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Review of Agricultural Extension in India

Are Farmers' Information Needs Being Met?

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Contents

List of Figures

ABSTRACT

Despite a wide range of reform initiatives in agricultural extension in India in the past decades, the coverage of, access to, and quality of information provided to marginalized and poor farmers is uneven. This paper aims to ascertain why farmers are not accessing information and where information gaps exist, despite the variety of extension approaches in India. Using information provision and access as the basis for analysis, the paper reviews some of the major agricultural extension programs in India by considering their ability to provide information and facilitate information sharing and use in farming communities. The review gives a broad overview of the current extension scene in India while providing a synthesis of recent debates and the observations of various authors as well as working groups in the Ministry of Agriculture and the Planning Commission. The paper examines the challenges and constraints of each agricultural extension approach as it attempts to provide farmers with access to information that is relevant to their farm enterprises. As a result of this analysis, opportunities are identified for increasing extension services' effectiveness and efficiency in reaching smallholder farmers. Research gaps are also identified. The review concludes that there is an increasing need to work in partnership and to share knowledge and skills in order to provide locally relevant services that meet the information needs of marginal and smallholder farmers in India.

Keywords: India, agricultural extension, knowledge, information, innovation, public-private partnership

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ABBREVIATIONS AND ACRONYMS

ACABC	agriclinics and agribusiness centers
AGLED	agricultural, livestock, and enterprise development
ATIC	Agricultural Technology Information Centre
ATMA	Agricultural Technology Management Agency
DAATTC	District Agricultural Advisory Transfer of Technology Centre
DoA	Department of Agriculture
EEI	Extension Education Institute
F2FS	farmer-to-farmer school
FAC	Farmer Advisory Committee
FAO	Food and Agriculture Organization of the United Nations
FBO	farmer-based organization
FIAC	Farm Information and Advisory Centre
FIG	farmer interest group
FF	farmer friend
FFS	farmer field school
IAR4D	Integrated Agricultural Research for Development
ICAR	Indian Council for Agricultural Research
ICT	information and communication technology
IPM	integrated pest management
ITC	Indian Tobacco Company
ITD	Innovation in Technology Dissemination
KHDP	Kerala Horticulture Development Program
KVK	Krishi Vigyan Kendra
MANAGE	National Institute of Agricultural Extension Management
MKV	Mahindra Krishi Vihar
NABARD	National Bank for Agriculture and Rural Development
NAEA	National Agricultural Extension Agency
NAES	National Agricultural Extension System
NAETS	National Agricultural Education and Training System
NARI	National Agricultural Research Institute
NARS	National Agricultural Research System
NATP	National Agricultural Technology Project
NGO	nongovernmental organization
NSSO	National Sample Survey Organisation
PRA	Participatory Rural Appraisal
RKVY	National Agricultural Development Project
SAU	state agricultural university
SAMETI	State Agricultural Management and Extension Training Institute
SHG	self-help group
SREP	Strategic Research and Extension Plan
SSEPER	Support to State Extension Programmes for Extension Reforms
T&V	training and visit

1. INTRODUCTION

Approaches to agricultural extension in India and worldwide continue to evolve. Since the Green Revolution in the 1970s and 1980s and the acknowledged unsustainability of the training and visit (T&V) program (Anderson, Feder, and Ganguly 2006; Moore 1984), agricultural extension, with its focus on increasing production via technology transfer, has adopted decentralized, participatory, and demand-driven approaches in which accountability is geared toward the users (Birner et al. 2006; Birner and Anderson 2007; Davis 2008; Hall et al. 2000; Kokate et al. 2009; Sulaiman and Hall 2008; Swanson 2009). While the call for demand-driven agricultural extension has existed for several decades now, new modes of reaching out to farmers could have significant impact in India, as they might better reflect the local information needs of farmers. The diverse nature of the Indian subcontinent, with its wide variety of agroclimatic regions and broad range of socioeconomic conditions in the rural population, calls for agricultural extension approaches that are context- and situation-specific. With more than 81 percent of Indian farmers cultivating an area of 2 hectares or less (India, Directorate of Economics and Statistics 2009; NSSO 2006), there is an increasing need for stronger intermediaries that can facilitate information access for diverse smallholder farmers. Further progress in poverty and hunger reduction crucially depends on the increased productivity and profitability of these farmers, which in turn depends on the successful delivery of agricultural extension.

Several emerging challenges confront Indian farmers. These include limited land and water availability, which is further exacerbated by degradation of natural resources; climate changes; changes in demand and consumption patterns, moving toward high-value agriculture; increasing population pressure; and liberalization of trade (Lele et al. 2010). Recent global food price increases and high levels of inflation have provided an opportunity to increase farmers' profitability. However, to realize the benefit of higher prices, farmers need to access a wider range of information, related not only to production technologies but also to postharvest processes, access to remunerative markets, price information, and business development (Sulaiman and van den Ban 2003). This information could be integrated with services that support the use of the information. For example, technology information needs to be supported with information about reliable sources for that technology, and where credit can be accessed. In India, the role of agricultural extension in improving agricultural growth is today being recognized with increasing investment. India's 10^{th} and 11^{th} five-year plans emphasize agricultural extension as a key to increasing agricultural growth by reducing the yield gap in farmer fields, and therefore stress the need to strengthen agricultural extension in India (Planning Commission 2001, 2005, 2006).

However, despite the renewed interest and investment in agricultural extension in India, the coverage of such services is inadequate. Government extension programs, extension services of the national agricultural research system, cooperatives, and nongovernmental extension programs have a very limited outreach (NSSO 2005). The 2003 National Sample Survey Organisation (NSSO) survey showed that 60 percent of farmers had not accessed any source of information on modern technology to assist in their farming practices in the past year. Of those who had sourced information, 16 percent received it from other progressive farmers, followed by input dealers. Of those farmers who had accessed information, the major problem of extension services was found to be the practical relevance of the advice (NSSO 2005). The coverage and relevance of information provided to farmers through the agricultural extension system is therefore questionable. While this may be partly due to inadequate contact by the services, which need to reach a large and complex farming community, inappropriate or poor-quality information could also be a key hindrance to farmers' use of extension services. In other words, the content of the information provided by agricultural extension approaches, and the information farmers actually need, may not be aligned. There is therefore a need to reexamine the current agricultural extension approaches in India to understand where information gaps exist and determine why farmers are not accessing information through the large, well-established public-sector extension system in addition to emerging private and third-sector actors.

The objective of this paper is to examine agricultural extension programs within the public, private, and third sectors in India by focusing on the programs' ability to meet farmers' information needs. This review builds upon existing reviews of agricultural extension in India, namely Raabe (2008), Birner and Anderson (2007), and Sulaiman and Holt (2002). Primary and secondary sources are used to examine the strengths and weaknesses of each approach to providing farmers with access to information relevant to their farm enterprises. Discussions with key actors in the public-sector agricultural extension system at a recent workshop support the literature review.[1] The paper also analyses the main challenges and constraints each agricultural extension approach faces in its operation in order to identify opportunities for increasing its effectiveness and efficiency in reaching smallholder farmers. The main limitation of the review is the lack of thorough impact evaluation of the projects, which have largely been examined descriptively, thus making it difficult to compare the efficiency and effectiveness of each approach—a comment also made by Raabe (2008). This problem is not specific to India but is present globally, as there is often very little information available on the performance of various extension systems worldwide, considering the investments made in this area (Birkhaeuser, Evenson, and Feder 1991; Davis 2008).

The paper is organized as follows. Background on farmers' information needs and the frameworks used to examine agricultural extension approaches is provided in the next section, followed by the framework used to examine current extension programs. Section 4 presents the framework for some of the public-, private,- and third-sector agricultural extension programs that are currently implemented in India. The constraints and challenges to agricultural extension in India are discussed in section 5. Section 6 summarizes the lessons learned from the current approaches, and the paper ends with some concluding remarks.

[1] Discussions with participants at the National Academy of Agricultural Research Management (NAARM)-IFPRI workshop Redesigning Agricultural Extension in India: Challenges and Opportunities, August 20–21, 2010, Rajendranagar, Hyderabad, India.

2. BACKGROUND

2.1. Farmers' Information Needs and Preferred Information Medium

Agricultural extension, or agricultural advisory services, comprises the entire set of organizations that support people engaged in agricultural production and facilitate their efforts to solve problems; link to markets and other players in the agricultural value chain; and obtain information, skills, and technologies to improve their livelihoods (Birner et al. 2009; Davis 2009). This definition has evolved since the T&V program, where the focus of extension was transfer of technology to improve productivity, especially for staple food crops. While transfer of technology still has relevance, agricultural extension is now seen as playing a wider role by developing human and social capital, enhancing skills and knowledge for production and processing, facilitating access to markets and trade, organizing farmers and producer groups, and working with farmers toward sustainable natural resource management practices (Swanson 2008). Within this expanded role, the breadth of information that agricultural extension can support—through provision and facilitating access and sharing—is much larger. In addition, as the agriculture scenario has become more complex, farmers' access to sources of reliable and relevant information has become increasingly important.

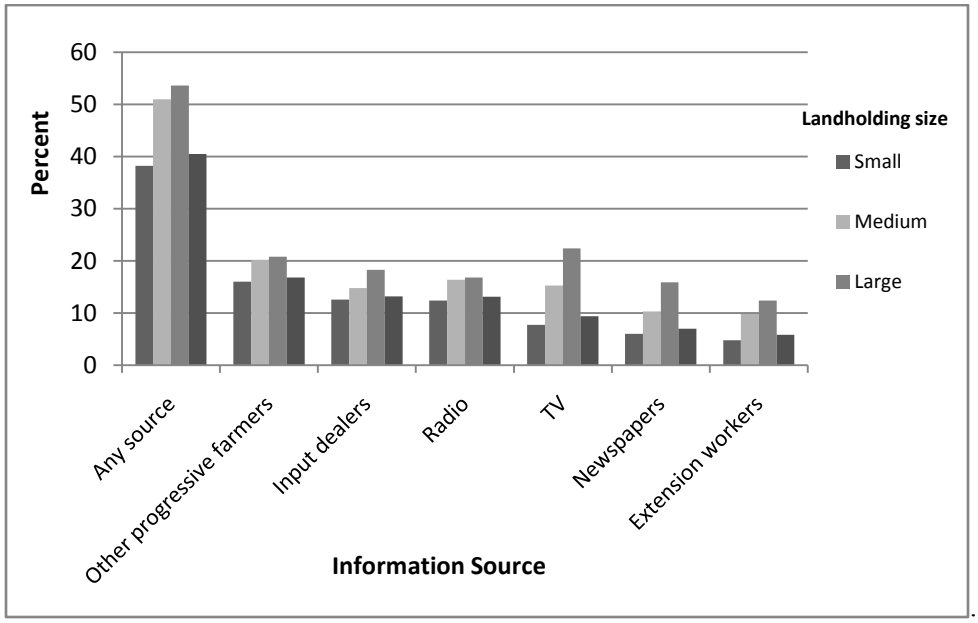
Farmers require a diverse range of information to support their farm enterprises. Information is needed not only on best practices and technologies for crop production, which the traditional public-sector extension system provided during the Green Revolution, but also information about postharvest aspects including processing, marketing, storage, and handling. Farmers require information related to the following (Van den Ban 1998):

- Most appropriate technological options
- Management of technologies, including optimal use of inputs
- Changing farm system options (mixed farming and diversification, animal husbandry, fisheries)
- Sourcing reputable input suppliers
- Collective action with other farmers
- Consumer and market demands for products
- Quality specifications for produce
- Time to buy inputs and sell produce
- Off-farm income-generation options
- Implications of changing policies (input subsidies, trade liberalization)
- Access to credit and loans
- Sustainable natural resource management and coping with climate change

The information required will differ between categories of farmers and can be targeted to specific groups, based, for example, on landholding size or agroclimatic region (Rivera 1996). In addition to needing different types of information and using different information sources, different farmers will have different search behaviors. Factors such as literacy or access to resources will have a large impact on information needs, searching behavior, access, and use. Swanson (2008) described various target groups: rural and farm women, small and marginal subsistence farmers, medium-scale farmers, commercial farmers, and rural youth. In India, for example, the information needs of the 360 million farmers (expected to rise to 600 million by 2020) who operate under rainfed conditions and contribute 45 percent of production will be different from the needs of farmers in well-endowed irrigated areas (Farrington, Sulaiman, and Pal 1997; Sulaiman and Holt 2002). In most rainfed areas, due to higher temporal and spatial variability in rainfall, nutrient-poor soils, and poor socioeconomic conditions, many farmers are not able to produce beyond the quantity needed for self-consumption. Additionally, livestock plays a

greater role in these areas than crop production does, and rainfed regions also employ a greater number of women than irrigated areas do (Rangnekar 1998). The information needs of resource-poor farmers and farmers operating under rainfed conditions differ substantially from those of farmers who are able to enter the market economy. There is little opportunity to utilize new technologies in rainfed areas because farmers lack the financial means, credit, and capacity to take risks, and consequently technology gaps are much wider in these areas compared to irrigated areas. Due to higher levels of poverty in rainfed agriculture areas, improved access to information is essential to increase the productivity and profitability of these farmers (Planning Commission 2006). In addition, integrating information with supporting services and inputs is important and will have a greater effect than providing information alone.

Figure 1. Information sourced on modern technology by farmers according to landholding size, from 2003 NSSO survey



Source: Adhiguru, Birthal, and Ganesh Kumar (2009).

According to the 2003 survey (NSSO 2005), access to information from any source increased with larger farm size (Figure 1). Most farmers sought information on seed for cultivation, followed by veterinary care in animal husbandry, and then management and marketing in fisheries. The main information source was other farmers (16.7 percent), followed by input dealers (13.1 percent), radio (13 percent), TV (9.3 percent), and newspapers (7 percent). Public-sector extension was used for information by only 5.7 percent of survey respondents. In terms of differences in sources of information for the 40 percent of farmers who had accessed information, smallholder farmers relied primarily on other progressive farmers, input dealers, and radio for information, while medium-size and large-scale farmers equally used radio, TV, and newspapers. Contact with extension workers for medium-size and large-scale farmers was almost double that of smallholder farmers (Adhiguru, Birthal, and Ganesh Kumar 2009).

It is still not understood in the literature why marginal and smallholder farmers do not access information more frequently. Whether it is because the information is not available or not relevant or there is no incentive to access information is still unknown. Another possibility is that these farmers do not have the means to use the information. If this is the case, information that is supported by services and inputs could be highly relevant. There are few studies on the information needs of farmers, so research into this area could help analysts understand the information-seeking behaviors of different types of farmers.

Considering the dependence of Indian farmers on input dealers, there is a need to understand what is hindering the coverage of agricultural extension approaches and the relevance of the information provided.

2.2. Frameworks to Review Agricultural Extension Approaches

Given the increased attention devoted to agricultural extension, or agricultural advisory services, by governments and donors worldwide, there is a growing body of literature examining and reviewing agricultural extension. However, within the existing literature, no common analytical framework that can be used to compare and review agricultural extension programs is defined, though there are a number of common themes and issues that are tackled similarly in different reviews.

Demand-driven and participatory approaches are considered an important aspect of improving agricultural extension provision to improve accountability and increase transparency in organizational performance. Consequently, a number of papers use this aspect to analyze performance in extension. Birner and Anderson (2007) examined theoretical failures inherent in market (private), public, and third-sector agricultural extension approaches to making extension demand-driven, and then examined strategies for overcoming these failures and investigated whether these strategies were incorporated into India's policy framework for agricultural extension. Feder et al. (2010) investigated community-based failures in agricultural extension with reference to India's Agricultural Technology Management Agency (ATMA) program, among others. Raabe (2008) reviewed agricultural extension approaches in India by considering supply-side and demand-side reform aspects. Demand-side aspects explored were governance structures, capacity development, and affirmative action. Supply-side aspects addressed included administrative and fiscal decentralization, private- and third-sector involvement, capacity development, and information and communication technology (ICT) use. Demand-driven approaches may improve accountability and incentives, but if organizations suffer from low staffing and low morale and are underresourced, organizational performance and the implementation of such reforms may continue to be poor.

Sulaiman, who has written a number of articles on agricultural extension in India, uses the innovation systems concept to describe the weaknesses in public- or private-sector extension programs and provide suggestions for strengthening the systems (Sulaiman and Holt 2002; Sulaiman and Hall 2002; Sulaiman 2003a; Sulaiman and van den Ban 2003; Sulaiman 2003b). Within these reviews, the analysis focuses on, among other aspects, issues related to scale and complexity, linkages, operational resources and sustainability, conceptual problems, human resource capacity, and creating learning environments. These analyses examine the underlying processes and structures inherent in the organizations that provide extension. Suggestions for the public-sector extension system include reform by replacement with a new organization, piloting different models for learning and capacity development, and learning from positive deviants and worldwide experiences in innovations in extension (Sulaiman and Hall 2008).

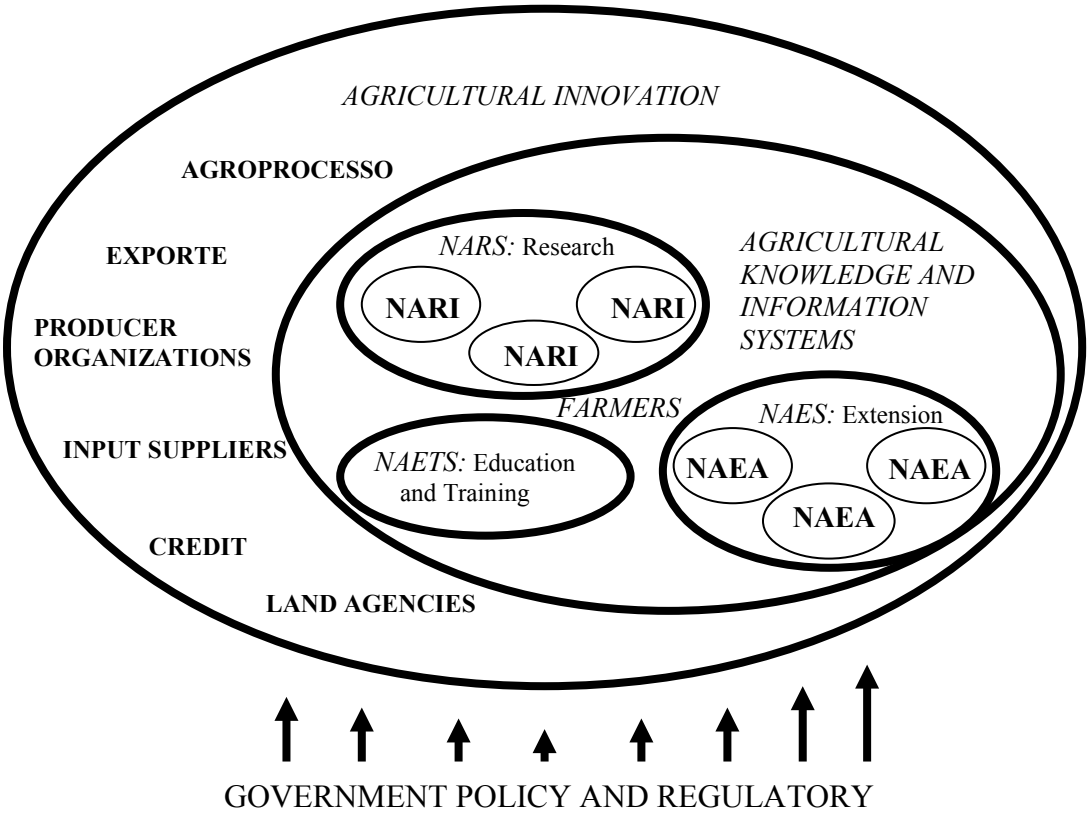
Poor extension performance conditions, as defined by Feder, Willett, and Zijp (2001), include the scale and complexity of agricultural production, dependence on the broader policy environment, weak linkages between the extension and research systems, difficulty in attributing impact, weak accountability, weak political commitment and support, public duties other than knowledge transfer, and difficulties with fiscal sustainability. These generic problems also relate in part to organizational capacity. This framework was used by Anderson and Feder (2004) to review T&V extension, decentralization, fee-for-service and privatized extension, and farmer field schools. Birner et al. (2009) developed a framework that examines aspects highlighted by Feder, Willett, and Zijp (2001). The framework considers the contextual factors within which the extension approach is found (including policy environment, capacity of providers, farming system type, and nature of local communities), along with the governance structure, capacity, management, and methods of the extension service itself, and consequent performance and impact. While the focus of this analytical framework relates specifically to the extension component itself, the analysis considers agricultural extension within agricultural innovation systems.

Agricultural innovation systems are a paradigm in which information dissemination need not be performed only by extension workers. The conventional pipeline approach to agricultural research and technology development and dissemination, whereby research is performed by researchers and the results are turned over to extension staff for dissemination to farmers, has produced numerous success stories, but it has serious limitations for broad-based, sustained agricultural growth and poverty reduction. It has failed to reach many of the actors who need information to improve their productivity and production, achieve food security, and create wealth. Increasingly, the innovation systems approach is seen as a viable alternative to the pipeline approach. The entry of new actors, demographic pressures, and a value-chain approach to agriculture and market forces, combined with new economic pressures and new insights into sociocultural realities and human behavior, created the need and opportunity for more interactive approaches. The innovation systems approach is seen as a useful paradigm for this interaction.

An innovation systems approach considers innovation as a systemic process and recognizes that innovation can emerge from many sources, complex interactions, and knowledge flows. Clark, Smith, and Hirvonen (2007) defined an innovation system as a network of agents whose interactions determine the innovative impact of knowledge interventions, including those associated with scientific research. The World Bank (2007, 18) defines an innovation system as "a network of organizations focused on bringing new products, new processes, and new forms of organization into social and economic use, together with the institutions and policies that affect their behavior and performance."

A great deal of knowledge already exists that can be used to improve the livelihood of the smallholder. The innovation systems approach represents an effective way to use, adopt, or commercialize existing knowledge. The innovation systems approach moves away from a traditional linear research and development model in which research is completed and results are passed on to users through extension. Instead, it emphasizes the need to nurture the demand for knowledge and technologies among a range of actors, including farmers, researchers, extension officers, policymakers, private-sector companies, entrepreneurs, agroprocessors, nongovernmental agencies, and other intermediary organizations, and to encourage them to demand relevant knowledge (Figure 2). The flow of knowledge between these actors is important in enabling innovations to work to advance food and agriculture.

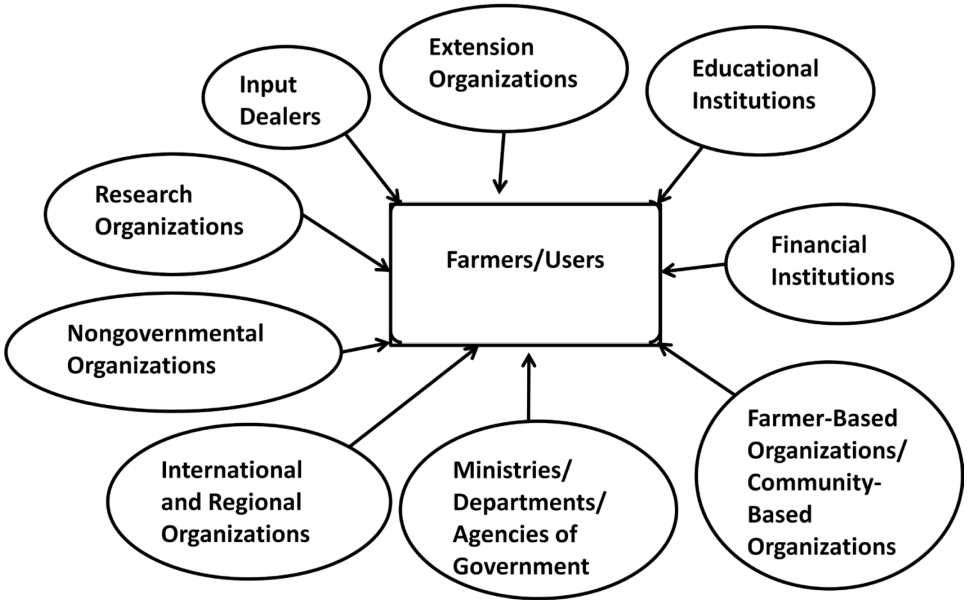
Figure 2. Agricultural innovation system



Source: Rivera et al. (2006).
Note: NARS = National Agricultural Research System, NARI = National Agricultural Research Institute, NAETS = National Agricultural Education and Training System, NAES = National Agricultural Extension System, NAEA = National Agricultural Extension Agency.

To operationalize the innovation systems paradigm, the Integrated Agricultural Research for Development (IAR4D) concept puts farmers and users at the center of innovative practices (Asenso-Okyere and Davis 2009). Agricultural productivity cannot be tackled if the capacity of the actors engaged in the sector is low. Capacity, in terms of knowledge and information, must be built in the farmers and other operators in the agriculture value chain to enable them to operate efficiently in the knowledge economy (Figure 3). IAR4D encourages learning through the exchange of ideas, successes, and failures between stakeholders.

Figure 3. Integrated Agricultural Research for Development schematic



Source: Authors.

The organization or person who will play the role of building capacity and enabling farmers to operate in the innovation system is known as the innovation broker or innovation intermediary (Klerkx and Leeuwis 2008). Howells defines an innovation intermediary as "an organization or body that acts as an agent or broker in any aspect of the innovation process between two or more parties. Such intermediary activities include: helping to provide information about potential collaborators; brokering a transaction between two or more parties; acting as a mediator, or go-between, [for] bodies or organizations that are already collaborating; and helping find advice, funding and support for the innovation outcomes of such collaborations" (2006, 720). An innovation broker therefore coordinates and facilitates partnerships and linkages between the stakeholders involved in the innovation system through bridging, bonding, and linking social capital. This evolving idea of innovation systems in agriculture moves beyond the traditional role played by agricultural extension and into a system in which the innovation intermediary could be, but does not necessarily have to be, an extension agency (Klerkx, Hall, and Leeuwis 2009).

3. A CONCEPTUAL FRAMEWORK FOR ASSESSING THE ROLE OF AGRICULTURAL EXTENSION APPROACHES IN INFORMATION PROVISION AND ACCESS

A holistic approach to agricultural extension today goes beyond technology transfer for major crop and livestock production systems. It also includes goals for human capital development, in terms of enhancing the management and technical skills of farm households relating to production and postharvest handling of high-value crops, livestock and fisheries, sustainable natural resource management, family health and nutrition, and leadership and organizational skills, in addition to social capital development, that is, organizing producer groups (Swanson 2008). As already discussed, agricultural extension facilitates problem solving; creates links to markets and other players in the agricultural value chain; and provides access to information, skills, and technologies.

The conceptual framework described here focuses specifically on the role of agricultural extension approaches in engaging and facilitating farmers' access to information. This is one of several functions extension is now expected to address in the provision of a diverse set of services.

Information can be easily transferable and is context-independent, while knowledge is a process of contextualizing information through awareness so that it becomes situation-specific. Despite the wide scope agricultural extension must now cover, focusing the analysis on information provision and access will help identify challenges, constraints, and possible solutions that can help refine the existing methods and approaches.

The provision of information and farmers' use of it are influenced by a number of key factors, which include the following:

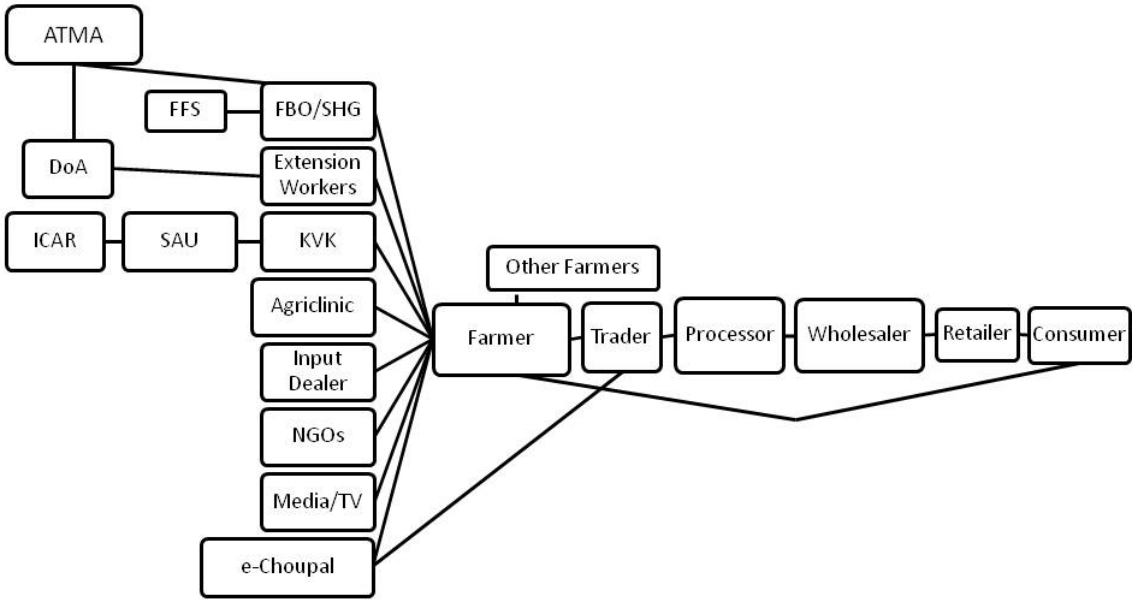
1. Human capacity: The capacity of extension personnel to engage and obtain feedback from farmers, and also to seek global and local information for sharing with farmers, influences how farmers use the information provided. Human capacity can also refer to both the quality and quantity of extension personnel. Their ability to acquire and develop new information and knowledge and to contextualize it for farmers in the operational area affects the use and impact of this knowledge on farmer productivity and income. Additionally, supporting farmers to process and integrate information from many different sources is important.
2. Content: The reliability, relevance, usability, and timeliness of the information is critical. Beyond the provision of information on the main cereal crops and technologies, efforts are needed to augment the content to include market intelligence, policy insights, farmers' experience, and off-farm enterprise information, as well as the integration of information to create links with supporting services and inputs.
3. Processes: The process through which the information is shared can determine the effectiveness of the information and its use. Setting priorities for information needs in consultation with users, adding value to the information collected, learning from how information is used by farmers, and changing the dissemination strategy by stratifying and targeting users will influence the success of the extension approach.
4. Technology: Increasing use of technology can improve the nature and speed of information sharing. Effective and sustainable use of technology depends on the appropriateness of the technology for the user and the content shared via this technology.

For each of these factors, information sharing can operate at different scales—at the extension-farmer interface, within the extension organization itself, and between organizations. At each of these levels, the four factors described above influence whether the information needs of farmers are being met.

The framework centers on farmers' needs for information and considers the type of information needed in various contexts, which can also include links to postharvest and consumer demands (Figure 4). At each link in Figure 4, information is exchanged and shared by a number of actors, including input suppliers, cooperatives, traders, processors, nongovernmental organizations (NGOs), and government

extension services. On the left-hand side of the "farmer" in Figure 4 are some of the current agricultural extension approaches in India, which generally provide information for on-farm production only. On the right-hand side of the "farmer", information is also exchanged but it refers to postharvest and market access links to the consumer, which could also be the farmer himself or herself.

Figure 4. Information exchange of some agricultural extension approaches in India



Source: Authors.

Notes: Information flow is the line between the boxes, though strength and feedback in each line are not described here. ATMA = Agricultural Technology Management Agency, DoA = Department of Agriculture, ICAR = Indian Council for Agricultural Research, FFS = farmer field school, FBO/SHG = farmer-based organization / self-help group, SAU = state agricultural university, KVK = Krishi Vigyan Kendra (farm science center), NGO = nongovernmental organization.

The success of an extension approach will depend on how it enhances the information flow along the agriculture value chain, and whether this is done sustainably and effectively. Sustainability and effectiveness, in turn, are determined by the four factors already described: the type of information provided, how and to whom the information is provided, the strength of feedback in each link, and the capacity of the approach to provide relevant information. Entry points can be identified for improving information flow and content by using ICT tools, and for strengthening the capacity of the entities within the system and of the approach as a whole to meet farmers' needs. In this paper the functional organizational structures for the information flow of the agricultural extension services reviewed are also identified.

4. REVIEW OF SELECTED AGRICULTURAL EXTENSION APPROACHES IN INDIA

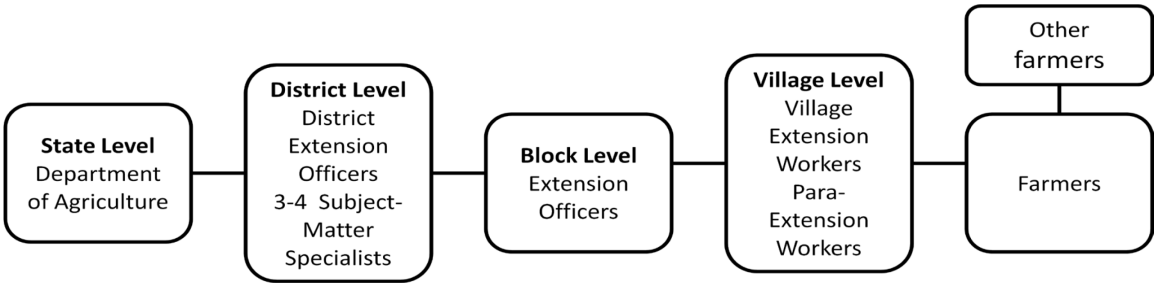
4.1. Public-Sector Extension

4.1.1 State Departments of Agriculture

Extension is implemented at the state level, and public-sector agricultural extension provision still takes place through the state Department of Agriculture (DoA). Extension is organized differently in each state, with wide diversity in personnel numbers and program focus; however, it is beyond the scope of this review to examine the specific operational characteristics of extension in each state, so a broad overview is presented.

The extension staff of the DoA operate at the district and block levels, which are administrative subdivisions. A block is a subdivision of a district. The numbers and capacity of the staff vary greatly throughout the country, but it is well acknowledged that staff numbers are low, as there has been no recruitment since 1998. The ratio of staff to farmers varies widely across the country (1:300 in Kerala, 1:2,000 in Rajasthan), as does the capacity of frontline extension staff—for example, only 20 percent of staff are university graduates (Sulaiman and Holt 2002). Senior and mid-level extension staff are trained by the National Institute of Agricultural Extension Management (MANAGE), with four Extension Education Institutes (EEIs) providing regional-level training to mid-level functionaries working in the line departments (India, Department of Agriculture and Cooperation 2007b). Information is transmitted from the district and block extension staff to the village levels through contact farmers or para-extension workers (Figure 5).

Figure 5. Information flow in the extension activities of the state Departments of Agriculture



Source: Authors.

Staff of the DoA receive their information from various sources, including the research stations of the Indian Council for Agricultural Research (ICAR). However, the linkages between the two systems, research and extension, are well known to be weak, and information flow remains linear and top-down. Feedback from extension to research is limited, so research agendas are not influenced by extension experience (Sulaiman and Holt 2002). The information the DoA provides still relates to the transfer of technology to bridge the yield gaps between farmers' fields and research stations, and largely focuses only on crop production (Sulaiman and van den Ban 2003). The use and generation of knowledge in the DoA tends to be isolated from other extension actors, including private- and third-sector organizations and even other state government line departments, such as animal husbandry, fisheries, and forestry.

In this approach, the farmer is at the end of the information chain, with little opportunity to provide feedback. Due to low staff numbers, communicating information directly to a large number of farmers is difficult. Low operational budgets, with 85–97 percent of expenditures going to salaries, limit the ability of DoA staff to visit farmer fields (Sulaiman and van den Ban 2003; Swanson 2008). Due to the large number of schemes and programs coming from the center and state, extension staff also tend to perform public duties not related to extension, such as election or census duties (Anderson, Feder, and Ganguly 2006). In remote and marginal areas, further difficulties arise. Extension workers consider

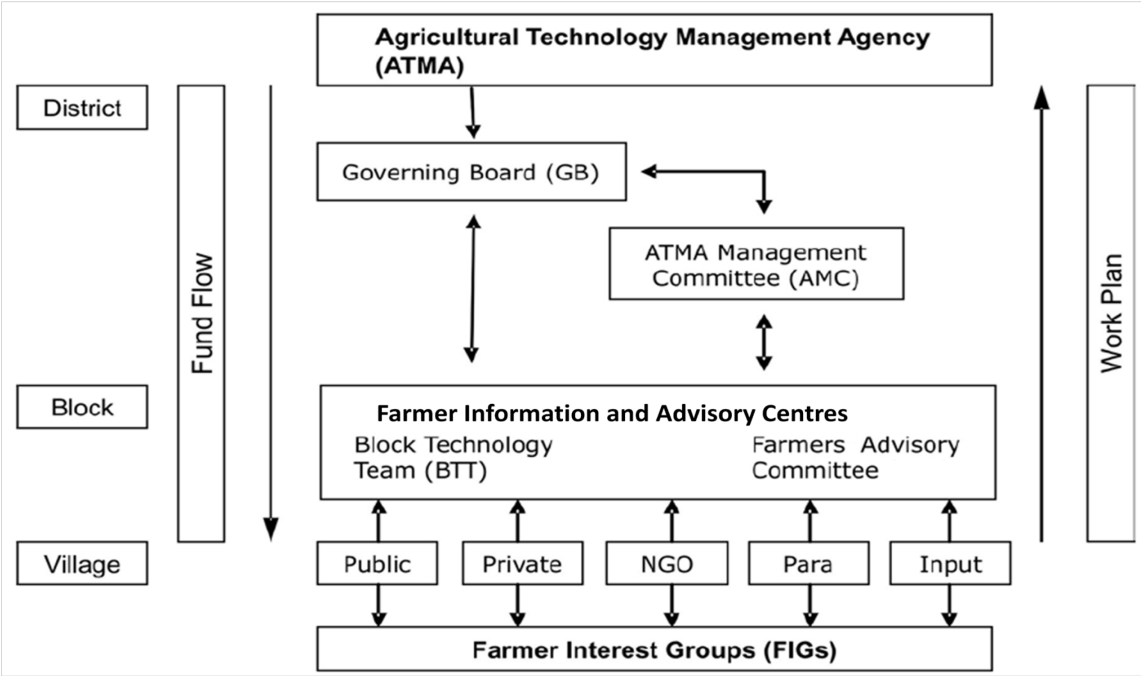
remote areas to be “punishment postings”; 50 percent of these posts are vacant, and the capabilities of those there are questionable (Sulaiman and Holt 2002). Monitoring and evaluation of staff is top-down, with no role for farmers, so there is a lack of accountability to farmers and a lack of incentives for staff, due to the difficulty of measuring the impact of their work (Anderson, Feder, and Ganguly 2006).

4.1.2 Agricultural Technology Management Agency

The Agricultural Technology Management Agency (ATMA), defined as a semi-autonomous decentralized participatory and market-driven extension model (Swanson, Singh, and Reddy 2008), represents a shift away from transferring technologies for major crops to diversifying output. The ATMA model is a central government initiative of the 2005–06 Support to State Extension Programmes for Extension Reforms (SSEPER) scheme, which was designed to be implemented by each state at the district level (India, Department of Agriculture and Cooperation 2005). The pilot test was initiated in 1998 under the Innovation in Technology Dissemination (ITD) component of the National Agricultural Technology Project (NATP) with the support of the World Bank in 28 districts in seven Indian states. In 2005 the Government of India expanded the ATMA model to 252 districts under SSEPER, and then in 2007 to all districts of the country (Reddy and Swanson 2006; Working Group on Agricultural Extension 2007). The Government of India has recently released plans to revise the scheme, invest a further US$630 million over the next two years, and add an additional 20,000 extension staff exclusively for the ATMA program (India, Department of Agriculture and Cooperation 2010).

ATMA represents a platform for integrating extension programs across line departments, such as animal husbandry, fisheries, and forestry; linking research and extension units in a district; and inviting farmer participation in decisionmaking (Swanson 2008) (Figure 6). Extension intervention is based on the Strategic Research and Extension Plan (SREP) prepared after a Participatory Rural Appraisal (PRA) in each district. The Farm Information and Advisory Centre (FIAC) is the physical platform at the block level where farmers, members of the private sector, and extension field staff members from each line department meet to discuss, plan, and execute extension programs. The block technology team includes technical officers from various line departments and consults with the Farmer Advisory Committee (FAC), which includes the heads of farmer interest groups (FIGs), at the FIAC to develop a block action plan. The block action plan is then approved for funding by the ATMA governing board (Singh and Swanson 2006). The FIGs and SHGs can be formed by local NGOs and then organized into producer groups by extension staff. In the first year of operation, the capacity of the groups is built through awareness campaigns, exposure visits, and training courses (Mishra and Swanson 2009). Each state has a SAMETI (State Agricultural Management and Extension Training Institute), whose mandate is to strengthen the capacity of mid-level and frontline extension staff and orient them to the ATMA scheme.

Figure 6. Organizational structure of the Agricultural Technology Management Agency up to 2010



Source: Singh and Swanson 2006.

During the pilot, sufficient resources were provided to the Indian Institute of Management, Lucknow, for thorough and regular monitoring and evaluation, which uncovered empirical evidence of the impacts of ATMA (IIM Lucknow 2004a, 2004b; Tyagi and Verma 2004). The study revealed an increase in diversification of crops and a 14 percent increase in yields in ATMA pilot districts. Farm income increased by 24 percent in the pilot districts, which was larger than the 5 percent income increase in the other districts. Nevertheless, the impact of the pilot study was not uniform across states and depended on the state government's commitment to the program (Sulaiman 2003b). Additionally, the capacity and motivation of the project director were seen to greatly influence the dynamism of ATMA activities. A number of authors have drawn attention to deficiencies in the impact analysis, which may have overestimated the benefits of ATMA due to selection bias, poor pairing of districts for comparison, restricted sample data indicators, and less statistical control for nonproject effects (Anderson 2007; Birner and Anderson 2007). Furthermore, the study did not address endogeneity problems or identify the mechanisms or institutions that brought about ATMA benefits. Income gains with reference to landholding size were not considered, so the impact on small and marginal farmers has not been evaluated. Human capital development was evaluated based on the number of training courses and groups organized, but quality of training and group makeup was not considered (Raabe 2008). ATMA represents an institutional reform, but performance of institutions and processes was not considered (Birner and Anderson 2007; Raabe 2008).

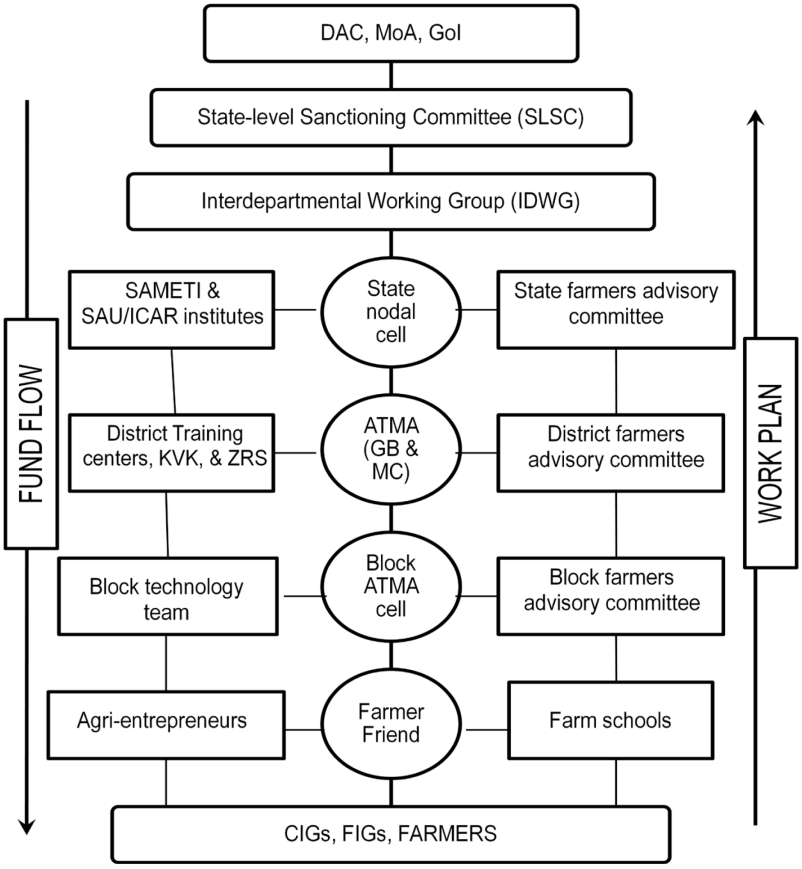
Despite methodological questions about the impact study, based on the success of the ATMA pilot the program was scaled up across the country. However, considerable challenges have been encountered in scaling up ATMA at the national level, including lack of government resources to train and support extension workers; lack of local ownership at the local levels, where ATMA is implemented as another scheme; and capacity and institutional constraints (Sulaiman and Hall 2008). Additional challenges include weak links between ATMA bodies and the ICAR extension unit, the district-level Krishi Vigyan Kendra (KVK). The ATMA model is also increasingly criticized for making the extension system more bureaucratic, as the chairman of the district committee is the magistrate of the district (administrative head), who is also responsible for administration for the whole district. This move away

from DoA coordination of agricultural extension activities to the administrative system for coordination is challenged by agricultural scientists. For example, agricultural scientists at state universities cannot be held accountable for plans developed at the district level. Also, the staff of state-level extension departments cannot be held responsible, as they do not report to the district magistrate. Therefore, the accountability of individuals is not clear.

ATMA provides a platform for encouraging the flow of information between the public research and extension systems, and encourages diversification in cropping practices. But in terms of information provision and sharing, ATMA currently still relies on the existing capacity of the public-sector system, which has already been described as focusing on technology transfer for crop production. There is a major need for extension in the areas of appropriate storage, postharvest handling, and marketing of crops, which has not been clearly addressed in this model. These aspects are not common in most of the public extension systems upon which ATMA capacity relies. During the NATP pilot, extensive training and monitoring helped orient the ATMA institutions to work toward identifying progressive farmers, markets, and high-value crops through PRAs in the preparation of the SREP (Swanson 2009). When ATMA was taken to the national level, that same capacity was not developed, resulting in varied applications of ATMA across districts, with many activities remaining in the DoA and focused on transfer of technology (Sulaiman and Hall 2008). There have also been suggestions that the FAC may not be a truly inclusive representation of farming communities, and members may be too weak to articulate their concerns or may be poorly involved in decisionmaking (Lenin, Singh, and Vijayaragavan 2009; Sulaiman and Holt 2002).

In June 2010, revised guidelines for ATMA were released to address some of the constraints identified since implementation began in 2005, especially the lack of qualified personnel at all levels; the absence of formal mechanisms to support extension delivery below the block level; inadequate infrastructure support to SAMETIs; and the lack of convergence with other central and state schemes (Gupta 2010b). Further personnel will therefore be added at the district and block level exclusively for ATMA, and a farmer friend (FF), a progressive farmer for two villages, will work to support extension at the village level. Other schemes, such as the agriclinics and RKVY (National Agricultural Development Project), will work with and through the ATMA structure (Figure 7). The guidelines themselves also admit that ATMA has changed focus with national-level implementation, and the reforms—including bottom-up planning, a multiagency extension strategy, gender mainstreaming, and coverage of allied sectors and convergence—have been neglected (India, Department of Agriculture and Cooperation 2010). In the new guidelines, the FF will fill the block-village gap and will also act to disseminate information to farmers, mobilize farmer groups, and access information for farmers. This approach seems similar to the T&V contact farmer approach, which was also selected by extension workers. During T&V, it was noted that larger-scale and richer farmers tended to be selected as the contact farmers, which reduced the capacity of the system to reach smallholder farmers (Anderson, Feder, and Ganguly 2006). This will be an important consideration when the FF is selected in the ATMA model, as this person will be the focal point for the implementation of village extension activities. The new revision also pushes the use of farm schools for farmer-to-farmer extension, for three to five focal points in every block, with guidelines to give 50 percent learning representation to small and marginal farmers. Effective monitoring and evaluation of these components of ATMA will encourage effective representation of the farming community. Nevertheless, the inherent weaknesses of the public-sector extension system are not addressed in ATMA.

Figure 7. Revised structure of the Agricultural Technology Management Agency

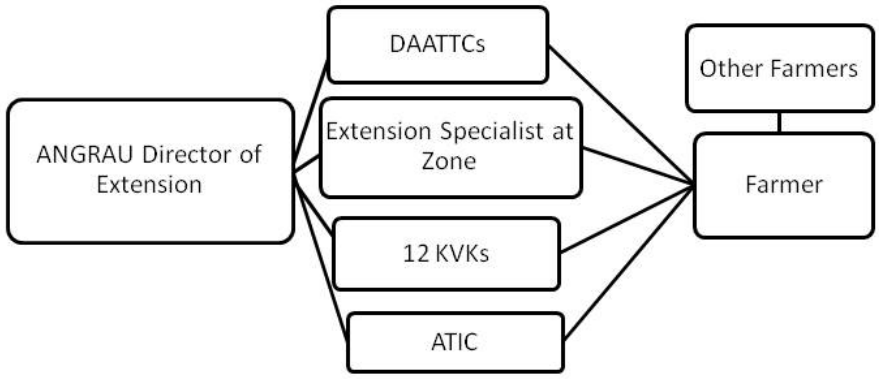


Source: India, Department of Agriculture and Cooperation (2010).
Note: DAC = Department of Agriculture and Cooperation, MoA=Ministry of Agriculture, GoI=Government of India, GB = Governing Board, MC = Management Committee, CIGs= Commodity Interest Groups, FIGs= Farmer Interest Groups, SAU=State Agricultural University, ICAR=Indian Council of Agricultural Research, SAMETI= State Agricultural Management and Extension Training Institute.

4.1.3 State Agricultural Universities

The main extension activities of the central autonomous Indian Council for Agricultural Research (ICAR) are achieved through the 40 Agriculture Technology Information Centres (ATICs) and 569 district-level Krishi Vigyan Kendras (KVKs), or farm science centers. Additionally, each state has a state agricultural university (SAU), which provides extension and training activities through the Directorate of Extension and Education but activities and organizational setup differ widely by state. For example, in Andhra Pradesh, the state agricultural university, ANGRAU, has organized District Agricultural Advisory Transfer of Technology Centres (DAATTCs) at the district level (Figure 8). At each of these centers, diagnostic visits to farmers are carried out weekly. Twice a year, before the Kharif (monsoon crop) and Rabi (winter crop) season, zonal research meetings take place, in which extension workers at the DAATTC, farmers, and state university scientists meet to identify research needs.

Figure 8. Information flow in Andhra Pradesh state agricultural university (ANGRAU)



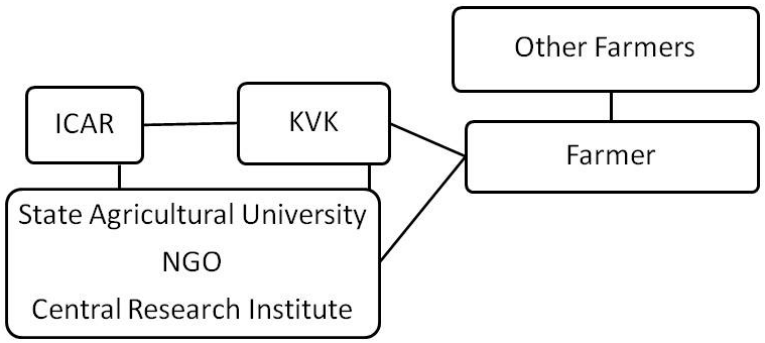
Source: Authors.
Note:ANGRAU = Andhra Pradesh State Agricultural University, DAATTC = District Agricultural Advisory Transfer of Technology, KVK = Krishi Vigyan Kendra, ATIC = Agriculture Technology Information Centres.

Information flows from the universities and research institutes to the KVKs, which are then tested for farmer demonstrations and trainings. The information flow in this approach is still largely linear, though efforts to obtain feedback on farmer information needs at the district level are included, such as the organization set up through the zonal research meetings in Andhra Pradesh. However in the ANGRAU model, it has been suggested that these meetings are too few, and contact with farmers is limited, with only around 100 farmers attending the zonal research meetings. There is also criticism that the ICAR research centers that provide extension tend to be restricted to farmers near their location (Sulaiman and van den Ban 2003; Sulaiman and Holt 2002). The National Academy of Agricultural Sciences (2005) suggests that information content rarely reflects local needs because of centralized agendas, and the system is still focused on the transfer of technology, with postharvest information and market access links rarely considered. This is also a key challenge in the state DoA. Additionally, weak partnerships and links between ICAR and SAU researchers have resulted in a single-discipline focus, with poor communication of new knowledge (National Academy of Agricultural Sciences 2005). Similar to the state DoA model, there is a need to broaden the role of these systems to encompass the wider definition of extension and provide more opportunity for farmer feedback.

4.1.4 Knowledge Transfer through Krishi Vigyan Kendra

The Krishi Vigyan Kendra (KVK), or farm science center, is a multidisciplinary educational institution situated at the district level, with funding and technical supervision from ICAR. There are currently centers in 569 districts, almost one for each district in India. Each center is under the administrative control of a state agricultural university, NGO, or central research institute. The performance of KVKs may vary depending on the administrative control. Each KVK is in one of 15 agroclimatic zones, and the zonal coordinator pays a visit to each of them every three months. Within each center, around 20 scientists are employed from different disciplines, including crop production, plant protection, agricultural engineering, and home science (Dash and Mishra 2004). At the NGO-administered Sri Arinashilingam KVK in Tamil Nadu, each scientist is expected to carry out two frontline demonstrations and two farm testing demonstrations per year. A meeting of the scientific advisory committee is held once a year, with the attendance of the heads of the various government line departments, progressive farmers, and the zonal coordinator, at which the KVK action plan for the following year is discussed. The action plan is based on a Participatory Rural Appraisal (PRA) assessment, carried out by KVK staff. In this way, the needs of the farmers are incorporated into the action plan of the KVK (Figure 9).

Figure 9. Information linkages in the Krishi Vigyan Kendra



Source: Authors.
Note: ICAR = Indian Council for Agricultural Research, KVK = Krishi Vigyan Kendra, NGO= Nongovernmental organization.

Currently, the impact of KVK activities is measured by the number of participants attending each learning workshop, the percentage of participants that adopt the technology/skill after the workshop, and changes in the participants' income (Sri Arinashilingam KVK, Tamil Nadu). Like most of the public extension system, the focus of the centers is assessment and refinement of technologies through learning programs, on-farm testing, and field demonstrations. Information on market access and consumer demands is rarely considered. KVKs have been criticized for reaching limited numbers of farmers, and largely those within close range of the center. There are calls to increase the number of KVKs within a district, and also the number of staff. This could help address coverage of farming communities. The KVKs have also been criticized for working in isolation from other actors in the extension system, namely the private sector—and with increasing technology emerging from this sector, partnerships with such organizations are necessary. As already described, the link between the KVK with the state DoA staff and ATMA is weak. Despite the structural guidelines for the two systems to work together, there is in some cases a serious lack of partnership.

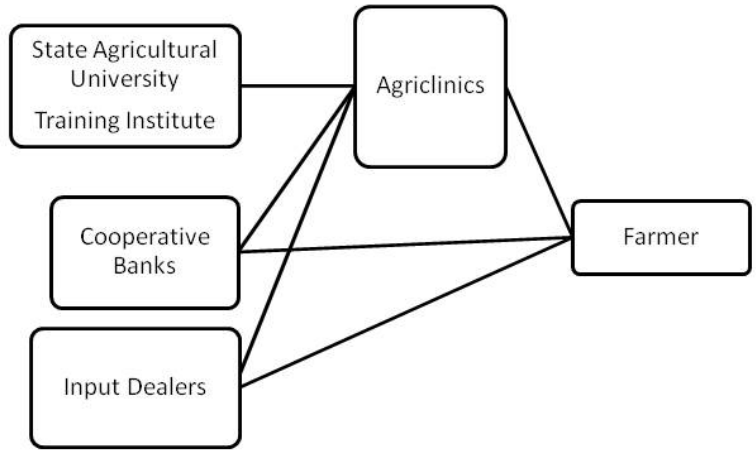
4.2. Public-Private Partnership: The Agriclinics and Agribusiness Centres (ACABC) Scheme

Agriclinics and agribusiness centers (ACABC) provide agricultural advisory services to farmers through technically trained agricultural graduates at the village level, known as "agripreneurs." Bank loans are available for the agripreneurs to start an agriclinic. The central government provides 25 percent of the cost as a subsidy. In addition, the states have adopted the approach and add their own additional subsidies for agriclinic implementation. The objectives of the program are to supplement the public extension system, increase the availability of inputs and services for farmers, and provide employment to agriculture graduates (Global AgriSystem 2008). The role of an agriclinic is to provide expert services and advice to farmers, while agribusiness centers provide inputs and farm equipment hire. This service aims to fill the gap in the public-sector extension system where currently the input dealer plays a major role in providing advice to guide input use. The program is open to agricultural graduates nationwide and has been implemented since 2002 (Karjagi et al. 2009). The centers provide a wide range of services, depending on the interests of the graduates, and can include, but are not limited to, soil, water quality, and input testing laboratory; plant protection services; vermin composting units; horticulture; veterinary clinic; and agroservice centers for farm machinery and primary processing.

There are currently 41 agriclinic and agribusiness training centers throughout the country that provide the two-month training course to agricultural graduates. After training, the agripreneurs set up their "agriventure," with one year "hand-holding" support from the training institutes. Information support for the agripreneurs comes from the training centers; for example, in Tamil Nadu some agripreneurs have access to expert advice from the state agricultural university (Figure 10). Different

versions of public-private partnerships in establishing agriclinics exist; for example, in Tamil Nadu, some agriclinics are owned by cooperative banks and employ an agricultural graduate to run the clinic, while other graduates run their agriclinics independently. Revisions to the scheme, which were released in September 2010, have broadened the eligibility of graduates who can apply for training, in addition to offering increased subsidies. Other extension programs, including KVK, ATMA, and Panchayati Raj institutions, will provide surprise or periodic visit reports submitted to the National Bank for Agriculture and Rural Development (NABARD) or the financing bank or ATMA office (Gupta 2010a).

Figure 10. Information flow in the agriclinic program



Source: Authors.

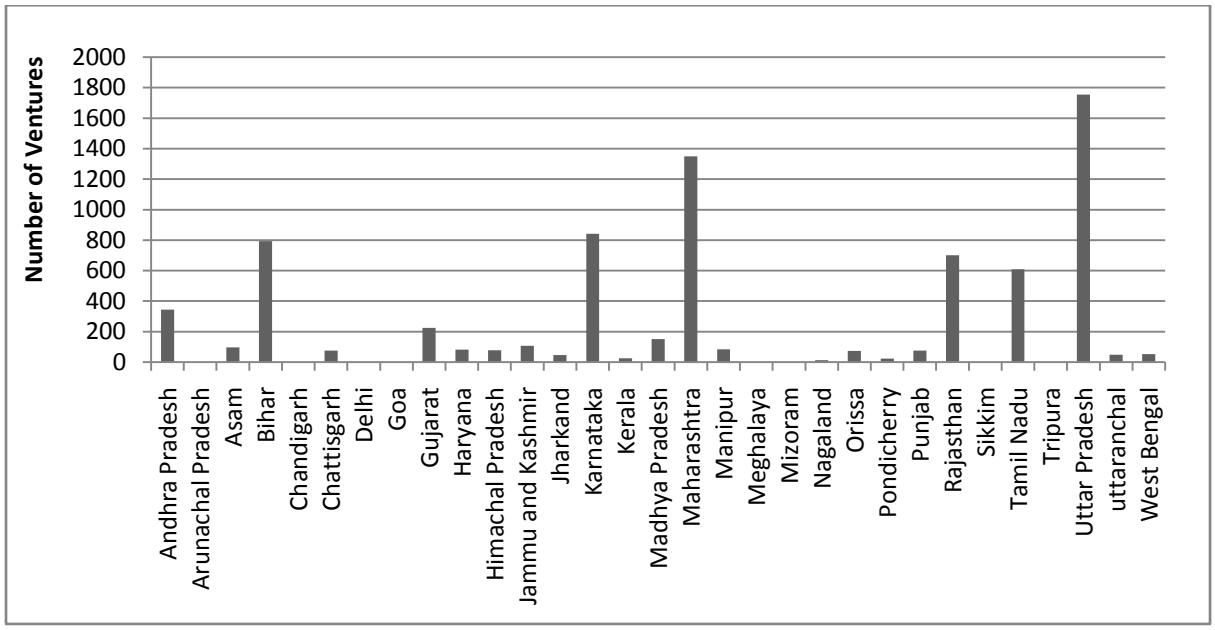
There is no evidence regarding the extent to which the scheme has benefited smallholder farmers, but an independent midterm evaluation provides a guide (Global AgriSystem 2008). Discussion with officials in Maharashtra, Andhra Pradesh, and Rajasthan suggested increased productivity of crops in areas where agriclinics are available. According to the farmers, benefits obtained from agriclinics included optimum usage of farm inputs, plant protection, and increased productivity. With reference to the satisfaction level of farmers, the majority of farmers were "very satisfied" with the services provided (Global AgriSystem 2008). From 2002 to 2008, of the 75,000 agriculture graduates in the country, 4,152 have gained employment through the scheme, serving 2.3 million farmers and 126,000 villages. Each venture services about 30 villages, with about 19 farmers in each village (Global AgriSystem 2008). Across the country, Uttar Pradesh has the highest number of agriclinics and agribusinesses, while the northeastern region has very few (Figure 11). Most ventures were self-financed (70 percent), with only 30 percent having taken out loans from banks, suggesting that greater awareness of the scheme is needed in banks. Of the graduates who undertook the two-month training, 47 percent did not start an agriventure. Problems encountered in establishing ventures include the high rate of interest, a lack of support from the training institutes, and banks' lack of interest in providing financing due to limited knowledge about the scheme. Those who had started a business considered competition from established dealers as the major problem faced, followed by farmers asking for products on a credit basis and noncooperation of the farmers in repaying their credit (Karjagi et al. 2009).

Additional problems associated with the scheme include the absence of dedicated nodal officers at the training institute level for coordinating the scheme, inadequate funds for training and hand-holding activities, a lack of participation by agribusiness companies in the implementation of the scheme, unattractive credit packages for agripreneurs starting agriventures, and complicated procedures for obtaining a license for the sale of inputs (Working Group on Agricultural Extension 2007). Despite the challenges, the Working Group on Agricultural Extension recommended that the scheme continue in the

11th five-year plan, as it complements the public extension system, which is suffering from a shortage of personnel.

Despite limited evaluation studies, the results suggest that farmers could be well served by the scheme, as the incentive and capacity of the agripreneurs to meet the needs of farmers is greater than in the public-sector extension system (Chandra Shekara and Kanaka Durga 2006). Farmers are required to pay for services such as soil testing, so the value of the information and service provided must be relevant and useful, and at reasonable prices for farmers to be willing to pay for them. Generally, advisory services are provided free in the agriclinics and usually accompany the purchase of services. Agripreneurs' maintenance of contact with the training center to access information and expert knowledge is an important link that could be further strengthened through the use of information and communication technologies (ICTs). The advantage of the agriclinics is that they provide a problem-solving approach that is largely nonexistent in the public-sector extension system. However, the small number of ventures (around 8,000) is small considering the scale and complexity of Indian farming.

Figure 11. Number of agriclinic ventures established by state in India (as of June 2010)



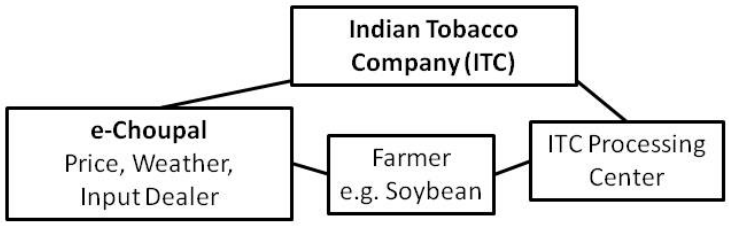
Source: India, Directorate of Extension 2010.

4.3. Private-sector Extension: e-Choupal

In 2000, the Indian Tobacco Company (ITC) launched an initiative called e-Choupal. The project is a private commercial initiative in agricultural extension. The e-Choupal initiative, which consists of 6,500 kiosks, serves four million farmers in 40,000 villages in 10 states (ITC 2010a). Essentially, an e-Choupal is a kiosk located in a village and equipped with computers with Internet access. To manage the e-Choupal, ITC identifies and trains a local farmer (*Sanchalak*), who bears the operative costs. The e-Choupal provides farmers with an alternative marketing channel, information on local district weather, agricultural best practices, feedback on quality of crops, and input sales with accompanying field-specific testing such as soil tests (Annamalai and Rao 2003; Bowonder, Gupta, and Singh 2007). However, the main purpose for which the kiosks were started was to procure crops, including soy in Madhya Pradesh, wheat in Uttar Pradesh, coffee in Karnataka, and seafood in Andhra Pradesh (Upton and Fuller 2004), thus reducing the procurement costs of ITC (Annamalai and Rao 2003). Farmers, who can access information on prices, can chose to sell directly to ITC through the e-Choupal (Figure 12). The initiative

requires a significant initial investment, which is large due to infrastructure challenges such as poor power supply and limited bandwidth (Annamalai and Rao 2003). However Kumar (2004) reports that the project has a potential payback period for all capital investment and running costs of 3.9 years, which makes it worth the investment.

Figure 12. Information flow in the e-Choupal model



Source: Authors.

The e-Choupal initiative has had a supposedly positive effect on the incomes of participating farmers, as the system has brought efficiency to the supply chain by removing intermediaries and reducing transaction costs (Bowonder, Gupta, and Singh 2007; Karnani 2007). According to Bowonder, Gupta, and Singh (2007), an e-Choupal reduces all the transaction costs of the farmer. Productivity may also improve due to access to timely information and better support services that accompany input supplies. However, the magnitude of the income change and the factors that influence that change are not known. Nevertheless, a recent article by Goyal (2010) empirically found that the presence of e-Choupals in Madhya Pradesh increased the average price in the *mandis* (government-regulated wholesale agricultural markets) in a district by 13 percent. Farmers' net profits increased by 33 percent and soybean cultivation increased by an average of 19 percent in districts with e-Choupal kiosks (Goyal 2010).

The initiative has opened a market channel that appears more efficient than the *mandi* system (Goyal 2010). e-Choupals integrate information with services. Despite the noted benefits of e-Choupals, the social impacts are not well documented. However Annamalai and Rao (2003) reported that in some villages not everyone could approach the *Sanchalak* and access the computer, especially females. Caste, political alignment, and farm size influenced access to e-Choupals in Madhya Pradesh, where kiosks have been established in larger and more prosperous villages (Kumar 2004). The accountability of the *Sanchalak* has been questioned (Sridhar and Ballabh 2007). It has also been suggested that there could be a possible market monopoly by ITC in the future, as the *mandi* and local agents lose business (Dangi and Singh 2010). Nevertheless, the private sector's role in extension provision is important, but the private sector can work only where it is profitable. For example, in Madhya Pradesh, the kiosks and hubs were built mainly in the high-soy-producing districts (Goyal 2010).

The e-Choupal initiative highlights the impact that price information provided by village Internet kiosks, coupled with supporting services, can have on farmer decisions and ultimately profits—information and services that are currently not provided in the public-sector extension system. But, as Goyal (2010) concludes, the impact on individual farm income and poverty is not known. This would require further empirical studies, which could also examine the social impacts.

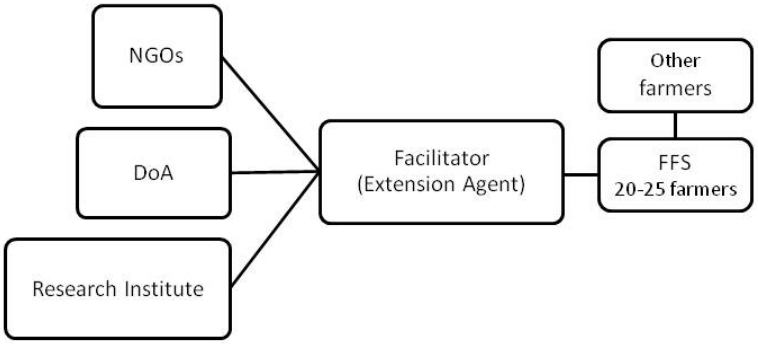
4.4. Farmer Field Schools

Since the 1990s, farmer field schools (FFSs) have been established by the Government of India in partnership with the Food and Agriculture Organization of the United Nations (FAO) and European Union to provide integrated pest management (IPM) for cotton farmers. Implementation was undertaken in the states of Maharashtra, Karnataka, and Andhra Pradesh. The FAO-EU IPM cotton program in India was completed in 2004, but provisions for FFSs were made in national programs. The National Policy for Farmers provides guidelines for "farm schools," which involve farmer-to-farmer learning from the fields

of progressive farmers. The farm schools could be linked to KVKs to strengthen technology dissemination, but whether the formal structure of these schools would follow an FFS approach is not clear (India, Department of Agriculture and Cooperation 2007a; India, National Commission on Farmers 2006). In the revised structure of ATMA, farmer schools will play an important role in the dissemination of technologies and practices to other farmers within a block.

Essentially, the FFS is a participatory training method that involves a "learning by doing" approach whereby 20–25 farmers, through weekly field observations and analysis, supported by a facilitator (an extension agent), test and adapt farming practices to their local conditions (Figure 13). The school runs for a full crop season. Participants in the FFS are selected with community involvement and are expected to contribute to the community after the FFS (Feder et al. 2010). In India, alumni of FFSs were trained to establish their own FFSs, known as farmer-to-farmer schools (F2FSs)(FAO 2008). From 2000 to 2004, more than 50,000 farmers were trained in cotton IPM strategies through extension services, NGOs, and research institutions. The number of facilitators trained meant that states could conduct about 2,000 FFSs a year to train 100,000 farmers directly. In Maharashtra, 143 FFSs were conducted in chickpea in 2003, and 248 FFSs/F2Fs in 2004. In Andhra Pradesh, FFSs were renamed "Polam badi." Since the Rabi season of 2004, 6,947 Polam badies have been organized, benefiting over 200,000 farmers. Impacts include an increase of 30–40 percent in knowledge (India, Directorate of Extension 2009). In Andhra Pradesh, 6,947 Polam badies were organized in 2005–2007 (FAO 2008).

Figure 13. Information flow in farmer field school approach



Source: Authors.
Note: NGO=Nongovernmental organization, DoA=Department of Agriculture, FFS=Farmers Field Schools.

Global impact studies of FFSs show reduced use of toxic pesticides and 4–14 percent higher yields for FFS graduates who cultivated cotton compared to the control (van den Berg and Jiggins 2007). Despite these impacts, and additional benefits of FFSs—including facilitating collective action, leadership, organization, and improved problem-solving skills (Waddington et al. 2010)—some challenges include delayed release of funds, lack of coordination between stakeholders, and the overloading of local extension officers by FFS organizations. There are also problems of elite capture where groups contain officials and large and wealthier farmers. This is a common problem in rural development programs and in extension. Elite capture occurs where poor farmers and socially marginalized groups, including women, are underrepresented in field school groups (Feder et al. 2010). One strategy to address this is to form groups exclusively for women farmers or disadvantaged farmers. Another concern of the FFS program is the potentially limited diffusion of specific component technologies through farmer-to-farmer interactions on a large scale, as it is difficult to scale up the benefits received by farmers who participate in the FFS to farmers who do not directly participate in the FFS (Braun et al. 2006). Braun et al. suggest that, based on the experience of FFSs to date, "too many characteristics of the FFS erode during mass replication for the benefits to be sustained" (2006, 39). In Africa, FFSs increased productivity, knowledge gain among farmers, and empowerment, but these benefits were limited to the most directly engaged farmers (Davis 2008). A recent study by Davis et al.

(2010) found that FFSs increased income and productivity in East Africa. The FAO IPM program for cotton farmers focused on productivity but recognized a need to provide support beyond technology transfer.

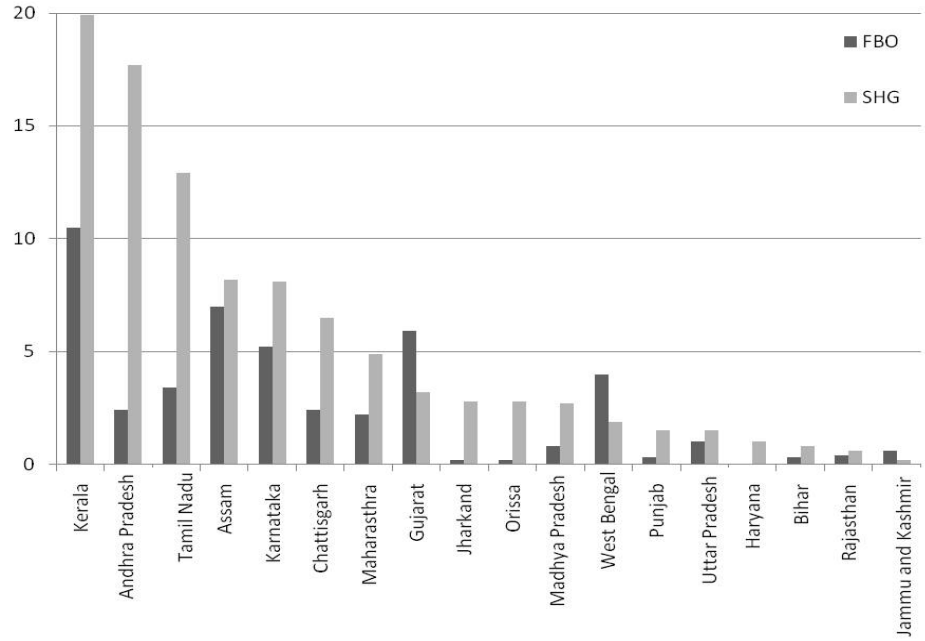
4.5. Civil Society Organizations

Due to the number of smallholder farmers, farmer-based organizations (FBOs) and self-help groups (SHGs) are key organizations to make extension demand-driven. In groups it is easier to get feedback on the information needs of the members (Swanson 2008). For example, within the ATMA model, the capacity of the FIGs to articulate their needs will influence how demand-driven and accountable the extension services provided will be (Singh 2003). This reduces many generic problems of public-sector extension, namely accountability to farmers and incentives for extension staff (Feder et al. 2010). However, the main challenges in community-based extension, as identified by Feder et al. (2010), include the limited availability of competent service providers, deep-seated cultural attitudes that prevent effective empowerment of farmers, and difficulties in implementing farmer control of service-provider contracts.

Advantages of FBOs include the possibility of farmers achieving economies of scale and the shortening of the supply chain (Swanson 2006). Additionally, because the main source of information for farmers is other progressive farmers, belonging to an FBO or SHG may be an effective way of sharing information. For an FBO or SHG to become sustainable, the group will likely need capacity-building and technical and management support (Swanson 2008). NGOs that have skills in building social capital could be contracted to form FBOs, SHGs, or producer groups, as during the pilot stage of ATMA.

Despite the continued call for and interest in farmer groups such as FBOs, SHGs, and commodity interest groups (India, Department of Agriculture and Cooperation 2007a; India, National Commission on Farmers 2006), the number of such groups is small, except in the southern states (Figure 14) (Birner and Anderson 2007). Also, farmers' associations and producer cooperatives are established for only a few crops and commodities in a few locations (Sulaiman and Holt 2002).

Figure 14. Percentage of farmer households with at least one person belonging to a farmer-based organization and/or self-help group



Source: NSSO 2005, adapted from Birner and Anderson 2007.
Note: FBO = farmer-based organization, SHG = self-help group.

4.6. Mass Media and Information and Communication Technology Approaches

The policy framework for agricultural extension (India, Ministry of Agriculture 2000) highlights the opportunity for information and communication technology (ICT) to improve the quality and accelerate the transfer and exchange of information to farmers, and ICT is consequently given a high priority, particularly as a tool for improving the marketing aspects of farm enterprises. ICT has the ability to reach farmers directly, can enable two-way information sharing processes, has greater storage capacity, is faster, and can increase market efficiency by addressing information gaps and blockages (Chapman and Slaymaker 2002). There currently are a great number of ICT initiatives in agriculture in India. The focus of this section is to identify a few of these initiatives. There has generally been limited evaluation or impact assessment of these programs.

Public radio and TV programs, which account for 13 percent and 9.3 percent, respectively, of sources of information accessed by farmers (NSSO 2005), are broadcast by All India Radio and Doordarshan, respectively. In the 10th five-year plan, the Department of Agriculture and Cooperation introduced new central schemes in an attempt to address the poor coverage of public extension services. The mass media support scheme launched a Kisan Channel on Doordarshan, which telecasts agriculture-related programs. Narrowcasting, which is area-specific telecasting of agricultural programs, is also being used. Through the All India FM Transmitter Network, 96 stations of All India Radio are broadcasting half-hour agriculture programs. Despite farmers' greater use of TV and radio than KVKs and extension workers, the empirical impact of these services on farm household income is not known.

Kisan Call Centres is another central government scheme introduced to provide information to farmers on demand. This program began in January 2004. Farmers call a common toll-free number and access expert advice from Level 1 experts (agricultural graduates) in 13 regional centers across the country, in 21 local languages (India, Department of Agriculture and Cooperation 2007b). Level 2 experts support queries from Level 1 operators. Some of the challenges to the scheme include lack of awareness, the relative inexperience of Level 1 operators, and weak links between Level 1 and Level 2 experts (Working Group on Agricultural Extension 2007). Additionally, providing the required localized and specific information requested by farmers who use the service is problematic.

The 2003 NSSO survey showed that 7 percent of farmers accessed information on modern technologies from newspapers. Considering the increasing emphasis on mobiles and telecenters, this comparatively "old" approach is still a relevant source of information for farmers—greater than that of the extension worker or KVK. Nevertheless, within the central schemes and programs in extension, and the current ICT initiatives, newspapers are rarely considered. The "mass media to support agricultural extension" scheme focuses on TV and radio only.

Mobile phone penetration in rural India is expanding rapidly (from 1.4 units per 100 people in 1995 to 51 units, or one phone per two persons, currently). There are a number of initiatives using mobiles to communicate information directly to farmers; these include IKSL (IFFCO Kisan Sanchar Ltd. in collaboration with Airtel), Mandi on Mobile (BSNL and Uttar Pradesh Marketing Board), Reuters Market Light, and Nokia Life Tools. Most of these approaches provide market information through SMS or voice messages, or question-and-answer capabilities. To date there has been little evaluation of the impact of these services on farm production. Other projects, such as e-Sagu and Lifelines, also use mobile phones in combination with computing technology to provide expert advice based on farmer queries. While these approaches are ICT-driven , an approach by Digital Green uses ICTs to support existing extension services provided by NGOs. Digital Green partners with NGOs to promote a video-based process for disseminating technology and agricultural practices. The videos are made with local resource people from the community and are shown to farmer groups established by the partner NGOs. Assessment of adoption practices in the pilot of Digital Green shows a higher adoption rate through this video-based process than through T&V-style extension approaches (Gandhi et al. 2009).

There are also a number of web-based ICT approaches that are attached to kiosks, known as telecenters, such as Unilever's iShakti, or that work entirely online, for example, aAQUA. There is also a wide range of web portals that act as information repositories, including the Tamil Nadu Agricultural

University's Agritech web portal. Another web portal, AGMARKNET, launched during the 9th five-year plan, provides marketing information on the latest commodity prices from 2,800 major agricultural produce wholesale markets. Other web portals include Agropedia, AGRISNET, DACNET, e-Krishi, the agribusiness portal Agriwatch, and iKisan by the Nagarjuna fertilizer group (Saravanan 2010).

Due to the rapid spread of technology, many of the ICT initiatives in agriculture in India are still in the experimental stage. Consequently, there are few systematic impact studies of ICT initiatives in agriculture. Despite the lack of empirical evidence, however, sustainability is clearly an issue, with many of the projects implemented as pilot studies but not scaled up. The different approaches tend to work in isolation from each other, with little sharing of knowledge and best practices between projects (Saravanan 2010).

4.7. Other Private-sector Approaches

Many private agrifood businesses are introducing rural business hubs that serve as one-stop shops for rural communities, supplying consumables, farm inputs, and technical information (Reardon and Gulati 2008). These include the ITC e-Choupals' links to Choupal Sagars, or hubs, of which there are now about 24 (ITC 2010b). The 300 Haryali Kisaan Bazaars of DCM Shriram Consolidated Ltd. provide inputs, agronomic services, financial products, consumer goods, access to output markets, and information (Farming First 2009). Similarly, Tata Kisan Sansar, an initiative of Tata Chemicals, provides not only inputs and technical information but finance and credit to farmers (Tata Chemicals 2010). There are 32 hubs, which cater to 681 Tata Kisan Sansars covering around 22,000 villages in Uttar Pradesh, Haryana, and Punjab. Other companies investing in rural business hubs include Rallis, Mahindra and Mahindra, Godrej, and Reliance. The impact of these approaches on smallholder farmers has not been evaluated, but these services could possibly provide better-quality inputs and technical services than those offered by the local input suppliers upon which most farmers currently rely (Goyal et al. 2008). These private initiatives provide products for purchase and offer information to farmers on the products they sell, along with agronomic advice. However, the empirical impact of these rural business hubs on farm households is not known, and the characteristics of the farmers who use these services have not been identified.

Contract farming in India has existed for a number of decades (Singh and Asokan 2004). Contract farming involves a forward contract according to which growers are committed to provide an agricultural commodity of a certain type at a certain time and price in a specified quantity to a known buyer, an agribusiness company (Singh 2002). To support growers in producing the specified commodities, companies can provide credit, inputs, and extension services such as new technologies (Singh 2002; Singh and Asokan 2004). In contract farming, agribusiness firms tend to work with larger farmers in better-endowed regions (Singh 2002, 2005). For example, in Punjab, Pepsico selected farmers based on the ability of the farmer to adopt new technologies; the suitability of the land; assured irrigation; and the farmer's financial position, commitment, and literacy level (Singh 2002).

In Punjab, Pepsico first started contract farming for tomatoes in the early 1990s and now contracts farmers for potatoes and chilis. Pepsi's own research and development activities helped develop and disseminate new technologies, including agricultural practices such as deep chiseling and new seed varieties, through Pepsi field officers, field demonstrations, and booklets (Khairnar and Yeleti 2004; Singh 2002). Despite the advantages provided by access to these services, the services tend to be highly crop-specific, do not work toward an integrated farming system, and rarely rely or build upon the traditional knowledge of the farmer (Khairnar and Yeleti 2004). While farmers feel no obligation to follow company recommendations, they generally do so to avoid potential quality problems. Also, some farmers found that pesticide recommendations tended to be costly, and there was distrust by farmers of company motives in promoting certain products. Extension through contract farming was also criticized for maintaining high chemical-input intensity in farming. Nevertheless, farmers felt that they received higher and more reliable incomes from contract farming and developed new and better farming skills (Singh 2002).

In India there are also a number of large farmer cooperatives, for example, Mahagrapes in Maharashtra, and commodity boards, such as those for coffee and rubber, that act as sources of information for farmers involved in these organizations. These organizations work in specific regions for specific crops, but analysis of their establishment and operation could give greater insight into best practices for involving and organizing farmers in such groups, as ATMA is trying to do.

4.8. Innovative Approaches

A number of agricultural extension approaches have been highlighted for their success. These approaches tend to better reflect the contextual information needs of the farmers in the areas where they work.

The Kerala state government initiative, funded by the European Union, of the Kerala Horticulture Development Program (KHDP) used SHGs based around a commodity to provide better access to technology, markets, and credit for farmers (Sulaiman 2003b). The KHDP encouraged group marketing, developed unique credit packages, contracted the state agricultural university for research, and undertook participatory technology development with farmers. The impact study saw a significant increase in the area under fruit and vegetable cultivation and an increase in income (Sulaiman and Hall 2004). KHDP is now the Vegetable and Fruit Promotion Council of Kerala.

A private initiative of Mahindra Shubh Labh Services Ltd. in 2001 aimed to establish franchises of Mahindra Krishi Vihar (MKV) to provide access to inputs and machinery, credit, and advisory and field supervision services. Among the MKVs established, the franchise of Bhuvi Care Limited is seen as successful. A survey of farmers showed that participants increased crop yields and income. The success is attributed to the experimentation, reflection, and learning process within the company. However, it was also found that private extension provision tends to be skewed toward better-off areas, larger farmers, and high-value crops (Sulaiman, Hall, and Suresh 2005).

Other approaches include the microfinance institution initiative of BASIX, which operates in 16 states in India. BASIX works to find alternate market channels or value-addition possibilities for farmers by collaborating with farmers, NGOs, processors, and other agencies (Sulaiman and Hall 2004). BASIX provides a range of services to farmers, including financial inclusion services; agricultural, livestock, and enterprise development (AGLED) services; and institutional development services. AGLED services are supported by 1,000 livelihood service providers who work like extension agents for 200–400 customers for nine crops and two livestock products (Mahajan and Vasumathi 2010). The capacity of the livelihood service providers is developed by BASIX, and services are contextually designed so farmers are more willing to pay for them.

The approaches of KHDP, MKV, and BASIX provide not only farm-related information to increase productivity, but they also address postharvest aspects such as market access and value addition to commodities. By widening the range of information provided along the whole value chain, these approaches have had what has been described as a successful impact at the farm level. Context-specific approaches thus seem to better meet the local information needs of farmers.

5. GENERAL CHALLENGES AND CONSTRAINTS TO AGRICULTURAL EXTENSION APPROACHES IN INDIA BY SECTOR

The review of various agricultural extension approaches in India presented in this paper is by no means exhaustive but includes well-highlighted and known examples of agricultural extension practices. This section draws out some of the main challenges facing agricultural extension in India. Many of the conclusions are not new to the literature, but they reaffirm the continued challenges prevalent in agricultural extension, particularly the public-sector system. Nevertheless, in the current scenario, where increasing numbers of stakeholders are becoming involved in agricultural extension in India, the opportunity to reach a greater number of farmers is growing. This is coming largely from the private sector, which is incorporating extension services within existing service provisions and experimenting with ICT. But the inherent challenges each sector faces in reaching different farmers means that partnership and coordination between the sectors will best serve the interests of the farmer. In order to make the most of that opportunity, key actions that address the current challenges and constraints are necessary.

5.1. Public Sector

Information flow within the public sector moves linearly, with content focusing on the transfer of technology for increasing crop production. A wider definition of agricultural extension, beyond improving crop productivity, has not been embraced. Information flow is supply-driven and not needs-based or area-specific (Raabe 2008), so farmers see the quality of the information provided by the public extension staff as a major shortcoming (NSSO 2005). This is due to the static and inflexible nature of the organization, where a top-down hierarchical approach continues (Hall et al. 2000; Raabe 2008). Access to extension is also an issue, because of the low level of outreach by public extension services. This is partly due to the public staff being overburdened with implementing state and centralized schemes, which are also not easily modified to suit local needs and conditions (Sulaiman 2003b; Sulaiman, Hall, and Suresh 2005). There are also insufficient funds for operational costs, training, and capacity development, which limits the activities and continual development of the extension staff (Sulaiman, Hall, and Suresh 2005; Swanson 2006). Of the required 1.3 million to 1.5 million extension personnel required, there are only about 100,000 on the job (Working Group on Agricultural Extension 2007). At the state level, the various line departments have been criticized for working in isolation, with weak linkages and rare partnerships (Sulaiman, Hall, and Suresh 2005), which limits information flow. Additionally the research–extension link has been criticized for not absorbing or using feedback from farmers and extension staff. Extension personnel and farmers are passive actors, and scientists have limited exposure to field realities (Reddy et al. 2006). The various components of the public-sector extension system suffer from duplication of programs, without convergence. While ATMA is pushed as the platform through which the multiple agencies can converge, the implementation difficulties are proving too great for effective integration, with shortages of both personnel and funds (Working Group on Agricultural Extension 2007). The 2010 revision of ATMA attempts to address this (India, Department of Agriculture and Cooperation 2010), but enabling the new personnel to achieve the necessary understanding of the concept for proper implementation will require strong training and capacity development.

5.2. Private Sector

Private-sector examples in agricultural extension are developing context-specific models and using ICT tools to bring information directly to the farmer. The private sector is increasingly playing a role in extension services in India. The public sector acknowledges this, with the policy framework for agricultural extension referring to the need for public extension services not to crowd out private services (India, Department of Agriculture and Cooperation 2000). Additionally, the policy framework for agricultural extension notes that “public extension by itself cannot meet the specific needs of various

regions and different classes of farmers" (India, Department of Agriculture and Cooperation 2000). One alternative discussed in pluralistic extension systems is that the private sector can provide services related to proprietary goods, while the public sector can provide extension services related to public goods, which tend not to be addressed by private-sector firms (Swanson 2008). Although few empirical studies have been carried out, the performance of private extension is said to vary widely; it tends to focus its services on areas with sufficient resources and is limited to a few crops and areas where profits can be assured (Sulaiman and van den Ban 2003). This has already been suggested in the discussion of the e-Choupal initiative, which services larger villages and specific crops. Additionally, the private sector serves a corporate interest, working with individual farmers, so social capital is not built. Moreover, private extension can only work well if farmers are willing and able to pay. One option suggested by Swanson (2008) is that the private sector could serve the needs of medium-size and commercial farmers, while the public sector could work in remote areas, which are currently not serviced well. This sort of system would require public-private partnerships that currently do not exist in India. It would mean changes in the way the public sector views and interacts with the private sector. Relying on the public sector may also be difficult for remote and resource-poor farmers, considering the existing problems and poor reach of the public sector in those areas.

5.3. Third Sector

Within the information value chain, the capacity of farmers to articulate their needs will influence their ability to obtain the information they need. Considering the large number of marginal and small land holdings in India, FBOs and SHGs could play important roles in articulating the needs of farmers to knowledge intermediaries. FBOs and SHGs can operate side by side with either NGOs or the public sector, but challenges exist in both sectors. Public capacity to build FBOs and SHGs is limited, while NGOs, which are not numerous, rely on donor funds and would need public support to develop the technical skills to facilitate the groups (Swanson 2008; Sulaiman and Holt 2002). Within FBOs or SHGs, problems related to social identity, including gender and caste, mean that these organizations may not be completely inclusive and are subject to elite capture problems. When farmer groups interact with other institutions, social identities and other social status perceptions mean that they may be too weak to articulate their concerns (Sulaiman and Holt 2002). Building the capacity of such groups, and promoting the development of leadership and management skills so that farmers can demand the information they need, is therefore an important component of agricultural extension approaches.

6. LESSONS LEARNED AND THE WAY FORWARD

Due to changing agricultural conditions—including climate change, increasingly degraded and marginalized land coming into production, limited water availability, increasing use of inputs, rising fuel costs, and unknown market opportunities—farmers require access to timely, reliable, and relevant information that can support the complexity within which their farm enterprises operate. Although agricultural extension today has a broad mandate, this review shows that despite pluralistic extension approaches in India, the coverage and use of these services are limited. Considering the large number of marginal and smallholder farmers, particularly in rainfed regions, a major need is to build the capacity of farmers to demand and access information to increase their productivity, profitability, and incomes. The information must be reliable and timely. For example, technologies need to be suited to the farmers' capacity to take risk, which tends to be low in rainfed regions, and integrated with available and timely services that support the relevant technology. To achieve this, incentives need to be created for knowledge intermediaries to act for farming communities.

The innovative case studies described in Section 4.8 highlight extension approaches that have evolved over time as the local contexts require. Agricultural extension in these examples has expanded beyond the linear transfer-of-technology approach, which is still the norm in the public-sector extension system.

The public-sector extension system still receives significant investment from the central government and is increasingly pushed as the major source of knowledge through a presumed transfer of technology. ATMA is a key component of the system. However, although ATMA has to some extent proved its usefulness in the pilot study, at the national level it still carries some of the deficiencies of the public-sector extension system, which has reduced its impact. The shortcomings include limited staff, rigid organization, poor capacity, a top-down linear culture, weak links to the research system (particularly KVKs), and limited reach to farmers. One option would be to delink public administration from extension, allowing it to be more closely associated with the research system and the KVKs, where technologies come from. The KVKs also face challenges that limit their ability to meet farmers' needs. They require more staff and greater partnership, which would facilitate the joint offering of demonstrations of recent technologies.

Despite the pluralistic extension system in India—with the public sector, private sector, and third sector all playing some roles—this review concludes that the sectors tend to work in isolation from each other. The difficulties of working with the public sector mean that the private sector has few partnerships with public-sector extension. The scale and complexity of Indian agriculture, with many small farmers, remote regions, poor and subsistence farmers, and varied farming systems, means that a pluralistic extension system, as encouraged by the policy framework on agricultural extension, will reach farmers more effectively than a will focus on one method of funding and delivery. Public-private partnerships—for example, through the agriclinic and agribusiness center (ACABC) scheme—are one aspect that could be strengthened and encouraged. The ACABC scheme revision, which further supports agripreneurs through increased subsidies and widening the criteria for eligibility, is a positive action. The ACABC program provides an integrated service to the client (the farmer), with diagnosis facilities combined with input and equipment sales. The scheme could strengthen the link between agripreneurs and agribusiness companies, as input supply is becoming an important component of many agriclinics. There must be flexibility at the local level to facilitate public-private partnerships so that complementarities can be achieved to maximize the provision of information that meets the needs of farmers. However, the inherent culture and attitudes mean that public-private partnership and collaboration is not common.

Considering the poor reach of extension services in India, contacting the farmer directly is an appealing idea, with ICT approaches abounding. However, inadequate capacity development, infrastructure challenges, and lack of sustainability of these projects are major hindrances. ICTs could be useful tools to increase connectivity between the various extension approaches. However, ICTs alone

cannot improve the institutional weaknesses in the system. Attitudes and perceptions within the various sectors need to be conducive to use such tools.

If extension is to remain relevant in India, particularly for marginal and smallholder farmers in rainfed regions, it needs to evolve to provide a diverse set of services that support agricultural livelihoods, offering relevant technologies that are integrated with appropriate services. Agricultural extension should also support and address relevant areas beyond the farm, such as storage, processing, market access and trade, agribusiness management and entrepreneurship, natural resource management, and issues related to women. Within the paradigm of innovation systems, extension agencies can act as innovation intermediaries or innovation brokers, working with many partners to strengthen linkages and provide support for innovations. There must be innovations in extension delivery that embrace different methods and offer flexible adaptations to cater to the needs of users across states, regions, and communities. Extension must be able to respond to emerging issues in agriculture. Content needs to be part of an integrated knowledge system in which all actors in the food and agriculture value chain collaborate, contribute knowledge, and share the knowledge among the users.

In India, there are large gaps in research and unanswered questions on the role of agricultural extension approaches within the agricultural innovation system. Empirical studies examining the performance and impact of extension programs, particularly across different states and in the programs of the private and civil sector, are lacking. A greater understanding of public-private partnerships is also needed, including what works and why, and what mechanisms help encourage partnerships. There is a need for a thorough evaluation of extension approaches in order to identify best practices and understand their impact on farming communities, and to recognize how extension can be strengthened, particularly to reach smallholder and marginal farmers. Additionally, the typology of clients that use private-sector extension services is relatively unknown, so understanding the characteristics of farmers who are not accessing various extension services will be useful in planning the dissemination of knowledge and information to different categories of farmers. Studying smallholder farmers' willingness to pay for knowledge and information may give an indication of the extent to which extension services can be privatized in India.

7. CONCLUDING REMARKS

This paper has reviewed some of the agricultural extension approaches currently in operation in India and has discussed their ability to provide locally relevant information to support farmer livelihoods. The aim was to ascertain whether the information needs of Indian farmers are being met, to understand how information reaches farming communities, and to identify the major challenges and constraints to information flow in the agricultural extension system in India.

The public extension system dominates the provision of knowledge and information to smallholder farmers, especially in rainfed agricultural communities. Essentially, information that is provided to farmers through the public-sector extension system relates to the transfer of technologies through a linear pathway. Although farmers require information for the whole food and agriculture value chain, the public extension system largely concentrates on on-farm activities. While the ATMA model attempts to increase demand-driven extension and encourages crop diversification, the difficulties of implementation through the existing mode of organization are great. The private-sector e-Choupal initiative and various small-scale models have tried to provide farmers with information not only regarding on-farm production but also regarding prices and accessing markets. However, these approaches work only for specific crops and regions where farmers have the incentive to take risks and are willing to pay for services. The impacts of the multiple ICT approaches are not documented and tend to work in small communities.

Despite the variety of agricultural extension approaches that operate in parallel and sometimes duplicate one another, the majority of farmers in India do not have access to any source of information. This severely limits their ability to increase their productivity and income and thereby reduce poverty. The importance of improving the coverage and relevance of agricultural extension in India therefore cannot be underestimated. Research to understand why farmers are not accessing information will be useful in designing an extension system that adequately caters to the information needs of farmers in rainfed and irrigated regions, in different agroclimatic zones, with various sizes of landholdings, and of both genders. Understanding the behavior of farmers in seeking information for their enterprises and communication through social networks will assist in the development of appropriate agricultural extension strategies. The existence of context-specific and relevant information for farmers also needs to be considered.

In the context of innovation systems, operationalized by integrated agricultural research for development, an innovation can emerge from many sources and through complex interactions and knowledge flows, with the farmer being at the center of the process. Therefore, knowledge sharing should go beyond the formal public-sector extension system and utilize the various agents and intermediaries who interact with farmers and other stakeholders in the innovation system so that the knowledge and information required by farmers to innovate can be provided and linkages developed. In this respect, the organizational innovation presented by agriclinics in integrating the provision of several services to farmers, including advisory services, is worthy of study.

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