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Appropriate Technology Movement in India: An Emphatic Drift

This paper offers a comprehensive understanding of the concept of Appropriate Technology (AT) and brings out its relevance today both from the standpoints of developing and developed countries. The paper also focuses on the evolution of AT movement in India and ideological contributions by various thinkers like M. K. Gandhi, E. F. Schumacher, and others to this movement. It also stresses that AT movement as a discursive one is not about mobilizing activities and people but is about academic discourses on AT. Lastly the paper presents three empirical case studies of AT promoting organizations emergent of the said movement that represent the original discourse and the later turning points of the discourse in the AT movement in India. Noteworthy, that these three case studies are analyzed from the vantage of the well known resource mobilization theory of social movements.

Keywords: Appropriate technology, Discursive movement, Resource mobilization theory, Sustainable technologies, Intellectual mobilizations, Institutionalization.

Introduction

Arrival of 20th century sounded a 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 labour intensive technologies and use of steam engines causing environmental and pollutions 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 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 to developed technologies by the developing countries and the built in depenedencies there as well as growing unemployment and income disparities in developing countries lead 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.

Objectives of the Paper

The objectives of this paper are: First, to understand the conceptual framework, debates on AT both from the standpoint of developing and developed countries; Second, to study the intellectual heritage and historical antecedents of the AT movement in India; Third, to study empirically the functioning of AT organizations, i. e. case studies of three Appropriate Technology (AT) Centre's, e. g. Appropriate Technology Development Association (ATDA): Lucknow, Application of Science and Technology to Rural Areas (ASTRA) later turned into Centre for Sustainable Technologies (CST): at the Indian Institute of Science (IISc) Bangalore and the Honey Bee Network (HBN): Ahmedabad and to articulate their contributions to enrich the movement, if any and; Fourth, to portray the trajectory of the AT movement in India through its varying thrusts and traits at different points of time.

Methodology: The study is based on both (empirical) primary and secondary data. Apart from empirically studying the three AT organizations, the relevant information regarding the functioning of these organizations was collected through interviews among a few of their personnel. And secondary data were collected from various sources like their, annual reports, documents, and publications. From sampling view points, if ATDA is an older organization started by a Gandhian like M. M. Hoda to pursue ATs, the ASTRA cell is an example of a research organization started by a citizen scientist like A. K. N. Reddy who was inspired by the ideas of M. K. Gandhi and E. F. Schumacher to develop AT, but its thrusts have changed over decades towards the notion of sustainable technologies. Lastly, HBN 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.

Appropriate Technology (AT): A Concept

AT is a concept that denotes a set of ideas or a frame-work 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 and 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 (Tandon, 1974: 75). 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 (Long, 1980: 38). AT is a line of thought and action which 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 its capital intensive character (Bertha, 1979: 1). 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 labour 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, environmentally sound, 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, windmills, recycling of waste to produce methane and compost, composting toilets, urban greenhouses and rooftop hydroponics' gardens etc (Holden, 1977: 857–859).

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 environmental soundness, labour 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.

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 numbers 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 of appropriate/ alternative technologies.

Appropriate technology for Developing countries: The major problem developing countries face even today is 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 '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. However, the indicators of AT in the context of developing countries continues to be its labour intensive character, suitability to local climate, dependence on local raw materials, self- reliance in matters of spare parts, technical services, R&D, etc and cultural relevance (embeddedness). Added to these are the indicators like, eco-friendliness and energy efficiency of the technology.

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; it is a 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) (Lewis, 1983: 2–3). Nevertheless, the two major concerns of AT in the developed countries are its eco-friendly and energy efficient character.

Exiting Literature on Appropriate Technology in Developed and Developing Countries:

Many groups and scholars in the last three decades have been critical of the modern technology, and have advocated changes in 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, energy and resource problems of developed nations.

Developing Countries: In developing countries, a few decades ago, there was a debate on the issue of AT. The kind of technology which Schumacher (1973: 153–156) 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, as cited in Hollick, 1982: 214) 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, as cited in Hollick: 214) 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: as cited in Hollick: 215), the 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.

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: Harper (1976), Clarke (1972), Lovins (1977), Rybczynski (1980) McRobie (1981), and Illich (1973).

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 lifestyle 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. Clarke (1972) 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 labour intensive, produces in small-scale, 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 Lovins (1977), '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 the absolute nonviolent technology may not be achievable. Technologies do differ on their degree of disruptive effects. As McRobie (1981) 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 Illich (1973) 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.

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 hope 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 (Willoughby, 1990: 6–9).

The 'AT' movement, while failing in some respects, has opened pathways for helping individuals to 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 (Smith, 2007: 3).

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. The interest in AT was spreading to other aid-giving countries. 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 (Jequier, 1976: 135–155).

The Early Ideological Mobilizations for Appropriate technology movement in India

(a) 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 technologies and to give them a new dignity. In fact Charkha and village industries were the means to realise the Gandhian Swaraj. Gandhi had appointed 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.

(b) Low-cost technology as a Post-modern technology: The meaning of intermediate or appropriate technology had been aptly summarized by M. K. Gandhi. Soon after independence of India, Prime Minister Nehru went to the small East Bengal village in the Noakhali District where M. K. Gandhi was trying to bring about communal harmony. Nehru went there to seek his advice and guidance on how to run the administration and the government. 'Just keep one small thing in mind', said Gandhi, 'when you are taking any action or making any decision, try to judge how this action or decision is going to affect the poorest of the people in the country'. In this context, Intermediate or appropriate technology could be the solution, which can serve the poorest of the people and its impact on the masses should determine the appropriateness of technology. For developing countries, in many cases it provides work and also dignity to work. One of the lowest untouchable castes in India was the 'Chamars' who were traditionally scavengers. 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. 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. Similarly in every field, some simple technology should be provided to the poorest men of the developing countries. Intermediate technology represents a sort of converging point for rich and poor countries and also for a life of quality, 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 (Jequier, 1976: 146–147).

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. Today it has 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 Congres government in 1970s (Krishnaswamy and Reddy, 2006: 118). However people like Jammlal Bajaj, Maganlal Gandhi, M. M. Hoda, Vinoba Bhave and Sarvodaya workers followed Gandhi's approach and contributed significantly for the AT development in India.

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-minded 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 labour-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 (Jequier, 1976: 146).

(c) *J C Kumarappa and AT development:* The other influential protagonist of AT in India was J C 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.*

Appropriate technology: Beyond Gandhi and Schumacher: Many scholarly writings on AT came after Gandhi and Schumacher and notable among those were the following: Russel (1952), Jequier (1976), Meadows et al (1972), Willoughby (1990), Kunwar (1991), Vittachi (1993), Jamison (1994), etc. Russel (1952: 11–16) noted that science and technology had made tremendous impact in modern society. The most obvious and inescapable effect of scientific technique is that it makes society more organic, in sense of increasing the interdependence of its varied parts. Technology and science definitely have a role to play in shaping up a society and by integrating modern technology in traditional systems, in certain cases at least, can radically change the resource use efficiency and minimize the ecological impacts. Jequier (1976: 31–32) noted that *swadeshi* movement lead by Gandhi and the revolution lead by Mao in China to 'walk by their own leg' 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 (software) etc. Diwan and Dennis (1979: 93–95) 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. Kunwar (1991), Meadows (1972), Vittachi (1993) and Jamison (1994) have also discussed on the Issue of AT movement. Kunwar (1991) 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. But AT is area specific and there cannot be an AT relevant for all countries or regions. Long (1980: 38) evaluated that AT was a movement to develop new tools and techniques and technologies suitable to the needs of the poor people (Olson, Franklin, 1980). Meadows et al (1972) 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 has accelerated the pace of thinking on AT.

According to Willoughby (1990: 6–9) AT has evoked mixed responses among different sections of scholars. He said that according to the majority of scholars AT designated the 'hardware'-solar collector, the oxharness, the windmill etc; where as 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, Vittachi (1993) 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.

Jamison (1994) argued that search for an alternative for western science and technology was common for all third world countries that were under foreign domination. Common feature of such a search was their indigenous tradition. 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.

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 the 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 (1951–1956) 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, by 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 long as 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 through 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 (Bhatt, 1980: 151–175). 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 (*Planning Commission of India document, 1970*).

Further with a view to providing policy backing for the growth of indigenous technology in India, a Technology Policy Statement (TPS) 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 focused 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 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 technologies.

And in, Govt. of India's Science and Technology Policy Statement (2003), the basic strategy was development of indigenous resources and traditional knowledge systems. Indigenous knowledge was enhanced for the purpose of wealth and employment generation. Innovative system to document, protest, 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. IIT Bombay and IISc. Bangalore were the first to initiate work in technologies applicable to rural areas. These institutes engaged in activities of design and development of 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 in the Indian Institute of Science (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 (more later as a case study). And further, Centre for Technology Alternatives for Rural Areas (CTARA) was initiated by Anil Date at Indian Institute of Technology (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. 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. Reflecting the same 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.

Khadi and Village Industries Commission (KVIC), a largest government sponsored organization was set up 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 in 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, and carpentry and blacksmith etc.

Appropriate Technology Development Unit (ATDU) at Varanasi was established way back 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, I. I. Ts 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 (ATDA Progress Report, 1977-1979-3). 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 (More later as a case study).

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 analysis 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 nationlist 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. M S 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 1988–1989. It is the biggest network of grassroots level creative and experimenting farmers and artisans in the world (more, later on the case study section).

Some of the other AT promoting organizations which have come into existence as offshoot 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 these days because of the preponderance of neo-liberal thoughts.

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 (McCarthy, Zald, 1977: 1212–1238; Tilly, 1978). 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 Buechler, 1993: 218). 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 in the individual. It does not centre around the question of why individuals join social movements, the rationality or irrationality of their intentions or behavior as participants, but 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 (McCarthy & Zald, 1977: 1212–1238).

Empirical Studies in AT

In India, some noteworthy efforts have been made to study the organizations involved in AT activities. Reddy (1979: 116–129) had made a study of AT groups spread in Asia, Africa and Latin America, through a detailed questionnaire, sent to 180 groups out of which only 75 responded. The major finding of the study was that, most of the groups had great deal of active interest in the concept. There was a vast difference between voluntary organizations on the one hand and the established institutions of education, as well as institutions of science and technology research on the other with regard to incentives for work on AT. Only about half of the groups and institutions have direct contact with the main target groups noted Reddy. Date (1981: 15–67) had examined the functioning

of about 27 voluntary groups involved in the field of appropriate technology in India. The objective was to locate the organization's role in transfer of technology to the rural areas. He had concluded that, those organizations were involved in one or other activities especially providing raw material, credits, and management to the rural poor and some were engaged in organizing people and bringing about their material development.

Ton de Wilde (1977: 160–177) had studied three research institutions named International Rice Research Institute (Philippines), Brace Research Institute (Canada) and Technology Consultancy Centre (Ghana). The aim was to understand the way technology was employed in the industrialized societies. Moulik and Purushotham (1986: 233–269) attempted to provide a comprehensive and analytical account of the technology transfer process in the Indian decentralized rural industry sector and further provided detailed case studies of a number of village enterprises and national R&D organizations in rural life situations. 20 such cases have been studied. Some of the states which were under consideration include Gujarat, Bihar, U. P., Tamil Nadu, Karnataka etc. Those R&D organizations studied were found to be poorly staffed and lacking motivation, running short of innovative approach in the identification of target beneficiaries. Askin (1976: 14–31) has conducted case studies at Philippines, Indonesia and Srilanka. The aim was to locate the less developed countries attitudes towards AT. The study reveals the fact that there is a very narrow base of AT research in the developing countries. And further those centers are understaffed and under-funded. There is lack of coordination in policy formulation and also decline in the center.

Further, in a study being conducted by Jequier and Blanc (1983: 9–17), a careful statistical analysis is being made on AT movement, which was published under the title, 'Appropriate Technology Directory'. There-in they gave an account of 277 organizations, which were working in the field of AT throughout world, particularly involved in one way or other in the development and promotion of ATs. Goodman (1976: 1–6) discussed the issue of intermediate technology and AT for less industrialized countries to make some recommendations. The study found that there existed indeed a relatively large number of R&D activities covering a wide cross section of ATs in many Asian countries. One of the major problems was lack of coordinated efforts to maximize available resources.

Pursell (1993: 629–637) noted the rise and fall of AT movement in the Unites States (1965–1985). His findings indicate that, there was 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 Smith (2005: 106–118) 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.

Operationalizing the Resource Mobilization Theory (RMT)

Before we analyze the five case studies from the view point of the RMT perspective, as per the theoretical requirements of McCarthy and Zald's (1977: 1212–1241), it becomes almost a necessity to explicate as to why these AT organizations (case studies) be treated as social movement organizations, Following are the reasons: (i) All these AT organizations have a set of specific goals to attain, (ii) All these AT organizations have their 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 all these AT organizations, (iv) All these AT organizations also have 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) All the sample organizations also possess sufficient resources to strengthen the movement and accomplish their 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. But it is need less to emphasize that the resource mobilization theory for analytical purposes concentrates on Social movement organizations only.

Case Study. 1:
Appropriate Technology Development Association (ATDA), Lucknow

1. Mobilization of intellectual Resources: Actors, Conception and Evolution of ATDA

India has one of the oldest traditions in rural industry. These industries based on economically viable craft based technologies like weaver's loom, potters' wheel; oilman's kolhoo (crusher), etc were the backbone of rural economy from times immemorial. They suffered a serious setback due to the introduction of large-scale modern technologies after the industrial revolution. No systematic work was done to improve the technologies of the rural areas in their own setting. M. K. Gandhi tried, in his own way, to revive and put a new life into them. It is only due to his sustained efforts and directions he gave to rural industry that made to improve the rural technology and enabled it to survive even now.

After the independence, Khadi and Village Industries Commission (KVIC) did a yeoman's service to rural technology and industrialization even though their efforts were more concentrated on Khadi (homespun textile). Other government institutions, research laboratories and voluntary agencies carried out research and experiment for impoving the methods, techniques and processes of small-scale manufacturing for rural as well as urban areas. The Planning Research & Action Division of U. P. State Planning Institute, Lucknow, was specially set up to give a new dimension to action-research on rural technology and it did a commendable service in this field. During first two decades, the research laboratories of CSIR, Government of India, have also laid considerable stress on the development of AT for generating employment in the rural areas and for increasing the income level of the rural populations (Hoda, 1977: i).

In this background, The Appropriate Technology Development Unit (ATDU) was set up at the Gandhian Institute of Studies, Varanasi in November 1972 as a result of decision taken by Shri Jayaprakash Narayan, Dr. E. F. Shcumacher. Shri M. M. Hoda then Project Officer of the Intermediate Technology Development Group, London, became the Head of this Unit which functioned upto 1976. Later, with the approval of late Dr. E. F. Schumacher and Shri Jayaprakash Narayan, this ATDU was recognized as Appropriate Technology Development Association (ATDA), registered under the societies Registration act, 1860 and started functioning from 10th August 1976 with its headquarters at Gandhi Bhawan, Lucknow, India (Hoda, 1979). Therefore, Jayprakash Narayan, E. F. Schumacher and M. M. Hoda truly are the 'Conscience Constituents' (McCarthy and Zald, 1977) of this SMO.

Shri Jayaprakash Narayan the noted nationalist and Sarvoday leader was the motivating force behind ATDA who had visualized a 'samagra Bikash' through AT. Because, developmental imbalances have created disparity between rural and urban folks in terms of employment and it had accelerated the rural urban migration. If the basic needs of life like, employment, shelter, sanitation, electricity etc are met with at village level then migration can be reduced. So, this organization aimed at basic needs of the rural poor and to improve their conditions of living, and its research was basically directed in that direction. And in this backdrop, a group of philanthropic people led by Mr. M. M. Hoda, Mr. T. N. Bajpai, Mr. K. M. Bajpai, Mr. Shiv Gopal Mishra, Mr. M. S. Hoda, Mr. K. M. Tiwari, Padma Shri A. K. Karan, Mr. V. S. Mathur and other likeminded people who were motivated to bring a change in the field of rural development to check migration to urban areas created this organization called ATDA. Thus this group of AT activists make the true 'Conscience Adherants' (McCarthy and Zald, 1977) of this SMO called ATDA.

The organization was set up with the spirit of an autonomous independent centre. Four people were employed during initial stage and almost like 300 people were employed at peak period (1993-1994). ATDA is not a purely research organization doing work in laboratory or at the headquarters, but it specializes in action research on the field level by establishing pilot projects. For this purpose, there was a core group of technologists at the headquarters and another at each project level. Each project had got its own technical and managerial staff. Besides this, they had technical collaborations with a number of foreign organizations which provided technical expertise by sending their technologists to ATDA.

They did have collaborations with the Government of India and sometimes drew on their technologists as well, in spite of the fact that some retired technologists worked on voluntary or part-time basis. They had also collaboration with other development organizations in India.

2. Organizational Resources: Objectives of ATDA

The objective of the organization was to create technological infrastructure for generation of employment and work places in rural areas with low capital investment and high labour usage. The idea was to create jobs where most people live, i. e. rural areas and not in urban areas where they tend to migrate. It was considered that this objective can be achieved by developing new processes and new products in rural industries and facilitate rural industrialization. This envisaged utilization of local skills and resources by promoting employment-generating technologies and by harnessing decentralized and renewable sources of energy and improving habitat, human settlements in the rural areas for improving quality of life. The AT movement in India believed in M. K. Gandhi's maxim of 'production by masses' instead of 'mass production'. The ATDA followed the Gandhian Principles and ideology (Hoda, 1979: iii).

Membership of ATDA: The Association, according to its constitution, consists of various classes of members, namely, Founder Members, Life Members, Ordinary Members and Institutional Members who also constitute its General Body. And any individual, institution, organization or government department, interested in the programme of Association can become its member by paying requisite fees. The General Body was to meet annually and elects the members of the Executive committee and office bearers. The executive committee was to meet quarterly. For day-to-day work, an Administrative and a Finance sub-committee had been constituted. In addition to that, a Technical sub-committee, a Publications sub-committee and a Policy-making sub-committee were also constituted to meet as and when required (ATDA Progress Report, 1981–1983: 3–4).

Activities of ATDA: Main activities of ATDA were to carry out R&D for AT development with a view to enhancing productivity of the rural poor. The domain of ATDA's R&D included areas like, non-conventional energy, cement technology and sugar cane. Its R&D works were published widely and circulated. In terms of regular publications, they did publish 'AP-Tech Newsletter'. It was in two languages. One was in English and other was in Hindi. The purpose was to update and inform rural masses about development of recent or latest technologies in the field of AT. Other occasional publications were about Solar Cooker, Cement and the like. It used to inform people about development through the use of AT. For imparting Education and training of personnel ATDA used to send staff to various training institutions of India and abroad. ATDA staff used to visit Singapore for imparting extension and training programme pertaining to ATDA technology. For Technology diffusion, ATDA staff used to give training to electricians in India.

ATDA Lucknow is also a consultancy organization to provide information to the grassroot level voluntary workers mostly with respect to AT and allied subjects. The technologies developed by ATDA includes solar cookers, fixed bio-gas plants, 12 spindle cotton spinning charkha, wool spinning Bageshwari Charkha and processing machine for cotton and wool have been taken up by a large number of voluntary agencies all over India and abroad for raising the income of the rural artisans and also providing employment to the rural unemployed.

Programmes: ATDA planned to achieve its objectives in the following systematized manner by:

• Up-grading basic village technologies like pottery, oil extraction, black smithy, carpentry, weaving, yarn spinning, food processing, tanning of hides and skins and leather work.

• De-scaling large-scale manufacturing processes for important consumers item like sugar, cement, paper and cotton spinning to create new employment opportunities in the rural areas.

• Improving physical amenities in the villages and other habitat and human settlements for better quality of life in rural areas like building material, smokeless mud stoves, solar cookers, rural sanitation, water supply, education etc.

• Harnessing renewable and unconventional sources of energy to provide for power to industries and other works, improving rural transport, making it pollution free and making it cheaper.

• Training for rural health management and making of a delivery system for rural areas.

3. Financial Resources: Funding Agencies

The funding sources for ATDA Lucknow had been the various Governments (central as well as state of U P) departments and agencies. Since the government has also set up a number of departments, councils, action groups for assessing the need of various voluntary organizations these have funded research as well as implementation and dissemination programmes

of ATDA. The more important among such organizations are the Council for Advancement of People's Action and Rural Technology 'CAPART', Department of Science and Technology New Delhi, the Department of Non-conventional Energy Sources (DNES), National wasteland board, Ministry of Human Resource Development (MHRD), Ministry of Environment and Forest (MOEF) all under the central govt. In addition, funds were also provided at local level through Integrated Rural Development Programme (IRDP), Development of Women and Children in Rural Areas (DWCRA), Training of Rural Youth for Self- Employment (TRYSEM) etc. The U P Council of Science and Technology of the state government has also funded ATDA several times. Besides these, oversea voluntary/private and semi-Govt. organizations like the European Commission, East West Centre Hawaii, India Development Group London, Community Funds UK, Intermediate Technology Group London, Overseas Development Authority London, ICCO Holland, K Delco of Molen Russia had been funding the ATDA. Further, Indian voluntary agencies like PRAD-ITIS, Gandhi Smarak Nidhi, KVIC Bombay etc have also funded ATDA (ATDA source).

4. External Linkages of ATDA:

ATDA's external resources were both from inside and outside the country as it had collaborations both in India and abroad. In India the collaborators (mostly for extension work) were; (i) Gandhi Smarak Nidhi in UP, (ii) KVIC Bombay, (iii) Planning Research and Action Institute in Lucknow etc. And the foreign collaborative agencies (mostly for consultancies) were; (i) ITDG London, (ii) Inter-church Coordination Committee for Development Projects (Netherlands), (iii) International Research Centre Siege Social (Canada), (iv) Overseas Development Authority London, (v) ICCO Holand etc.

5. Intellectual Resources:

Pilot projects implemented 1976 onwards: The ATDA has done various projects for internationally and nationally known organizations. For research purpose it had taken up a Mini-cement Plant, based on appropriate technology by utilizing locally available raw material like Kankar and Marl to produce Portland cement. It was developed with a motive to produce or develop low cost rural housing facilities for the rural poor. This project was funded by Intermediate Technology Development Group (ITDG) London and U. P. Science and Technology Department. Second was, Wealth from Waste. This project was designed to use cow-dung for preparation of gas, which could be domestically used for preparation of food and at the same time generate electricity in the village. It was extension of bio-gas technology. This project was completed with the assistance of Overseas Development Administration (ODA), London. Then, there was a project named Regeneration of village eco systems through bio-gas technology. It was designed to enhance the productivity and income of village people who are mainly dependant on diary. This project was designed to improve eco-system through bio-gas technology. The partner of this project was ICCO, Holland. Wool Spinning pilot project was conceived for carding and weaving of raw wool. It was supported by U. P. Council of Science and Technology. There was a Mini Sugar Technology project which evolves the technology for production of liquid sugar. This project was with the partnership of U. P. Council of science and technology, PRAD & ITIS and Gandhi Smarak Nidhi (Source: ATDA Gen secretary, 2010).

ATDA has also done a project of HRD Ministry, Government of India for development of environmental and educational activities and models. This project was named as Area Intensive Environmental Educational Programme (AIEEP). Ministry of Environment,

Government of India also had given a project. It was a sort of organizing workshop for state level teachers training for their capacity building in organizing environmental education activities. Community Funds (U.K.) London has funded a project known as Integrated Women Rural Development project (IWRDP) with the aim to empower women involved in mint farming and processing at village level. It was done in Mohanlal Ganj area. ATDA also reclaimed parts of Wasteland through plantation of green fodder. The project was named Development of Waste Land. It was funded by Wasteland Development Board of Government of India, Institute of Technology, K. Delco of Molen, Russia. The project was to develop floating pump for irrigation by using water current. It was AT for water lifting. Then the other project was, four roller care crusher. This project was funded by U. P. Council of Science and Technology. It was developed with an objective of extracting juice from sugarcane. U. P. Council of Science and Technology also funded for the project named Solar Cooker. They aimed at introducing bulbs for cooking. ATDA had developed some experiments on rural technology to reduce drudgery of women. Then, the East West Centre, Hawaii, and Honolulu in collaboration with ATDA have done some foreign participatory management of forest. Next project was from K.V.I.C Bombay that funded the project of leather processing skills to develop among cobblers. The U.P. Council of Science and Technology also funded a project named 'Leaf cup making'. European commission and UK funded a project with ATDA on capacity building of rural youth through self employment under the project name Skill development of rural youth.

These are by and large projects, which were taken in the past. From 2003 onwards, there is no such project. Last year, 2010, they have got a project given by government of U. P. The project was from ICDS (Integrated Child Development Scheme) in Kanpur to run a training programme. This project was known as Kishori Shakti. The modest budget was around 96 thousand. It was 60 days training programme in which they trained rural girls for some tailoring skill development. Only 60 students joined in such programme (ibid).

Cases of Success: ATDA Lucknow has some achievements in reaching out to the rural needs. It has improved upon the rural technologies like manually-operated cotton spinning, wool spinning, and irrigation pipes. It has de-scaled the process of manufacturing of white crystal sugar, Portland cement, cotton spinning and brought them down to scale appropriate to rural areas. It has introduced a biogas technology of fixed dome type for the use of human excreta, and any sort of animal dung like that of elephant, horse, goat in addition to cows and buffaloes. It has developed new methods for making leaf cups and containers from dry leaves, which had great employment generation potentialities.

The ATDA also organized training and orientation programmes for AT practitioners from all over the world. The State Government was also deputing their trainee officers to ATDA for orientation course in AT. The Association was also undertaking survey of rural industries to determine their status and efficient methods for improvement with a view to improving the condition of the rural artisans through technological inputs. The Association in collaboration with India Development Group, UK and others had set up Schumacher Institute of Appropriate Technology for creating a cadre of rural artisans and imparting training in various rural and appropriate technologies for wider dissemination including environment, social forestry, and rural health.

Causes of Failure of ATDA: So long as ATDA was involved in research work, it was doing well. But later on NGOs stepped into picture. Commercialization took place. They started to commercialize cement. The organization faced problem in marketing of cement as it had no expertise in marketing. As the entire workforce was not trained for marketing purpose,

they failed to market the cement successfully and their money was blocked. They failed to recover the money from marketed cement and that resulted in stoppage of wages to the workers of cement plant and subsequent closer of the plant due to unavailability of funds to continue production. Their liability towards sale tax and electrical dues could not be cleared because of their failure to realize money from the market. The organization by then faced with the problem related to license. They cleared liability of labour by selling the plant. Thus, plant was shut down because of recurring losses.

Initially, the product was meant for research purposes only and it was not meant for marketing purposes. The organization committed this mistake. That is how, it became sick. The people who were employed in the cement factory asked for wages while doing no work. Money was not there ultimately even to clear their liabilities. Once there develops liability with an organization like ATDA, no funding agency came forward to fund its next projects. It was the root cause of decay of the organization. Thus, when a research organization shifts its activities from R&D to production and tries to behave like a commercialized firm, it would face serious problems. Of course for the obvious reason that they do not have the knowledge and staff of a manufacturing and commercial organization. There would be serious legal problems with regard to taxation, excise duty, auditing etc. Corruption was also a factor behind failure of ATDA in terms of project financing (ATDA source). The organization also lacked initiative and dynamism following the death of its founders like M. M. Hoda and M. S. Hoda sometimes around 2003. The organization could not develop further leadership and its direction (Ibid). Absence of dynamic and committed leadership was also a major factor for failure.

Present Scenario and future direction

Once ATDA was one of the reputed centers of AT in India. It was internationally recognized. It had a good track record of implementing the projects with various international partners. But, today ATDA has gone to oblivion. It had done many pioneering works in AT, but has gone without recognition from the Government.

Today this organization is merely alive, being on sleeping mode, lacks the spirit of the earlier decades. Now, it does not have any project and also no funding. It has a financial crisis too. The biggest challenge today before the team is growing corruption in the field of project financing by funding agencies and therefore even good projects of larger public benefit or interest are gathering dust in the selves of various government departments and ministries. And also they need a vision and bold leadership. "ATDA is waiting for someone who can come up with a vision to carry forward its unfulfilled dreams. It has a distinguished record in implementing its projects with various international partners. If the Government and right-minded NGOs recognize ATDA's outstanding contribution in the field of appropriate technology for enhancing the productivity level of rural poor in India, they must take over the responsibility to rehabilitate such a pioneering institution in national interests" (personal interview, General secretary, ATDA on 23rd Nov, 2010).

Case Study. 2: Application of Science and Technology to Rural Areas (ASTRA) Cell at the IISc, Bangalore

1. Intellectual Mobilizations: Actors, Conception and Foundation of ASTRA Cell

Prof. A. K. N. Reddy, the noted citizen scientists of IISc Bangalore was the mind behind the mobilization for the foundation of ASTRA Cell. Reddy had strong conviction on the necessity of developing an AT research centre like ASTRA Cell. Reddy was convinced

that modernization and industrialization which occurred over the years in post-independent India could not attend to the problems of rural areas. The most immediate result was mass unemployment, massive migration to cities, rural impoverishment, environmental degradation, decreasing social participation and declining control over surrounding resources, etc. One of the major reasons for this situation was the continued dependence on import and adaptation of inappropriate technologies of the industrialized countries. But these technologies were not suitable for the countries like India where these faced the critical shortage of capital, energy and skills amidst growing surplus manpower. In this context, there emerged a need for alternative or AT which had relevance to rural problems. But it is unfortunate that these technologies could not be viewed as glamorous enough to merit the attention of major scientific and technological institutions, felt Reddy (1974). These institutions were overwhelmingly manned by elites with a 'westernized' life-style and aspirations, often accentuated by foreign training. These elites were alienated from the rural poor, rural problems and from their traditional technologies. This alienation was amplified by the strong linkages with the corresponding 'western' institutions. Hence, indigenous institutions derived from western institutions the patterns of organizing science and technology, prioritizing areas of research, their approach to solve human problems, their criteria of excellence and the source of recognition, awards, kudos even their techniques of evaluation. However unlike their 'western counterparts, scientific and technological research institutions in developing countries were invariably insulated from indigenous industries and favoured the flow of industrial technologies from abroad.

The result was that educational, scientific and technological institutions in the developing countries tended to be elitists, alienated and related to the society without native roots. As a consequence, they tend to be pre-occupied with irrelevant work or with work which is only relevant to urban industries or problems of the 'west'. The relevance of native rural problems was completely forgotten. It is no wonder that no major scientific and educational institution was doing anything about rural development in fields other than agriculture (Jagadish et al., 1980: 123).

ASTRA research cell at IISc Bangalore, was established in the year of 1974 with an aim to deliver the fruits of science and technology to rural areas. Prof. A. K. N. Reddy was the founder and guiding philosopher of this centre. Besides A. K. N. Reddy, there were many researchers and actor intellectuals like Vinod Vyasulu, Sethu Rao, and C. V. Seshadri, K. S. Jagadish, D. K. Subramanian, Low Cross, Krishna Prashad, H. S. Mukunda, Gururaja etc all made fantastic strategy for getting the then Karnataka state support to the ASTRA Cell. Then the Director of the institute, Prof. Satish Dhawan also gave the group ample support in this pioneering effort. Therefore, these make the true 'Conscience Constituents' (McCarthy and Zald, 1977) of this SMO. In this context, the idea of founding the Karnataka State Council of Science and Technology (KSCST) evolved after detailed discussions with eminent researchers like Satish Dhawan, M Y Ghorpade, GVK Rao and others. Thus, the latter group of intellectuals could justifiably be treated as the 'Conscience Adherants' (McCarthy and Zald, 1977) of this SMO called ASTRA cell. When ASTRA cell concentrated on identifying and generating on appropriate rural technologies, KSCST took steps to diffuse ASTRA cell's proven technologies with the active involvement of the government of Karnataka. Hereafter, ASTRA cell pooled together the competencies existing in different departments of the Institute and channeled these engineering researchers towards problems of rural development. ASTRA cell therefore was born with well-defined objectives, viz., the generation and diffusion of appropriate technologies for rural development, and promotion of sciences underlying these technologies (Raghunandan & Chanakya, 2004: 3).

To quote S Dasappa of ASTRA Cell, *The kind of work we do here at ASTRA Cell is economically and environmentally viable, socially acceptable and these reinforce self-reliance. Their impact should be sustainable and visible. This approach will serve the purpose of development in the long run. That is our aim.* (Personal Interview / CGPL, 6th April 2011.)

Personal contribution of A. K. N. Reddy in shaping ASTRA as a Research centre:

A. K. N. Reddy was an electrochemist, energy analyst, rural energy and AT practitioner, spokesman for sustainable development and campaigner against the nuclear weapons and a cricketer by hobby. He has pioneered the entire field of research in policy analysis and action. He was instrumental in setting up the ASTRA Cell. He too was instrumental to the founding of the Karnataka State Council for Science and Technology (KSCST). He with his collaborators also had set up International Energy Initiative (IEI). As the founder president of IEI he edited its research journal *Energy for Sustainable Development.* With this experience, approach and perspective behind, ASTRA cell over the decades has worked in different areas like bio-energy, biogas, gasification, fuel efficient stoves and driers, water purification, renewable energy, climate change, forestry and alternate and low-cost buildings. Much of the experimental work in the areas of Pura and Ungra influenced many colleagues and students to work with commitment and excitement on developing rural technologies to suit the needs of the rural India. A. K. N. Reddy was essentially aiming at strengthening self-reliance, energy alleviation, poverty eradication, and typical problems of developing countries related to energy perspectives. He was engaged in the learning, questioning and challenging the dominant perspectives. His work on rural technology and development led him to question the existing paradigm of energy which was by passing the poor and ignoring environmental sustainability. His approach for energy was a consumption-oriented and supply driven approach.

Lessons on Energy and Environment by A. K. N. Reddy:

It was suggested by Reddy that, if we are really caring about the environment, we must care about the production and utilization of energy in society, because a major threat to the environment is from energy related activities. If we care about the environment being sustainable in the long run, we must care about how energy is produced, in particular whether from non-renewable or renewable sources. If we care about people, particularly the poor, we must care — not merely about energy supplies and consumption — but about the utility that energy provides to people and we must care about how energy is used. If we care about energy use, we must care, not merely about increasing energy generation and consumption, but also about improving the efficiency with which energy is utilized because 'energy saved is equivalent to energy produced'. If we care about promoting the efficient production and use of energy for sustainable development, we must as a body emphasize not only on information and training but also on analysis leading to advocacy and action.

ASTRA Cell's Experience of Technologies for Rural Development: A. K. N. Reddy's Message for his future followers:

A. K. N. Reddy had a vision of formulating and implementing ASTRA with a motto that science and technology should be a weapon (or Ashthra in Sanskrit) in the interests of the poor. During the initial nine years of his work at ASTRA cell, he worked as its Convener and the remaining years, he involved himself in various projects like community biogas, plant project at Pura Village, Kunigal Taluk, of Karnataka state. Many lessons came forth with his involvement with the villagers. These lessons were shared with a hope that coming

generation can make use of those for understanding the problems of the masses and can put forward with technology development initiative.

Some of the relevant lessons were: (1) Rural people may be poor and illiterate but they are not poor indeed, rather are rich with experiences and local wisdoms; (2) Technological choices of the people are rational; (3) Rural rationality should be taken into account in order to make technology policy suggestions and recommendations; (4) We must first be students if we want to be successful teachers. Information must flow in both ways- from the people to the rural technologies, and from the rural technologies to the people. There are several important steps in this information flow process like scientific study of the lives of the people, identification of felt needs, rather than perceived needs, presentation of the technology options to the people, subsequent technology selection, technology generation, technology testing, technology finalization and technology dissemination etc; (5) We should start with the people and end with the people; (6) Women are often the best agents for disseminating technologies for rural development; (7) People may be poor, we must not ignore their preferences and needs; (8) We must curb our market tendency toward developed technologies in response to imagined needs; identified in remote and alien settings; (9) Traditional technologies were optimal solutions for the challenges of the past and therefore they must not be ignored as sources of innovation, these have evolved through a long process of natural selection of innovations; (10) Although traditional technologies were optimal solutions in the past, almost all of them are suboptimal and inadequate today because of changed needs, resource availability and circumstances; (11) The So-called 'modern' technologies, which are only bad zerox copies of western technologies, are invariably inaccessible to the poor; (12) It is therefore a Hobson's choice for the poor — if traditional technologies are inadequate and modern technologies are inaccessible. To permit the poor to escape from this dilemma, scientists and technologists must generate new options, each more effective than the traditional and more accessible than the modern; (13) But the ultimate choice of technology must be made by the people, because technology choice is too important to be left to the technologists and other experts; (14) In generating technological options, three approaches must be taken into consideration like, making cost effective western technology, developing alternative technology and transforming traditional technology; (15) The transformation of traditional technologies is a rich source of, and promising route for, technologies appropriate for rural development; (16) Technology developed are likely to be region specific, location-specific and culture specific; (17) Any fool can make a thing complicated, it takes a genius to make it simple; (17) In case of most rural technologies, there is a first generation of unsuccessful device and second generation of successful device; (18) Thus, the penetration in the countryside of rural technologies involves a learning curve; the initial part of the curve shows a very slow penetration of the potential 'market', then a rapid catching up, and finally a saturation; (19) During the initial part of the learning process, there has to be intense back-and-forth interaction between the lab and field; (20) There are four main mechanisms for the dissemination of rural technologies such as , the market, the top-down approach, the bottom-up approach and the franchising approach; (21) The technologist must ensure that all the objectives in the rural users list are included in his or her design criteria; (22) If the designer can not meet all the user's objective simultaneously but only in stages, then it is imperative that the designer's sequence must be in same order of the user's priorities — otherwise the implementation may run into problems; (23) Irrespective of the successes in generation and dissemination, rural technologies alone can not remove poverty. Technology is only a subsystem of society, which acts as an instrument of development of

society. Thus, technology is a necessary condition for rural development, not a sufficient condition; (24) Technologist must approach rural work with empathy and affection for the people. And last but not the least, rural technology is a path to a new society and it is an instrument for development (Rajan, 2009: 171–182).

2. Organizational Resources

Organizational Resources: In terms of structure, ASTRA cell-CST has been an interdisciplinary group where specific teams work on well defined technologies. The departments/centres of IISc Bangalore which came forward to work then with ASTRA cell were Chemical Engg, Civil Engg, Computer Science and Automation, Center for Ecological Sciences, I.P.C., Mechanical Engg, Management, Aerospace Engg etc. Currently the cell has 06 regular faculty members and 05 associate faculty members, one technical officer and more than a dozen research scholars.

Programmes: ASTRA cell has certain major studies on rural technologies pertaining to, (a) Energy Studies (e.g. rural energy planning, alternate energy sources, energy devices and applications), (b) Building Materials and Technology (e. g. system studies, walls, roofs and construction), (c) Water (e. g. water harvesting and water lifting), (d) Wood burning devices (e.g. improved Jaggery stoves, ASTRA stove for domestic cooking), (e) Bio-Gas (e. g. optimization of biogas plants, solar heating of biogas plants), (f) Wind energy (e. g. study of wind energy potential, optimization of wind mill towers), (g) Solar energy (e. g. designs and development of solar collectors, solar ponds skytherm cooling of building using solar energy), (h) Rural Industries (e.g. Sisal leaf processing, rope making, recycling of chemicals from black liquor etc), (i) Agro processing (e. g. processing of agricultural products and residues) etc.

An extension centre of ASTRA cell was established at Ungra, 113 kms away from Bangalore on the outskirts in Tumkur district, Karnataka state, for actual field research study. Many of the technologies of ASTRA cell which go out on a pilot scale generally get tested there. In this environment, faculty members could monitor or do close interactions with end users and try to find out solutions to technology packages. For technology diffusion, ASTRA cell took the help of various voluntary groups and institutions like TIDE (Technology Informatics Design Endeavour). KSCST also supported ASTRA cell in matters of to technology diffusion. And second way to diffuse the technology was through arrangement of educational programmes for ASTRA cell technologies.

In the late 1980s and early 1990s in the development discourse in India, there came an emphasis on the theme of 'sustainable Development' which emphasized equitable, self-reliant and environmentally sound development. ASTRA cell had started with the objective of developing technologies which are economically efficient and environmentally sound ensuring self-reliance and long term viability. ASTRA cell renamed itself as the **Centre for Sustainable Technologies (CST)** in the year 2003 with a motive of promoting sustainable technologies that would maintain a sustainable environment. Its current area of research includes: (a) Low Carbon building materials & systems, (b) Biomethanation, anaerobic digestion & nutrient recovery, (c) Biomass gasification, (d) Water Treatment technology, (e) Fuel-efficient wood burning devices, stoves and agro-processing driers, (f) Sustainability evaluation and forecasting, (g) Sustainability in architecture, human settlements and design, (h) Green Buildings: energy efficient, climatic responsive and thermal-comfort, (i) Building Integrated Photovoltaic (BiPV), (j) Ecotoxicology, aquatic biodiversity & bioremediation of lakes, (k) Solid Waste management, (l) Climate Change;

green house gas inventory, mitigation, adaptation, vulnerability assessment and policy studies, (m) Environment quality assurance and impact studies, (n) Energy, environment and climate change policy analysis.

3. Financial Resources

Federal agencies like Department of Science and Technology (DST), Ministry of Non-Conventional Energy Sources (MNES), Council for Advancement of People's Action and Rural Technology (CAPART), state agencies like DST Karnataka, Karnataka State Council of Science and Technology (K.S.C.S.T) and a private agency like Tata Energy Research Institute (former TERI) have funded the ASTRA cell.

***4. Intellectual Resources- Successful dissemination of technologies from ASTRA Cell-CST*:**

ASTRA Cell-CST has successfully disseminated some of its technologies in India and other developing countries. There is providence of certain technologies which were implemented in field and have received enormous success. Some of the selected applications of ASTRA cell technologies are: (a) Dissemination of ASTRA stove (1983), (b) Biogas plant dissemination (1985 - 1989), (c) Open- top Wood Gasifiers (1987, 1990), (d) Large Scale Dissemination of Solar water heater (1990-1995), (e) Dissemination of Lead Litter-based biogas plants (2004), ASTRA cell's rural technology is well recognized in India because those technologies are of energy efficient, low cost and sustainable.

Regarding patents, ASTRA cell-CST has varieties of patents. Sometimes, they have open patents, where they allow users to acquire license on the technologies. Patent has a new technology otherwise it does not come under the theme of patent. Some of the patent details are: (1) A process of removing Hydrogen Sulfide from a Gas Mixture — India (August 1996), (2) Biomass Gasifier — Switzerland (October, 2000), (3) Improved Biomass Gasifier — Sri Lanka (February, 2001), (4) Improved Biomass Gasifier — Brazil (July, 2001), (5) Improved Biomass Gasifier — Thailand (February, 2002), (6) Improved Biomass gasifier European patent (November, 2000), (7) CN Technology for cleaning Tar and Dust Laden Gases for use in reciprocating Engines/Gas Turbines for Power Generation — India (September, 2001), (8) Improved Biomass Gasifier — Japan (March, 2002), (9) A Novel process and Apparatus for the manufacture of Precipitated Silica from Rice Husk Ash — India (February, 2003), (10) The same technology patented later on in several other countries like, Thailand, (in February, 2003), (11) Vietnam (in September, 2005), (12) Japan (in August, 2005), (13) China (in February, 2004), (14) and Indonesia (in August, 2005), (15) IISc Advanced Biomass Cook Stoves — India (in September 2005).

Commercialization of Improved technologies in rural areas: problems and promises:

The problem of commercialization of rural technologies is the biggest ever problem and efforts have also concentrated on disseminating many of these technologies. The efforts of dissemination have been over a number of sectors ranging from rural industry and agriculture through transport, energy to health and housing. There are different mechanisms for the commercialization of rural technologies, such as; (a) the facilitation mechanism (e. g., Venture capital, subsidy, equity/share, awareness building and extension works done by NGOs etc), (b) the centralized mechanism (e. g., technology marketing agencies like NRDC), (c) decentralized mechanism (at local level), and (d) the necessity of modified market mode/ non-market mode of technology commercialization (Krishnaswamy & Reddy, 2006: 244–261).

The efforts to disseminate those sustainable energy technologies (SETs) are the biggest of challenges in the field of renewable energy and energy efficiency. Commercialization of those technologies refers to the process of moving a technology from laboratory to market acceptance and use that takes it to mainstream economic activity. SETs in India are at a very low level of commercialization because of Government's apathy (e. g. partly because of the withdrawal of protectionism). Barring a few SETs like solar water heaters, wind energy, most of the SETs in India have fallen inside the valley of death, where the cost of the production is high and scale of production is low.

For example, ASTRA Cell-CST has developed and commercialized Bio-Energy technologies (BETs), e. g. biogas based technologies, too. But it too faces problems in diffusion. In terms of family biogas, the problems were high first cost and procedural delay for obtaining subsidy. In community biogas, the problems were of inadequate demand for electricity, large investment at village level, absence of institutions to plan, implement and manage community biogas systems and absence of strong community organizations at village level. But in Biomass gasifiers, the problems were basically the land availability, sustainable biomass supply etc. In diffusing the other BET, e. g. improved stoves, the bottlenecks were, short life of mud stoves, low performance of improved stoves, lack of user education etc.

As pointed out by the ASTRA Cell-CST research team (through personal interviews), for the dissemination of these technologies and for overcoming the related bottlenecks, the following recommendations are made: (a) Capacity building for the effective and efficient technology transfer process, (b) Financing for technology transfer, (c) Funding R&D for specific technologies, (d) Policy to find large-scale demonstration programmes, (e) Rational energy pricing policy, (f) Private sector participation like that of NGOs and international agencies, (g) Policies to promote participatory approach, (h) Periodic assessment and evaluation of technologies, policies and programmes, and (i) Bilateral and multilateral mechanism. ASTRA cell — CST as a programme of the institute has survived (not flourished) for more than 30 years now. Its most positive aspect is its being sufficiently funded. CST's programme at the IISc Bangalore has influenced other research units even at IITs. It has been able to place rural technology on the agenda of national institutes. The contribution of CST to the field of AT in India is well recognized.

Case Study. 3: The Honey Bee Network (HBN), Ahmedabad

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 ideas? 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 1988–1989 to address those very issues (Gupta, 2006: 49–66). 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.

***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 make the 'Constituent Adherants' (McCarthy and Zald, 1977) of this SMO called the HBN.

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.

Objectives of Honey Bee Network: The objectives of HBN were:

(1) to project the intellectual property rights of the grassroots innovators, and generate models for recognizing, and rewarding their technological creativities;

(2) to add value on the products for making better commodities;

(3) to explicate the insights learned from such traditional technological and institutional innovations developed by individuals as well as communities;

(4) 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).

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. IIM Ahmedabad 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.)

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 (SRISTI, unpublished document, 2011). 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.)

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 Adherants' of HBN SMO.

Society for Research Initiatives for Sustainable Technologies and Institutions (SRISTI)

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 less 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.

Activities 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 were 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 downtroddens of society, through its programmes on educational rehabilitation, setting up village libraries, distributing books among villagers etc.

(3) *Shodhyatra: 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 to 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 learned 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 in the market are shared with the innovators. Distribution of profits is fixed by the discussions 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) *Honour 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 transformed into technologies too. If it could be commercialised, 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 vetnary 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 (SRISTI update: 2011).

2. Economic Resources: Funding Details / Facilitators of SRISTI

International Development Research Centre (IDRC), Canada has been working with SRISTI since the early 1990s, providing core support for institutional strengthening, and a range of activities related to the preservation and valuation of traditional knowledge and practices related to natural resource management. IDRC has been a core support to SRISTI, as it granted USD $ 150,000 to SRISTI and this transition was possible with the help of Pew Charitable Trust. R. A. Mashelkar former Director General (DG) of the Council of Scientific and Industrial Research (CSIR) has also been a vocal supporter of SRISTI's work. About SRISTI, Mashelkar noted that 'when most people speak of India's contributions to society and the economy they refer only to the educated minority — the tip of the iceberg in India. But SRISTI's pioneering work has been considering the rest of the iceberg, and that the major challenge now lies in linking the two — linking formal and informal

systems of innovation'. He was one of the initial mentors of SRISTI (IDRC Report, 2003). The persuasive personality, commitment and credibility of Anil Gupta have also been an enormous facilitating factor in this case. Gupta has been and continues to be the "policy entrepreneur" of this endeavour — he has relevant expertise; political, academic, and international connections; negotiating skill; and is truly dedicated to SRISTI's work. For its Lab, SRISTI took the help of Department of Science and Technology (DST) for value addition. Sadbhav Foundation (Charitable Trust) also helped SRISTI for providing Rs. 6.0 million for instrument project. Wagh Bakri (tea group) has also donated Rs. 2.5 million to SRISTI (Burton, 2003: 7–8).

3. The Internal and External Linkages of SRISTI

SRISTI has its internal linkages with NIF, and GIAN. Its strong external linkages are with, Indian Council of Medical Research (ICMR), Council of Scientific and Industrial Research (CSIR), Indian Council of Agricultural Research (ICAR) and Gujarat University, Centre for Research and Social Development (Gujarat), Innovative Orissa Initiative (Bhubaneswar), SEWA Tamil Nadu, Centre for Interdisciplinary Studies (West Bengal), Development Research Communication and services centre (West Bengal), Sadbhav Foundation Mumbai, and the several engineering colleges of Gujarat (for scouting by students). All these organizations extend their cooperation to SRISTI in scouting, documenting and processing of innovations.

Grassroots Innovations Augmentation Network (GIAN)

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.

Members of Governing Body of GIAN: The Governing Body of GIAN (Gujarat) consists of its Executive Vice Chairman, Principal Secretary, Secretary, and Faculties from IIM Ahmadabad, Director of International Centre for Entrepreneurship and Career Development (ICECD), Innovators and entrepreneurs, Chief Innovation Manager, Project Manager, Finance and Administrative officers. That apart, it includes representatives of Gujarat Government, IIM Ahmedabad, SEWA, SRISTI and Gram Swaraj Shiksha Kendra.

2. Financial Resources

National Micro Venture Innovation Fund (MVIF) has been the principal financial source for GIAN which was made available with the help of SIDBI in the year 2003. It too has other small sources of fund like from Gujarat Government and DSIR.

3. Intellectual Resources of GIAN

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.

GIAN and value addition: GIAN is busy doing value addition particularly in mechanical engineering technology. For this purpose, GIAN has 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 the fabricators third party designers/entrepreneurs/ or by innovators. There are cases where innovator becomes the entrepreneur by himself.

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. 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 & L Gates of Boston etc outside India. So far GIAN has facilitated filling 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 (GIAN Update, 2011).

Technology transfer/technology commercialization: Out of these 150 000 traditional knowledge and practices documented, GIAN has selected 150 such 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 Prajapatoi, (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.

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. 15.83 lakh 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).

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.

4. External Linkages of GIAN

GIAN has also linkages with Govt. of India Depts. like DST and DSIR for taking advantage of schemes such as Technopreneur Promotion Program (TEPP) of TIFAC and the like. Leading nationalized banks finance innovators for the purpose of developing product prototype, workshop establishment, holding conference, seminar etc. GIAN played an instrumental role as a knowledge partner in building Global GIAN as an international incubation platform being supported by SRISTI and *Asian and Pacific Centre for Transfer of Technology* (APCTT) network. GIAN West was also extending financial supports to the innovators under the MVIF a Venture support, Value Addition Research & Development (VARD) support and Workshop development support. Apart from these, GIAN maintains its external linkages with Gujarat Govt.'s dept. of Industry and organizations like SEWA and legal firms like Anand & Anand, Surana and Surana etc. And noteworthy that GIAN also maintains strong linkages with academic institutions like, IIT Bombay, IIM Ahmedabad, National Institute of Design (NID), and Institute of Rural Management Anand (IRMA) for consultations in technical matters.

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 R A 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 knowledges/practices at the grassroots.

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 Dr. R. A. Mashelkar. Prof. Anil K. Gupta is the Executive Vice Chairperson. Below the National Coordinator, there are senior fellows, associate fellows, junior fellows and research associates 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.

2. Intellectual Resources

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, 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 by the firm abroad.

(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 1,000 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 labour. 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, 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: This Tile making machine, was highly cost efficient and also easy to make machine for cement roof-tiles. It was scouted during Shodhyatra 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.

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 proptotype 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-Energised Stove by Shri. Bharatbhai Agrawal etc are glaring cases of innovations supported by NIF for conversion into sustainable technologies (NIF Update, 2011).

*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 former President Dr. Abdul P. J. Kalam.

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 on-firm 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).

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 Shodhyatra 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.

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.

Technologies sold by HBN Abroad: (1) Coconut tree climber USA (Florida, Massachussets, Carlifornia, Hawai etc), Australia, Maldives, Srilanka, Brazil, Mexico, West Indies etc), (2) Pomegranate deseeded — Turkey, USA, (3) Garlic Peeling machine — Pakistan, (4) Arecanut husker — Singapore, (5) Milking Machine — Philippines, Uganda and Ethiopia, (6) Resin grading machine — Peru, (7) Cassava Peeling machine — Kenya, and (8) Herbal growth promoters — Ghana.

Following are the patent details of NIF:

Table 1

Lists of Patents filed by NIF and GIAN in the USA

Innovation Catalogue	Nos. of patents filed
Electronic gadgets	1
Agriculture machinery & farm implement	2
Auto components, accessories & garage equipments	1
Agro based food processing machinery	1
Transport	1
Energy conservation and generation technology	1
Herbal formulation	1
Consumer durable	1
Sub Total	9

Table 2

Patents Filed in India

Innovation catalogue	Nos. of Patents
Agri-Plant variety	2
Agricultural machinery and farm Implement	27
Agro based food processing machinery	30
AC/ventilation machinery & equipment	6
Auto components, accessories and garage equipment	29
Construction & building equipment	7
Consumer durables	26
Diary Machinery	3
Earth moving and excavator machine	2
General purpose machinery & equipment	29
Electronic gadgets	6
Energy conservation and generation technology	21
Environment management technology	9
Transport	7
Traditional Knowledge	10
Herbal formulation	159
Mixed return (social and commercial) technology	17
Any other	8
Sanitation	3
Open source technology: no license fee required	4
SubTotal	405

3. Economic Resources:

NIF has a fund of Rs. 40 million from SIDBI (Small Industries Development Bank of India) as Micro Venture Innovation Fund (MVIF) to support innovations which have market potentials and also support to those entrepreneurs and companies which are interested in commercializing these innovations. It was sanctioned in October 2003 and operationlized in January 2004. MVIF is not a grant, it is rather a loan. It helps in extending risk capital to many ventures which otherwise are too risky for financial institutions to fund in the beginning. It supports the innovations in various ways like, (i) Support for converting market ready prototype to manufacturing in a small quantity based on the orders received by the innovator, (ii) Support for certification by Regulatory authorities, field trials, Market Research and Benchmarking etc.

4. External Resources of NIF

Collaborators of NIF: NIF has collaborators across the country. Collaborator details include, Retd. Brig. Pogula Ganesham (VSM), Andra Pradesh, Dr. Egul Padung from Arunachal Pradesh, Dr. Ranjan Kumar Singh from Haryana, Mr Azhar Hussain Ansari from Bihar, Mr. Ramji Bhai Dabhi (Centre for Research and Social Development): Gujarat, Mr. Ramesh B. Patel (SRISTI): Ahmedabad, Dr. Arun Chandan: Himachal Pradesh, Mr. Mushtaq Ahmed Dar and Mr. Zahoor Ahmed Shah from Jammu Kashmir, Mr. Rajeev Ranjan Pandey (Social Upliftment Trust): Jharkhand, Dr. T. N. Prakash (PRITVI): Karnataka, Father Hubby Mathew

from Kerala, Mrs. Anita Mahajan (Vishwasewa Foundation): Maharashtra, Dr. Balaram Sahu (Innovative Orissa Initiative/Aama Aakhha Paakkha): Orissa, Mr. Ranjan Mahapatra (SHRISTI Orissa): Orissa, Mr. Janmeja Johi: Punjab, Mr. Sundaram Verma: Rajasthan, Mr. P. Vivekanandan (SEVA): Tamil Nadu, Dr. Debal Deb (Centre for Interdisciplinary Studies): West Bengal, Shri Kamaljeet (Sristi-Gyan Kendra): Haryana, Peermade Development Society (PEDES): Kerala, Development Research Comminication and Services Centre: West Bengal.

For Scouting, there are many who extend their helping hands to NIF. Some of them are Mr. Azhar Hussain Ansari: Bihar, Mushtaq Ahmad Dar (Innovator): Jammu & Kashmir, Zahoor Ahmad Shah: Jammu & Kashmir, Mr. Goutam Rana: West Bengal, Mr. Bibhuti Bhusan Chakraborty (Innovator): West Bengal, SF Ahmad: Jammu & Kashmir, Syed Ahmed: Jammu & Kashmir, Sabzar Ahmad Wani: Jammu & Kashmir, Syed Nadeem: Jammu & Kashmir, Mrs. Sonia Suryavanshi: Uttarakhand.

Regarding GIAN & NIF cells, the collaborators are: Piyush (Chief Innovation Manager): GIAN-North: Rajasthan, Mr. Mahesh Patel (Chief Innovation Manager): GIAN — West: Ahmedabad, Mr. V. Abhai Kumar: GIAN cell — Tamil Nadu, Gangadharaiah — Memorial Entrepreneurship Development and Incubation Center (G-MEDIC): GIAN Cell — Karnataka, Prof. G. Mohiuddin Bhat Chairman: GIAN cell and J. & K. Director, Mr. Kishore Kalita: Indian Institute of Technology (Guwahati): NIF Assam Cell, Sikkim Manipal Institute of Technology, Sikkim (NIF Sikkim Cell), Dr. Natabar Hemam: NIF Manipur Cell.

MOUS with other organizations: NIF has also signed several MoUs with various national and international organizations. The aim was to promote mutual cooperation for grassroots innovation systems. It has signed MoUs with Malaysian Innovation Foundation (MIF), referred to as YIM, Botanical Survey of India (BSI): Kolkata, GB Pant University for Agriculture and Technology: Uttaranchal, IITG: Guwahati, IL&FS Education and Technology Services Limited: Mumbai, National Botanical Research Institute: Lucknow, Gangadharaiah-Memorial Entrepreneurship Development and Incubation Center, (SSITSTEP): Tumkur, University of Agricultural Sciences: Dharwad (UASD), CSIR: New Delhi, ICMR: New Delhi, IITK: Kanpur, Thiagarajan College of Engineering (TCE): Madurai, and Tamil Nadu Agricultural University (TNAU): Coimbatore.

It has also linkages with various private consultants and voluntary professional organizations like Matrix Agri Sciences Pvt Ltd (Matrix): AP and Small Industries Development Bank of India (SIDBI): Lucknow. It has also linkage with Govt. funded institutes of technology like IIT Mumbai, IIT Delhi, IIT Kanpur and NIT, Jalandhar. It has also linkage with NID (National Institute of Design) Ahmedabad and Grassroots Innovation Design Studio (GRID) Ahmedabad. Lastly the external linkages of NIF are inclusive of its several partners which are voluntary organizations like: SEVA — Madurai, PDS — Kerala, CED-Tamil Nadu, Sristi Kendra — Orissa, Prithivi: Karnataka etc (NIF Presentation Slide, 2011). The HBN, a network of three organizations namely SIRSTI, GIAN and NIF plays a very significant role in the grassroots innovations of India today. HBN is now well recognized for its original ideas and efforts both in India and abroad.

Conclusion

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

from the transformation of ASTRA cell into CST. So is the case of innovations of HBN, of which are being construed as sustainable technologies as many have been converted into commercialized technologies and some have been patented. These are indigenous technologies which are people centric and often tradition based. The notion of AT is fast becoming obsolete in the context of developing countries, of course because, (i) the neoliberalism 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, labour 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. Hence the concept of appropriate industrial technology in the earlier sense is now a misnomer. 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. Thus as evident from the empirical explorations from ASTRA-CST and the HBN, there seems to be a shift in the search and focus of research from appropriateness to sustainability of the technologies. 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 being embedded in people, their culture and their traditions. And this also makes the people's participation in these technologies easier as these are non-alienating. The other source of their sustainability is of course their being participatory. The evidences in favour of their being participatory are not far fetched. As in the ASTRA-CST the lessons of A K N Reddy are very categorical about the people's involvement with these technologies. Even if the ASTRA-CST model of technology development is from Laboratory to Field, Reddy had advised them that even in conceiving a solution the technologists have to keep the end-user in mind. Further in this model at field level there is a need of extensive use of extension works for the introduction of these technologies in rural areas and these 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. Similarly in case of the HBN, the model of technology development is from People (via Laboratory) to People and accordingly HBN documents the innovations from the people directly and often from the daily lives and culture embedded practices of people. Hence they carry out the Shodh Yatras to meet farmers, artisans of different regions/cultures, Food Festivals in different regions etc. And the HBN also engages lots of people for scouting the innovations from grassroots level. Even in formal ways HBN organizations involve the innovators in patenting, commercializing and even in cases of transferring technologies to entrepreneurs. HBN is emphatic about the grassroots nature of the innovations it scouts and documents. This participatory nature of the technologies provides the strong bases of their sustainability.

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