Enabling Factors and Performance of S&T Based Societal Projects: An Indian Case Study

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Abstract

The aim of the present study was to analyze various intricacies and complexities of the S&T based societal projects, and to identify the enabling factors of such projects. An analysis was carried out to assess the benefits to the community of these funded projects by evaluating the impact of technologies on the project outcomes, and on the target beneficiaries. For the present analysis, the societal projects supported during a five-year period were considered. The analysis covered 491 projects sponsored to 306 organizations in different parts of the country, at a total cost of about INR 360 million. The analysis shows that such projects not only bring tangible benefits to the target beneficiaries and the area but also empower them in deriving benefits of the technological advancements.

The analysis was conducted covering two major aspects- outcome of the projects and identification of the enabling factors which governed the design, management and performance of the projects. The second part of analysis focused on the identification of a set of enabling factors comprising input and output variables to quantify the design and management aspects as well as performance of projects in terms of productive outcomes, extent of sustainability and potential for replicability.

The analysis also presents a methodology to the funding agencies as well as to the planners in designing S&T based societal programmes keeping in view the critical enabling factors so that the returns from the investments are optimally utilized and to make these projects successful in terms of ensuring their replicability and utilisation in various sectors of sustainable development. Based on the analysis, the paper suggests that a package of strategies can be adopted for the projects to be more focussed, productive and sustainable over the time, particularly for development of sustainable micro-enterprises, and for potential replication and scaling up.

Keywords: Science & Technology, Societal Project, Innovation, Rural Development, Performance Indicators, Livelihood.

1. Introduction

An important role of science and technology in a developing country like India is to facilitate the community with the tools and techniques to address the realities of life, e.g. poverty, unemployment, drudgery in daily chores and livelihood works, lack of essential amenities. Technology is considered to be among the greatest enablers for improved quality of life. Brewer et al. (2005) presented the benefits of a variety of ICT applications in developing regions, including in India. Through S&T interventions, a lot of employment generation is possible in the rural sector, leading to value addition in the rural living (Haque, 1991). Kumar and Jain (2002) analyzed the inherent uncertainties and associated risks in the development

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and commercialization of new technologies for societal benefits, and presented policy perspectives for encouraging new technologies in an enabling environment.

India now has few successful models of community based development works in rural areas (even involving private sectors), covering the activities in areas of healthcare, education and literacy, water, sanitation, environment, livelihood skills. Use of ICT in irrigation and water distribution, post-harvest technologies for processing and adding value to the produces, cold storage and cold-chains for short-term storage and transportation to market, appropriate energy systems at affordable costs, etc. are some examples of needed technology applications in rural areas. Societal projects operating in India basically aim at providing economic and environmental benefits to the society, for example through application of technology in agricultural, horticultural, health, water & energy sectors, thereby integrating science and technology with the village economy.

Technology based societal projects have generally performed well and had good success rate in the country (Goyal & Dixit, 2008; Raina, 2008). These projects are largely supported by Ministry of Science & Technology, Ministry of New & Renewable Energy, Ministry of Rural Development, and in the non-government sector by agencies like DFID, UNDP, UNESCO, UNEP, World Bank, Asia Development Bank, NABARD (RIF), and SIDBI. In such projects, the problem to be solved and the solution offered (including technology) are based on the local conditions, needs, demands and availability of resources, and are derived from the field through participatory approaches involving local community (Dasgupta et al., 2004). Rural Innovation Policy Working Group (RIPWiG) of the UNU-INTECH, as part of a DFID funded research project "New insights into promoting rural innovation: learning from civil society organizations", reviewed two science and technology-based rural development schemes of the Government of India. The Group reported that the S&T Applications for Rural Development (STARD) scheme of the Department of Science & Technology, which forms part of the schemes covered under the present paper, facilitated strengthening and capacity building of the supported NGOs in developing into centres of excellence (INTECH, 2005). Evaluation of such R&D-based projects based on the outcomes and analyzing their performance indicators is critical to make them more effective as well as productive (Hong et al., 2012). This study attempts to identify a set of enabling factors which tend to make the project-based interventions more productive in terms of the outcomes, techno-economic viability and long-term sustainability and replicability.

2. Research Framework

Through societal projects, the Department of Science and Technology (DST) has been performing the role of a facilitator in creating a strong interface between science and the country's poor, particularly in the rural areas. The programme has helped a large number of grassroot organisations, beneficiary groups and development institutions in understanding the S&T needs of the poor and supported a large variety of S&T-based development projects (GoI, 1997).

All the supported projects are evaluated annually through a peer review mechanism comprising of subject experts and departmental officers. At these 'annual review meetings', the project investigators make presentation of the progress achieved against the approved objectives during the reported period. Continuation of the project (and release of funds) is subject to the satisfactory performance of these projects.

Further analysis was carried out on a set of completed projects to assess the benefits to the community of these funded projects by evaluating the impact of technologies on the project outcomes, and on the target beneficiaries. The analysis was conducted covering two major aspects; outcome of the projects and identification of the enabling factors which governed the design, performance and management of the projects.

The second part of analysis focused on the identification of a set of enabling factors comprising input and output variables to quantify the design

and management aspects as well as performance of projects in terms of productive outcomes, extent of sustainability and potential for replicability. The information required for analysis was also supplemented through field visits to the project sites. The analysis gave useful insight into the intricacies and complexities of the S&T based societal projects, which could be used for fine tuning the future direction for such projects.

3. Case Study

In this study, the societal projects sponsored by DST during a five-year period (1998-99 to 2002-2003) were considered. The analysis covered 491 projects sponsored to 306 organizations in different parts of the country, at a total cost of about INR 360 million. The main type of activities undertaken during execution of these societal projects included (1) technology development, (2) technology development and transfer, (3) technology transfer and training, and (4) training programmes. The first category of projects, i.e. 'technology development' includes technology adaptation with upscaling/downscaling and modifications suiting the local conditions. For the present analysis, a representative sample of 103 projects was used to perform a correlation analysis to derive the inferences. The sample projects selected were those which demonstrated good results during execution and performed well during various evaluations.

3.1 Projects Coverage

3.1.1 Target Beneficiaries

81% of the projects were undertaken in rural areas, 11% in urban and 8% covering both. The analysis indicates that 25% of the projects were addressed to the SC/ST population (including scavengers and collectors of non-timber forest produces) and 24% to the farmers, which included orchid farmers, poultry farmers and fishermen. For about 12% of the projects, the target groups were artisans and crafts-persons, about 30% of the interventions were designed to reach out to women and 7% to youth. Also, 2% of the projects were found to be focused on the handicapped, rickshaw-pullers, disaster management personnel, Gharat (watermill) owners and slum dwellers.

The finding also suggests that 64% of the projects addressed target groups of less than 100 beneficiaries, indirectly indicating their relatively smaller geographical coverage. For 17% of the projects, the size of target groups was 100-200. Another 19% of them were designed to reach out to more than 200 beneficiaries.

3.1.2 Projects Distribution

During the reported period, 44% of the societal projects sponsored by the DST pertained to transfer of available technologies at the grassroot level. 17% of these were focused on technology development and transfer (including skill building among the target beneficiaries). Significantly, 15% of the projects led to development of improved technologies to meet the needs of socio-economic development at the grassroots. The percentage of projects that were focused primarily on imparting training for skill formation among the beneficiaries was 12%. Another 12% of them pertained to awareness building, publications, research studies, scholarship scheme, workshops, website development, etc.

About 52% of the total funding pertained to projects dedicated to technology transfer and training. 16% of this funding was provided for technology development and transfer and 13% for conducting R&D for technology development. The projects with the mandate of providing training accounted for about 10% of the total funding and 10% projects belonged to the other categories.

3.1.3 Project Dispersal Ratio and Funding Dispersal Ratio

This indicator was used to ascertain the dispersal of projects among the participating organizations. It is defined as:

$$\text{Funding Dispersal Ratio} = \frac{\text{accounting for 50\% of projects}}{\text{Total number of organizations}} \quad (1)$$

It was found that 72 organizations accounted for 50% of the projects sponsored during the reported period. Therefore, *Project dispersal ratio*= 72/306 =23.5. This shows that the projects' sponsorship is not very widely distributed among the participating organizations, and a group of select organizations tends to dominate in project funding.

To ascertain the dispersal of project funding among the participating organizations Funding Dispersal Ratio was used, which is defined as:

$$\text{Funding Dispersal Ratio} = \frac{\text{Number of organizations}}{\text{accounting for 50\% of total funding}} = \frac{\text{Number of organizations}}{\text{Total number of organizations}} \quad (2)$$

It was seen that 47 organizations accounted for 50% of the project funding during the reported period. Therefore, *funding dispersal ratio*= 47/309=15.2. Since this ratio is less than the project dispersal ratio, it implies that project sponsorship in terms of funding was even far less distributed among the organizations.

3.1.4 Type of Organizations

During the study period, 306 organizations received project support under the Programme. 74% of the projects were undertaken by S&T based voluntary agencies and 17% by educational institutions (universities/ college/medical colleges/engineering colleges/IITs). The national labs accounted for 5% of the projects, and the private R&D centres and State S&T councils accounted for 2% each. Thus, S&T based voluntary agencies accounted for 82% of the total funding during the five-year period with a share of education institutions being 11% and that of national labs/ institutions about 4%. The funding support to the State S&T councils and organizations in other category was very small.

3.1.5 S&T Activities

Since the programme mainly focuses on the rural settings, the farm and off-farm activities, categorized under various operational S&T fields, dominated in the supported projects (Table 1). The highest number of projects pertained to agriculture and related areas (21%), followed by forestry (14%), artisanal and crafts technologies (10%), animal husbandry (6%), health and hygiene (6%), integrated rural development (6%) and water resource management (5%). In about 5% of projects, Technology Parks were set up for promotion of livelihood opportunities based on S&T based interventions.

3.1.6 Source of Technology

In 51% of the projects, the technologies/know-how employed was developed solely in-house by the project implementing organizations, while in 7% this was worked out in consultation with outside experts. 27% of the projects were based on transfer of technology from a technology generator (S&T institution/development agency/voluntary agency/ individual innovator). In case of 15% of interventions, the technology was developed by carrying out modifications in the existing practices of the beneficiaries.

3.1.7 Sustainability and Replicability

From the study, the sustainability of the project-based interventions at the grassroots was found to be low as only 21% of the projects seemed to have developed clear-cut follow-up mechanisms after their completion. Only 4% of the projects investigations reported replication of their work in other locations and dissemination of their project model among other agencies. This indicates a rather self-limiting and isolating nature of most of the projects. This observation is further supported by very low coverage (2%) of the project investigations in media.

Table 1 Projects according to operational S&T field

S&T Field	% of projects
Agriculture and Related Areas	21
Forestry and Related Areas	14
Artisanal and Crafts Technologies	10
Integrated Rural Development	6
Animal Husbandry	6
Health and Hygiene	6
Rural Technology Parks (including Women Technology Parks)	5
Water Resources Management	5
Information and Communication Technologies	4
Fisheries	4
Construction Technologies	3
Waste Management	3
Engineering Tools and Equipment	3
Energy Sources	2
Food Processing	2
Watershed Development	2
Others (e.g. rehabilitation technologies, environment technologies, transport technologies, disaster management)	4

3.2 Project Outcomes

The societal projects' basic intent is to enable the local community achieve sustainable livelihoods by building their own technical and organizational capacities, achieving technology choices, and adopting and improving technologies. In this process, technologies are generated, technical facilities are created, livelihood opportunities are improved, environmental benefits are achieved, and extra-mural links are established. Some of these outcomes are discussed next.

3.2.1 Creation of Technical Facilities

In about 39% of the projects, technical facilities were set up in order to facilitate transfer of technology and imparting on-the-job training to the beneficiaries. Some of the facilities established include: herbal garden, nursery, rain water harvesting system, natural dye processing unit, oil-extraction unit, pottery kiln, low-cost house models, weaving units using improved handloom, hand-made paper making unit, water quality analyzer, bio-gas plant, vermi-composing unit, improved fishing boat, grain storage unit, sewage treatment plant (Figure 1).

3.2.2 Generation of Technologies

During the period under study, the total number of technology generated under the project-sponsorship mode was 144. This corresponds, on an average, to 29 technology generated in a year. Since the number of project implementing organizations was 306, the average number of technologies generated per organization was 1 technology every 2 organizations. Also, the average number of technologies generated per project was 1 technology every 3 projects.

Table 2 provides the distribution of these technologies among the eight main S&T fields. The highest number (20%) of technologies pertained to agriculture, followed by artisan and crafts technologies (13%) and water management technologies (11%). Animal husbandry and fisheries constituted 9% of the technologies developed under project sponsorship, energy sources 8%, weaving technologies, medicinal


Figure 1 Grain storage bank (left) and hand-made paper recycling unit (right)

Table 2 Technologies developed in various S&T fields

S&T field	Number of technologies	Percentage
Agriculture	29	20
Artisan & Crafts	18	14
Water Sources	16	11
Animal husbandry/ fisheries	13	9
Energy Sources	12	8
Weaving	9	6
Medicinal Plants	9	6
Biofertilizers	9	6
Construction	9	6
Health and sanitation	5	4
Natural dyes	5	4
Oil Extraction	4	3
Hand-made paper	2	1
Rubber technologies	2	1
Environment technologies	2	1
Total	144	100

plants, bio-fertilizers/bio-pesticides and construction technologies 6% each. The technologies pertaining to the other sectors are health and sanitation (4%), natural dyes (4%), oil extraction technologies (3%), hand-paper making (1%), rubber technologies (1%) and environment (1%) (Figure 2-4).

3.2.3 Economic Outcome and Employment Generation

It was observed from the available data that 43% of the projects sponsored during reported period led to creation of employment/ income generation opportunities for the target beneficiaries. While only 20% of the projects led to development of sustainable business models such as production and marketing groups/cooperatives/paani-bijali panchyats (water-electricity local governments)/individual micro-enterprises (Figure 5).

Also, it was found that the project sponsorship involved 441 PIs and 279 Co-PIs (excluding repetition of those with more than one project). The total project-based employment generation during the five-year period was found to be 1606 indicating that the Programme supported, on an average, project-based employment to 300 persons in a year.


Figure 2 System of rice intensification (left) and mushroom cultivation (right)


Figure 3 Fish aggregation device (left) and artisan technology (right)


Figure 4 Ethanol-based lantern (left) and biomass gasifier (right)

3.2.4 Social Outcome

The social outcomes considered relevant for the Programme are (i) better access to energy sources, (ii) better access to water sources, (iii) better health and nutrition, (iv) betterment of women, (v) services to children, (vi) protection of environment, (vii) reduction in drudgery, and (viii) better living conditions. In this analysis, 'protection of environment' and 'betterment of women' emerged as the foremost social impact areas promoted by 27% of the projects in each case. This seems to indicate that eco-friendly sustainable development and socio-economic upliftment of women through S&T interventions are built strongly in the

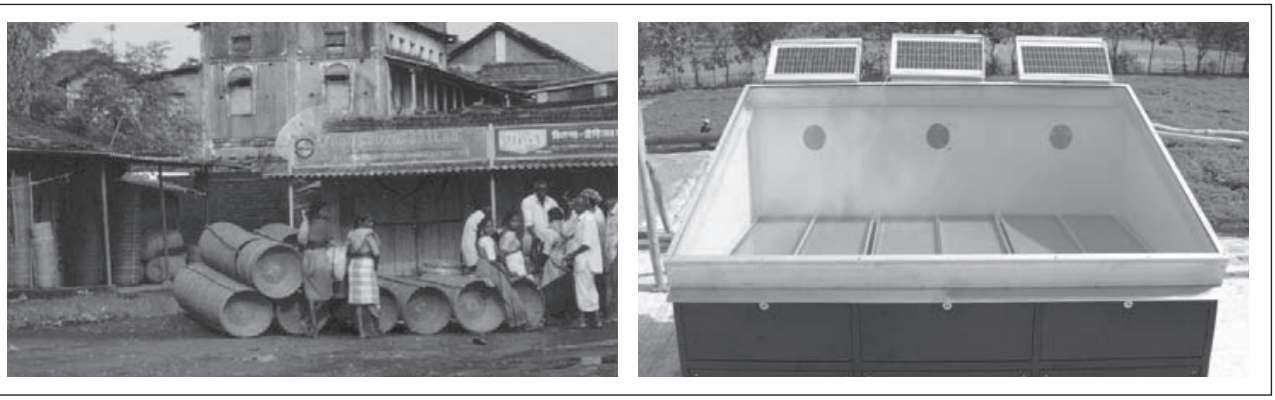

Figure 5 Enterprises based on bamboo baskets (left) and solar drier (right)

project sponsorship. 16% of the investigations led to betterment of health and nutrition status of the beneficiaries, while 14% created better access to water facilities and 12% led to better living conditions. The number of projects leading to reduction in drudgery (7%), better access to energy sources (6%) and providing services to children (5%) were relatively far less.

3.2.5 Setting Up of Beneficiary Organizations

For successful implementation of these projects, an effective strategy is to involve the local community in various operations of the project. Establishment of local beneficiary organizations, such as self-help groups, women's cooperatives, village development committees, saving and credit groups, farmers' groups, watershed committees, forest protection groups, youth clubs, women cells, eco clubs and water cooperatives, has demonstrated its utility in success of these projects. In case of 28% of completed projects, beneficiary organizations were set up. The highest number of beneficiary organizations (40%) was set up in tribal areas.

3.2.6 Extra-mural Links

During the period under study, several project implementing organizations established links with S&T institutions, local development bodies, voluntary organizations, industry for creation of technical facilities, testing and fabrication, and market for procurement of material/tools/equipment and for sale of produce (Figure 6). 57% of the projects links were established with the S&T institutions. In 34% of the projects, the projects teams generated the support of the local bodies (Panchayats/village development committees/block development office), while the expertise of the local NGOs were made use of in 27% projects. The links with local industry were set up in 23% of the projects, but the links with market were reported only in about 10% of the projects.

Also, as seen in Table 3, the project implementing organizations availed the expertise of as many as 505 S&T institutions. This corresponds, on an average, to setting up of one linked organization per project, and 100 such links per year.

Among the type of these institutions, the largest links were set up by the implementing organizations with the research institutions (including national labs),

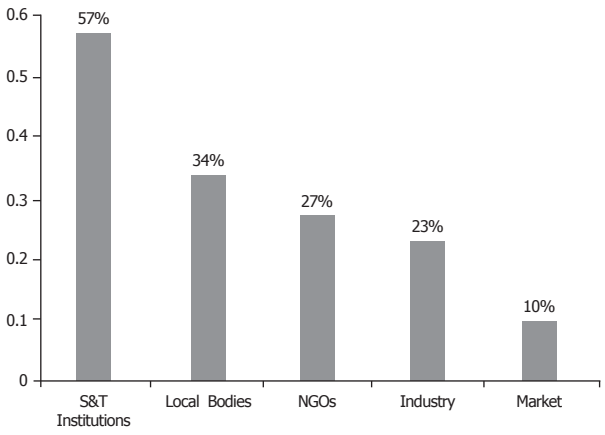

Figure 6 Extra-mural links according to type of organization

which constituted 53% of the total number of links established. This group of institutions were followed by universities/colleges (18%) and State government agencies (16%).

The links with engineering colleges constituted 6% and those with medical institutions 4%. Significantly, 2% of the extra-mural links were set up with international organizations including the UNDP, the Asia Pacific Centre for Technology Transfer and the World Bank.

3.2.7 Publications/ Patent Filed

During the study period, 17% of the projects led to various types of publications (booklets/ manuals/training material/research papers), which are considered important for preservation of knowledge generated, and for wider dissemination among scientists, project implementing organizations and young researchers. The number of research papers generated during the five-year period was 29, and the average number of papers per project was 6 papers every 100 projects. Also, the project sponsorship led to the filing of three patents. It is observed that the intellectual property (e.g. publications and patents) generated in the projects was low, and will need improvement in the coming years.

3.3 Analysis of Enabling Factors

For this analysis, a set of enabling factors was identified comprising input and output variables to quantify the performance of projects in terms of productivity, sustainability and replicability. A representative sample of 103 projects was used to perform a correlation analysis to derive the inferences. The sample projects selected were those which demonstrated good results during execution and performed well during various evaluations, i. e. those rated excellent/very good/good at the annual Group Monitoring Workshops (GMW). The GMW comprised independent evaluation by a group of experts and departmental officers. The information required for analysis was also supplemented through field visits to the project sites.

Table 3 Extra-mural links according to type of S&T institution

Type of institutions	Number	Percentage
Research institutions/national labs	266	53
Universities/colleges	93	18
Engineering institutions	33	6
Medical institutions	23	5
State government agencies	81	16
International organizations	9	2
Total	505	100

3.3.1 Enabling Factors

As described next, a set of enabling factors pertaining to the project productivity, sustainability and replicability were identified. Many of these identified factors have emerged as the outcome of the individual initiatives and farsightedness of the implementing organisations (Raj, 2000).

1) Project Productivity
   i. Expertise of an organisation in the specific project related S&T area
   ii. Linking with S&T institutions for sourcing of appropriate technology, and for training of the project staff
   iii. Creating common technical facilities for production/infrastructure development
   iv. Providing in-built components for motivating and improving skills of beneficiaries and their involvement in project design and management
   v. Financial and material contribution by beneficiaries in project execution
   vi. In-house training of master trainers followed by their institutional training
   vii. High quality training curriculum and diversity in training materials used
   viii. Linking beneficiaries with financial institutions and micro-credit facilities
   ix. Building synergy and networking with other organizations in the area
   x. Using professional inputs in project design and

implementation

xi. Using innovative approaches in project design and implementation, including grass-root innovations carried out by local people

xii. Projects staff resides at the project site

2) Sustainability

i. Designing projects to become self-supporting after completion, through beneficiary's contribution and management

ii. Building strong component of project monitoring and evaluation

iii. Building capacities of the community in handling the project interventions

iv. Building supply chain systems by developing strong links with local markets, and beyond

v. Developing enterprise models and potential entrepreneurs during project execution

vi. Evolving suitable models for scaling up of the project interventions

vii. Supplementing income generation activities by support services and infrastructure development

viii. Integrating the project activity with other projects in the area

ix. Incentivizing proficiency and project delivery efficiency

x. Promoting socio-cultural mobilization to ensure acceptance of interventions, especially for projects located in remote and tribal areas

3) Replicability

i. Potential for replicability of a project enhances if the shortcomings in its design and implementation are identified through close monitoring and resolved under the follow-up actions

ii. Establishing direct links with existing networks and SHGs, such as farmers' forums, artisans' associations, in the project area

iii. Linking project-based intervention with State government policies and programmes

iv. Arranging media coverage to build awareness among potential replicators

3.3.2 Project Performance

Project performance indicators were evaluated based on the following outcomes and using some of the significant output variables in Table 4.

The variables y_1, y_2, $y_3 \ldots y_{19}$ were quantified using the rating scale adopted for analyzing the projects covered under the study (Excellent=1, Good=0.5, Satisfactory=0.25, Poor=0). For the variable y_{20}, which represented an inclusive rating by a group of experts during the GMW meeting, the 'GMW rating scale' was used, i.e. Excellent= 1, Very Good= 0.5, Good= 0.25, Satisfactory=0.

Composite Project Performance Index

Assuming equal weightage to these variables, the six performance attributes are estimated using the following equations:

$$Technical\ Outcome\ Index\ (TI) = \frac{1}{3}(y_1 + y_2 + y_3) \quad (3)$$

$$Economic\ Outcome\ Index\ (EI) = \frac{1}{3}(y_4 + y_5 + y_6) \quad (4)$$

$$Social\ Outcome\ Index\ (SI) = \frac{1}{3}(y_7 + y_8 + y_9 + y_{10} + y_{11} + y_{12} + y_{13} + y_{14}) \quad (5)$$

$$Sustainability\ \ Index\ (SuI) = \frac{1}{3}(y_{15} + y_{16}) \quad (6)$$

$$Replicability\ Index\ (SuI) = \frac{1}{3}(y_{17} + y_{18} + y_{19}) \quad (7)$$

Finally, performance of the selected projects was quantified in terms of a *Composite Project Performance Index (CPPI),* using the above attributes:

$$CPPI = \frac{1}{5}(TI + EI + SI + SuI + RI + y_{20}) \quad (8)$$

If for a given project, all the five attributes score the value of 1, then the ideal value of *CPPI* will be 1. A correlation exercise was conducted between the

Table 4 Profect pcrformance indicators

	Technical outcomes
y_1	Quality and extent of technology development and transfer/ training
y_2	Extent of creation of technical facilities
y_3	Number of papers/patents
	Economic outcomes
y_4	Extent of income/employment creation among beneficiaries
y_5	Number and soundness of business models/micro-enterprises established
y_6	Extent of asset creation among beneficiaries/in the area
	Social outcomes
y_7	Better health and nutrition
y_8	Better access to water sources
y_9	Better living conditions
y_{10}	Betterment of children
y_{11}	Better access to energy sources
y_{12}	Betterment of women
y_{13}	Environment impact
y_{14}	Less drudgery
	Sustainability
y_{15}	Follow-up system and its effectiveness
y_{16}	Prospects of long-term viability of operations in terms of acceptability of facilities/utilization of technology in adoption/economic activities by beneficiaries
	Replicability and dissemination
y_{17}	Extent of project replicated in other locations
y_{18}	Dissemination among other prospective users
y_{19}	Quality of documentation/extent of media coverage
	GMW rating
y_{20}	Group Monitoring Workshops (GMW) rating

Table 5 Variables hypothesized to have relation to the performance

Organization-related
- Location of organization & distance from the project site (x_1)
- Age of organization (x_2)
- Level of expertise (x_3)
- Size of organization (x_4)
- Past links with DST (x_5)

Project Design Characteristics
- Qualification of the PI (x_6)
- Type of activity (x_7)
- Project budget (x_8)
- Project duration (x_9)
- Size of target beneficiaries (x_{10})
- Number of project staff employed (x_{11})

Implementation Approaches
- Sourcing of technology (x_{12})
- Creation of technical facilities (x_{13})
- Extent of beneficiaries involvement in project design and management (x_{14})
- Setting up of beneficiaries' organizations (x_{15})
- Extent of beneficiaries' mobilization (x_{16})
- Beneficiaries' material contribution to the project (x_{17})
- Mode of technology transfer (x_{18})
- Links established with institutions (x_{19})
- Links established with NGOs (x_{20})
- Links established with local bodies (x_{21})
- Links established with industry (x_{22})
- Links established with financial institutions/market (x_{23})
- Generation of publications (booklets/manuals/research papers/ patents) (x_{24})
- Training of beneficiaries (x_{25})
- Popularizing projects results and achievements through media (x_{26})
- Follow up mechanism after project completion (x_{27})

Performance Evaluation
- Number of monitoring/evaluation conducted (x_{28})

CPPI and each of the variables that are hypothesized to have relation to the performance as follows.

A high degree of association (implying correlation coefficients differing from zero with more than 95% level of confidence) was found with the variables: age of organization, level of expertise, size of organization, duration of the project, mode of technology transfer, extent of mobilizing beneficiaries, extent of beneficiaries involved in project design and management, links with financial institutions/market, and beneficiaries' material contribution to the project. The variables that were found to have moderate correlation (confidence level between 90-95%) with the CPPI are: project budget and setting up beneficiaries' organizations.

The societal projects present an altogether different challenge to the project implementing agencies. In such projects, overall design of the project and implementation strategies (including innovative

approaches) play an important role than the traditional factors, such as high professional qualification of the PI, specialized laboratory facilities and infrastructure of the organization, etc. This explains a somewhat weak correlation (with confidence level of 75-90%) in cases of the variables 'distance of the organization from the project site (x_1)' and 'qualification of the PI (x_6)'.

The correlation coefficients for the other variables were as expected: larger organization and higher level of expertise can better manage a project; more accomplishments are expected in projects with longer duration; organizations adopting better and effective mode of technology transfer are likely to be more successful; greater mobilization or involvement of the beneficiaries would make a project more successful; establishing linkages between beneficiaries and the financial institutions/ markets would help the beneficiaries to become self-sufficient and thus make the project a success; and better material conditions of the beneficiaries would help them absorb benefits more effectively. Similarly for the moderately correlated explanatory variables, it may be argued that larger budget enables deployment of more productive resources, setting up of beneficiaries' organizations like SHGs would help them realize larger benefit from the project. Building technical facilities for technology transfer and establishing extra-mural links with S&T institutions will also enhance the outcomes of the project.

However, many of the variables were internally correlated and it was difficult to isolate which ones are actually influencing the project performance. For instance, budget size and duration were highly correlated (0.66), that is larger budget projects are of longer duration and thus difficult to say which one is influencing. A stepwise regression modeling exercise revealed that the most important variables influencing performance are x_3, x_{12}, x_{13}, x_{15}, x_{23}, and x_{25}. They together explain 47% of the variation in Y. The estimated value of c and the coefficients of x_{14} and x_{23} are significant at less than 1% level and the coefficients of x_2, x_5, x_{17} and x_{28} are significant at 9-12% level. Because of high adjusted R-squared value (0.47), the estimated linear model has high predictive power that may be used for policy purposes. For example, project performance may be improved by establishing greater market linkages, by mobilizing beneficiaries, by asking contributions from the beneficiaries, etc.

4. Summary and Discussion

It was observed that older and large-size organizations with high level of expertise and past links with the DST seemed to be having proved as good performers. Therefore, to promote the participation of new and smaller organizations in the Societal Projects, it may be prudent to link them in their formative years with the well-established and performing organizations so as to enable them share the expertise and resources of their senior partners.

The projects which employed a technology based on modification of beneficiaries' traditional practices or developed in-house by the organization seem to perform better than the technology developed outside or borrowed from another institution. The effectiveness of mode of technology transfer has emerged as one of the most enabling factors in influencing the overall impact of the projects. Therefore, quality of training staff and material used, creation of easily useable technological facilities for training and production and in-situ transfer of know-how is of critical importance for the project-based grassroots interventions.

The projects dedicated to technology transfer based on training programmes are relatively more productive than those pertaining to 'technology development' and 'technology development and transfer'. This shows that the main forte of the Projects has been 'technology transfer and training'. This may be because the projects on technology development per se are more lab-based and require specialized technical background. Link with appropriate S&T institutions is desirable to achieve the desired outcomes in such projects.

Links with financial institutions and the market has emerged as the most critical enabling factor for the sustainability of the projects. This means that the project designer at the outset should ensure pursuing these linkages in the first place. The projects which

facilitated monetary and material contribution from the target beneficiaries seem exhibiting a higher level of performance, indicating this aspect should be considered as an essential component of the project proposals.

The following three factors related to the target group participation have been found to be of immense importance in enhancing productivity of projects:

(i) Extent of all around mobilization of beneficiaries through community organizations, Panchayats and door-to-door campaigning,
(ii) Beneficiaries involvement in project design and management and in follow-ups, and
(iii) Organizing beneficiaries in the form of self-help groups/similar organizations.

Successful completed projects indicated cost and risk sharing with local beneficiaries through the formation of local self help group system/development committee/co-operative system for commercialization towards generation of sustainable livelihoods. The study's general conclusions is most of the projects led to various types of publications (booklets/manuals/ training material/research papers), which is a very important source for preservation of knowledge generated under the project mode and for wider dissemination among scientists, project implementing organizations and young researchers.

5. Conclusion

S&T based societal projects definitely provide a useful vehicle for integrated and inclusive development for community benefits. The analysis shows that such projects not only bring tangible benefits to the target beneficiaries and the area but also empower them in deriving benefits of the technological advancements.

Based on the above analysis, it is recommended that a package of strategies can be adopted for the projects to be more focussed, productive and sustainable over the time, particularly for development of sustainable micro-enterprises, and for potential replication and scaling up. These may include interventions built around strategic actions, such as:

1. Sourcing of technology/know-how from proven sources
2. Integrating capacity building, training and technology transfer
3. Mobilizing beneficiary participation and contribution
4. Working with an enterprise model and ensuring sustainable links with financial institutions and market
5. Strengthening extra-mural links with S&T institutions
6. Monitoring, evaluation and follow-up
7. Replication, dissemination and scaling up
8. Reaching out to organizations and bringing operational synergy as well as networking for achieving sound management of supply chain
9. Improving project dispersal among States, especially targeting economically backward districts
10. Including innovative approaches

The analysis presented in this paper provides an insight into the functioning of societal projects in India, and in the DST-supported projects in particular. The analysis also presents a methodology to the funding agencies as well as to the planners in designing S&T based societal projects keeping in view the critical enabling factors so that the returns from the investments are optimally utilized and to make these projects successful in terms of ensuring their replicability and utilisation in various sectors of sustainable development.

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