Adaptive research: a critical institutional gap in India's agricultural research for development system

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Absence of an organic linkage or interface between the research system and the extension machinery, constitutes a critical constraint for rapid and wider adoption of technologies identified and promoted by the research system (Planning Commission, 11th Five Year-Plan, 2007–12). Technology generation by research often fails to take into account farmers' concerns, perception and location-specific needs causing low uptake and adoption of technologies. Inadequate linkages amongst the research, farming and extension communities have serious implications for the way in which the scientific community perceives farmers' problems and defines and prioritizes research agenda. It is in this regard that the Science, Technology and Innovation Policy, 2013 (ref. 1) observed that S&T systems must undergo a paradigm shift from the current input-driven model, to one which is output-directed development strategy. This would contribute to involving the scientific community with the user segment (farmers) and industry to work towards finding solutions and applications that correspond to the field needs. Institutionalizing farmer participatory adaptive research as an integral part of the research system is critical to building a farming systems perspective in research for accelerated generation and wider adoption of appropriate location-specific technologies and moving away from the dominantly crop/commodity-driven generation of technologies that we have pursued thus far. It is the objective of this communication to focus on the need for research system to recognize this gap explicitly and to institutionalize adaptive research as an integral part of the research system to be able to effectively respond to the new challenges which the system now faces.

The past approach

Since 1960, Indias agricultural research and development system has adopted an approach largely aimed at enhancing and achieving maximum crop productivity levels by addressing all pervasive concerns of development and spread of improved high-yielding crop cultivars, improved nutrition by promoting use of chemical fertilizers and adopting pest-control measures. Towards this end, the system adopted a 'transfer of technology' approach, which implies that while the research system develops a technology aimed at improved crop, soil, nutrient and water management, the task of further spreading the technologies rests with the extension agencies. Though quite rewarding in the initial phase, over a period of time the approach has proved increasingly inadequate resulting in low levels of adoption rates of recommended technologies as is reflected in the overall stagnation of productivity levels and concerns for food security. Strict division between researchers and the extension community has several limitations and consequences for the way we find solutions to the farmer's problems.

The research system is largely organized in sectoral and disciplinary modes and for this reason technological needs and solutions to farming problems are conceived and sought within disciplinary boundaries. Solutions to the problems facing the farmers, on the other hand, are rarely amenable, which view the problem through a narrow commodity or a discipline-based approach. Farmers operate and take decisions being a part of an integrated farming system, where every decision is required to be viewed in relation to its possible impact on other system components. Finding solutions to the complex systems-based problems therefore, calls for more holistic perspective and multidisciplinary approaches in finding solutions, particularly in relation to economic and social viability of promoted technologies.

Widespread problems of resource degradation, a result of continued commodity-based approach, are a major concern seriously limiting the productive potential of our farmlands. Integrating concerns of sustainable use and management of natural resources and those of enhancing productivity are therefore critical to our future research and development efforts. Problems of natural resource management are specific to a given location. Understanding resource base issues, in relation to their use and management, calls for a shift from the current dominant commodity or a discipline-based approach to one which focuses on the sustainable use and management of a given resource base. The current approach basically aims at making available to the farmers, yield-enhancing inputs with little consideration to the felt technological needs aimed at solving farmer's priority problems, i.e. more of a supply-driven rather than a demand-driven approach.

Importantly, the approach fails to recognize that the farmers themselves are innovators and are constantly striving to develop and adopt new ways of farming. Farmers are also in the best position to assess likely benefits and whether or not a new technology could be easily adapted within their farming situation given the natural resources devoted to production and the associated socio-economic features, which together define a management domain within which farmers take and implement decisions. The chances of adaptation and wider adoption of technological interventions are much higher when developed and promoted by researchers in tune with the needs of the farmers. In the absence of mechanisms which allow and require a strong interactive mode in conceiving and developing technologies, little or low adoption rates of recommended technologies will remain a critical bottleneck to agricultural development.

An important consequence of the existing divide between those responsible for generating knowledge and technologies and those responsible for their wider adoption and spread has been the constant source of mistrust, the former maintaining that a number of technologies are awaiting 'transfer', while the latter often maintaining that the farmers are hardly enthused and unwilling to adopt new technologies for reasons of being uneconomical or otherwise unsuitable.

In the recent years, there is an increasing recognition of concerns emerging from climate change-induced enhanced variability as critical to our overall efforts to

address problems of farmers. Climatic events impact both socio-economic and natural resource use-related elements, in the local and regional context. Responding to these new challenges calls for effective communication with the farming communities to benefit from their cumulative knowledge and experience in adapting to variability, and devising management strategies better adapted to changing and uncertain climatic variability elements.

Recognizing the serious gap in the research system which constitutes a major bottleneck in the way of wider uptake of technologies, it is important to institutionalize/mainstream research elements aimed at overcoming these constraints linking research to extension machinery in ways which facilitate accelerated adoption of technologies while also providing an effective feedback mechanism to the research community, as to the effectiveness or otherwise and impact of promoted technologies.

Adaptive research

The term 'adaptive research' refers to the part of research for development continuum which aims at translating existing knowledge and technological elements or products into farming practices adapted to specific farming situations. The aim of adaptive research is to contribute to developing and adapting farming practices which are more profitable, contribute to sustainable resource use, improve use efficiency of inputs and enhance adaptation to and mitigation of climate change[2]. The approach has gained increasing importance and acceptance in many developing countries since the eighties. In these countries, it was increasingly felt that results from 'on station' research led to development of technologies which were too broad and had severe limitation in terms of their adaptation to specific situations. For agricultural technologies to be effective they need to be better targeted and more focused in terms of the clients or communities. Improved targeting of research implies better definition of problems in terms of nature, extent and severity of the problem and its likely impact on socio-economic and resource conditions. Adaptive research aims at building a perspective of the biophysical resource base and associated socio-economic conditions, the farming system, for defining the need for developing appropriate technologies. Building a farming systems perspective helps in faster adoption of technologies in tune with the felt needs of the farmers. Adaptive research also recognizes the centrality of the farmer as a key decision-maker in relation to the farming situation. Hence it considers involving farmers in the process of defining technological needs and developing appropriate technologies as fundamental. The aim is to generate technologies to increase resource productivity of identified farming groups in a short term.

Activities aimed at achieving the objectives of adaptive research organized in a few interconnected steps include[3]:

Broad characterization of the area being targeted: The aim is to build a broader context of an agro-ecoregion or a subregion in defining specific agenda for adaptive research based on homogenous sub-areas and target groups. Background information will include details of biophysical features (climate, soil, land, geology, groundwater conditions, surface and subsurface hydrology, etc.), associated features of land use and dynamics, changes in crop patterns and underlying socio-economic driving forces. Information on these aspects is normally available from published sources.

Building a farming systems perspective: The term 'farming system' refers to a population of individual farm systems that have somewhat similar resource base, enterprise patterns, household livelihood and farming constraints, such that similar development strategies and interventions would be appropriate to address the farming constrains[3]. A farming system reflects an integrated picture of both the socio-economic elements and biophysical resource base. It is important to view farming system in totality to be able to define technological needs to address the identified problems. Understanding farming system implies being able to see farming problems the way farmers view these; i.e. researchers have to understand how farming system operates and use this understanding in designing and evaluating new technologies, to respond to farmers' needs. Building a farming systems perspective, i.e. an explicit recognition of the importance of various interactions within the system is essential to defining technological and development needs of a target region.

The concept of building a farming systems perspective is also important for researchers working on a single commodity or problem in a particular discipline. A better understanding of the system provides a sound rationale for designing and evaluating new technologies offered to the farmers. Building a farming systems perspective in defining and developing technological solutions will also constitute a good beginning towards building a system's perspective in the overall management and functioning of the research system for greater efficiency and effectiveness in responding to the multiple challenges that the system faces.

Farmer participatory research

Thus far research aimed at developing and promoting yield-enhancing technologies has been conceived by the scientists from their respective commodity or disciplinary perspective with little consideration to understanding of the environment in which the farmers operate and respond to day-to-day and emerging challenges. Lack of this perspective is at the root of low effectiveness of research. The term 'farmer participatory research' implies active involvement of farmers in the research process, which includes prioritizing the research needs, defining possible interventions, testing and evaluating technologies and assessing adoption and impact, and providing a feedback to the research system. Involving farmers in the technology generation process has several distinct advantages. Importantly, building a system's perspective greatly improves the chances of wider acceptance of technologies. Further, the approach builds upon farmer's knowledge and understanding of the farming system, functioning in the face of a variety of situations arising from variations in the resource base, uncertainty and variability in climate-related events, experience with introduction of past technologies, etc. Solutions to the farming problems invariably require input from several disciplinary areas. This calls for involving a team of scientists with differing specialized knowledge to focus on solution to a problem together with the farmers. Such an approach constitutes a distinct departure from the way technology needs have been viewed and solutions sought thus far and calls for reorganization of institutional arrangements and trained scientific personnel who are able to think in the

new system's perspective, i.e. the way a farmer thinks.

According to Tripp[4], learning from the farmers is a piecemeal, fragmented and interactive process requiring repeated interactions between researchers and farmers over an extended period of time. The learning is in the context of solving a problem embedded in the farming system. Narain[5] pointed out the need for adopting a dialectical approach in agricultural research and development in place of a largely unidirectional input-to-output approach. Farming problems cannot be fully understood and appreciated by looking at them in a fragmented way and that the problems have to be defined in a holistic manner to find comprehensive solutions considering varied elements. It is here that building a relationship with the farmers has to be a starting point. Over the past decades, considerable efforts have gone into elaborating the concepts of farming systems and farmer participatory research[3,4,6–8]. Regular biannual organization of International Symposia on 'Farming Systems Design' since 2007 has aimed at providing a forum to interact and advance understanding in relation to opportunities to integrate knowledge across disciplines aimed at analysis of farming systems, design and innovation, to compare qualitative and quantitative approaches in order to identify operational tools and research priorities for this community of enquiry.

Operationalizing adaptive research

The need for a developing adaptive research capacity within India's agricultural research system to be able to increasingly generate and promote locally adapted practices, emphasizing closer interaction between researchers, farmers and extension workers has been recognized for quite some time. The World Bank supported the National Agricultural Research Project (NARP, 1978–96) helped establish some 120 zonal research stations and 222 additional substations covering majority of the agro-ecological zones as a part of the State Agricultural Universities. These and associated efforts served to put in place infrastructure and staff, required to generate, refine, adapt and promote technologies to address problems which the farmers are facing in diverse farming situations and needs. However, in the post-project phase, inadequate attention and required follow-up to bring about the much required institutional adjustments and capacity building for systems-based research, has seriously hampered progress in moving from a commodity/discipline-dominated top-down and a 'package of practices' approach, towards more participatory ways of finding solutions to the farming systems-based location-specific problems. For this reason also, the research system has not been able to link emerging complex systemic field/regional problems to the strategic research needs. This has further weakened the generation and flow of knowledge for developing and adapting relevant technologies[9]. During the 11th Five-Year Plan, another World Bank Project, National Agricultural Innovation Project (NAIP) has been implemented. While building a farming systems perspective in identifying and promoting technologies for improved livelihood opportunities is one of the key objectives, in the absence of clear recognition of the need and implementation of required institutional changes within the system, 'more of the same' approach is unlikely to yield the desired results.

While adaptive research will be largely the task of State Agricultural Universities through their respective zonal research stations and Krishi Vigyan Kendras (KVKs), the initiative for developing conceptual clarity and appropriate methodologies for farmer participatory research, etc. will need to come from ICAR institutes. A greatly strengthened social science and nature resource management (NRM) research components will be a key requirement. Developing a cadre of trained scientists with ability to interact meaningfully with the farmers to understand and build a farming system perspective and work with the farmers to find solutions to identified problem is the principle challenge in bringing about the required paradigm shift – one where learning from the farmers and not offering them prescriptive solutions based on preconceived notion of their problems becomes the starting point.

Institutional changes aimed at operationalizing adaptive research essentially have to be a part of the overall efforts to build a system perspective in research for development. Given the multiplicity of challenges which the research system faces, defining and implementing the 'change' agenda relating to 'how to do?' is now as much or even more important that 'what to do?'

Farming system-linked adaptive research constitutes a critical part of the research for development system and contributes to system effectiveness and efficiency in many ways. Importantly, it helps recognize linkages and interactions between the system components and at different scales. Building a systems perspective is the key to finding solutions which are more integrative. Sustainability issues, particularly, call for solutions which integrate concerns of natural resources, degradation and productivity. With climate change issues coming to occupy a centre stage in global development agenda and an overarching concern for food security and agricultural sustainability, it is important to put in place mechanisms that enable viewing and finding solutions to agricultural problems from a system's perspective and be able to address these through more integrated approaches.

1. Ministry of Science and Technology, Government of India, Science Technology and Innovation Policy, 2013.
2. Murithi, F. M., In Proceedings of the Second Scientific Conference on Soil Management by Small Holders in Kenya, Mombasa, Kenya, 2000.
3. Anandajayasekram, P., In *Concepts and Practices in Agricultural Extension in Developing Countries: A Source Book*, International Liverstock Research Institute, 2008.
4. Tripp, R., Data collection, site selection and farmer participation in on farm experimentation, CIMMYT Working Paper 82/1, 1982.
5. Narain, P., *Curr. Sci.*, 1998, **74**, 663–665.
6. Farrington, J. and Martin, A., Farmer participation in agricultural research: A review of concepts and practices, Occasional Paper No. 9, Overseas Development, London, 1988, p. 17.
7. Byerlee, D. and Collinson, M. P., Planning technologies appropriate to farmers: Concepts and procedures, CIMMYT, Mexico, 1984.
8. Norman, D. W., In 17th Symposium of the International Farming Systems Association, Florida, 17–20 November 2002.
9. Indian Council of Agricultural Research, National Agricultural Technology Project, ICAR, New Delhi, 1998, p. 193.

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