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Extension Research and Technology Development

Though extension scientists in the NARS can potentially engage in useful research that can influence the technology development process, they are mostly engaged in organizing training programmes, conducting events, dealing with visitors to the institute and handling documentation responsibilities. Senior extension scientists, Dr M J Chandra Gowda, Dr Sreenath Dixit, Dr R Roy Burman and Dr P N Ananth reflect on this situation here and suggest how extension research can better contribute to technology development.

INTRODUCTION

Technology is a design for instrumental action that reduces uncertainty in the cause-effect relationships involved in achieving a desired outcome. Technology embodies both software and hardware aspects, although software aspects are generally less visible than the hardware. In India, agricultural technologies are mostly generated by scientific research activities carried out by public (mostly ICAR Institutes and SAUs) and private R&D institutions (mostly manufacturers/producers of inputs). Besides, there are umpteen number of location specific technologies developed by practicing farmers.

The technology development process, in a formal set-up, consists of 6 stages viz., Problem – Research – Development – Commercialization – Diffusion & Adoption – Consequences (Rogers, 2003). Extension research has the potentiality and responsibility to contribute to this process directly as well as indirectly. Unfortunately, the extension stream in ICAR research institutes as well as state agricultural universities haven't been able to contribute in this area for various reasons. This is an attempt to discuss how extension research can re-catalyze agricultural technology development and utilization scenario in the country.

TECHNOLOGY DEVELOPMENT PROCESS

Problem Identification

The technology development paradigm as discussed above assumes that all research processes must necessarily start with indentifying the problem or need. There is a serious concern over the way problems are being perceived or research agenda is set in public agricultural research agencies. There is a general feeling that, at present, research projects are mostly designed based on review of literature, thrust areas decided by funding agencies and continuation of previously implemented projects in some other institutes.

Bi-monthly workshops, a successful mechanism of NARP (National Agriculture Research Programme) days, had a give-and-take symbiotic purpose, wherein the researchers used to get first-hand feedback on burning issues and the development departments used to get technologies and advisories for communicating the same to farmers. Bi-monthly workshops may not exist now, even if exist, these have become routine, ritualistic and have lost the sting. Extension researchers must explore new arrangements to get the flow of farmers' problems into technology development process. Some of these are discussed in Box 1.

Box 1: Accessing farmers problems and linking it to research

The ICAR has a netion-wide network of Krishi Vigyan Kendras (KVKs) and majority of them located in remote areas, thus having close proximity to farmers. KVKs are identifying farmers' problems through district diagnostic surveys, rapid rowing surveys and regular field visits. Thousands of farmers visit KVKs in pursuit of solutions to their problems. Though these are documented in KVKs, researchers in NARS are not properly using these. There is a huge scope for systematizing the flow of researchable issues, particularly to ICAR and SAU research stations and also get back to farmers within a reasonable time limit. Extension research that enables pooling and up-linking of researchable issues to the larger system of NARS is a challenging and daunting task. The Promotion and Uptake Pathways (PUP) of technologies generated by the research system will be an emerging area of research for extension itself.

Kisan Call Centres (KCC) of Department of Agriculture and Cooperation, Ministry of Agriculture, Government of India, function on 16 x 7 basis across the country. Kisan Call Centres are receiving about 6 lakh calls a month or about 20000 calls a day. At least half of these calls are genuine and real indicators of problems of various kinds – mostly pest & disease outbreak, climate/weather related events, input availability, water and soil management etc. But, there is no mechanism to get these problems conveyed to research systems on a real-time basis. A software and network driven mechanism needs to be put in place so that these problems are automatically categorized according to the domain of each Institute and fall into their e-mail box for use in research activities. Accessing the data base of farmers' problems, including the personal and demographic details, from the Ministry of Agriculture, is a precursor to the whole process.

Ex-ante analysis of ground realities related to a researchable issue ensures integration of users' or stakeholders' perspectives in the research stage. Most of the internationally funded projects insist on an *ex-ante* analysis, preferably carried out by a socio-economist, who is also a part of the project team. On the contrary, very few ICAR and SAU projects follow multi-disciplinary team approach with socio-economist as part of these teams. A mechanism has to be put in place to ensure that the socio-economic perspectives are built into the technology development process. Extension faculty may be weak (in terms of numbers as well as professional competency) in certain institutes. In such cases, efforts have to be made to strengthen their capabilities to contribute to the research process.

Development

This stage deals with putting new ideas in a form that is expected to meet the needs of potential users. The concept of 'social construction of technology' argues that technology acceptance is shaped by social factors. Technology is a product of society and is influenced by the norms and values of a social system. For example, an oilseed crop variety that is not accepted by oil mill industries will never see the light of day. The social construction of technology is yet to get its due share in the technology development process. For institutionalizing the social construction of technology, nation-wide research in extension needs to be built into research agenda of the entire NARS (Box 2). The present structure of ICAR and SAUs has not been encouraging for extension research to facilitate the technology application process. Most of the extension scientists are deployed in routine works such as organizing training programmes, conducting events, managing visitors to institutes, handling documentation responsibilities etc.

Box 2: Strengthening extension research in ICAR

Extension research in India has never taken-off beyond a certain level of applied research. During XIIth Five Year Plan, the Agricultural Extension Division of ICAR has proposed for a specialized institute for Extension Research. To begin with, there is a need to identify a team of small but free thinking teams of researchers to pioneer in creating "extension innovations" that facilitate social construction of technologies. This could be similar to "skunk works", a name that became popular during World War II, for the dedicated work carried out by a small group of individuals in an enriched environment in developing military technologies. Steve Jobs of Apple Computer, Inc. used this strategy to develop the Macintosh, which became a super hit product. In a similar fashion, crash teams are required to be set up by ICAR so that the extension research gets a foothold in the NARS. Besides, the output of such research could serve as basis for policy formulation to facilitate extensive up-scaling of high-impact innovations.

Commercialization:

From the extension research point of view, commercialization of a technology can be facilitated by identifying its potential application zones. Under NARP, the entire county was categorized into 127 agro-climatic zones. Each agro-climatic zone is not only vast (the country has 640 districts, an average of 5 districts per agro-climatic zone), but also vary widely in their micro-situations. Soil conditions vary by tens-of meters than kilometers. High degree yield variation exists across regions and between farmers. Part of the variation is being explained by climatic, *edaphic* and management factors. But variability exists despite similar climatic and *edaphic* factors and the reasons range from non adoption of technologies to lack of support systems. Yield gap analysis is a known and well accepted practice to ascertain the scope for introduction of new technologies to a given agro-climatic situation (Box 3).

Box 3: Yield Gap Analysis

Analysis of yield gaps is also a continuous process, as adoption of technologies may vary from season to season and hence, the yield gap levels may also likely to change. It is, therefore, essential that extension research must standardize the ways and means to accurately and continuously assess yield gaps for all major crops and agro climatic zones. Recently, the Working Group on Agricultural Extension constituted by the Planning Commission (Government of India) has indicated the following broad levels of yield gaps:

Gap-A : Genetic potential yield - Maximum yield at the Research farm
Gap-B : Maximum yield at Research farm - Maximum yield under FLDs
Gap-C : Maximum yield in FLD - Maximum yield on farmer's fields
Gap-D : Maximum yield on a farmer's field - District average
Gap-E : Maximum yield on a farmer's field -Average yield in a group of villages around
Gap-F : Maximum yield on a farmer's field - Average yield of farmers in the same village

Farmers manage their each piece of land differently. In such situations, it is foolhardy to think and recommend technologies very generically. What is needed is technology mapping and indexing (Box 4) which needs a strong and viable partnership between research, extension and local institutions. Mechanisms, are therefore, needed to institutionalize this concept through strategic and translational extension research.

Box 4: Technology Mapping

Technology mapping has been used here in two senses. In the first case, a technology is tested for its applicability/suitability in as many locations as possible through technology assessment process being carried out by Krishi Vigyan Kendras. Second and most important dimension is mapping of all relevant and suitable technologies to a particular micro situation, which may give us the Technology Availability Index to that micro-situation. A similar mapping may also be used for indicating technology adoption. A comparison between technology availability and technology adoption maps throw out technology gap for each micro situation. The challenge lies in not only the preparation of such maps and indices, but also in updating and digitizing them for wider utilization on a continuous basis.

Commercialization of technologies doesn't always happen through commercial organizations. It could be achieved through small organizations as well. Successful promotion of paddy mechanization by a group of trained and equipped women group in Kerala known as Paddy Task Force is an example of how small organizations can commercialize a technology. Production and supply of bio-products viz., *Trichoderma, Pseudomonas* by tribal women groups in *Waynad* district of Kerala for use in controlling wilt disease in pepper, and mass multiplication of *Acerophagus* predator against papaya mealy bug in tapioca in *Namakkal* and neighbouring districts in Tamil Nadu are some other examples.

At a time when rural youth are shying away from agriculture, attracting and retaining rural youth in agriculture is a researchable area for extension. Agri-entrepreneurship is an achievable proposition since the characteristics of entrepreneurs are not inherited but can be developed through systematic motivational training and capacity building. Farm and non-farm business opportunities that ensure more employment and income to rural youth need to be tested and applied through partnership approaches. Developing entrepreneurial motivation training modules, designing appropriate strategy to develop entrepreneurship and agri-business models and agri-based business models for peri-urban systems should be an agenda for extension research.

Diffusion and Adoption

Extension services in India are pluralistic in nature, with multiple service providers under both, organized and unorganized sector. Convergence between and among stakeholders in agricultural research and development has become a buzzword, but we still need to identify the limitations and constraints in developing linkage and convergence at the ground level. In the Development Departments, majority of the states have their staff up to block level only. Several positions below block level (which is often called the cutting-edge level) remain vacant. Extension personnel who are in position, perform multiple roles, and hence have very limited time and resources for extension education. Most of the times, they are pre-occupied with implementation of government schemes linked to subsidies and subsidized inputs.

Research on designing and validation of alternate extension approaches, identifying potential partners and mechanisms to achieve sustainable partnership has attained greater significance. The effort of Division of Agricultural Extension, IARI in this regard through developing linkage with branch post masters at village level is very pertinent. About 1.55 lakh post offices exists in India and out of these more than 90 per cent are rural. Each of these branch post offices cater to six to sixteen villages and the branch post masters are generally resident of that area and practice farming. Capacity building of rural branch post masters for technology dissemination has been experimented and found successful.

Critical inputs like quality seeds of improved varieties can also be delivered to the farmers through this channel. Another Institute which has equally strong presence in the village level is Milk Cooperatives. These can be potentially used as Extension Outreach Centres. Such innovative experiments can prove research in extension meaningful.

Use of ICTs

Information and communication technology (ICT) tools are proving to be an important mechanism to maintain continuous contact with the farmers. Very little evidence is available on the utility of these ICT tools in improving technology adoption. Application of ICT tools have been limited by the constraints both from the demand and supply sides. From demand side, the major limitation is that not all farmers can be reached through language other than their local dialect. Many women farmers who are the actual practitioners and users of the agricultural technologies in real field situations are yet to accept ICT tools for communicating with extension system. On the contrary, supply side has the limitations of lack of connectivity and power availability in rural areas, non-availability of gadgets that support local

language etc. Research on strategies and avenues that stimulates use of ICTs for extension, keeping in view these supply and demand side constraints, needs priority attention.

Content management

It is very important in any information and communication intervention. The localization and customization of content is influenced by the way the content is accessed from different sources, assessed to a particular context and delivered in the form and style acceptable to end users. Participation of local farmers in developing these modules is also a key factor as the farmers identify themselves with the situation and the technology. Participatory content development is being attempted in many rural settings and programmes (eg. *Digital Green,* Community Radios etc). However, there are no easy ways to tap, track and put to use the available information and knowledge (tacit as well as explicit, formal as well as informal). Research based efforts are needed to put in place data warehouses, repositories, search engines and social & technical networking to harness the unearthed potential of ICTs for agricultural development.

Extension Management

The management efficiency of extension and development organizations has to be increased to accelerate the process of development. There is a need to analyze the drivers and processes of innovation and institutional development, devise strategy for sustainable institutions and synergetic convergence, assess the effectiveness of extension models and approaches and develop training modules for enhancing management competencies of extension professionals.

Social mobilization for technology uptake

Group approach to extension has become inevitable considering the widening and unmanageable ratio of farmers to extension workers, which is the result of increased number of holdings on one hand and non-filling-up of vacant posts of extension personnel on the other. Farmers' groups are being formed by many agencies, but are not being nurtured properly to facilitate uptake of emerging agricultural technologies for enhancing their entrepreneurship prospects. Delineation of the factors responsible for successful group mobilization and documentation of good extension practices (GEP) for technology application, group action, empowerment and capacity building are other promising areas for extension researchers.

Consequences

Commercialization of any technology leads to consequences for its adopters/users. These consequences have, in the past, been skewed towards elite sections of the society. Even the change agents, who are recruited to serve the entire community, have a tendency to work with progressive farmers. It's a challenge to develop technologies which are scale-neutral and diffuse them into the social system in such a way that use of such technologies leads to greater equity in the socio-economic consequences. There is a need to bridge the time gap in the technology uptake between "innovators" and "laggards". Even more desirable is to eliminate the late adopter categories. Extension research that facilitates development of scale-neutral technologies is as much important as that of extension tools and methods that empower small and marginal farmers to accept and benefit from such technologies. Extension research in this area is urgent as well as important. Undertaking tracer studies is one such option in this context (Box 5).

Box 5: Tracer studies

In order to ascertain the successful cases of technologies which have been developed and disseminated with greater degree of equity, "tracer studies" may be very appropriate. These tracer studies are very useful in a detailed study of successful innovations and possibilities of replicating the best of such innovation development processes by scientists of NARS. There are certain weaknesses in tracer studies. These tracer studies are always retrospective in nature, study only the innovation development process but not the consequences part, use limited sources of information for data collection and give a notion that all innovations are developed in a planned manner. It's a challenge to design and carry out tracer studies overcoming limitations and use the results for generating and disseminating technologies resulting in achieving equity.

Acceptance and continued use of many technologies depend on the prevailing development policies, climate/weather parameters, availability of inputs, supporting factors like market, institutions, credit availability and user/consumer preferences. The extension researchers may have to constantly watch the suitability of earlier recommendations to changing circumstances. The changing climate and market forces may necessitate frequent recall of technologies with new/alternate technologies suitable to different micro-situations. It is interesting to know the impact on credibility of change agency if innovation discontinuance is desired for a previously recommended innovation. Research is needed to understand the concerns while handling such tricky situations.

Feminization of agriculture has become a reality and has implications for technology application, but the problem is yet to be taken cognizance of by the extension researchers. Gender empowerment is essential to face paradigm shifts in agriculture. Conscious and concerted efforts and research are required to push forward the processes that would help, generate and promote technology, policies and institutions based on participatory assessment of gender needs, roles and resources.

CONCLUSIONS

Most of the evidences to substantiate the importance of extension research for agricultural development have been only anecdotal. Though the field of extension globally has moved beyond technology transfer, extension research in India is still stuck in need assessment of farmers and constraint analysis. As extension discipline has drawn its contents from various other disciplines, scope and space for interdisciplinary research is very high. There is an urgent need for a strong extension research to generate acceptable proof of contribution of extension research to agricultural development.

Technology development that is happening in informal sector, by farm innovators, entrepreneurs etc. have strong fundamentals as they are essentially problem-solving in nature. However, these innovations fail at commercialization and dissemination stages for lack of support from formal systems. Thus, extension research needs to work with both formal and informal R&D set up so that research for development becomes a reality. Extension research has to be more inclusive in order to ensure that problem-solving agricultural research generates results that are not only commercialized and widely disseminated, but also have equity concerns.

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