strategy. In most developing countries the conventional development strategy was in operation for the last 50 years. But no substantial results have been observed. They noted that it is because of the failure of the conventional development strategy that an alternative development strategy in congruence with AT was experimented in a number of countries. They conclude that alternative development strategies are more radical and basic. Refs. [15,17,23,36] have also discussed on the Issue of AT movement. Ref. [17] observed that the sophisticated technologies are very costly and they have created undesirable side-effects or externalities in the societies. Technology created within a particular socio-economic framework of a country may be irrelevant for another country or region. So AT is area specific and there cannot be an AT relevant for all countries or regions. Ref. [19] evaluated that AT was a movement to develop new tools and techniques and technologies suitable to the needs of the poor people. Ref. [23] in the report to the club of Rome on 'limits to growth' established the fact that unlimited growth is impossible in a world with limited resources. High technology solutions for the resource problem are not a comprehensive and final solution to the problem but it will push off the problem to certain extent only. The gloomy picture of scarce resource base provided by the report, of course, had an effect on the resource use pattern, and had accelerated the pace of thinking on AT.

According to [38] AT has evoked mixed responses among different sections of scholars. He said that according to the majority of scholars AT designated the 'hardware' e.g. solar collector, the oxharness, the windmill etc. To some others it is rather a process. A technology was appropriate only if it were designed, built and owned by the local producer. Yet some others take AT as a life style of living on less and recycling wastes. Some do believe that AT is an economic system. Further, Ref. [36] pointed out that the bigger the better trend would always make it difficult for the intermediate or AT to make headway. He held the view that appropriate structural changes should go hand in hand with AT introduction in a society. Otherwise the experiment may fail. Technological appropriateness is not only a matter of introducing a new gadget in a village, but of equity, of introducing new systems of land tenure, land use, banking, cooperative ownership, management, maintenance of equipment and eventually of the apportionment of produce for local use or sale.

Ref. [15] argued that search for an alternative for western science was common to all third world countries that were under western domination. Common feature of such a search was their indigenous traditions. He says that AT movement of 1970s was a worldwide alternative in which a creative combination of traditional as well as modern technologies had taken place. It had 'developed as a multifaceted movement. AT addressed or challenged the traditional dimension of western science and sought to break the link that had formed already in the early modern period between the development of science and development of practical techniques'. To him AT tends to be seen as a process of development from below, a non-scientific locally based technological activity that made better use of the available human and natural resources than a technology from above, directed by scientific experts with little awareness of local conditions and capabilities. He also traces the reason of marginalization of AT during 1980s. Of course, AT had difficulties in meeting the challenges of new advanced technologies of microelectronics and biotechnology that began to appear in the international market place in the late 1970s. These technologies were based on latest scientific understanding and they seem to imply a re-westernization. AT could not pace with these developments. This powerful discursive movement was in fact global and it resulted in re-conceptualizing 'innovation'/'technology' as it could bring out to the forefront its cultural (lifestyle), social (network relations) and the environmental components. And it gave rise to the social constructionist approach to innovation/technology. Lastly it also gave rise to articulation of the alternative path of development for the developing societies.

4.2. Appropriate technology movement in India: from mobilization to institutionalization

Intellectual mobilization for AT movement started in India aiming at a discursive movement where intellectual activists started only with a discourse, not in the form of rallies, but in the form of expression of speech, scholarly writings that later on manifested in some form of research organizations. Gradually these organizations have acquired institutional character. There was a shift from mobilization to institutionalization. Centers and organizations were being set up with the aim of developing tools, techniques and processes for the local communities and institutions

which are simple, direct, small-scale, inexpensive, eco-friendly and sustainable by nature.

Various efforts have been made by Government of India and the Planning Commission of India for the development of AT. It was for the first time that the essentials of a common production programme were defined in the *First five year plan (1951–56) of planning commission* in the context of the development of small scale cottage industries. It states that village industries should place central importance on the rural development programme. As far as village was concerned, the main aim was to process local raw materials for local markets with simpler techniques. The scope for such industries depends, in part, on their relation to the corresponding large-scale industry, in part, on the development of agriculture and the growth of rural amenities. As agriculture becomes more intensive, there will be greater demand for certain articles of consumption and tools/implements which could be met by village industries. Amenities in rural life such as supply of pure drinking water, street lighting, sanitation, hospitals, recreation grounds, community centers and roads would enhance the scope for village industries. The possibility of turning waste into wealth, for instance, through production of gas from cow dung and other refuse of the village through gas plants (so far as the operations prove economic), production of bone manure through bone digesters, soap making out of non-edible oils, etc., will further provide scope for the development of village industries. So villages worked largely as self-sufficient units, goods and services were mutually exchanged within a group and there was a great deal of inter-dependence and identity of interests within the village. As a result various institutions were set up to pull their skill and resources at village level such as the All-India Village Industries Association, the All-India Spinners Association and the *Khadi Pratisthan*, Sodepur, which have a long record of valuable work and considerable experience in the field of village industries. In addition to organizing industrial co-operatives, a useful method of developing village industries would be to give a measure of assistance to such associations so that, in turn, their workers can assist village artisans. A programme of village industries was supported by specific measures of assistance by appropriate State policy. In addition to the emphasis on technical improvements, research and other measures for improving efficiency, the primary objective of the state policy should be to provide a field within which each cottage industry may be able to organize itself. Various research and training programmes were then provided by government of India. Fiancés were also given in aid programmes. Various programmes were then given to rural artisans in consultation with State Governments and other organizations engaged in the field of village industries [3]. Accordingly the *Industrial Policy Resolution of India 1956,* stressed the development of village cottage industries within the framework of industrialization. Subsequently the *Fourth five year plan (1969–1974)* proposed to step up the tempo of activities to the extent compatible with maintaining stability and progress towards self-reliance. The plan proposed detailed action through regional and local planning to help the very large numbers of smaller and weaker producers and increase immediate employment and future employment potentials [27].

Further with a view to providing policy backing for the growth of indigenous technology in India, a Technology Policy Statement (TPS) [6] was enunciated in 1983, with the basic objective of developing indigenous technologies and adapting imported technologies, as appropriate to national priorities and resources thus paving the way to a self-reliant economy in the country. The aims were; first, to attain technological competence and self-reliance, by reducing vulnerabilities, particularly in strategic and critical areas of development, making the maximum use of indigenous resources; second, to provide the maximum gainful and satisfying employment to all strata of society, with emphasis on the employment of women and weaker sections of society; third, to make use of traditional skills and capabilities, making them commercially competitive. In technology development, special emphasis was given on areas of food, health, housing, energy and industry. In particular, stress was laid on agriculture including dry-land farming, optimum use of water resources, increased production of pulses and oilseeds, low-cost housing, development and use of renewable non-conventional sources of energy etc., which will lead for development of AT.

In view of the cost of technology development and the time necessary for successful marketing of a new or improved product, indigenously developed items are invariably at a disadvantageous position compared to the imported products or those based on imported technologies and brand names. Owing to the TPS [6] 1983 support were provided through fiscal and other measures, for a limited period, in favor of products made through indigenously developed technologies, care being taken to ensure equality. Further, fiscal incentives were provided in particular to promote inventions, increase the use of indigenously developed technologies, enhance in house R&D in industry and efforts directed to absorb and adopt imported technology.

And in, Govt. of India's Science and Technology Policy Statement (2003) [7], the basic strategy was development of indigenous resources and traditional knowledge systems. Indigenous knowledge was enhanced for the purpose of wealth and employment generation. An innovative system to document, protect, evaluate, and to learn from India's rich heritage of traditional knowledge base, of the natural resource base of land, water and bio-diversity was enlarged and introduced.

It shows that through intellectual mobilizations for AT movement in India institutionalization took place in the form of emergence of Govt. policies and consequent Govt./(semi govt.) bodies. Number of institutions and organizations were set up with the aim of developing appropriate technologies. The central Government was persuaded to fund AT centers in various government bodies and academic institutions. Reflecting this line of thinking the DSIR had founded its National Research and Development Corporation (NRDC) at the Zamroodpur community Centre Delhi in the year 1953 to support and finance small scale and indigenously developed technologies for marketing and commercialization. And Indian Institute of Technology (IIT) Delhi and Indian Institute of Science (IISc) Bangalore

were the first academic research institutes to initiate work in technologies applicable to rural areas. These institutes engaged in activities of designing and developing solar energy gadgets, wind mills, peddles, and hand operated machines, etc. A cell for the Application of Science and Technology to Rural Areas (ASTRA), a voluntary research group was created by A.K.N. Reddy at the IISc Bangalore in 1974 to initiate and promote work of rural relevance as a weapon *(Ashtra* in Sanskrit) against poverty. The objective was generation and diffusion of technologies appropriate for rural development. Centre for Rural Technology was set up at Indian Institute of technology (IIT) Delhi in 1979. It had a vision to understand the technological requirements of the rural sector and to locate formal and informal production sectors in rural areas; where majority of India's population lives. And further, Centre for Technology Alternatives for Rural Areas (CTARA) was initiated by Anil Date at IIT Bombay in 1985 for the purpose of responding to the technological needs of rural areas. The center has been working on developing and disseminating technologies from diverse fields that are relevant to the rural areas.

Khadi and Village Industries Commission (KVIC), a largest government sponsored industrial organization was set up way back in 1957 with Gandhian ideas. It is an industry specific organization and addresses technical problems particular to the rural artisans. With a series of research laboratories and workshops of its own, the commission has played a significant role in upgrading technology of traditional artisans. The operations of KVIC cover the following industries: cotton spinning, weaving, carpentry and crude metal, etc.

Appropriate Technology Development Unit (ATDU) at Varanasi was established in 1973 with the aim to develop 'appropriate technologies' that will really solve some of the problems of the rural poor in India. The Unit proposed to become a 'Knowledge centre', where information on such techniques and technologies could be pooled and farmed out to those who require them and R&D could be promoted. One of its first priorities was to motivate the scientists/the technologists, the students and the teachers of the universities/engineering institutions, IITs and other research and scientific institutions to carry out the research work for appropriate technologies to help the poorer sections and small communities in India [1]. ATDU Varanasi is now stagnating, looking for fresh lease of life with a flush of fund and active scholars to infuse more relevant and creative thinking. Similarly the Appropriate Technology Development Association (ATDA) Lucknow founded by noted Gandhian scholar M.M. Hoda in the year 1976, after a brisk and vibrant life is now breathing the last phase of its life.

Patriotic and People Oriented Science and Technology Foundation (PPST Foundation) at Madras, a trust came into existence to explore various aspects of indigenous/traditional sciences and technologies. It started as a movement of ideas in 1980 and it was registered as a trust in 1986. During the period 1980 to 1995 the PPST Foundation produced a magazine named, '*PPST Bulletin*' which had undertaken detailed analyses of the various aspects of traditional Indian sciences and technologies. The PPST Foundation has also been holding a number of state level conventions on indigenous science and technologies. PPST Foundation was founded by some radical as well as nationalist scientists and technologists of the 1980s. A section of the intellectuals who mobilized for PPST Foundation were the campus breed of IIT Kanpur. As a nationalist voice these group of scholars were desirous of reviving the traditional Indian sciences and technologies lost in the history. However PPST Foundation is no more an active organization. MS Swaminathan Research Foundation (MSSRF) a similar non-profit research organization was established in 1988. MSSRF has all along been developing and promoting pro-nature, pro-poor, pro-women and pro-sustainable on-farm and non-farm livelihoods through development of appropriate, ecological technologies and knowledge for empowerment. Inspired by the same ideology, Honey Bee Network (HBN) was established at Ahmedabad during 1988–89. It is the biggest network of grassroots level creative and experimenting farmers and artisans in the world (more, later on in the case study section).

Some of the other AT promoting organizations which have come into existence as off-shoot of the movement and have contributed significantly for AT development in India are: (a) Appropriate Technology Cell, Ministry of Industrial Development, Udyog Bhawan, New Delhi, (b) Kisan Krishi Yantra Udyog, Moti Bhawan, Collectorganj, Kanpur, (c) Vigyan Shiksha Kendra, Attara, Banda, U.P., (d) Asian Institute for Rural Development, Kanakpura Road, Basavanagudi, Bangalore, (e) Rural Agricultural Institute, Narayangaon, Pune, Maharashrtra, (f) Sarvodaya Ashram, Nawada, Bihar, and (g) Village Reconstruction Organization Brodipet, Guntur, A.P. etc. But, during 1990s, the AT movement in India declined due to the globalization of the economy and liberalization of Indian industrial and technological policies resulting in flow of foreign technologies and large scale technologies. The AT movement has been out of gear in India these days because of the preponderance of neo-liberal thoughts.

5. Studying appropriate technology organizations through resource mobilization theory

Appropriate technology organizations can be studied empirically from a sociological perspective, i.e. Resource Mobilization Theory (RMT). This perspective emerged in the 1970s as a distinctively new approach to the study of social movements. It is today a dominant perspective for understanding collective action. To this perspective the actors are engaged in instrumental action through formal organizations to secure resources and foster mobilization. The perspective has demonstrated considerable theoretical and empirical merit for understanding social movements [21]. AT movement in India, with which we are concerned here, can be effectively studied within the resource mobilization framework. For instance, the actors or the scholars of AT movement are construed to be engaged in instrumental action by making use of resources and fostering mobilization for development of AT.

Second major feature of RMT is that it takes a distinct position on questions of recruitment, motivation and participation. Based on a rational actor model, individuals

are viewed as weighing the relative costs and benefits of movement participation and opting for participation when the benefits outweigh the anticipated costs (McCarthy & Zald, 1977, as cited in Ref. [4]. Motivation, recruitment and participation aspects of the AT movement can be understood within the analytical framework of RMT.

The RMT also takes its starting point for analysis in organizations and not with the individuals. It does not only centre around the question of why individuals join social movements, the rationality or irrationality of their intentions or behavior as participants, but also it centers around the effectiveness with which they participate in the movements, that is otherwise, making the movement organizations use effectively their resources in attempting to achieve their goals. AT has some characteristic features, where the major emphasis is on the organization playing a dominant role than a single individual member. RMT also helps us to understand the structure of AT organization and the role it plays to achieve certain goals and more specifically for the development of AT.

One of the most important features of the RMT is that it develops through the ongoing movements. The RMT emphasizes in the light of new evidences, the role of 'entrepreneurs, in the rise of social movement. Further RMT is not restricted to the direct beneficiaries of the social change pursued, but is inclusive of diverse kinds of individuals, groups and institutions which mobilize a 'conscience constituency' of adherents. These may come from different strata co-opted from institutional resources like, private foundations, media, social welfare institutions, non-government organizations, universities and even business corporations. Likewise, in AT movement, diverse kinds of individuals, groups from different sections of society come up with their ideas to put into action [21].

6. Case study: the Honey Bee Network (HBN), Ahmedabad

6.1. Operationalizing the resource mobilization theory (RMT)

Before we analyze the sole case study from the view point of the RMT perspective, as per the theoretical requirements of [21]; it becomes almost a necessity to explicate as to why this organization (case study) be treated as social movement organizations. Following are the reasons: (i) This organization has a set of specific goals to attain, (ii) It has its own strategies, tactics to mobilize resources be it material or immaterial, (iii) Leadership (both from inside as well as outside) played a major role in this organization, (iv) This organization also has a small memberships and full time staff intending to speak for cause without involving the group itself (meaning end users and/or innovators/entrepreneurs) and, (v) This sample organization also possesses sufficient resources to strengthen the movement and accomplish its goals. Further, the large number of AT organization operating in India (both in Government sector and voluntary sector, whether R&D or manufacturing, etc) do make a strong 'social movement sector', in the true sense of McCarthy and Zald (ibid). And the vast domain of assertive social movements of various kinds prevalent in contemporary Indian society like, the cooperative movement, SHG and micro-finance movement, Forest protection movement, etc make a perfect 'social movement industry' in the sense of McCarthy and Zald (Ibid). Thus a perfect 'social movement industry' subsumes a true 'social movement sector' which in turn is inclusive of several 'social movement organizations', e.g. AT organizations. And the resource mobilization theory for analytical purposes concentrates on Social movement organizations only.

6.1.1. Intellectual mobilization of resources: actors, conceptions and foundation of HBN

The importance of local traditional agricultural techniques, knowledge about medicinal and nutritional value of nearby plants etc. can hardly be neglected. The issue of how local knowledge and innovations can be documented and recognized is of immense importance under a globalized technology regime. How can those who seek to document local inventions ensure reciprocity between the innovators and those who may seek to use and perhaps even commercialize those documented inventions? What mechanisms would help an inventor to further develop, share or commercialize their inventions? How could this work be accomplished without undermining the communities from which the knowledge originates? With answers to such questions in mind, Prof. Anil K. Gupta, presently a faculty member at the Indian Institute of Management (IIM) Ahmedabad established Honey Bee Network (HBN) as an informal network in 1988–89 to address those very issues [11]. The HBN aimed to recognize and encourage the creative potentials of ordinary people and also to document the innovative ideas embedded in the folk/local traditions and traditional practices of communities.

6.1.1.1. Anil K Gupta's vision and establishment of HBN. In the year 1985, Anil Gupta was invited by the Research Council of Bangladesh to advice on how to help scientists work on the lands and fields of the poor people and how to develop research technologies which are based on marginality? While writing a paper in the context, he discovered tremendous creativity among the tenants and landless farmers of Bangladesh that he was completely overawed. He received messages of tens of thousands of people from the villages, who have solved problem by their own indigenous efforts without any outside input, a point that he had been raising from last 21 years. The point was that people may be economically poor, but they are not poor by their ideas. In other words, 'the minds on the margin are not the marginal minds'. That is the message with which he started 21 years ago. So, Anil Gupta & Colleagues started with a message: Minds of the margin are not the marginal minds; shall we join hands in learning from grassroots innovations. That is the message, where he got inspired to establish HBN. Along with Anil K Gupta, the other scholars who have made immense contribution toward the growth of HBN were: Prof. Vijay Sherry Chand (faculty member at IIM Ahmedabad), Jyoti Capoor (now Editorial Assistance: HBN Newsletter), Kirit K. Patel (now Associate Editor: HBN

Newsletter), Kapil Shah (Active member of Gujarat Network), Hema Patel (now in SRISTI, Gujarat), T.N. Prakash (now Regional collaborator: HBN, Karnataka), P. Vivekanandan (now Executive Director, SEVA & Coordinator, HBN), Riya Sinha (now National Coordinator: Scouting & Documentation, National Innovation Foundation: Ahmedabad), Prof. Rakesh Basant (faculty member IIM Ahmedabad), Amrutbhai Agrawal, Chiman Parmar, Shailesh Shukla, Sudhirender Sharma etc. Hence this group of intellectuals makes the 'Constituent Adherants' [21] of this SMO called the HBN.

6.1.2. Organizational resources of HBN

The principal organizational components of HBN include the National Innovation Foundation (NIF), the Grassroots Innovation and Augmentation Network (GIAN) and the Society for Research and Initiative for Sustainable Technologies and Institutions (SRISTI). But the network is inclusive of many of the branches of these organizations spread all over India.

6.1.2.1. Objectives of Honey Bee Network. The objectives of HBN were: (i) to locate/identify by scouting and registering grassroots level innovations; (ii) to protect the intellectual property rights of the grassroots innovators, and generate models for recognizing, and rewarding their technological creativities; (iii) to add value on the products for making better commodities; (iv) to explicate the insights learned from such traditional technological and institutional innovations developed by individuals as well as communities; (v) to help develop entrepreneurial abilities among those innovators to generate returns from this knowledge/innovations and to enrich these innovative people and their providers (scientists, engineers, leaders and administrators).

6.1.3. HBN and its internal linkages

A dream to encourage the creativity of grassroots is known as HBN. Gradually, HBN felt that an independent institutional structure is much needed which could help to sustain the Honey Bee Newsletter and its associated activities. On the day of 1st June, 1993, The Society for Research and Initiative for Sustainable Technologies and Institutions (SRISTI) an organization was formed as a supporting institute of HBN. Based at Ahmedabad, Gujarat, SRISTI is a registered charitable organization under Bombay Public Trust Act, 1950 and the organization was registered under Sec. 80 of Income Tax Act, 1961 and foreign contribution regulation act, 1976. It is a voluntary organization. Another organization named, Grassroots Innovation Augmentation Network (GIAN) was set up in 1997 to disseminate basically the mechanical innovations of HBN. The idea of GIAN was to link the three viz. innovations, investments and enterprises. And the National Innovation Foundation (NIF), another organization was formed in the year 2000, and was set up as a society by the DST (Govt. of India), as an outcome of the collection and documentation of work of the HBN in the last decade or so. It became the main institution of the HBN to maintain the national registrar of grassroots innovations. So, the main aim of NIF was to provide institutional platform to grassroots innovators from different parts of the country.

The IIM Ahmedabad has a major role to play in this as it provides institutional support to the network. It also provides editorial and logistical support to Honey Bee Newsletter which is one of the major activities of HBN. Regarding IIM's role, Anil K. Gupta says: *IIMA is playing a vital role for HBN. It has given me a place to do what I wanted to do. It has given me time, space, opportunities and social capital too. IIMA makes lot of things easier* (Personal Interview, 16th July, 2011).

6.1.3.1. HBN and its initial attempts. In order to expand the scope of local creativity and to accelerate the interaction of creative grassroots innovators with scientists, academics, policy makers and civil society, the network decided to publish Honey Bee Newsletter. It was published in English. HBN printed its first newsletter in May 1990, which had only 44 subscribers including scientists, public aid workers, financiers, farmers and craftsman. Anil Gupta along with his colleagues collected handful of information and presented those in the form of write-ups and articles in the newsletter. The second issue of the newsletter was published in 1991; it was published in English and Tamil. The work of those early years was encouraging for Honey Bee's core activities which included scouting, documenting grassroots innovations and traditional practices and sharing this knowledge in a larger scale among a wider audience. HBN is now spread in different states. It has published its reincarnated versions in regional languages (in collaboration with different magazines) like, in Kannad, Malyalam, Oriya, Tamil, as *Loksarvani* in Gujrati, and as '*Suj Buj Aas pass ki*' in Hindi. Chief functions of the Network institutions are to collect, edit, promote, reward and campaign for the new innovations as well for the old traditional wisdom [33]. HBN Newsletter is now sent to 75 countries around the world. The uniqueness behind Honey Bee philosophy is that 'they are trying to transform the resources through which poor people became rich. The resources are their knowledge, innovations and sustainable practices'.

During the last 21 years, since its foundation, HBN has documented 150,000 innovations and traditional knowledge based practices in areas like – energy, agriculture, transport, food processing, herbal drugs, human drugs, agricultural inputs, horticulture, and utilities. These innovations are either of contemporary origin or based on outstanding traditional knowledge/practices primarily from India and from other parts of the world. Many of these innovations are extremely simple and can improve efficacy of farm workers, small farmers, artisans and others to a great extent. A handful of inventions have resulted in patents. *We are building awareness on the potential value of indigenous innovations in India. The experience of HBN over the past decade and half has proved how critical it is to document the traditional knowledge as a first step towards realizing their values* (Personal Interview, Anil K Gupta, 11th July, 2011).

6.1.4. External linkages of HBN/collaborating institutions

The external linkages of HBN are very wide spread. Some of its collaborating institutions could be identified as

follows: Prithvi, SEVA Madurai, PEDES Kerala, Innovation Club Orissa, and the Network of Gram Veedya Piths like, at Sardar Krushinagar, Nootan Gram Vidyapith (Thava: Bharuch), Lok Bharati (Sanosara, Tal: Bhavnagar), J.C. Kumarappa Gram Vidyapith (Gadhada: Bhavnagar), Gram Vidyapith Shardagram (Junagadh district), Gram Bharti Gram Vidyapith (Amarapur, Tal: Mahesana), Mahila Gram Vidyapith (Nardipur: Mahesana), Shree Sarswati Gram Vidyapith (Samoda-Ganwada: Mahesana), Nootan Bharti (Madana-Gadh: Banaskantha), Sabar Gram Vidyapith (Sonasan: Sabarkantha), Lok Niketan Vidyapith (Ratanpur, Banaskantha), Gram Seva Mahavidhyala (Dumiyni: Rajkot) and the Gujarat Agricultural University. Mostly students from these Gram Vidyapiths help assist HBN in scouting and documenting the grassroots innovations. These could be treated as the 'Conscience Adherents' of HBN SMO.

7. Society for research initiatives for Sustainable Technologies and Institutions (SRISTI)

7.1. Origin and organizational resources of SRISTI

SRISTI grew out of the informal network (Honey Bee) of academics, farmers, scientists, and others who wanted to stem the erosion of traditional knowledge in India, and to document and share local innovations. As HBN sought to link formal with informal science and traditional knowledge, SRISTI was to carry forward this aim of HBN. Traditional knowledge has the potential to expand the frontiers of formal science, which could itself enhance or build upon local creativity. As the HBN grew, there was a need to – and thereby consolidate – its vision. SRISTI was established and registered as a formal organization in 1993. SRISTI is based at the IIM Ahmedabad, and this has helped to secure its reputation as a legitimate and leading NGO in the country. SRISTI is least structured as an organization. It does not have any hierarchy and neither has it maintained any division. It follows the philosophy of HBN. It is a voluntary organization. Anil K. Gupta is the Chairman of this organization and who is also the guiding force and the initiator of SRISTI's activities. Vijay Sherry Chand is the Vice-President. Ramesh Patel is the Secretary. SRISTI also has a governing body. Currently 20 employees are working at SRISTI, involved in different activities ranging from scouting, editing, publishing, and lab work etc.

7.2. Intellectual resources of SRISTI

The various activities of SRISTI include: (1) *Documentation, Dissemination of innovations and Networking with other grassroots organizations*; (a) In order to process the documentation, SRISTI takes the help of students (who do summer courses at IIM Ahmedabad) to identify innovators. In the next step, it takes the help of government officers/ *Gram sevaks*, etc in finding the innovators. Students who have contributed significantly in this regard are awarded by the network. (b) Survey through innovators: It also happens that innovators come forward to locate other innovators of the same kind. This process has been very rewarding in identifying innovations in farm implements and soils/water conservation. (c) Competitions for 'Innovation Scouts': Competition has also been organized in Gujarat and Rajasthan among students of agricultural colleges and grassroots level government functionaries to scout innovations. Workshops were first organized in order to provide some background about prior research and to illustrate many of the innovations that had been identified by village level workers. The entries sent by the participants were evaluated and the winners awarded the prizes. (d) Biodiversity contests for documenting innovations: Biodiversity contests also were organized among school children and adults in order to scout 'little geniuses' among children, and make them aware of their collective ecological knowledge systems. These contests also help them in accelerating the knowledge transfer from older generation to younger generation. (e) *Shodh Sankal:* SRISTI also provides scope for lateral learning among those who solve problems and not those who merely articulate the problem. In order to strengthen the lateral learning among the grassroots innovators SRISTI has initiated the concept of *Shodh Sankal* – a chain of experimenting farmers. Such meetings or *Kishan Gosti* encouraged the several farmers from the host villages to show their own innovations and took a major responsibility for networking and diffusion of ideas. (f) Agricultural fairs: Agricultural fairs are one such vibrant traditional institution in rural India where a large mass of people assemble either for religious or cultural celebrations or for exchanging agricultural information. *Loksarvani* is a magazine of SRISTI in Gujarati language for sharing information with the farmers.

(2) *The educational initiative*: SRISTI also has taken some initiative for educational development of the downtrodden section of society, through its programmes on educational rehabilitation, setting up village libraries, distributing books among villagers, etc.

(3) *Shodh Yatra, a study tour: Shodh Yatra* has been one of the major activities of SRISTI. *Shodh Yatra* means a journey of explorations. The idea is to walk for 8–10 days in extreme summer or winter to explore innovations and share its own database. The aim of *Shodh Yatra* is to meet the farmers, learn about their experimental techniques and note what is learnt from them. Next, the aim is to get children interested in creative farming techniques and to educate the farmers about HBN activities and objectives. *Shodh Yatra* has become a tradition of HBN. So far SRISTI has conducted 27 *Shodh Yatra* festivals in different parts of India in order to collect information regarding grassroots level innovators and innovations.

(4) *Sadbhav SRISTI Research Laboratory:* SRISTI has set up a R & D Laboratory in the year 2000, with the help of *Sadbhav* Foundation (Charitable Trust, Mumbai) to test all the information systems scientifically and bring traditional knowledge oriented products to the consumer market. Both have procured a fixed percentage of the royalty and the share of innovators upon the profit fetched by the use of their techniques. Laboratory works include: (a) preparation of herbal and animal medicines, (b) preparation of herbal solutions to the disease generating bacteria in the farm, and (c) study of micro bacteria of the soil. Profits on the products are shared with the innovators. Distribution of profits is fixed by the agreement among the innovator, scientists and the members of the Governing body of SRISTI.

(5) *SATVIK traditional food festival:* SRISTI organizes traditional festival in order to publicize innovator's idea at public. Every year, December 3rd and 4th, they organize the food festival. Traditional recipe is being placed at festival. Through this kind of food festivals, they sell the recipe. From Ahmedabad city itself, almost like 50,000 people gather every time. Till now six such festivals have been organized.

(6) *Honor of SRISTI/SRISTI Sanman:* A function to reward various artisans of different fields, traditional doctors, and or the persons having special or unique contribution in traditional art and knowledge is organized every year on the day of the yearly meeting of HBN and SRISTI. For SRISTI *Sanman*, i.e. Sristi award, the best researchers' innovations, experiments and new innovative ideas are selected from the entries received throughout the year. The public utilities of those innovations and their social contributions are also noted for the selection of the award. The innovations made by women are given special place in the quota of special series for the SRISTI award.

(7) *Compilation of the wisdom from century old mothers:* In order to make the youth aware and sentimental towards the importance of culture and wisdom, SRISTI initiated to reward centurion mothers, since 24, April, 2003. SRISTI has made survey of more than 200 such women.

(8)*Loksarvani:* A magazine named *Loksarvani* is devoted to the prevention and procurement of intellectual property rights by editing and compiling the experiments of any creative artists or farmers with organic farming systems. SRISTI through *Loksarvani* is trying to provide literature about less expensive and innovative techniques to the small and remote farmers at their homes with subscription fee of mere 100 rupees.

(9) *Tech Pedia:* SRISTI provides for a platform called Tech Pedia, where engineering college students from different parts of Gujarat, interact with HBN network. Whatever problem the network encountered, they put in Tech Pedia, for which, engineering students come forward to offer technical solutions.

(10) *Grassroots innovation as grassroots Technology/ appropriate technology:* SRISTI works on eco-friendly technologies. To SRISTI, technology is a broader term, not only a scientific way of producing things. It may be layman's invention to make a product whatever the tools he may use. That may be poor but useful. Technology does not only mean scientific product or process being followed for development. Some grassroots innovative practices can be converted into technologies too. If it could be commercialized, then, it is technology and if it is appropriate to particular circumstances, one can consider it as AT. SRISTI scouts, documents, registers and even helps in commercialization of such technologies by protecting the interest of the innovators (SRISTI unpublished source).

(11) *SRISTI commercialization of grassroots technologies:* SRISTI has also made some value additions in grassroots technologies. Those value added products are transferred to industries for their better publicity. SRISTI has successfully transferred 8 technologies. Five agro products have been transferred to Matrix Biosciences Pvt. Ltd, Hyderabad, two veterinary products also have been transferred to Matrix Biosciences Pvt. Ltd, Hyderabad and one Herbavate product has been transferred to Troikaa Pharmaceuticals Pvt Ltd., Ahmedabad. Technology transfer is done by keeping in mind the local and international policies [33].

8. Grassroots Innovations Augmentation Network (GIAN)

8.1. Origin and the organizational resources of GIAN

SRISTI's research and action programmes have triggered an institutional form of innovation. i.e. GIAN (Grassroots Innovations Augmentation Network). GIAN (Gujarat) was established at Ahmedabad and developed as an autonomous body. It was registered as a trust and society, supported by the Government of Gujarat, SRISTI and IIM Ahmedabad with a view to linking innovations, investment and enterprise. The need of a micro venture for promoting and financing the needs of grassroots green innovations was recognized during an International Conference on Creativity and Innovations at Grassroots (ICCIG), which was held at IIM Ahmedabad in the year 1997. Thereafter, it has been given the status of a Scientific and Industrial Research Organization (SIRO) by the DSIR, Government of India. It plays an active role within HBN by coordinating activities with NIF. GIAN has more than one campuses e.g, GIAN West/Gujarat and GIAN North/Jaipur.

8.2. Intellectual resources of GIAN

8.2.1. GIAN activities

The activities of GIAN are three fold. First, it helps the innovators in standardization and development of improved prototypes. Second, it protects the intellectual property rights of the innovators. Third, it extends business development support to the entrepreneur through venture finance, technology transfer and enterprise development.

8.2.2. GIAN and value addition

GIAN is busy doing value addition particularly in mechanical engineering technology. For this purpose, GIAN has acquired reputed technocrats and faculty members from engineering colleges as its advisors. At Ahmedabad, they have only the office. They do all their fabrication and prototype development outside their office. For that they involve local fabricators. Around Ahmedabad, there are industrial areas in Naroda, Chammur, etc, where they do fabrication and prototype development. Sometimes, value is also added by fabricator/third party designers/entrepreneurs/or by innovators. There are cases where innovator becomes the entrepreneur by himself.

8.2.3. Intellectual property right

GIAN extends its helping hand to protect the IP rights of individual innovators. It also helps in filling-in patent forms for those who are ignorant about the procedure. The Patent Assistance Cell at GIAN performs various activities like providing basic patent education to the innovators and general masses by disseminating information at various events and workshops. It also tries to understand the novelty in innovation by conducting prior art search. GIAN also acts as a bridge between innovators and entrepreneurs

by means of giving proper IPR protection with the help of patent attorneys and law firms like Anand & Anand, Surana & Surana, Y.J. Trivdei in India and International law firms such as K & IL Gates of Boston, etc outside India. So far GIAN has facilitated filing 30 patents in India out of which 15 patents have been awarded. Further, it has filed seven patents in USA out of which 4 patents have been awarded [10].

8.2.4. Technology transfer/technology commercialization

Out of these 150,000 traditional knowledge and practices documented, GIAN has selected 150 cases of innovation based on its demand for market. GIAN has actually worked or done with 50 technologies. There are 19 such cases, where GIAN has successfully transferred the technologies to outside entrepreneurs through legal agreements, where, the innovators will get the priority. GIAN has also accomplished successful cases of technology transfer, e.g. (1) technology for natural water cooler developed by innovator Arvindbhai Patel, (2) Technology for low cost wind mills (funded by Alstom Foundation, France), (3) Technology for Non stick Clay Tawa, Mitticool Refrigerator and Clay Cooker developed by Mansukhbhai Prajapati, (4) Technology of Cotton Stripper machine developed by Mansukhbhai Patel, (5) Technology of Bullet driven Santi developed by Mansukhbha Jagani, (6) Technology of scooter mounted floor mill developed by Sheikh Jahangir, etc.

8.2.5. New initiatives taken up by GIAN

Some of the new initiatives taken by GIAN includes: (1) Establishment of innovator based incubator with the financial support from NIF. GIAN extended support of Rs. 1,583,000/to six innovators of Gujarat under the program, (2) Tie up with Reuters for technology diffusion to farmers through mobile (SMS) phone. Each innovator received about 20 calls per day on an average, (3) GIAN West also carried out market research on some herbal formulations developed from the traditional knowledge of traditional healers viz. Herbaglow, Pain Relief, MosqHit, Herboheal and Zematic, (4) In order to provide market identity, GIAN has also developed brands for two innovative products and launched it in the SATVIK traditional food festival which is held end of every year, (5) GIAN also approached automobile manufactures Shri. Sunil Parekh, Shri. Rahul Bajaj, (Chairman, Bajaj Auto Ltd.) and Shri Sunil Munjal (Chairman, Hero Honda Ltd) to incite their interests in automobile technologies developed by grassroots innovators, (6) In case of innovative tractor operated cotton picker machine, GIAN has extended financial support to the innovator for value addition and prototype development through NIF. It has also filed patent application to protect the IPR of the innovators, (7) Looking at the potential of Gas Iron in Gujarat, GIAN West carried out Market research and organized a demonstration with the help of SEWA (Self Employed Women's Association) Ahmedabad, (8) GIAN West has extended its help in terms of value addition and patent protection support to the innovator of Jhulla operated washing machine and for further development and commercialization of the machine, (9) In case of Mobile Groundnut Thresher, GIAN West is helping the innovator in value addition by involving formal experts from IIT Kharagpur (W.B), (10) GIAN also established the Grassroots Innovations Design Studio (GRIDS) at National Institute of Design, Ahmedabad to provide world class design inputs to the grassroots innovators supported by Gujarat Government (Ibid)

8.2.6. Problems with commercialization

Some of the major problems faced by the HBN during commercialization of those traditional innovations are: (a) Locational disadvantage, (b) Formal promotional or advertising problems, (c) Questions on preliminary results of tests done by GIAN/NIF, (d) Presence of low cost substitutes or machines, (e) Delaying payment of license installments fees, (f) Difficulty in tracking the sales record, (g) Subsidy problems, (h) No follow up of innovations by entrepreneurs.

9. National Innovation Foundation (NIF)

NIF as an autonomous scientific society was set up in February 2000 with a corpus of US 5 million dollars by DST Govt. of India under the chairmanship of Dr RA Mashelkar, President, Global Research Alliance and former Director General, CSIR to fulfill the long felt need for recognizing, respecting and rewarding innovations and outstanding traditional knowledge systems/practices at the grassroots.

9.1. Organizational resources

NIF has 5 sections devoted to: (a) Scouting and Documentation, (b) Value addition and R & D (c) Business development and micro venture, (d) Intellectual property right management and, (e) Dissemination and information technology. Each section is guided by a national coordinator. Head of the institution is Chief Innovation Officer. Above all, there is a governing board. The chairman of the board is R.A. Mashelkar. Anil K. Gupta is the Executive Vice Chairperson. Below the National Coordinator, there are senior fellows, associate fellows, junior fellows and research associates placed at different levels. Full time staff at Ahmedabad (NIF) would be approximately 40. Their main strength is the voluntary network spread by the HBN which contributes the bulk of the entries received.

9.2. Intellectual resources

9.2.1. Models developed by NIF to extend its helping hand to grassroots innovators

(i) *Idea Licensing*: Idea Licensing is one of the models developed by NIF. In case of Food Sprayer, the product was conceptualized based on the idea of the innovator. GIAN and SRISTI licensed the technology to an international firm. Business model was International Technology Licensing, with only one time payment of licensing fee. The present status is that the firm is using the technology for manufacturing toys. And a patent is filed by the innovator in India and abroad by the firm.

(ii) Innovator needs support for proof of the concept: It does happen like innovation sometimes need support to prove the significance of the concept. In case of '*Aaruni*'

bullock cart, the idea was for developing multi-purpose, efficient and user friendly bullock cart. SRISTI scouted the innovation and provided initial support for developing proof of concept. GIAN provided further support for product development, IPR and commercialization. In terms of business model, the innovator turned into an entrepreneur and also licensed the technology to three other entrepreneurs in different regions. Final status now is that the innovator earned so far Rs. 1.5 million.

(iii) Innovator develops proof of concept, needs financial support for prototyping: In case of Pedal Operated washing machine, a school girl from Kerala got the idea of a Pedal operated washing machine. She explained her idea to a local mechanic and got it developed. After scouting, she shared her ideas with NIF about the areas where this machine needs improvement e.g. Tap arrangement, improvement in makeshift arrangement, material of construction etc. So, for this, NIF extended financial assistance for improving the prototype. In terms of its potential for commercialization in market, it is found that the product could solve both the purposes like washing machine and also as an exercising machine, but it is yet to be commercialized.

(iv) Innovator comes up with prototype and entrepreneur gets involved in developing a commercially viable product: In case of Auto Air Kick Pump, the idea was easy and unique solution to a commonly found problem: Punctured tyres on roads. The innovator came up with initial prototype. GIAN scouted an entrepreneur for him who helped him in developing a refined product. The technology acquired by the entrepreneur with an upfront payment had a royalty arrangement for next ten years. The present status is like more than 1000 units being sold in market. And its patent is also filed both in India and US.

(v) Innovator turns into an entrepreneur: It is also found that innovator becomes an entrepreneur with the help of HBN. In case of Cotton Stripper technology, the idea was, a machine removes cotton from the cotton shell in faster and efficient manner and reduces drudgery for women and child labor. SRISTI scouted the innovator and GIAN mobilized technical support for product development, IPR and commercialization. Business model was innovator turned into an entrepreneur. Status of the product is that 65 machines being sold in market worth Rs.20 million. A patent has been filed both in India & US. And it is the first Indian Grassroots Innovations which has been awarded a US patent.

(vi) Innovator develops technology, GIAN licenses entrepreneur: In case of Kushal Sprayer, a Hand operated hassle free sprayer, GIAN helped the innovator with the support of National Institute of Design (NID) that helped in product development, NIF helped in protecting IPR, and TIFAC helped in commercialization. The business model entails, GIAN facilitating in transfer of technology and existing manufacturing facilities to an entrepreneur. The final status is that the entrepreneur is about to launch the product in market after some design improvements.

In case of Auto Sprayer, the idea was like a dead weight propels the spraying function while walking. GIAN motivated an existing innovator to develop a unique sprayer which does not require any manual stroking. As a result of lateral learning, innovator came up with a concept which was refined at GRIDS-NID, subsequently; IIT engineering students worked with the innovator and developed a working model. Entire cost of development was supported by GIAN. The Battery operated sprayer develops as a fine quality mist but runs on battery. And the Hand driven sprayer, it does the spraying by manual pulling of the sprayer mounted on a pair of wheels. The business model involved in this category was the technology acquired by the entrepreneur. The final status is that entrepreneur is about to launch the product in market. And the patent is being filed in India.

(vii) Innovator develops prototype and commercializes through the SHG: In this case of Tile making machine, it was highly cost efficient and also easy to make machine for cement roof-tiles. It was scouted during Shodh Yatra in Uttarnchal, GIAN financed the second prototype development. The business model was, GIAN identified an NGO which agreed to adopt this technology to manufacture low cost cement tiles for small medium houses with the help of women SHG's. Apart from being a cheap and stronger solution to roofing in houses, the technology is also being used as an instrument to generate employment for women in the region. Final status is that the innovator is about to start training of women who are going to undertake this activity as an occupation. Its Patent is also filed in India.

(viii) Joint Venture: *innovator and entrepreneur:* The case of Power saving technical Pump is a highly efficient double cylinder reciprocating pumping technology that saves about 60% energy. IIT Kanpur tested and validated the data for the first prototype. The first prototype of the pump was developed by the innovator with the help of GIAN. Two entrepreneurs joined hand with him and started a JV firm with 33% equity holding of each partner. Besides, the innovator gets employment in the same firm and earns a good salary for his technical inputs. The business model was joint venture with two entrepreneurs. The final status is the firm refining the technology e.g. trying to make parts made of strong, heat resistant plastic with glass to improve the performance. And a patent is also filed in India.

(ix) Corporate house acquiring technology: In the case of Unique coupling device technology, the idea was to save upto 12–15 % energy losses in transmission. Lever principle applied in circumferential manner on two wheels of a coupler. IIT Guwahati validated the claims for the first prototype in pumps. GIAN North East (NE) scouted the innovator who developed this device for bicycle, cars and buses. With IIT Guwahati inputs, GIAN helped in refining the technology. Kirloskar Industries groups showed interest and invited GIAN team to demonstrate the technology. The business model was, on successful validation, the company would enter into an MOU for ToT with royalty arrangement. The final status is like, tests at the factory are on and efforts are being made to improve the performance of final applications.

In case of Bamboo fan, which is of double layer, multi-bladed design, throws high volume of air in the first plane of about 6 feet. In this case, GIAN NE scouted the innovator who was using the technology for paddy cleaning. GIAN NE and Jadavpur University tested the results. Presentation was made to Crompton Greaves Ltd (CGL) by

NIF team. CGL promised to acquire the technology after validation. The business model was that the technology took a lot of inputs from CGL, creating a possibility of joint patent of modified technology and design. The final status of it was that validation was due in September 2003.

(x) *Platform for technology with great promises*: In the case of bicycle with rider-induced and terrain-induced forces for transmission, GIAN NE scouted the innovator and supported the prototype development. The Innovator developed several prototypes and reached upto a stage of E-BIKE, which is battery driven and is highly energy efficient as it gets propelling energy from the rider-weight and terrain induced jerks. The business model was technology transfer and licensing. Such kind of device has various applications like in automobiles, two wheelers, cycle rickshaws (where it can reduce drudgery for the puller). And the final status was product development and business development in process.

9.2.1.1. Projects supported directly by NIF so far. Sakun has innovated a multi-cylinder reciprocating pump. A prototype of the pump has been developed with the help of IIT Delhi. R. Jayaseelan has developed a coconut dehusker, with Industrial Design Centre, IIT Bombay. Tamarind Cultivation and processing techniques of A.I. Nadakattin has been developed through the linkage of IIT Delhi. All the above innovations have been supported by NIF for prototype development or familiar purposes. Mr. C.V. Pathak's pedal bore and other innovations have been supported by NIF for prototype development. A prototype has been developed and tested by the innovator. A windmill developed by Mr. N.V. Satyanarayan has been given product development support. The Innovator will be provided with further support after NIF receives a report of detailed work done by him. SEVA, Madurai along with NIF has supported several innovations in various ways. Such was the case of Sugarcane Off bearer cum Trash mulcher. Innovations in Power Tiller by the innovator Mr. Ansari, Tilting Bullock Cart by Mr. Amruthbhai Agrawal, Coconut Harvesting Machine by Mr. P. Karuppiah, and Improved Air-Energized Stove by Shri. Bharatbhai Agrawal, etc are glaring cases of innovations supported by NIF for conversion into sustainable technologies [24].

IGNITE Award: In 2007, they had started a campaign for Children's innovations, called IGNITE, for which NIF arrange award giving ceremony on each year October 15, the birthday of India's former President Dr. Abdul P.J. Kalam.

9.3. The mode of dissemination at NIF

The ways of technology dissemination includes, (i) presenting paper by the organizations at various National and International Seminars to promote advocacy for the usage of these sustainable and low cost technologies often based on traditional knowledge. (ii) Widespread decentralized demonstrations of technologies and large scale onfirm trials of promising agriculture related innovations are another model of diffusion. (iii) Various road shows to showcase promising technologies and to get feedback of potential users/customers is also a viable mode of diffusion. This feedback is used for identifying and improving features to find the best user fit for the technologies. Food and herbal festival programme is arranged by SRISTI regularly to create awareness among people. (iv) Diffusion also takes place through women Self Help Groups (SHGs) in active collaboration with HBN partners' viz. SEVA: Madurai, PDS: Kerala, CCD: Tamil Nadu, Sristi Kendra: Orissa, Prithvi: Karnataka etc. and through other diffusion clubs. (v) A subsidy scheme for percolation of technologies to marginal users, who could not otherwise afford the technology, but who can really benefit by usage of the technologies, is yet another mode of diffusion (NIF: web sources) [26].

One of the other ways of disseminating those grassroots innovations is through electronics Media Interaction. Activities of NIF received a big boost through the internet use and transmission through premier National and International Television Channels. In the year 2006, Discovery Channel-India profiled a few innovations of NIF for its television programme 'Beyond Tomorrow'. NDTV India ran a regular series 'India Innovates' in English and 'Aavishkar India' in Hindi profiling innovators across the country for one year. In 2006, *Eenadu* newspaper, a premier daily published from Hyderabad carried an article every week on grassroots innovations, which got tremendous response. Outlook India, a leading weekly published an article on innovators. BBC London covered NIF & 2006 *Shodh Yatra* in Northern India. Some of the other Indian TV channels which showed an interest in grassroots innovations include *Aaj Tak*, CNN IBN etc. Major newspapers like The Hindu, The Deccan Chronicle, The Times of India, The Statesman, The Telegraph, Wall Street Journal, The Daily Mail, and Magazine like *Yojana* also carried out stories about grassroots innovators of NIF. Another major mode of diffusion of those innovations is through a medium like 'All India Radio', which has got the widest coverage even in the remotest part of the country.

9.3.1. Grassroots to global (g 2G)

Global GIAN means Building Global Value Chain for an augmentation of Green Grassroots Innovations. GIAN innovation value chain has reached out to China, Brazil and many more countries. Collaboration steered by SRISTI takes it from grassroots to global.

9.3.2. Technologies sold by HBN abroad

(1) Coconut tree climber to USA (Florida, Massachussets, Carlifornia, Hawai etc), Australia, Maldives, Srilanka, Brazil, Mexico, West Indies etc), (2) Pomegranate deseeded to Turkey, USA, (3) Garlic Peeling machine to Pakistan, (4) Arecanut husker to Singapore, (5) Milking Machine to Philippines, Uganda and Ethiopia, (6) Resin grading machine to Peru, (7) Cassava Peeling machine to Kenya, and (8) Herbal growth promoters to Ghana. Following are the patent details of NIF (Table 1: Patents filed in India and Table 2: Patents filed in USA) [25]:

10. Conclusion

The principal outcome of the discourse on movement and the subsequent empirical exercise is that the AT movement in India has shown a shifting trend. It has transformed itself slowly into an alternate/sustainable

Table 1
Patents filed in India.

Innovation catalog	Nos. of patents
Agricultural-plant variety	02
Agricultural machinery and farm implements	27
Agro based food processing machinery	30
AC/ventilation machinery & equipment	06
Auto components, accessories and garage equipment	29
Construction & building equipment	07
Consumer durables	26
Diary machinery	03
Earth moving and excavator machine	02
General purpose machinery & equipment	29
Electronic gadgets	06
Energy conservation and generation technology	21
Environment management technology	09
Transport	07
Traditional knowledge	10
Herbal formulation	159
Mixed return (social and commercial) technology	17
Sanitation	03
Any other	08
Open source technology: no license fee required	04
Sub total	**405**

technology movement as evident from the growing innovation developments at HBN. Many of these innovations have been converted into commercialized technologies and some have been patented. These are indigenous technologies which are people centric and often tradition based. The first votary of these forms of technologies, Anil K Gupta claims these as sustainable technologies and decries the notion of AT, as to him, it has colonial implications. The notion of AT of course has become obsolete in the context of developing countries, because; (i) the neo-liberalism driven globalization of the less developed countries has rendered the Schumacherian notion of intermediate technology and the Nehruvian notion of self-reliance in S&T greatly irrelevant, (ii) the issue of appropriateness of imported technologies is no longer considered important as today the main emphasis is on technological efficiency and environmental friendly nature of technologies, (iii) with the growing maturity of industrialization in developing countries, labor intensiveness, adaptation to local conditions, etc are no more important considerations, what matters is quality of the finished products and (iv) all the industrial technologies of the world today are global.

Table 2
Lists of Patents filed by NIF and GIAN in the USA.

Innovation catalog	No. of patents filed
Electronic gadgets	01
Agriculture machinery & farm implement	02
Auto components, accessories & garage equipments	01
Agro based food processing machinery	01
Transport	01
Energy conservation and generation know how	01
Herbal formulation	01
Consumer durable	01
Sub total	**09**

The economic globalization of the world has linked most of the developing economies and even former socialistic economies to western capitalistic economies but in a different footing. Limited competition between these two types economies has been possible because of 'glocalization' process by which some typical (exotic) products and processes from the developing economies have been globalized. Some of the developing economies particularly of the BRICS countries continue to experience high growth rate in spite of western recession. Growth of Chinese technologies continues to defy western logic. Thus the well known technological dependence theory of [34]; that puts the perspective of technological growth and transfer in the developing economies within the dependence perspective of Neo Marxists, has become obsolete. Ref. [37] 'semi-periphery' economies have grown in number and size. And hence it is no more construed that the technologies transferred from the western capitalistic economies to the developing ones are necessarily inappropriate. World over the essence of the technological growth is market and competition and even agricultural subsidies are frowned upon. And dependence has grown on both kinds of economies. Hence the concept of appropriate industrial technology in the earlier sense is now a misnomer. Even the digitalization of technologies which is enabled today to work in hot, humid and rugged climates has contributed to this disappearing concerns over appropriateness. The notion of appropriateness today do not persists even in the context of small scale, agricultural and rural technologies. With the recognition of indigenous alternative sources that are popular and culturally embedded (those other than from laboratories) in the context of small scale, agricultural and rural technologies the issue of sustainability (in terms of resource utilization), environment friendliness, and cost effectiveness have taken over the issue of appropriateness. Of course these indicators do meet the requirements of appropriateness too. But energy and environment are today two universal concerns.

Thus as evident from the empirical explorations of the HBN, there seems to be a shift in the search and focus of research from appropriateness to sustainability of the technologies. It must not be construed as a paradigm shift in the movement but certainly a drift on the locus of the movement that has shifted away. This is a definite turn in the movement that has of course renewed itself with an emphatic drift. The last issue emergent of this concluding observation pertains to this new notion of sustainable technologies. What makes these technologies essentially sustainable is their participatory and embedded character. And this also makes the people's use of these technologies easier as these are non-alienating technologies. In this context non-alienating means not imported but home grown. Being rooted in the people, in the culture and traditions, these technologies are more viable and tenable. This certainly is an indicator of self-reliance in technology which further ensures sustainability. The major source of sustainability of these technologies is of course i.e, their being embedded in the culture and tradition.

As the case of HBN, the model of technology development is from People (via Laboratory) to People and accordingly HBN documents that these innovations emerge

from the people directly and often from the daily lives and culture embedded practices of people. The most profound bases of sustainability of the HBN technologies have been their socially and culturally embedded character. Most of these grassroots innovations are painstakingly collected through annual *Sodh Yatras, Sodh Sankal* (Lateral learning), *Kishan Gosti*, etc where HBN ideologues and activists reach the rural folks and do scouting on farmers, rural craftsmen, medicine men, etc for innovative knowledge often based on their traditional knowledge systems, traditional practices and even some imaginative popular innovations. Most of these innovations are deeply culturally rooted and hence not do not lead to alienating technologies.

As indicated earlier, the other major source of sustainability is the participatory character of HBN technologies. The evidences in favor of their being participatory are not far fetched. In this model at field level there is a great need of training and extensive use of extension works for the introduction of these technologies in rural areas. And these training and extension works cannot be carried forward without involving the local voluntary organizations/NGOs who are in touch with the target population and reflect their interests. This certainly is an evidence of their being participatory. The other evidence of HBN being participatory is the involvement of academicians, students, NGOs, and innovators in HBN activities as 'conscience constituents' and 'conscience adherents'. NGOs are of course involved in a participatory manner in the training and extension work for HBN technologies as well as in scouting the grassroots innovations. Further bases of sustainability of this model refers to the involvement of innovators and their licensees in the process of technology dissemination. Even in formal ways HBN involves the innovators in patenting, commercializing and in cases of transferring technologies to entrepreneurs. There was a case of commercialization of the HBN technology where the innovator was not only made a share holder but also an employee of the company to contribute technically to the operations and subsequent up-gradation of the technology. The involvement of students from rural universities (*Gramin Vidyapeeths*) in scouting and documenting the grassroots innovations on a continued basis for HBN and the further involvement of students of various engineering colleges of Gujarat to offer solutions to the technical problems encountered by HBN through the scheme of Tech-Pedia are also other bases of sustainability of HBN technologies.

The other but fundamental basis of the sustainability of HBN technology is its very organizational base. It is needless to reiterate that HBN is a network of three organizations that are playing mutually reciprocating roles. SRISTI is mainly devoted to scouting and verification of the reported grassroots innovations whereby it links the informal science with the formal science. Then GIAN is to augment investment on forging a strong link between innovations and enterprises. That apart it is engaged in incubation, IPR protection and market research for SRISTI's guided innovations. Similarly NIF is exclusively engaged in registration and documentation of innovations scouted by SRISTI and it also helps in value addition of some reported grassroots technologies and their disseminations. This network of mutually reinforcing three organizations make a novel and ideal model for transforming grassroots innovations to sustainable technologies, as this facilitates interaction of the innovators with the entrepreneurs and even at times transforms the innovator into an entrepreneur whereby the uninterrupted to flow of technical knowledge is ensured. Thus the HBN model of technology development is not only a model with nuance but also it produces technologies with nuances as these are rendered sustainable.

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