SCIENCE AND TECHNOLOGY SOLUTIONS FOR RURAL AREAS: ISSUES IN DISSEMINATION

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Abstracts

Poverty, relative backwardness and other problems in rural India have prompted interest in exploring new ways to reduce afflictions and limitations, and promote rural development through modern science and technology (S&T). There have been diverse 'science-for-rural-society initiatives' of different kinds from quarters beyond the official, each with its core competency, distinct model and specific linkages. Yet, Science and Technology Solutions for Rural Areas (STeSRA) have not been transferred or disseminated as widely as intended. This article tries to explore the issues identified from the best practices in the present arrangements of select STeSRA constituents. The chosen constituents represent a broad range of rural interventions, ranging from academic and scientific institutions to assorted agencies. It provides a broadly representative set of issues in dissemination.

Keywords: Dissemination, transfer, Science and Technology Solutions for Rural Areas (STeSRA), rural development, empowerment

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Disclaimer

This paper is part of a larger study on issues related to the dissemination of Science and Technology Solutions for Rural Areas (STeSRA) in general, and towards building a robust framework for their effective dissemination. Here, the author highlights certain common themes identified across a variety of players and agencies in India.

I. Introduction and Scope of the Study:

Participatory approaches in Science and Technology Studies (STS) highlight the role of non-expert participation in S&T. The Sociology of Scientific Knowledge (SSK) and Social Construction of Technology (SCOT) approaches reveal the hidden influence of the "politics of artifacts". Subsequent developments in STS highlight the need for dynamic and democratic decision processes as a means to a new 'participatory turn' in S&T policy making (Jasanoff, 2003). Yet, one cannot ignore the existence of real-time problems, limitations and biases (Lengwiler, 2008). These limitations provide Science and Technology Experts (STEx) further opportunities to move beyond the linear notion of S&T, and emphasize multi-lateral interactions between science, technology, society and culture. STEx here refers to multi-disciplinary, academic and field-based inter-disciplinary expertise, and includes both academic and non-academic experts. STEx comprises people from engineering and also from sociological, economic, political, cultural, philosophical, anthropological, vocational and entrepreneurial, gender and management-related multi-disciplinary spheres. More significantly, they are involved in the existing rural empowerment dynamics. The term 'technology transfer', in the current context, signifies a successful movement of technology into society as a creative adoption, perhaps till it logically empowers the user (Guston & Keniston, 1994).

Dissemination, in this study, is defined as an inclusive process of design, transfer or delivery, monitoring, feedback, modification and re-innovation. It is a sustainable and dynamic process which has to upgrade, contextualize, re-utilize and replicate itself in wider contexts. The study understands the process of technology transfer as a specific activity spread out along the entire STeSRA cycle. As a result, an innovation becomes an elastic, flexible and broad idea, continuously re-constructed and combining both design and dissemination. If STeSRA have to influence rural sustainability and empowerment aggressively, STEx need to re-design innovations and disseminate them continually and systemically. Hence, **d**issemination is not a mere one-time delivery but a complex whole, consisting of hardware and

software, conveyed to the public right from the laboratory to the last mile, till it is integrated into society.

2. The Statement of the Problem

The central research question is why technologies like the radio, cell phones and automobiles have been quickly understood, accepted, assimilated and are easily transferable, while others like the smokeless chula, sanitation and solar energy solutions - specifically designed as appropriate, participatory and environmentally sound in rural areas - mostly fail to get disseminated widely, despite focused efforts.

Issues relating to the limited dissemination of the latter are little known to multiple STeSRA stakeholders (primarily academic STEx involved in the design), because they are either unexplored or underexplored. They are often context-specific and experientially confronted and hence need to be studied in depth. It is vital to disseminate the benefits of STeSRA to impact rural lives and bridge the wide gap between urban and rural areas by sharing the benefits of modern S&T. If the issues of limited dissemination are unresolved, modern S&T may become a channel that further enlarges existing divides or creates new ones within already polarized rural societies. Resolving these may directly assist STEx, rural people (as users), policy makers, multiple actors and/agencies, and markets and help them all work in tandem towards building a more workable, sustainable and dynamic STeSRA framework.

i) The Aim and Objective of the Study: The aim of the study is to learn from the experiences of the STEx involved with 'science-for-rural-society initiatives', particularly in the context of finding a better framework of the dissemination of STeSRA nationally. The objective of the study is to highlight the issues of limited dissemination from multiple experiences, practices and contexts, which will help STEx address them to empower rural areas.

ii) Research Methodology: The sampling technique adopted for the study was the *snowballing method. The total samples were 50. **T***he choice of samples was based on the criterion of the current involvement of STEx at various stages of the STeSRA cycle. The

designations of those who constituted the samples ranged from chief functionaries and program managers to cluster-level project coordinators. The primary data was collected through in-depth interviews, guided by a comprehensive interview schedule. The concerns of the wider areas of the entire STeSRA cycle were included in the interview schedule. Each in-depth interview was a rigorous process of collectively exploring the multiple dimensions of STeSRA for both the interviewee and the researcher. The primary data obtained from the interviews was transcribed and analyzed through a qualitative 'grounded theory'. Theoretically, the study drew its strength heavily from the Actor-Network Theory (ANT), which allowed the researcher to follow through with a perspective analysis of the 'actors' themselves on the multiple dimensions of STeSRA based on their internal experiences (Latour, 2005). The ANT primarily counts on the 'actors' own independent abilities to speak' for themselves, on their own and in complete freedom. Such abilities enabled the researcher as well to go to the actors' own sites in confidence and interact with them at ease to capture the conceptual transformations and changes they both had progressively undergone The ANT helped make clarifications possible, where needed, to arrive at logical conclusions in order to obtain validity.

In exploring the multiple factors of dissemination, this paper focused on the following select segments and specific actors: i) *Academic Outreach Agencies*, such as the Rural Technology Action Group (RuTAG), and the Telecommunications and Computer Networking Group (TeNet) of the Indian Institute of Technology (IIT), Madras; the Centre for Technology Alternatives for Rural Areas (CTARA), of IIT Bombay; the Centre for Rural Development and Technology (CRDT) of IIT Delhi; and the Application of Science and Technology to Rural Areas (ASTRA)/Centre for Sustainable Technologies (CST) of the Indian Institute of Science (IISc.), Bangalore; ii) *Science Non-Governmental Organizations (SNGOs),* such as the Community Agrobiodiversity Centre (CAbC)/M. S. Swaminathan Research Foundation (MSSRF), Chennai, and People's Science Institute (PSI), Dehradun; iii) *General Non-Governmental Organizations (NGOs),* such as the Action For Food Production (AFPRO) and Caritas India,

New Delhi; iv) *Government/Quasi-government Organizations* like the National Innovation Foundation (NIF); the India/Gujarat Grassroots Innovation Augmentation Network (GIAN), Ahmedabad; the Ministry of Rural Development (MoRD); the Office of the Principal Scientific Adviser (PSA) to the Prime Minster; and the Centre for the Advancement of People's Action and Rural Technology (CAPART); v) *Corporate Agencies,* like the Banana Value Chain (BVC) of Reliance Industries; vi) *Non-profit Social Enterprises,* such as the Technology Informatics Development Endeavour (TIDE) and Solar Light Pvt. Ltd (SELCO); and vii) *People's Science Movements (PSMs),* such as the Kerala Sahitya Sastra Parishad (KSSP)/Integrated Rural Technology Centre (IRTC), Kerala. These are dissimilar initiatives varying widely in their approaches and experiences, offering multiple and rich lessons from diverse empirical situations.

A Review of Literature

Rogers (1995) examined diffusion in the multiple contexts of how an innovation spreads and gets accepted. He defined diffusion as a process that permeates through multiple communication channels over a period of time through its members in a particular social system. Socially-oriented innovations, as new practices, try either to resolve festering problems in society or create new opportunities. Mobile phones and the internet have penetrated rural areas phenomenally and touched the lives of farmers, fishermen, youth, children and women in all walks of life. In contrast, technologies like solar lighting (and assorted value-added business solutions) and indigenous advances like the System of Rice Intensification (SRI), though specifically relevant to rural areas, have been slow in their dissemination. The causes for such differences are interrelated, involving different units of a social system. People resolve common issues differently by constructing dynamic processes. Rogers suggests five stages of dissemination: *knowledge, persuasion, decision, implementation and confirmation. At t*he *'knowledge'* stage*,* the user explores how an innovation is designed, works, and is integrated into real life. In the *'persuasion'* stage, the positive or negative features of an innovation lead to a favourable or unfavourable inclination on the part of the user, further reinforced through peer reviews. But it is at the *'decision'* stage that one

is either inclined to adopt or reject the innovation in question, based on its perceived relevance. During the *'implementation'* stage, the innovation is put into practice, though there still is a certain degree of uncertainty, owing to its newness. The challenge for STEx at this stage is, therefore, to reduce the uncertainty and so pursue its usage, wherein re-invention happens. In the '*confirmation' stage, the user looks for support in continuation of his decision to use it.* Roman (2003), in his study of telecenters, includes the restructuring processes of an innovation in the context of changing socio-economic, cultural and environmental sustainability. His contributions to diffusion studies are: theorized action; the decision-making process; adoption; and, based on the consequences of an adoption, the re-innovation. All the processes stated above have an integral relevance to the present study of the sociology of technology.

Neil McBride (2003) tracked mobile technologies to explicate how they get geographically spread across huge swathes of territory, involving both human and non-human realties. They are embedded within particular geographical, socio-economic and cultural entities. Thus, mobile phones have succeeded in overrunning otherwise impenetrable sociological landscapes, as an integral part of commonly existing 'socio-technological mechanisms'. Sinha (2013) elaborated further on the need for STEx to build alternative pathways of direct participatory communication processes, like that of organizing agricultural fairs to empower rural areas. The fairs offer new avenues to exchange ideas on laboratory experiments and new technologies, thereby accelerating the propagation of scientific knowledge by STEx. They also build a strong belief in rural people that S&T solutions can be effortlessly utilized in the field.

They help farmers share and exchange new ideas and ask STEx questions so as to collectively explore valid outcomes. These efforts by STEx have the potential to transform rural areas and build a regular interface. They will, further, help re-define the challenges of rural backwardness through disseminating the right information, alongside consistent education of the grassroots in the use of STeSRA alternatives.

The critique of 'value neutral' S&T has contested the understanding of the 'unquestionable' stature of modern S&T (Seelye, 2003). E. F.

Schumacher (1975) advocated 'Appropriate Technology' (AT) to assimilate existing problems, cultures, values and goals anew. The roots of AT in India date back to the times of Gandhi, who emphasized the need for S&T in responding to the challenges of local development, self-sufficiency, and empowerment of the grassroots (Kumar, 2006). Subsequently, post-independent India has seen significant efforts by premier academic and research institutions to re-invent numerous applications of modern S&T to be adapted to rural areas**.** One such early model is the 'Application of Science and Technology to Rural Areas' (ASTRA). Going by Gandhi's idea of 'gram swaraj', STEx at the IISc. turned ASTRA into a weapon to combat poverty. They established a direct interface for STEx to reach out to rural areas (Reddy, 1978). ASTRA, despite its success, has had limitations in terms of a lack of quality standardization, inadequate peer reviews, and vulnerability in addressing the interdisciplinary concerns of dissemination in a context of continuous flux among rural societies. Further, ASTRA was unable to scale up their STeSRA wider nationally, owing to micro-preferences. If STEx had addressed them earlier, ASTRA could have made a huge difference - internally, locally, and globally (Reddy, 2004). The subsequent decades saw several agencies get involved in the design and dissemination of STeSRA from all across India. These included government organizations (GOs), NGOs, SNGOs, academics, corporates, NPOs and PSMs with a broad vision of empowering rural societies.

Results and Interpretations:

This article analyses the issues of limited dissemination in the following specific areas of the STeSRA cycle: the identification of the need or gap; the design as a process; the nature of acceptance; the progressive involvement of community organisation (CO) networks; the impact, efficacy and outcome analysis, and unsuccessful scenarios. The issues discussed here are practically encountered and systemically integrative. The specific innovations taken up for the study are from the following sectors: agriculture (on-farm and off-farm activities), water resources, health, fisheries, medicinal herbs, sanitation, automobiles, gender, housing, and renewable energy-related technologies. These fields underscore the closeness of STEx **to rural people and their lives** In

spite of their relevance, they are beset with issues of inadequate dissemination. **Understanding the dissemination process calls for looking beyond Rogers' and similar explanations as being dynamically multi-dimensional.**

Need identification: STeSRA agencies **offer an appropriate platform for** need identification. Table 1 highlights certain basic issues, identified from past experiences, that redefine the significance of need identification. The major tools used to deal with need identification are surveys, pilot studies, and the Participatory Rural Appraisal (PRA). They

Table 1

Significance of Need Identification

STeSRA Dimension	Significant Issues Identified and Lessons Learnt
Need identification	STEx need to Conduct need identification on a serious level,Appropriate existing tools, Build a strong rural extension and direct interface to attract networks, Go beyond need identification to integrate local solutions, and Re-define the nature of intermediation and the choice of intermediaries.

help actors locate exact gaps. These are potent tools that help STEx specifically identify, locate and shape, and enhance the skills of rural stakeholders. Of all these, the PRA is a thoroughly tested, contested and preferred route, but that methodology has to re-invent itself every time, based on the kind of techno-scientific problem-solution engagement. The use of the PRA must go beyond merely identifying problems that need solutions from outside and seek to identify, learn and integrate with locally-devised solutions. People do exhibit their skills in terms of designing their own solutions - as in, for instance, an innovation like the locally made, low-cost 'jugard', a vehicle used in rural areas to transport people and raw material on rough rural terrain. The NIF makes a conscious attempt to map such local solutions, tabulating and validating indigenous expertise through its formal or informal associations like the Honey Bee Network and GIAN. Ideally, a direct

understanding of the problems, the application of indigenous solutions and their spread would give STEx a distinct advantage. Need identification thus shapes the quality of an innovation and leads to its eventual acceptance. A low-cost, simple bamboo windmill as an alternative to pumping water is another case in point. Here, the primarily role of STEx was to validate and upscale local solutions. The windmill was designed by a grassroots innovator to fulfil a locally felt-need. The NIF facilitated its successful testing at a lab in IIT, Guwahati. GIAN installed several windmills in the salt farming area of Kutch in Gujarat for pumping brine. It has also been used successfully for farm irrigation. But, there are limitations in the STEx abilities (in terms of the availability of time and expertise in dealing with wider rural communities) to directly get involve with rural areas. This calls for a significant change in the nature of intermediaries and intermediation.

ii) The design of an innovation: Table 2 sums up new revelations in understanding key issues of the design, taken as a process. The identification of gaps and the design of new solutions are seen generally as linear processes.

Table 2

Revelations on the Design as a Process

STeSRA Dimension	Significant Issues Identified and Lessons Learnt
The design of an innovation	STEx need to Consider the design as 'an integrated and cyclical process', Include value-addition through successive packages to empower rural people, Establish a competent socio-techno and scientific corps to direct the STeSRA cycle, Include multi-level consultations, and Train multi-disciplinary and inter-disciplinary expertise teams.

A degree of simultaneity and interlocking would be fruitful. Also, the most important (rather than the temporal) dimension of 'interlocking' would be the one between designers and end users. Design, as a

process, is beneficial for designers and for the people it is intended for, as well as for further processes like value-addition and final packaging. The participatory approach to design has its advantages (Sanders & Stappers, 2008) as well as its constraints, like the lack of time for STEx (Shah & Robinson, 2007). It was heartening to note that a majority of the actors were positively disposed to the concept of participatory design. They were conscious of its benefits to people as an innovation, and as a value-addition to their own creativity. The interviewees were aware of their limitations and mentioned the lack of progress in that direction. The agencies (especially academic) felt they have more techno-scientific competencies than rural integrative mechanisms. Ultimately, there is a felt need among all for a well-equipped and integrated sociological, professional and techno-scientific competency-based specialist corps to promote participatory design and the co-production of sustainable STeSRA packages to empower rural masses. In co-designing, the question of 'empowerment' **is doubly significant**: the *final solution* aimed at empowering the target communities, and the *very process of involving* the community in the design stage in itself denotes empowerment in a psychological and very real sense. This is another aspect which does not figure prominently in other studies related to socially-oriented STeSRA. The respondents appreciated the need to regularise the consultation processes, and specialize in diverse methods and channels of consultations by involving multi-disciplinary expertise to enable design as a continuum.

iii) The acceptance of the innovation: Respondents noted several individual, collective and micro issues (like community ownership and availability of after-sales services) as major factors impacting wider acceptance of the innovation.. There are other, multiple factors

Table 3

Factors Widening Acceptance

STeSRA Dimension	Significant Issues Identified and Lessons Learnt
Acceptance of the innovation	STEx need to Ensure ownership of innovations rather than offering them as freebees, Make after-sales services available in rural areas, Integrate major aspects of user friendliness and long-term sustainability utilities of STeSRA, Incorporate multi-tasking and diversification abilities to multiple fields, Come up with multiple models and choices, Display STeSRA at multiple outlets and make them readily available, and Monitor it continuously to ensure successive improvements.

specific to each innovation. Common features which widen the acceptance criteria have been provided in Table 3. The acceptance criteria of STeSRA depend on the kind of features STEx are able to incorporate, including aspects such as the period of use, user-friendliness, and pride in owning an innovation, all of which are closely connected**.** The innovation's ability to empower the user in more than one way, through multi-tasking, significantly impacts the wider acceptance of STeSRA. SELCO initiated a solar lighting project primarily aimed at serving households with basic lighting. But on realizing its value, the villagers themselves voluntarily sought outdoor portable solar lighting solutions for their roadside fish stalls so their women could extend the sale of merchandise late into the evenings. SELCO thereafter extended solar lighting solutions to small-scale businesses like wayside hotels. Subsequently, farmers began counting on solar solutions even to pump water for irrigation. Soon, the impact of solar lighting gradually extended to the point where solar portable lighting solutions helped children study late into the night.

From the lessons learnt, it has become obvious that the long-term acceptance of STeSRA depends on the 'ownabilty criteria'. Quite interestingly, it was noted that free distribution inhibited people from 'owning' STeSRA. Clearly, people prefer to make judicious choices to own pieces of STeSRA rather than receive them as freebees. Freebees do not command their respect. For instance, the subsidised rainwater harvesting and sanitary solutions provided by CAPART to rural areas have often been used as storerooms.

Another trend noted by the study is that once an innovation is initially accepted, there is pressure to make it available non-stop. For instance, ASTRA experienced initial success in disseminating energy-saving stoves for cooking. Unfortunately, STEx could not ensure their continuous availability. Nor could they come up with additional choices to satisfy the requirements of different groups, because ASTRA did not design multiple models, because they believed that the task was to be taken up by entrepreneurs. Hence they trained entrepreneurs to bring about the requisite changes to create market demand. Thus, STEx and entrepreneurs together ensured the uninterrupted availability of the energy-saving stoves in the market. There are also growing expectations from the system to deliver more than its initial features. The IRTC had initially set up bio-gasifiers to supplement household cooking needs using household waste. Later, STEx realized that biowaste from large establishments could be used to generate fuel on a large scale.Consequently they set up a large unit in the Government Medical College Hospital, Calicut, to meet the fuel needs of a canteen. Such visible improvisations before peoples' very eyes give rise to expectations beyond what a particular innovation was initially introduced for. Hence, an essential determinant for STEx would be to enhance their abilities to provide successive improvements through regular monitoring and continuous research. The points discussed above reinforce the fact that the ball of acceptance of STeSRA does not lie only, or mainly, in the court of STEx, or for that matter in any of the players' hands.

iv) The need for community networks:

Table 4

The Role of STEx in Building Extensive Rural Community Networks

STeSRA Dimension	Significant Issues Identified and Lessons Learnt
The need for community networks	STEx need to Build qualitative intermediary mechanisms to empower rural areas, Draw out suitable modes of interaction between multiple groups/actors, Establish a specialist corps to spearhead flatland networks, Evolve dynamic, multi-dimensional and sustainable intermediary mechanisms to address rural issues exclusively, and Construct a national-level meta-framework of dissemination.

Table 4 above highlights the role of STEx in building extensive rural community networks as a means to strengthen national-level flatland rural networks. A constantly recurring theme on building community networks is the urgency to stabilize and build qualitatively-empowered intermediary mechanisms, and carve out multiple modes of interactions. This dimension has been highlighted by STEx, who need intermediaries to reach out to rural spaces, and by the intermediaries themselves. General NGOs have voiced their inadequacy in considering the special type of mediation STeSRA.calls for. Even in the case of SNGOs who combine both techno-scientific and social outreach skills, they miss out on the expertise of major players like the IISc., the IITs, or similar prestigious research centres. This calls for the re-working of their own networking processes in a different **direction, in tandem with established** centres of excellence. In this regard, there is an overwhelming consensus on the need for a professional intermediary corps. The role of the corps is to re-invent a wide range of extension networks (especially with agricultural universities, multi-disciplinary professional colleges, government departments, and similar domains) that are related to rural sectors so as to respond to the

complex demands of intermediation. There is a specific, deeply-felt need for a greater integration and sharing of academic expertise on a case-by-case basis to facilitate the creation of metamodels of collaboration, without simultaneously losing sight of the specificities of each innovation. The new framework has to be alert to the different kinds of networks and approaches to be integrated with, such as the identification of problems, pre-existing expertise, participatory design, and continuous feedback mechanisms for re-innovation. All of these are required to be sensitive to the wider, inter-related socio-economic factors of rural empowerment. The vibrant multi-dimensional intermediary facility will take time **to evolve, but needs to start sooner rather than** later. Much of the success of future STeSRA will depend on the quality of its new kind of intermediation and its sustainable construction.

v) An impact analysis: There is a genuine realization that STeSRA can empower rural spaces more widely, though STEx consider it far-stretched at present. Nevertheless, STeSRA alternatives have demonstrated their abilities in promoting employment, productivity, infrastructure and livelihoods. STeSRA have also checked human exploitation to a certain extent. Its proponents realize that it is important for STEx to offer more technology alternatives to prevent displacement and promote the development of rural areas. There are circumstances, however, in which STeSRA have created problems in rural spaces. For instance, RuTAG at IIT **Madras designed a spinning wheel which pregnant women could not operate comfortably, either sitting or standing. It drew resistance** from women. **STeSRA, likewise, has had similar experiences. Certain innovations have been well received, though not all. Such fallouts need to be studied carefully in a multidimensional framework to analyse their impact and address them.** This will contribute to building a comprehensive mechanism to deal with sustainable design, as a process of building a cohesive 'socio-technical system' (Trist, 1981).

vi) Unsuccessful innovations: Multiple lessons can be learnt from unsuccessful innovations. Some technologies simply fail the test of time. For instance, breaking stones is painful drudgery**.** Considering its

intensity, RuTAG at IIT Madras designed a stone-crushing device to break stones into micro-gravel. But after it was unveiled and put to use, it was observed that the device was injuring its users and was not user-friendly. There are other ones that are inappropriate, too, in addressing the actual needs of people, as in the case of the biogas technology offered by CTARA in their maiden attempt. Although the biogas stoves were intended to meet the fuel needs of rural households in a new way, they turned out otherwise because of recurring maintenance issues and the lack of readily available troubleshooting facilities in rural areas. The villagers were forced to get to other outlets and get them repaired with substandard components. Ultimately, the efficiency and lure of the device were lost. STeSRA sometimes do not reach potential users as a result of the lack of concerted efforts. The Ministry of Rural Development, for instance, made low-cost housing technology available through CAPART to serve rural areas, but the technology has not been used or disseminated widely by the intended communities, thanks to bureaucratic delays and procedural difficulties in obtaining it. In the case of smokeless chulas or solar stoves, the users expect them to work robustly, or at least be told where and how to get them repaired or replaced, when they stop working.

Discussion:

The analysis of the STeSRA dimensions above necessitates that STEx discuss the following areas extensively to ensure a sound national-level dissemination framework*: Firstly,* actors should look out for how best the new arrangement can combine and connect STeSRA from various R&D centers with new research from STEx nationwide. Based on the demands and outcomes of the research, STEx need to design a more diversified, elaborate and collectively desirable framework of dissemination. *Secondly*, STEx must provide after-sales service centers and update STeSRA with new features to impact empowerment. *Thirdly,* STEx are to lay down a concrete roadmap to disseminate STeSRA wider in remote rural areas. *Fourthly*, there is a need to link STeSRA with existing rural markets and widen their scope by journeying from local to national to global. *Fifthly*, there is an absolute need to initiate multi-disciplinary and inter-disciplinary STEx forums,

involving both academicians and field specialists. *Sixthly,* STEx have to continuously invent and re-invent new strategies to establish sustainable goals through consistent intermediation, and sustain nationwide flatland dissemination. *Seventhly,* the framework has to facilitate, enhance and encourage the direct stake of the government in the entire arrangement of the STeSRA dissemination framework to ensure empowerment for rural people. *Eighthly,* the new roles of STEx have to be understood as going beyond academic functional specializations to where rural people are empowered.This can happen through a direct rural interface within their neighborhoods, along with multi-disciplinary academic institutions, local self-government (LSG) offices and the village administration. *Ninthly,* STEx need to reduce their primary dependency on NGOs, as it limits their capacity to expand STeSRA beyond their sphere of relevance. *Tenthly*, the new framework has to identify potential rural areas and entrepreneurial development sectors, wherein new research can be taken up. *Finally*, there is an urgent need for STEx to take up the task of evolving horizontal and vertical technology transfer processes to disseminate STeSRA wider across the entire nation.

Conclusion

The field of dissemination of STeSRA has rightly become attractive to all who want it to impact comprehensive social change in rural areas. Although much of STeSRA hinges around the efforts of STEx, they are just one element in an intricate web of relations. Dissemination being a multi-dimensional activity, the innovator must address it right from its design, as an integrated whole that is always conscious of the different aspects of its constituents. However, STeSRA is too important to be left exclusively to STEx or their direct initiatives. Others actors, too, have to play their part consistently, based on which STEx could re-invent their design processes to tap into more of STeSRA's potential by shifting from their primary areas of competence. Ultimately, users themselves have to take on the task of disseminating STEx-driven STeSRA widely in rural areas. The lesson to be learnt from this vantage point is that S&T personnel from a formal academic background have a unique role to play in the development of STeSRA and the

empowerment of rural areas. But how they do it is something that calls for considerable homework from STEx. The very way they look at the rural scenario is important. If STeSRA is looked at as a machine that solves technology gaps alone, half the battle is lost. However, if 'gaps' are seen as spaces where they can consistently play a meaningful role, there is room for great promise. This will help STEx look at target areas not just as problematic zones but as fertile ground for collective empowerment, to be nurtured through meaningful interaction within their internal and external actors' networks.

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