Lessons from the Design of Innovation Systems for Rural Industrial Clusters in India

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Summary

Practical experience with technology implementation for the upgrading of very small village industries in India suggests that innovation failures are not merely a result of the lack of proper interaction between the users and suppliers of technologies under implementation, but also a result of adoption of the primitive conception of competitiveness in their practice of technology development. The approach of promoting the small producers to become individually competitive by using labour intensive, small-scale intermediate technologies is proving to be totally inadequate for the achievement of technological efficiency in a dynamic sense. Guided by a primitive notion of competitiveness, the suppliers of intermediate technologies are thus being led into limiting their technological efforts in the sectors of direct interest to the rural industrial clusters to the transitional objectives of mainly poverty alleviation.

Consequently they have not been able to target the small producers of these village industries for the objectives of business growth. This paper posits that under competitive conditions the self-employed small producer has not only to come together for access to resources, but also has to emerge as a multi-sectoral collective of producers, co-operating in production. With the aim to draw lessons that are generic and have policy implications for the development of innovation systems for local economy based rural industrial clusters and value chains, the author analyses in this paper the experience of innovation in technological systems for the sectors of leather, fruits and vegetable processing and agro processing by the People's Science Movements with the help of the Ministry of Science and Technology and other sectoral ministries in India where rural poor were required to pool the resources and capabilities for raising the scale and scope of their collective production organization.

Key words : design, innovation system, rural clusters, self-employed producer, intermediate technologies

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1. Introduction

In India over 50 percent of the manufacturing employment is in unorganised sectors and in rural areas (Papola, 1992: 242). These sectors and territories have managed to survive mostly as local economy based rural clusters and are source of subsistence for a large part of the Indian population. Many of these activities are household based (Mathur and Pani, 1993: 334), and their ability to absorb workers is declining. In spite of possessing immense potential for employment generation, they are, therefore, unable to create more productive jobs in rural areas. However, in view of the ever increasing need of rural employment generation in the country, the government continues to have interest in giving due priority to this sector in the national programmes for employment generation.

The Special Group of Planning Commission is planning to achieve an overall growth rate of 6 percent in terms of employment by the terminal year of the tenth five-year plan (FYP). The challenge of generation of employment through the village industries is going to be taken up by expanding coverage of Margin Money Scheme, continuation of financial assistance to traditional village industries activities and involvement of self-help groups. The 'Khadi and Village Industry Commission' (KVIC) is entrusted to focus on the sustainability of past employment and make it more remunerative (The Special Group of Planning Commission, 2002).

But in practice, notwithstanding the help that the KVIC system provides even today to the rural poor in respect of earning additional income, protection of these industries via the existing above mentioned schemes has led to the preservation of backward or inefficient technologies, and thus to low productivity and low wages. When the poverty line in 1990-91 was fixed at Rs. 11,000 for a household offive, the average annual earnings of the five million workers supported by the whole Khadi and Village Industry Commission (KVIC) system in 1990-91 were only Rs. 1,771 (Fischer and Mahajan, 1997). Because such industries merely provide presently supplementary income for the workers concerned, it is only appropriate that the planners and implementing agencies should be looking into the possibilities of how the productivity of these activities can be enhanced using improved technologies. During the 10th FYP while continuing with the ongoing efforts at in-house and sponsored R&D centres, as a measure of economy in this regard, the Planning Commission has proposed that a few best functioning R&D institutions be identified and motivated to undertake extensive R&D activities in Khadi and Village Industries Programme with suitable tie-up arrangements.

Regarding improvements in the effectiveness of R&D and technology implementation activities in respect of the Village Industries programmes, with which this paper is essentially concerned,

it is our view that the rate of innovation failure has been quite high. KVIC's record in promoting research and improved technologies is poor. Though the commission has 34 research and extension centres, their impact has been limited[1]. An analysis of the success and failure of technologies developed by the KVIC led R&D centres and the Council of Scientific & Industrial Research (CSIR) linked R&D institutions for Village Industries is also provided in section 3.

Notwithstanding the long list of failures that the technologies based on the approach of intermediate technologies have experienced in the country in general, in a way as a sign of possible hope for the revival of village industries in India, this paper provides an analysis of, relatively speaking, a more positive experience of recently introduced interventions of the People's Science Movement (PSM) linked organizations who have been working in collaboration with the Ministry of Science and Technology and other sectoral ministries. It assesses their experience of development of innovation systems for local economy based rural clusters with the aim to draw lessons that are generic and have relevance for the implementation of sustainable innovations for the benefit of rural and urban poor in the developing countries. This paper argues that self-employed artisans working in isolation are severely handicapped. They cannot successfully participate individually on their own in the process of acquisition of in-house technological capabilities and compete in the markets where the large capitalist enterprises are also operating. Under competitive conditions the self-employed small producer has not only to come together for access to resources, but also has to emerge as a multi-sectoral collective of producers, co-operating in production.

The paper is divided into five sections. Section 2 proposes how a certain type of conceptualisation of competitiveness has adversely affected the theory and practice of policy formulation for innovation management in the case of Village Industries programmes. It helps to frame the emerging relevant issues for further development of the theory and practice of innovation management from the standpoint of poor in the developing countries. Section 3 addresses the experience of the lack of achievement of sustainable innovation in the sectors of direct interest to poor for whom the access to knowledge for innovation is even today quite underdeveloped in India. Section 4 reviews the experience of ongoing innovative technology implementation experiments of the

1) Fischer and Mahajan (1997: 120), for example, report that during 1991-2 KVIC disbursed only Rs. 98 lakhs for 22 research and development projects. They also cite the KVI Review Committee, which quotes the Indian Institute of Management, Ahmedabad study, to make the point that there was lack of clarity in the objectives of the research institutes, the progress of research was hampered by poor staff, inadequate number of scientific personnel, delay in release of funds, administrative overburden, and rigid culture, and above all, that the policy-making body did not provide adequate timely support to the R&D institutions.

PSM linked organizations who are undertaking activities with the help of publicly funded R&D institutions to demonstrate a new model of innovation in use. Section 5 suggests how the policymakers could design and govern the processes of technological change and shape the innovation systems for successful introduction of innovations into the rural industrial clusters.

2. Assumptions of the Implementation of Technological Innovation

2.1 Innovation for Poverty Alleviation or Business Growth

Policy oriented innovation studies undertaken for the benefit of developing countries, pay little attention to the nature of failure of innovation being experienced presently in the sectors of direct interest to rural industrial clusters. These sectors are treated as populated with occupations that are essentially transitional, amenable only for the objectives of poverty alleviation in small enterprise support projects, and are not capable of technological upgrading for business growth. In their recent paper, Abu and Scott (2001) underline that their paper is concerned about two apparent omissions in particular: the role which private-sector-markets play in livelihoods of poor people and the role of technological change and its contribution to livelihoods. They point out that explicit provision for considering processes of technological change, as a determinant of livelihoods is rare[2]. They point out that in a review of livelihoods approaches, Carney, et al. (1999) found UNDP to be the only organisation to explicitly stress technology in its livelihoods framework. In the latest review of technology support for a small-scale industry in developing countries, Romjin also makes the point that self-employed workers such as traditional blacksmiths, potters and weavers, and very small family-run "micro-enterprises" operating in the informal sector are being considered as not capable of business growth Romjin (2001: 72).

However, the question does arise why for developing countries the policy makers have mostly tended to restrict the movement for appropriate technology to the introduction of intermediate technologies for the objectives of poverty alleviation. In what way their conceptual understanding is making them to assume that the appropriate technology movement would not be able to go beyond the transitional objectives of poverty reduction? And finally how would the objectives of business growth in the upgrading of village industries begin to find wider acceptance among the policymakers in developing countries.

2) Abu and Scott also cite Hobley (2001) to note that the market is missing from the entire SL framework.

2.2 Primitive Conception of Competitiveness

In our view, first of all, a primitive conception of competitiveness lies behind the view that innovation in rural industries should be restricted to the transitional objectives of poverty alleviation. The approach towards implementation of intermediate technologies has been to target the individual small producer to become individually competitive. In this approach, competitiveness of this segment is being judged by comparing the existing relative costs and prices to individual producers because there is no recognition of potential competitive advantages that might accrue through the exploitation of economies of scale and scope and cluster or network effects. As a result, the intermediate technologies have remained subject to severe competition from large capitalist enterprises. In this competition, the small producers of this segment are therefore able to sustain these technologies mainly by accepting to live a life of subsistence. Their costs of inputs per unit of output have been higher in the case of intermediate technologies.

Often the cost structure of intermediate technologies is on the higher side because the competing large capitalist enterprises are in a position of erecting barriers to competitive access for small producers in the input and product markets. Mutual competition amongst small producers also leads to narrowed access to inputs and technologies and adversely affects the effective demand for their products. In those cases where small producers are being organized only for access to inputs and credit, the absence of cooperation in production results in mutual competition at the marketing stage that in turn breaks their existing alliances. Often both, the traders and the large-scale capitalist enterprises (competing with them in the market for the sale of products) have an interest in aiding the processes that can disrupt the cooperation of small producers. As in turn this failure of cooperation among small producers leads to the establishment of a vicious circle for the utilization of intermediate technologies in these sectors, it is having an impact of the slowing of innovation diffusion as a whole in the economy of a country like India.

As shown later in Section 3, adverse consequences of the competitiveness of these segments are clearly observable from the practice of making largely technological improvements by upsizing traditional technologies with the aim to increase and improve their output or downsizing of capital intensive technologies that are already being utilized in modern small-scale industries. The suppliers of intermediate technologies have been trying to target basically the individual small producer to become competitive, and thereby have also been ignoring to a large extent the issues of economies of scale and scope and network effects. Due to their primitive notions of evaluation of competitiveness of the production and technology systems, technologies under implementation are failing to diffuse into the village industries.

The approach to technology implementation has to be thus guided by a systemic conception of competitiveness in respect of production and technology system. In our view, they have to innovate in respect of their systems and products, and also to reduce their costs by either resorting to alternate input using technologies or using the required inputs more efficiently in their production and technology system. It is necessary that the social carriers of these rural industries also actively co-operate among themselves in production with the aim of breaking the monopoly of large capitalist enterprises. In order to be systemic in the approach to innovation, small producers have not only to utilise those technological opportunities that connect well with the local markets, capabilities and resources, but also have to organise, develop and obtain technology for co-operation in production among themselves. This also implies the maximum utilization of local advantage while linking themselves internally and developing their capacities to plan for better market access and egalitarian organisation of production. They need to undertake technology choices that enhance co-operation in production via the development of production linkages, value addition, improved production & greater diversification.

2.3 Informational Conception of Partnership Design

Further, in India, in their practice of technology implementation the suppliers of intermediate technologies have also been largely guided by an informational conception of barriers to innovation. In mainstream thinking, the problem of establishment of interaction with end users has not only been viewed with the lens of an 'informational conception' of barriers to interaction and integration but also the end users like poor peasants, artisans and agricultural labourers have never been a target in the innovation policies. They have had no support from the government for the purpose of development of in-house capabilities for production and investment. Predominantly, machine training and process demonstration have been used as a key set of practices in technology implementation. Technology support has been conceived in the form of one-time injection of improved hardware. This means that in the case of rural poor user support is not oriented to the task of improving the 'participation' of these end users in the process of development of intermediate or appropriate technologies.

In the alternate approach to technology implementation, the formulation of strategy for system transition has to start from the standpoint of improving the 'participation' of the end users in the system of innovation. Calculations of the economic viability of technologies should not be made with the assumption that small producers in village industries are incapable of organizing themselves for a better access to the higher scales of production. Selection of technology development

objectives and choice of partners for user development need to be designed with the perspective of organising small producers in village industries to interface for achieving economies of scale and scope through their appropriate organization and assuring network and cluster effects, so far ignored in competitiveness evaluation.

However, as Cooper (1995) suggests, though governments of countries like India and China have attempted to act on the need for forms of social organization to deal with technological change, the degree of success of their efforts is debatable. Therefore, further action for upgrading of rural industries (through alternate forms of social organisation and technologies) has been a felt need of those organizations that are actively engaging with the lives of rural and urban poor in a country like India. In Section 4, an analysis of the positive experience of such an initiative is provided with the aim to reflect on the practicality of this theory. This is preceded by Section 3, which reviews the evidence of innovation failures in the case of rural industries.

3. Past Partnership Practice for Technology Implementation in India

Being a country of large rural population, Indian governments have been induced to consider the programmes that would enhance the competitiveness of this very segment of population. In the sectors of direct interest to them, the rural non-farm sector occupations constitute the main bulk of employment in India. Much of this employment is subsistence employment. It has survived because it is linked to either serving the local rural markets or meeting those needs of the urban poor that the modern industrial sector is yet not able to satisfy. Therefore, there exists an experience of three to four decades of interventions in technology development for the rural non-farm sectors. Programmes for the introduction of intermediate technologies are focused on the upgrading of traditional manufacturing. We analyse the past and current programmes of the Indian government to illustrate this very understanding on the basis of the examples taken from the publicly funded research laboratories of the CSIR and the Khadi and Village Industries Commission.

3.1 Village Industry Upgrading Programmes: An Analysis of Key Examples

In the past fifty years of development in India, the governments of both the states and the Union have sponsored a number of programmes to upgrade the rural non-farm sector occupations. The promotional policies and technology support programmes that have been applied directly or indirectly to the rural non-farm sector development, can be categorised in the Indian context

as policies and programmes for promoting: i) traditional rural industries and ii) self-employment among the rural poor.

Looking at the past practices of innovation in these sectors, the policy approach always remained one of promoting the cottage scale units: the individual weaver, the potter, the blacksmith, and the village shoemaker. The thrust was on employment maximisation. Policymakers were insistent on achieving this aim through the policy of ensuring maximum employment per unit. This policy has resulted in severe under-development of the concerned fields of traditional manufacturing. It has forced them to adopt technologies that are not the most efficient. Evidence indicates that the protection of employment in traditional manufacturing in rural areas was achieved often at the cost of protecting low productivity and the resultant low wages for workers. For example, both Khadi and handloom were protected, the former through subsidised credit and subsidies to consumers on purchases, the latter through non-imposition of excise on hank yarn.

Take another major example of government intervention. During the sixth five-year plan, the government launched a new package of programmes most relevant for the non-farm sector using the strategy of making the rural poor to take benefits from the opportunities for self-employment. In this programme too the same approach of promoting small producers was adopted. It was launched by the government as a part of its main strategy, in programmes like the Integrated Rural Development Programme (IRDP), Training of Rural Youth for Self-Employment (TRYSEM), Development of Women Children in Rural Areas (DWCRA) and State-specific schemes for self-employment of SCs & STs and Women. These programmes were initiated with the aim of targeting households below the poverty line, and the idea was to provide each of them with a productive asset through a subsidised loan so that they can rise above the poverty line. The assets provided to rural poor under these programmes included milch cattle, goats, sheep and poultry; equipment such as sewing machines, tool kits, camel carts, handcarts, rickshaws or bicycles for hiring out; or working capital for petty trading, tea or pan shops and the like. During the seventh five-year plan this strategy was supported in a bigger way through large allocations in the form of both government funds and bank credit. This emphasis was continued during the eighth five-year plan.

Today, there is however a growing realisation that the approach of promoting small producers among the rural poor through the programmes for self-employment is failing to achieve the objective on large scale and reduce rural deprivation. Wrong selection of beneficiaries, 'leakages', failures of enterprises, loss of assets, saturation of small markets for produce, etc. has been found to be responsible for the non-achievement of objectives on large scale.

Simultaneously, our analysis revealed that the approach taken could not ensure the economic

viability of the income generating projects. Projects were not on a cost-effective basis; backward and forward linkages were absent; beneficiaries selected among rural poor were not adequately skilled and lacked management competence; the role of the middlemen and contractors was inimical, leading to 'leakages', training in isolation without integrating them with specific projects, and often without reference to local demand for skills.

From the above analysis of the examples of the programmes of KVIC and self-employment it is quite clear that behind the implemented programmes there have been certain underlying stated or un-stated business model related premises that have prevented them to achieve the objectives on a large scale. One major premise preventing the achievement of objectives has been that the anti-poverty strategy must target each poor individual household separately and assist it to rise above poverty line by providing access to credit and training in traditional occupations. This premise has resulted in the approach of promoting small producers who are unable to compete with large producers in the marketplace by themselves.

3.2 'Technology Push' Approach for the Upgrading of Village Industries

In the seventies the efforts for the advancement of the practice of S&T for the industrial upgrading of traditional manufacturing received from the government for the first time a big push in India. But most of the technological solutions that this effort offered were unable to connect well with the local markets and capabilities accessible to rural poor. Mostly the processes of design of technologies under supply from the governmental agencies for traditional manufacturing were embedded in a technology push approach.

This technology push approach persists till date uniformly in all the agencies. Technologies are often getting created without a detailed assessment of the needs of potential users in terms of particularly the type of competition they face and the opportunities they can avail. For many traditional industries since the users come mostly from among the rural poor, it is not possible to create at all the required technologies without an assessment of their current level of access to markets, resources and capabilities. It is becoming quite difficult for the S&T agencies to help the rural poor to become competitive users of the technologies developed. The present passive approach is unable to help the non-farm rural sectors to benefit from the technologies under development.

But as argued earlier the conceptual framework underlying these technology efforts was also always somewhat primitive. In line with the then current thinking of the international literature about technology, these efforts tended to conceptualise the problem of technology support as

only of a one-time injection of improved hardware. Further, the concept of improved hardware was limited to creating the machinery and equipment through, mainly downsizing of large-scale modern technologies, upgrading of traditional technologies, or blending modern with traditional technologies with the aim of making only an individual producer efficient. The practice of technology development is failing to convincingly deal with the reservations of technology users that they apparently have regarding these improved technologies still being poorly connected with their existing local production as well as technology systems. These examples bring out clearly that the programmes have suffered not only from the lack of close collaboration between the scientists and the prospective users but also from the poorly constructed system designs of technology and business.

3.3 Technology Support to Village Industries from KVIC

The approach of the Khadi and Village Industries Commission (KVIC) has been to improve traditional technologies by scaling them up to intermediate levels and introducing power-driven machines. This approach has increased the costs, made practical functioning difficult and affected adversely the formulation of viable projects. For example, although the semi-automatic improved loom was developed in 1972, 90 percent of handloom weavers continue to use the pit loom. The power pottery wheel entered the market about two decades ago (1970); yet the village potter continues to operate the traditional wheel. The traditional ghani (oil expeller) is fast disappearing but it has not yet been replaced by the power-driven ghani. The large producer using solvent extraction / expellers is more competitive. Improved gur (jaggery) furnaces have been developed but not adopted adequately. These are only a few illustrations. It can be seen that in most cases technologies have been developed keeping the individual enterprise of small producer in mind. Technologies developed have failed to incorporate local resources-raw materials, engineering materials, energy sources immediately accessible by / or with the people. Local markets have been ignored. Efforts are needed to develop technologies that will strengthen inter-links in the local economy by developing input output relations among existing occupations, in terms of specific products and services. To use extensively local engineering capabilities and materials we were required to substitute non-local products by innovations using local resources mainly e.g. replace stainless steel vessels by glazed clayware and, if necessary, metal bottom or internal pipes, etc. for heat transfer. Then, it would have been possible for the agencies to lower investments and scales, and develop inter-links in the local economy. Non-conventional energy sources were not suitably integrated into industrial activities requiring machines. The focus was more on providing

non-conventional energy sources for the purpose of cooking and lighting. Technology for co-products and by-product formation was given very little attention (Panditrao, Y. A., 1994).

Efforts made by the KVIC to overcome the limitations of individual artisan's resources through the use of common facilities centres have also failed to finally upgrade the production of rural artisans in an economically viable way. These centres have ended up serving only those artisans who are working for large urban markets under the control of large traders or a state sector owned bureaucratic marketing facility.

3.4 Technology Support to Village Industries in CSIR

Rural technologies released by the Council of Scientific and Industrial Research (CSIR) laboratories have been mostly based on the processes intended for being used in capital-intensive small-scale industries. Many of these technologies were developed to meet the needs of the small and medium scale industrial sectors. These technologies are meant for catering to the urban markets. Most processes have needed high inputs of non-renewable energy source to operationalise machines to be utilized in the course of production. Entrepreneurs who have made a success using these technologies tend to come from well-established business families.

In the CSIR system of laboratories, since the early seventies attempts have been made to involve the R&D workers in the programmes of rural technology development. For its Karimnagar programme, the evaluation committee wrote that "the CSIR has made its own internal assessment of the project, however, it appeared to be general in nature. The assessment was not very sharp, well exposed, and objective. No definite programme was worked out to implement the project and decide as which area was having the gap, what technology could bridge the gap, how many demonstrations were required to establish the innovation, who will do extension work and serve the related needs and demands" (CSIR, 1978). Similarly, in another internal evaluation of the CSIR's rural development related technology development programmes, which the Tilak Committee carried out in 1978, there was again the same assessment. Out of 320 processes completed through the activity of national laboratories and meant for rural development, merely 134 (42.4%) processes had been released by the CSIR for exploitation and only 58 (14.5%) of the processes were in production. The Tilak Committee report also noted that a perusal of these processes awaiting utilisation leads them to even conclude that the processes are mainly intended for being used in small-scale capital intensive sector with moderately high inputs of non-renewable energy resources" (CSIR, 1979).

These evaluations clearly point out that in the seventies in the case of rural development

programmes the CSIR R&D managers did not configure the R&D projects for all the aspects to ensure that the technology being developed meets real world needs and can be fitted into the industrial and social infrastructure. The process of technology transfer was undertaken by pushing the available solutions without the technology adaptation effort required for fitting the technology to the conditions of the users. The interaction of R&D workers with users was weak. There was no attempt to match the mechanisms of technology transfer to technical and user conditions, to understand the users as systems and to manage technology transfer as an interactive process.

But even today after an elapse of two decades from the time when the above stated internal evaluation committees made these revelations the situation is no better. In the case of village industries, the conditions for technology development have not changed in any kind of significant way. From a recent survey of the five hundred users of CSIR rural technologies that the author took in collaboration with his colleagues, it has come out quite clearly that even the newly developed technologies are failing to make an impact on the rural scene. Only 18% of CSIR rural technology users were in production and the rest have either not started or have chosen to discontinue the production (Abrol, 1998). This report shows that the programmes of rural development have been apparently going on in the laboratories without any kind of critical evaluation being undertaken by the CSIR headquarters.

There has been very little learning in respect of the management of R&D and technology transfer for rural development in the last twenty years. Scientists continue to self-indulgently believe that their technologies are fully viable economically in rural areas. There is very little record being kept by the laboratories on the status of technology utilisation. Since the top management has been mostly indifferent to the efforts of R&D and technology transfer for rural development, there have been hardly any investments in bringing the users closer through the encouragement to link organisations / agencies that could have acted as the bridge. This lack of investment is reinforcing the habits of CSIR scientists in favour of technology spin-offs.

Technology programmes for rural development continue to be weak on the aspect of networking of external resources such as expertise and funding. During the phase of technology development the interaction with users is very poor. The laboratories continue to depend mainly on the efforts and inputs of their scientists alone and in-house R&D funding for technology development. Involvement of external experts and multi-disciplinary background of laboratory scientists significantly improved the technologies. The situation of networking is no better during the phase of technology implementation. With respect to both technology development and implementation the directions of the laboratories continue to be oriented toward linear model

of innovation where the laboratories produce spin-off technologies without fitting them to the conditions of users or involving them in the adaptive efforts (Pulamte and Abrol, 2003).

Successful examples have come in from the CSIR system, e.g., from Central Leather Research Institute (CLRI), Central Building Research Institute (CBRI) and Central Food Technology Research Institute (CFTRI). But this has happened only when the small producers could be involved in the process of technology development and the selected technologies were suited to the use of local resources, capabilities and markets that are accessible to rural poor. To give a few examples; vegetable tanning of leather, carcass recovery, fire retardant thatched roof, leaf cup making machine, dal mill, oil mill etc. are now beginning to diffuse a bit better. But what is interesting are in fact the examples from the improved alternate practice of those who have tried moving away consciously from the approach of intermediate technologies to promote a small producer to become individually competitive.

4. Experiences with Alternate Forms of Social Organization and Innovation

Production for the local markets is carried out mainly through the efforts of self-employed artisans, peasants and agricultural labour. They are the unorganized small producers or workers who work with the locally available resources to meet many of the local needs. They are mostly unable to compete with large producers by themselves in the market. In some areas co-operatives or groups were formed for input procurement and / or credit. This step, while in the right direction was inadequate. Mutual competition amongst the small producers resulted in breaking up of these co-operatives / groups. Viewed in terms of the production and distribution process and the functions performed, the new group based organisations fall into four broad sets.

In the first set are organizations whose members are all individual home based producers who have organized themselves as a pressure-cum-service group for securing common benefits such as better bargaining strength vis-a-vis traders and cheap credit form banks. The production process itself is left completely untouched by the organization. The main production function and ownership and control over assets are mostly in individual hands. The main disadvantage of this form is that because each individual operates singly there is a limit of production expansion and introduction of new technological and management practices. A good example of this intervention is the effort of the Self-Employed Women's Association (SEWA) to organise poor self-employed women in sector.

In the second set comes those organizations where the distribution process and a part of

production process is collectivised, leaving the major part of the latter in individual hands. It incorporates the advantages of the traditional putting out system without its exploitative features. Both government and private societies had initiated such effort. It is all right as an instrument for implementing labours laws. But organization of this type cannot have much import beyond trying to introduce minimum wages and other related non-wage benefits for its own members. Lizzat Papad is a good example of this type of collective action.

In the third set fall the government umbrella organizations for poor, which perform a variety of functions such as marketing and distribution, provision of infrastructural assistance such as credit technical and marketing expertise, etc. These efforts are one step removed from the actual production and are not even concerned with the implementation of labour laws. They only offer infrastructural support.

In the fourth set fall those organisations, which have attempted to undertake collective production and distribution. In this model the producers are usually organised into a co-operative society to produce one definite product for the market such as milk, raw silk, beedis, crafts etc. Where they are participatory, they own and control the assets, decide on the production policy and work at the production process themselves; sometimes they do hire trained personal to carry out certain type of functions. Such a model has been tried in the form of the Indian Coffee House and Dinesh Bidi (local alternative to cigarette).

As a part of this fourth set, now with the addition of People's Science Movements (PSMs), 'people's technology initiatives' (PTI) under the brand names of 'Farmers' in fruits & vegetable processing, 'Artisans' in leather and Jan Taknik Network (Jatan) in oil and pulse milling are trying to make efforts with an alternate approach to technology implementation. Below we provide an analysis of their experience with the alternate approach to technology implementation.

4.1 People's Technology Initiatives : Basic Model

People's Science Movements' (PSMs) and 'People's Technology Initiatives' (PTI) are structured to support the livelihoods of rural poor specifically through the development of local economy based systems by connecting science and technology to production and marketing through worker participation in management. This approach represents an alternative to mainstream thinking and practice on technology development and application in poverty reduction intervention. It is an offshoot or spin off of the People's Science Movement, the activities which go much beyond rural innovation, but shares a common set of values and principles. The approach owes its origin to the wider Peoples' Science Movement (PSM) that emerged in the early 1980's

around a range of science and society issues.

Several PSM organizations have undertaken a large number of feasibility studies to demonstrate the validity of its approach for a wide variety of field areas. Studies show that in order to be competitive the rural poor will have to come together for the implementation of a taluk-wide (Nodal Town-level) area based multi-sectoral large-scale network of production. The approach suggests that no village can and should exist as a closed self-sufficient entity. A viable unit for planned development at the local economy level is the system of 'taluk wide' economy. Every Indian village, for its major needs, is at least today closely dependent on the local taluk wide economy. This local economy is thus to be approached as a multi-sectoral network.

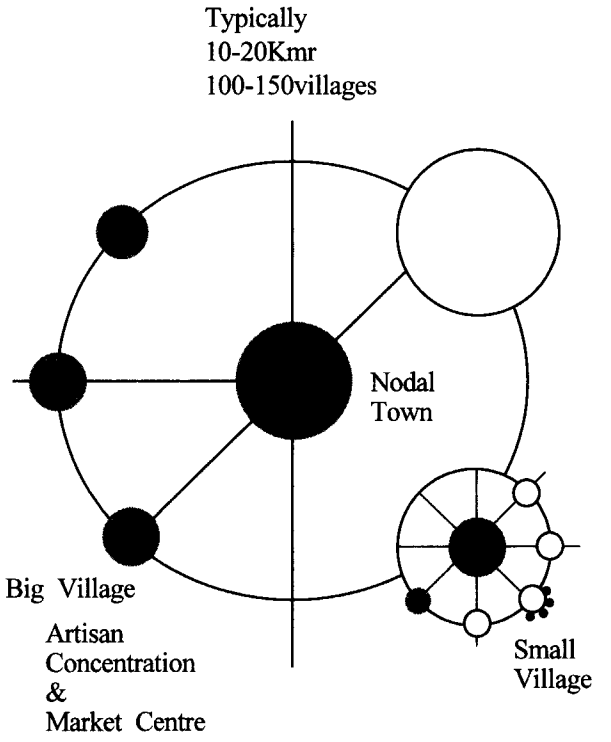

Fig. 1 : Town-Village Network of Rusal Local Economy

In this network for a lot of items the rural poor are themselves both producers and consumers. Sectors should be upgraded in the interest of small producers of village industries on a competitive basis and this can be fruitfully done only if the approach is not of small producers and is based on the principle of co-operation in production across sectors.

To get started the PSM organizations have based their efforts on the existing local peasant-

artisan economy. The assumption of this approach is that this economy is still partly under the control of rural poor and exists as a taluk wide network. The strategy is to develop the secondary and primary production being carried out today by the poor people for the local markets as a system in itself. This way rural poor can hope to establish a large-scale networked system of collective production on the top of this production system because the local economy is accessible and its several elements are already under their own control. Further, there is also the assumption that rural poor will be able to benefit far more from the interventions if we can develop the occupations in an interconnected manner. Occupations engaging the landless labour, artisans, small / marginal cultivators are mutually interrelated amongst themselves, as well as with that of cultivators pursuing bullock-powered agriculture and generally employing family labour. All existing techniques in order to be viable depend upon linked occupations / sectors for provision of inputs, utilization of outputs including that to nearby cultivator settlements (Small Village-Points) for daily labour, and these sub-areas which are also normally equal to panchayat area, form sub units (Medium-Small Village complexes) in the form of inter-linked villages. At these settlements we can locate intermediate processing functions. The kasbas (Big Villages with Artisan Concentrations or Traditional Market Centres) in their turn are inter-linked to the local taluk town that provides access to non-local products. The town also serves as an outlet for local products to the non-local economies. At the Taluk town we can locate the functions of technological services, fabrication, sales and distribution.

4.2 Technology Models Developed for Rural Non-farm Sectors in PTI

Currently, the PTI are focused on the development of technology application models for the rural non-farm sector. This choice is on account of the understanding that interventions encouraging local value addition through linking of primary and secondary production will allow the efforts to realize the economies of scale and scope, assure network and cluster effects better and develop the local economy as a system. In close to 6-7 states the users whose access to land is limited and who engage in mainly non-farm occupations are already using the above said principle for technological upgrading of the rural non-farm sectors in selected rural areas.

PSMs activists are helping these users to implement the innovative technology models developed to get kick-start local economies as a system in itself. Innovative technology models have been developed with the support of agencies like Department of Science and Technology (DST), Council for Promotion of Application of Rural Technologies (CAPART) and Technology Mission on Oilseeds and Pulses (TMOP). There exists today a wide range of technology models available

for rural application with the S&T voluntary agencies in the fields of agro processing, fruits and vegetables processing, processing of economic and medicinal plants, bio-mass based energy systems, leather processing, carcass utilization, etc.[3] Those readers unfamiliar with the approach may be surprised that in India there are already more than a dozen groups that have been established with these principles. Each group has been able to involve in its respective initiative about 200-300 beneficiaries directly spread over a region of about 30 rural and semi-rural settlements. Each of these initiatives benefits indirectly a target population of somewhere in the region of 100 to 120 thousand rural population. Most of these initiatives have been implemented through the financial support of government programmes for rural technologies.

4.3 Experience of Fruit and Vegetable Processing

To take an example, green natural products are on the way to get acceptance in the markets that are not elite and are competitive where price competition matters. In the sector of fruit processing, the PSMs have been able to launch very rapidly 'green', natural, fully safe, healthy products at competitive prices. In India today UNDP is promoting the same fruit-processing model now through the PSM linked S&T voluntary agencies to the parties interested in commercialising the technology in newer areas. Several organizations such as Society for Technology and Development (STD), Mandi in Himachal Pradesh, Centre for Technology and Development (CTD), Dehradoon in Uttar Pradesh, Forum for Scientists, Engineers and Technologists (FOSET) Calcutta in West Bengal, Centre for Social Work and Research (CSR), Agartala in Tripura, Himachal Environment Studies and Conservation Organization (HESCO), Garwhwal in Uttranchal, Haryana Vigyan Manch (HVM), Rohtak in Haryana, etc. are already working on the implementation of suitably designed systems of fruits and vegetables processing that are managed by the group enterprises.

Products are being marketed using a common brand name called 'Farmers'. The niche selected for intervention emphasizes the development of natural products. Technology models have been standardized under the field conditions of networked system of production for the operations of pulping / juicing / jamming, pickling / fermentation, drying / osmo-dehydration. The system design envisaged for processing and production involves a network of women beneficiaries organized at small village level units and a nodal processing unit at town / kasba level which receives the semi-processed materials from the previous level for drying and packaging.

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3) For further information see the following source books and directories (CSSTD, CSIR, 1981; DST, 2001).

4.4 Small-scale Systems for Processing of Oilseeds

In the area of mustard processing, traditionally bullock driven ghanis (oil presses) were in use for the processing of mustard oil in India. KVIC tried to replace these ghanis using the technology of power ghanis. Economics did not work favorably for the ghanis except in the markets where the premium is available for pungency. There was too much residual oil being left in the oil cake.

In 1998, Mechnical Engineering Research & Design Organization (MERADO) developed an expeller that not only ensured pungency of oil through temperature control, but also left less residual oil in oil cake. Developed at MERADO, Ludhiana, a constituent establishment of Central Mechanical Engineering Research Institute (CMERI), Durgapur, 1 TPD oil expeller was a small scale oilseed processing unit featuring several advantages: extraction of pungent oil from mustard oil, high oil extraction efficiency, low residual oil in cake, better hygiene than ghani, longer life of critical components. In the case of processing of mustard, the machine had been developed by the CSIR laboratory to obtain a substitute of kolhu, a traditional oil press used in the country for the production of pungent mustard oil. In spite of this advantage the technology was incomplete on its release to the user. In this case too, Haryana Vigyan Manch, Haryana (HVM), again a PSM organization has acted as the bridge between the laboratory and the local producers. The system was incomplete because the size of local market was insufficient to consume the oil that would be produced if run on its full capacity utilisation. The designed capacity of MERADO expeller is four times higher than the capacity of ghani.

Large producers, who use modern expellers of varying capacities in combination with ghanis, needed only when the pungent oil is to be marketed, have already penetrated the town markets. In the short run, for a new producer the reasonable solution turns out to be one of to sell the product in the non-local market niches where there are some niches available for co-operative production. Even when the enterprise is local, experience tells that it takes time for a new producer to establish itself in the local market.

But for tapping the non-local market the producer should have a set up for filtration. The package did not contain appropriately engineered filtration set-up. To save on the investment new strategies had to be devised for filtration. In the large-scale units the practice of double filtration is a norm. They deploy usually two filters in series to undertake double filtration. In the case of small units it would not advisable to go for the establishment of two filters. The only answer was innovating in filtration. By combining appropriately the processes of double filter cloth, settlement and decanting the producer achieved the innovation by himself.

Learning strategies used included talking to the workers, speaking to the technology generators and engaging in experimentation at the shop floor. For a group enterprise that is worker owned this kind of experimentation was easy to manage. It did equally well when it came to working out a solution in respect of the utilisation of oil cake. The option of selling this co-product to the solvent extraction units was ruled out. The option of preparing cattle feed was duly explored with a helping hand from the university nearby which specialises in agriculture and animal husbandry. Innovating was not easy. Cattle feed based on mustard oil cake was a new product for the local market where the preference for cotton oilseed or its cake are already well established due the animals having got used to these products.

Formulations had to be adapted not only in terms of promoting the utilisation of local ingredients but also in terms of adapting the preparations to suit the palate and body of the local animals. Experimentation was undertaken by the group enterprise keeping in view that the new preparations are economically competitive. Cattle feed markets are sensitive to the prices of substitutes that come seasonally into the market after the harvests as a cheap source of bulk supply. The networked group enterprise model was of tremendous help, it has allowed both the oil processing and the cattle feed making units to survive the ups and downs going on in the local markets every at the time of the seasonal fluctuations.

Thanks to the bridging organisations learning has been as per the requirements of systems designs needed. Both the technology system and the business system are coming up as per the requirements of the outcomes that are also radical in nature. The rural poor have not been eliminated. They are in command of the production organisation. The model of worker- owned group entrepreneurship is getting ready for acceptance in the agro-industrial environment where the modern forms of management are even today scarce in the large-scale operations.

It is important to note that when the PTI considered it for incorporation in its technology system design, as a commercial system 1 TPD oil-expelling unit was yet to be tried out in the field. The edible oil industry is highly competitive. The market is price sensitive. The large mill owners can even make money through speculative trading of oilseeds and oil. It was a foregone conclusion that it would not be easy for the rural enterprise to run a viable business based on this machine. Further, as the capacity of this expeller is four times the capacity of kolhu, it posed the problems like how would the rural enterprises get access to markets outside the village, dispose oilcake and raise the working capital to run a relatively higher scale unit.

MERADO, Ludhiana scientists had not applied their mind to the above-mentioned problems. They did not have a technology package to deal with all of these from the standpoint of rural enterprise. It was necessary to develop a complete technology package based on a system design

that would make this machine accessible to the rural enterprise. Modified system designs have allowed the rural poor to access local markets and practise successfully the establishment of forward and backward linkages within the local economy.

The above-discussed case of success of 1 TPD oil expeller is only a beginning of the plans developed for the development of local economy as a system. The said group enterprise is now getting ready to implement the mini dhal mill developed by Central Food Technological Research Institute (CFTRI), a constituent laboratory of the CSIR system. Technology demonstrations for mini dhal mill are already taking place on behalf of this laboratory in the major markets. Licensed fabricators are already marketing mini dhal mill units as commercial entities in the states of Bihar and Madhya Pradesh. Already, in Bihar, there exist some parties who are successfully working the mini dhal mills and hand operated pulse de-husking machines as viable commercial units in the city markets. It appears that many of them are successful only due to the forward integration they have been able to undertake because of their competitive access to the markets for sattu (a roasted, grounded gram product, used as a nutritional supplement in the states of Bihar and Uttar Pradesh), besan (a finely grounded gram product for preparing pakodas & pranthas), vadis and papads (pre-processed, easily preservable, spicy pulse products) and chanachur (mixtures made out of gram dhals, beaten rice and several other processed cereals).

They are using the machines as mainly in-house units for the enterprises engaged in the making of sattu, besan, vadi, papad and chanachur. However, in the rural environment close to the centres of raw material production their commercial viability is yet to be established. HVM, Haryana is in the process of establishing min-dhal mills as a part of the networked system of group enterprise in Hisar. It is attempting to integrate the operations of mini-dhal mill with the system design developed for the implementation of oil expeller.

These processing units are now adding to their portfolio the provision of services for the introduction of improved production technologies for mustard and gram production. From 2003 onwards the HVM, Haryana has started supplying agri-inputs like vermi compost and gypsum (as a source of sulphur) to improve the productivity and quality of oilseeds and pulses in the area around its processing unit in Hisar (Haryana). It has got the peasants to successfully introduce the use of bio-traps (pheromone traps) to deal with the problem of pod-borer a pest that seeks to eliminate gram from the cropping system of this area and other areas in India.

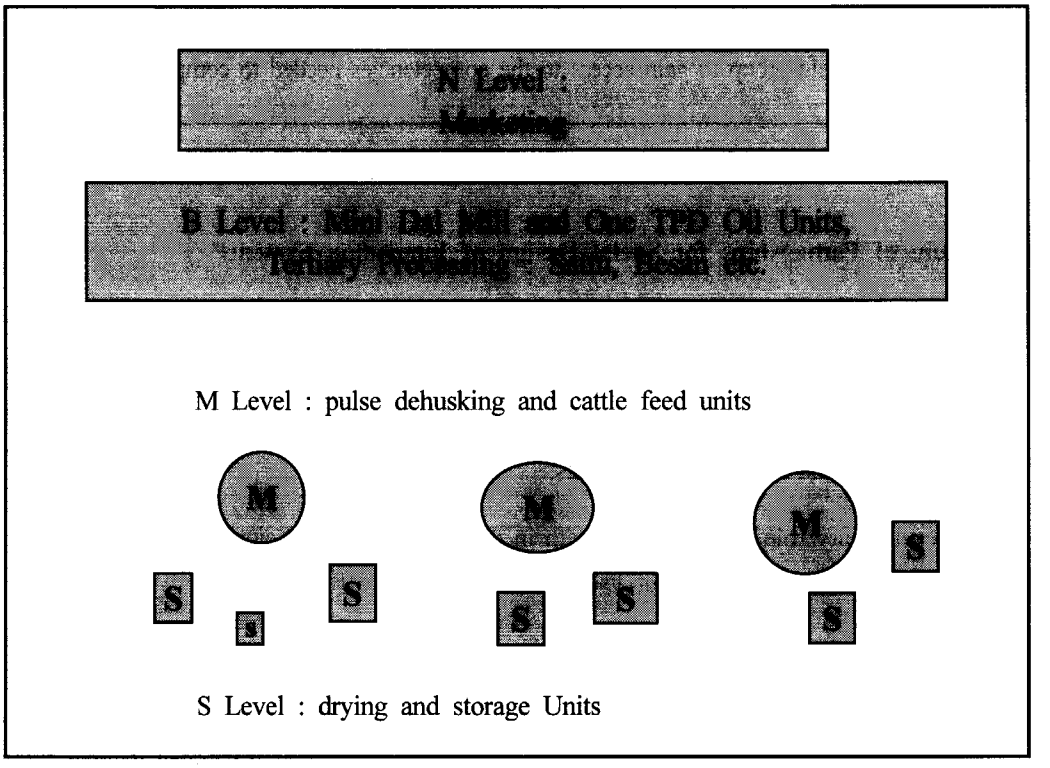

Fig. 2 : System of Production in Mother Cum Satellite Units

Experience with the implementation of interfaces in the innovation system, the support to HVM, Haryana, the S&T field group established at Kanwari from the youth of the village has been quite critical to the successful implementation of PTI including competence development for technological innovations. The village youth has supported the efforts for its mobilisation of local funds. As some of the young people are working in the mills in Hisar the field group was able to use those contacts to build links with the skilled innovative people working in large oil mill. Thanks to these contacts this field group has contributed extremely useful inputs for the successful development of the technology system, particularly in respect of oil filtration.

The nodal team (N level group) formed at Hisar with the help of the activists of Haryana Vigyan Manch (HVM), a PSM group was found to be an essential condition for success in the implementation of system design. It had access to external competencies of Hisar Agricultural University (HAU), Hisar and National Institute of Science, Technology and Development Studies (NISTADS), CSIR, etc. With the help of this nodal group the S&T field group could make easily all the efforts needed to learn the capabilities required for network development. The innovative protocols were required to be designed for in-house filtration, quality control and

packaging of mustard oil to be competitive in the local market. The nodal group located was able to help the field group to gain access to the competencies needed to complete the technology package.

5. Nature of Partnerships for Social Design of Innovation Systems

Several critical developments allowed the disparate parts of this movement to coalesce and take organisational form. These included :

- The Department of Science and Technology programmes of "S&T for weaker sections" and similar state sponsored schemes.
- The visionary role of individuals both in the Department of Science and Technology and within the activist movement itself.
- The emergence of Science and Technology Voluntary Organisations (STVO), starting with the Delhi Science Forum and others.
- The emergence of a collective identity of these organisations as a national Peoples Science Movement.

A further context that allowed this alternative approach to take shape concerned a loosening of institutional rigidities in public sector research institutes, particularly in the Council for Scientific and Industrial Research. The PTI viewed sources of knowledge in systems terms seeking to reorganise S&T expertise around technology systems embedded in community-based contexts (rather than disciplinary and corporate enterprise contexts). Programme support from the Department of Science and Technology helps to draw together cross-organisational expertise, breaking down the barriers of disciplinary funding and rigid mandates inherent in research council institutional arrangements.

A final contextual feature relates to the evolution of different STVO's and the way they have adapted the PTI ideals to different local institutional and development contexts, introducing considerable variation. The processes within PSM are being consciously utilized to articulate and communicate these conceptual and philosophical perspectives within and between the PTI. Needless to say, the processes are less than smooth. Debates exist inside on who is implementing to what extent the rules enunciated and share how much of the informal shared values within

the organisational culture of the broader PSM.

5.1 Four New Mechanisms of Technology Implementation

To develop this co-operation on a consistent basis experience indicates that interventions are required in respect of the following: To improve the transferability of available technologies for the establishment of multi-sectoral production networks of rural poor the S&T oriented development agencies need an approach of active intervention in respect of identification of the needs of peasants, artisans and agricultural labourers as producers, adaptation of the technologies to make them fully competitive in local markets, development of the users' capabilities with the aim to make the local producers competitive against non-local goods, formation of the networks in production for the establishment of forward and backward linkages within the local economy area itself to achieve competitiveness and establishment of the linkages for continuous improvement on a competitive basis with the laboratories, financial institutions and governmental bodies. To take charge of these interventions the proposed approach of establishment of multi-sectoral network system of group enterprises requires a new system of technology implementation, called the network system of technology implementation.

This system incorporates four new mechanisms: need identification, user development, technology adaptation, & network formation. These mechanisms are needed to incorporate integrated solutions to the problems that the rural enterprises face while adopting the technologies, such as choice of the markets, product-mix and production system design to tackle the competition arising from the large urban producers who have cheaper access to finance, raw materials, technological inputs and markets; adaptation of technology to connect the available technologies to local resources, capabilities and markets to improve the competitiveness of rural enterprises in the market; acquisition of the matching economic and technological competence by the enterprises for technology mastery and market development; and selection and implementation of the strategy for network development to establish the required forward and backward linkages. These four new mechanisms of technology implementation can be explained more in detail as the followings.

Need identification in the proposed approach to technology implementation is undertaken for system design to provide integrated solutions to the above said problems faced by the users. Needs are identified in the form of a feasibility study through field investigations by the S&T field persons in collaboration with the technology generating scientists and the scientists identified for technology system development. In these field investigations the users participate actively through the S&T field persons.

User development efforts are needed to help the users to organise themselves for the competitive processes. In the case of the rural enterprises the industries under consideration are highly competitive. Special efforts are required for the success of rural enterprises. Through the processes of creation of 'group enterprises' and 'networked system of production' and 'participative management in production', people's oriented development is created. Successes in user development are achieved via the guidance and support for economic competence development to be provided through the S&T field persons who also stimulate the users to organise themselves to make use of the help.

Technology adaptation efforts are undertaken by the technology generating laboratories through a field level programme of adaptive research, development & design (RDD) in which the identified scientists collaborate with the S&T field activists and the scientists identified for the development of system functions. Through a programme of adaptive RDD the selected technological designs are made compatible with locally available resources, locally controllable markets and locally developable capabilities. The shaping process for technology package is guided by the design heuristics of networked system of production.

Lastly, network formation is provided for in the efforts for production network development, technology proving and technology replication to tackle the problems of establishment of appropriate forward and backward linkages. Development of the local economy as a system in itself is incorporated into the approach to system design of production technology implementation. It is again taken up as a collaborative programme between the S&T field persons, the scientists identified for bridging role and the technology generating team.

5.2 Bridging Organizations for Technology Implementation

For these mechanisms to be established the approach suggests the formation of bridging institutions as its key requirement. In the proposed approach of technology implementation the bridging institutions play a very important role. Particularly, the organisation that plays the role of a system development group is critical. The approach to technology implementation suggests that as technology generating groups (TGs) the laboratories would be required to collaborate with the two new groups: the S&T field persons groups (FGs) and the system design and development persons groups (SGs). The proposal is that the S&T activists being identified for the bridging role should be asked to act as the system design and development persons (SGs). In this approach, the system design and development persons (SGs) take care of the functions of executive co-ordination of opportunity analysis, system design, technology specification, technology

adaptation and proving, management information system, monitoring and. organisational guidance for enterprise development, network formation and technology replication.

In this approach the TGs are also required to collaborate with the S&T field persons or groups (FGs) who are capable of performing the functions of entrepreneurial leadership. The S&T field persons would be selected from among the users. They are also themselves users, and selected from among the users for the ability to provide entrepreneurial leadership to the local producers. They are an active interface of the technology generating institutions in the field. Their income comes from the participation in production activities such as in the tasks of need identification, user development, technology adaptation, and network formation. They may be selected either from among the S&T voluntary agencies that are willing to perform this role, or from among the potential users who are willing to establish the role of mother units for the satellite users.

Needless to say, the above-mentioned collaborators will have to be nurtured by the agencies as close network partners in an interactive, bottom-up and user-oriented process of technology implementation. As described earlier in the description of technology implementation mechanisms and bridging organizations created, the partnerships involved in the PTI approach are of two types. The first is partnerships within the movement and its different organisational elements and the critical partnership with the poor themselves. The second is the partnerships between PTI and the formal (usually) public research institutes and the agencies funding the programmes that the PTI is involved with. Again to understand this some details of the approach are necessary. There are a number of elements to this.

5.3 System Design Group: Partnerships in Planning.

A PTI initiative usually starts with a system design group. This includes local representatives from the PTI often involving S&T volunteers who together with poor people from rural areas undertake a field investigation and develop an implementation plan. The term 'system design' is interesting here as it signifies an approach that is different from needs assessment in the conventional sense. Instead the approach is to identify resources in rural areas and opportunities in local economies and then formulate the nature of the technology system that would be required to strengthen the local economy and the participation of the poor in it. This type of approach suggests the implementation of an important and different type of partnership to that conventional found in development interventions. It is a partnership between rural people and the external agency (the PTI) and other actors in the local economy, with a view to identifying ways in

which the whole can be strengthened. PTI views its relationship with the rural poor as a critical partnership in its approach.

Such interventions have led to the successful establishment of a range of rural enterprises serving local markets in selected field sites. These have usually been related to agro-based products or natural resources; for example, pottery, leather tanning, agro-processing of fruits and vegetables.

5.4 Field Group: Partnerships in Implementation & Capacity Development

One of the key tasks of the system design group is to identify poor people in rural areas whom they can work with. The PTI approach takes a long term view recognising that will need to play and significant capacity development role to develop the skills and competencies of the field group. In particular the approach seeks identify and develop among rural communities entrepreneurial leaders. The organisational model, which they adopt, is that of the worker managed cooperative / society. Another aspect of the approach is that while the initiative and the system might be set up for example processing horticultural produce, this focus is used to anchor a related set of activities along side, i.e. processing different crops or other value addition or marketing activities. Once again the relationship between the PTI and field group is a critical partnership that is nurtured as the intervention develops and evolves along the way.

5.5 Scientific Organiztions without Walls

The task of the system design group is to develop linkages with scientists within the formal science system. The approach is that the design team will first look at the indigenous knowledge of rural people and use this as a starting point to build the technological system and its capabilities. Formal scientist is therefore used as way of strengthening existing technological starting points and building techno-economic trajectories from the bottom up. The PTI takes the perspective of starting with a village based industry, and looking at how formal S&T can improve the technologies involved and helps develop the quality and supply systems to link decentralized processing to the local and wider economy.

However, when it comes to developing partnerships with the formal science system, the PTI does not make partners with organisations, instead preferring to link with individuals. In fact this has been one key networking achievement of the PTI as it has built up a network of individuals working in the formal science system who recognise that S&T can be exploited in different ways. The PTI recognise this approach as one that helps to construct scientific organisations without walls. Building up these ties with the formal scientific (and as we shall see below)

government establishment has been an important mechanism for garnering sufficient support to make PTI initiatives a reality. Without this network support one could quite easily see how such an idea could remain little more than a pipedream.

5.6 Sources of Funds

As already suggested in the introductory sections one of the initial impetus for launching of the PTI was the start of the scheme entitled S&T for Weaker Sections within the Indian Government, Department of Science and Technology (DST). More specifically it was the funding that the DST made available, and indeed other sources of funding have been made available. An important point here is that DST was a key partner in the evolution of the PTI. The scheme entitled S&T for Weaker sections recognised the value of an approach that one could argue flies in the face of all that is held to be good scientific practice in the formal scientific organisations of India. This type of partnership needs to be recognised.

5.7 Institutional Rigidities

Naturally, an approach such as the PTI has repeatedly encountered institutional rigidities, rule sets and norms of the formal S&T organisations and other administrative systems. As has already been discussed, networking at an individual level has been an important way of dealing with rigidities. This has been important as a way of bring together formal S&T expertise from different institutional setting, an outcome that would have been much more difficult to achieve through partnerships at the organisation level.

One persistent area of rigidity concerns the rules that accompany many sponsors. The main problem is that sponsors like to have a clear statement at the beginning of the project about the nature of the "problem" and how it will be resolved and the project executed. This tends to sit uncomfortably when an approach is evolutionary in nature, i.e. in the sense it is process driven, concentrating on developing local capacities and pursuing opportunities in the local economy as they arise. In fact, the PTI felt that its reliance on grants was becoming rigid within the organisation itself. In other words, it has to make serious efforts to overcome a norm that is both creating dependency and bring with it the rigidities and norms of the outside funding agency.

5.8 Learning Processes

Active encouragement to the participation of workers in management of the group enterprises

has been a point of debate within the movement. It has been generally found that while the selected workers are always quite comfortable in these initiatives with the learning of technological competences they have taken more time to develop economic competences like market building, sales recovery and management. Particularly, experience with the reformist leadership practices of activists and preference for comfortable funding approaches has been debated. Conclusions are that the movement must shun these weaknesses at the earliest if it is to succeed better with the replication process.

And there are undoubtedly many more specific and general principles that have been learnt along the way. But, perhaps a more important question in relation to an approach that has successfully learned to evolve and developed in new and useful ways is how this learning takes place. Formal evaluations, usually associated initiatives supported by external funds, have been an important way of monitoring outcomes of the approach against stated aims. However, probably much more important has been constant debates and interactions among those involved in the peoples movement. This very much relates to the organisational culture of the PTI. All members have a very strong personal commitment to the underlying ideology of the movement and as such have a personal stake in the way this is interpreted and implemented. This appears to have led to a tradition of robust debate and reflection on the relative merits of approaches practices and principles. This sort of organisational culture seems to be the most recognisable mechanism by which the PTI learns and evolves, and with a fair degree of such success by all accounts.

6. Concluding Remarks

A new tradition of technology implementation is in the process of being created in India. It has been around now for over one decade. It offers a number of important lessons for the students of innovation.

First of all, it tells us that the notions of competitiveness evaluation can play a determining role in the practice of technology implementation and development. And, that the tradition of people's technology initiatives is building itself on the basis of systemic notions of competitiveness, which in turn are positively influencing the outcomes of technology implementation for the benefit of village industries in India. This new tradition indicates that under competitive conditions the self-employed small producer has not only to come together for access to resources, but also has to emerge as a multi-sectoral collective of producers, co-operating in production. Since

economies of scale are required to overcome adverse competition, rural poor must be consciously networked and technologically advanced in a mutually complementing way. Rural poor must pool the resources and capabilities for raising the scale and scope of their collective production organization. This change in the scale and scope can alone allow the participating members to lower the barriers facing them in the creation and adoption of more sophisticated and improved technologies, which can make their production in the local markets more competitive than before.

Second, as the weaker sections still have some advantage in these underdeveloped sectors in respect of the access to resources, market and capabilities, even today an important window of opportunity is readily available in these rural industrial clusters and territories for a sustained development of productive forces. But small producers will have to avoid mutual competition to undertake this endeavour on their own. Experience is that for superior access to resources and markets, and to technology landless labour, artisans and poor peasants are required to organise themselves for area based multi-sectoral large-scale production systems. And that co-operation on a large scale occurs only infrequently on its own; even when it does, it seldom sustains on its own. Further, for getting started they have to develop firstly the local markets accessible to them, where they are themselves both producers and consumers and then only diversify to non-local markets. This is absolutely essential if we want these organizations to be participatory and capable of self-promotion, with only a catalysis function being performed by the others.

Third, that these sectors need however a different model of innovation to avail this window of opportunity and in this model of innovation weaker sections have to be themselves encouraged to pursue consciously a new type of development strategy for the upgrading of local economies as systems-in-itself. In this development strategy industrial upgrading is undertaken via the establishment of muti-sectoral network systems of production. In these networked systems of production the weaker sections are not joined through market; they are joined through planning. This allows even the weaker sections to internalize successfully the division of labor in their organization. As a result, they are able to access non-local resources and capabilities in a competitive way and systemically connect these inputs with the local resources, market and capabilities. They can emerge as the effective new social carriers of innovation in these sectors. In developing these networks of production as systems embedded in the competitive access of weaker sections to local resources, market and capabilities, science is also able to become significantly instrumental in synthesizing the new division of labour. With an active interest in the creation and diffusion of innovations as adaptable recombinations to involve the rural poor, enterprises would be able to unfold and recombine the innovations to suit local conditions. It is in all these senses that the PTI espouses an alternative paradigm of S&T and rural development.

Fourth, the approach has emerged out of the broader People's Science Movement in India, itself a backlash against what was viewed as the weak governance of science and its failure to meet the needs of the poor and enhance their productive capacities. The elements of the PTI reflect these contextual origins with an approach that seeks to build technology systems around local knowledge and resources-rather than visa versa, as is the case with conventional models of technology development. As can be seen the networking and building partnership has been a very important element in the PTI-both in terms of individual initiatives as well as in terms of promoting and supporting the approach more widely.

A final point that is notable is the capacity development focus of the PTI. This is capacity development both in terms of enhancing the skills and technologies of poor people. There is also capacity development in the sense of linking the poor to sources of S&T and thus enhancing the capacity of the local technology system. The evolutionary characteristics of this capacity development are typical of such a learning based approach where the goals are competitive advantage of the poor and not of the nation in whose name the rich only benefit more. This case perhaps presents a rather radical alternative to mainstream S&T and rural development initiatives, how the principles of partnership and learning are clearly more widely relevant and could be adopted by others.

References

Abrol, D. (1998), *Technological Transformation of Rural Areas: A Guidebook on Network System of Technology Implementation,* New Delhi: National Institute of Science, Technology and Development Studies.

Abrol, D., Menon U., Pulamte, L. and Kumar, P. V. S. (1998), *Evaluation of CSIR Rural Technologies,* Report No. 293, New Delhi: National Institute of Science, Technology and Development Studies.

Carney, D., Drinkwater M., Ruisinow, T., Neefjes, K. and Singh, N. (1999), *Livelihood Approaches Compared: A Brief Comparison of the Livelihoods Approaches of the UK DFID, CARE, Oxfam and* UNDP, London: DFID.

Chadha, G. K. (1993), "Special Issue on Non-Farm Sector in the Rural Economy of India", *Indian Journal of Labour Economics,* Vol. 36, No. 3

Cooper, C. (1995), *Technological Change and Dual Economies,* Maastricht: Institute of New Technologies, United Nations University

CSIR (1978), *Karimnagar Project: Evaluation of Rural Development Experiment,* New Delhi: Council of Scientific and Industrial Research.

CSIR (1979), *Report of the CSIR Committee on Technology Delivery System for Rural and Small Sectors,* New Delhi: Council of Scientific and Industrial Research.

CSIR (1994), *CSIR Rural Technologies-A Compendium,* New Delhi: Council of Scientific & Industrial Research.

CSSTD (1980), *Gaon Ke Karigar and Science,* New Delhi: Council of Scientific & Industrial Research.

Dawson, J. and Jeans, A. (1997), *Looking beyond Credit. Business Development Services and the Promotion of Innovation among Small Producers,* London: Intermediate Technology Publications.

Hobley, M. (2001), Unpacking the PIP Box, Discussion paper on www.livelihoods.org, Somerset: Hobley Shields Associates.

Krisnaswamy, K. N. and Reddy, A. K. N. (1994), "The Commercialisation of Improved Technologies in Rural Areas", in Bhalla, A. S. and Reddy, A. K. N., (eds.), *The Technological Transformation of Rural India,* London: Intermediate Technology Publications.

Mike, A. and Scott, A. (2001), Understanding Livelihoods that Involve Micro-enterprise: Markets and Technological Capabilities in the SL Framework, Warwickshire: *Intermediate Technology Development Group.*

Panditrao, Y. A. (1994), "Experiences of the Khadi and Village Industries Commission in Technology Transfer" in Bhalla, A. S. and Reddy, A. K. N., (eds.), *The Technological Transformation of Rural India,* London: Intermediate Technology Publications.

Papola, T. S. (1992), "Rural Non-farm Employment: An Assessment of Recent Trends", *Indian Journal of Labour Economics,* Vol. 35, No.3.

Planning Commission (2002), *The Special Group on Targeting Ten Million Employment Opportunities Per Year,* New Delhi: Government of India.

Pulamte, L. and Abrol, D. (2003), "Technology Transfer for Rural Development: Managing Rand D at CSIR", *Economic and Political Weekly,* August.

Raghunandan, D. (2002), "Technologies and Systems for Rural Artisanal Industries: Case Studies in India", in *Development by Design,* Bangalore: Think Cycle.

Romjin, H. (2001), "Technology Support for Small-scale Industry in Developing Countries: A Review of Concepts and Project Practices", *Oxford Development Studies,* Vol. 29, No.1.

Thomas, F. and Mahajan, V. (1997), *The Forgotten Sector: Non farm Employment and Enterprises in Rural India,* New Delhi: Intermediate Technology Publications.