
Agricultural Extension: Good Intentions and Hard Realities

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What considerations lead policymakers to invest in agricultural extension as a key public responsibility, and what factors and agency incentives explain differences in extension system performance? To help answer these questions, this article provides a framework outlining farmers' demand for information, the public goods character of extension services, and the organizational and political attributes affecting the performance of extension systems. This conceptual framework is used to analyze several extension modalities and their likely and actual effectiveness. The analysis highlights the efficiency gains that can come from locally decentralized delivery systems with incentive structures based on largely private provision, although in most poorer countries extension services will remain publicly funded.

The goals of agricultural extension include transferring information from the global knowledge base and from local research to farmers, enabling them to clarify their own goals and possibilities, educating them on how to make better decisions, and stimulating desirable agricultural development (van der Ban and Hawkins 1996). Thus extension services provide human capital-enhancing inputs, including information flows that can improve rural welfare—an important outcome long recognized in the development dialogue (Leonard 1977; Garforth 1982; Jarrett 1985; Feder, Just, and Zilberman 1986; Roberts 1989). That interest continues in contemporary dialogue, as evident in the workshop on public extension services convened by the World Bank, the U.S. Agency for International Development, and the Neuchatel Group to review recent approaches to revitalizing extension services (World Bank 2002).

Investments in extension services have the potential to improve agricultural productivity and increase farmers' incomes, especially in developing economies, where more than 90 percent of the world's nearly 1 million extension personnel are located. Yet the impact of extension on farm performance is varied, reflecting

differences in how extension services are delivered and in the circumstances of service recipients.

Effective extension involves adequate and timely access by farmers to relevant advice, with appropriate incentives to adopt the new technology if it suits their socioeconomic and agroecological circumstances. Critical to adoption are the availability of improved technology, access to modern inputs and resources, and profitability at an acceptable level of risk. Farmers get information from many sources. Public extension is one source, but not necessarily the most efficient. Thus, although extension can improve the productive efficiency of the agricultural sector, the virtues and limitations of alternative mechanisms need to be considered in assessing the cost-effectiveness of delivering information (Byerlee 1998; van den Ban 1999).

Extension usually has its greatest impact in the early stages of dissemination of a new technology, when the information disequilibrium (and the productivity differential) is greatest. As more farmers become aware of the new technology, the impact of extension diminishes until the need for more information-intensive technologies arises (Byerlee 1998). The dynamic resolution of the information disequilibria associated with specific extension messages makes observing the impact of extension difficult.

The analysis here looks at what leads policymakers to invest in extension services and what factors and incentives explain differences in extension system performance. The following section provides a conceptual framework of farmers' demand for information, the public goods character of extension services, and the organizational and political attributes that affect the performance of extension systems. The second section analyzes several extension modalities and their effectiveness. The third looks at the methodological issues in assessing extension outcome and reviews the empirical literature on extension impacts. The final section notes the political economy implications of the difficulty of attributing outcomes to extension activities and the importance of internalizing the lessons of experience in the design of effective extension programs.

Conceptual Framework

Extension, broadly defined, focuses on the delivery of information inputs to farmers. Information can be of many types, from estimates of future prices for farm products to new research products, such as improved crop cultivars and knowledge about how to use particular inputs, such as the timing and intensity of fertilizer use (Byerlee 1998). Farmers have a demand for information and may be prepared to pay for it as they do for other inputs according to how productive they perceive it to be (Dinar 1996). Demand for information delivery systems supporting farming should be increasing if, as agricultural analysts argue, farming is becoming more information-intensive

(Byerlee 1998). How that demand is met varies greatly, depending on market and institutional conditions. Gautam (2000), for instance, concludes that there is significant unmet demand in Kenya for general agricultural extension services. How different types of information are best delivered depends crucially on the nature of the information and the circumstances of the farmer.

A Welfare Economics Context: Extension Services as Public Goods

In considering whether extension services are mainly public or private goods, the usual focus has been on market imperfections, relating in particular to excludability and rivalry (Umali and Schwartz 1994). On this basis, extension services are mixed public and private goods. Some services, such as tailor-made farm management advice, are excludable in that farmers who are not willing to pay for the advice can be excluded from its benefits. Services embodied in commercial products exhibit rivalry in that one farmer's use reduces availability to others.

Knowledge delivered by extension may be information embodied in products (improved seed, machinery) or it may be more abstract, disembodied information on agricultural practice. There are two broadly applicable types of disembodied agricultural information: general, nonexcludable information (market information or cropping patterns), which tends to be a public good, and specialized, excludable information (fertilizer recommendations for a specific field or farm operation), which tends to be a toll good, with high excludability and low rivalry—some farmers can be excluded from access, even though the value to other users is not diminished by one farmer's use (Umali-Deininger 1996).

Various mechanisms are available for coordinating the supply of services—private sector markets, public sector hierarchies with state authority, and collective action by civil society (Wolf and Zilberman 2001). Table 1 illustrates the alternative arrangements possible in the financing and provision of extension services, from traditional public sector extension services to fully private services and public-private partnerships. Whether services are best supplied or financed by the private, public, or voluntary sectors or through joint efforts depends on the characteristics of the information service (Schwartz and Zijp 1994; Umali-Deininger 1997).

These observations have several implications (Picciotto and Anderson 1997):

- Information closely associated with market goods (purchased inputs) is generally best left to the private sector.
- Information associated with toll goods can be effectively provided by combined public and private sector efforts.
- Information on the management of common pool goods, with low excludability and high rivalry (forests, common grazing lands, water), is usually best provided by cooperative or voluntary institutions.

Table 1. Some Alternatives for Public-Private Financing and Provision of Extension Services

Service Provision	Public	Finance Provision	
		Private (Farmers)	Other Private
Public	Traditional extension	Fee-for-service extension	Contracts with public institutions
Private	Subsidies to extension service providers	Commercial advisory services	Information provided with sale of inputs
	Publicly financed contracts for extension services	Sale of newspapers, magazines, other information products	Extension provided to contract growers Advertising in newspapers, radio, television, magazines

Source: Alex, Zijp, and Byerlee 2002.

- Only when market and participation failures are high should the public sector finance information provision—better would be public sector financing of private service delivery.

Reforms have ranged from contracting with the private sector to provide extension services in order to reduce costs and improve cost-effectiveness to drawing on private sector funding to improve the financial sustainability of extension (Beynon and others 1998). The economic rationale for farmers to pay for extension services is generally clear, and the practice is well established in high-income countries (Marsh and Pannell 2000). In developing economies, however, many producers are unable or unwilling to pay for services, in part because they have not seen examples of effective, responsive extension. Many countries have few extension service providers outside the public sector, and few public institutions have the incentives and institutional arrangements in place to encourage program cost recovery.

A Conceptual Framework for Analyzing Public Extension Organizations

Many aspects of extension work have strong public goods characteristics, and public provision of extension services (whether by central or regional governments) has been common in most countries, at least at some stage in their history. Some notable successes have been documented, but so have the many weaknesses that hamper the effectiveness of public extension. A recent worldwide review (Rivera, Qamar, and Crowder 2001:15) refers to extension systems as “failing” and “moribund,” in “disarray or barely functioning at all.” This suggests that there are some generic difficulties in the operation of public extension systems and in the typical bureaucratic-political environment within which they are budgeted and managed.

Feder, Willett, and Zijp (2001) identify eight interrelated characteristics of public extension systems that jointly result in deficient performance, low staff morale, and financial stress. These characteristics provide a framework for analyzing the performance of different levels of extension personnel, the system as a whole, and the underpinnings of different organizational forms and for predicting their likely performance.

Scale and complexity. In countries with large numbers of farmers working relatively small plots (as is common in most developing areas), the potential clients of extension services live in geographically dispersed communities. Underdeveloped transport links add to the cost and difficulty of reaching these farmers. High rates of illiteracy and limited connections to electronic mass media rule out reaching these clients through means that do not require face-to-face interaction (written materials, radio, television, the Internet).

Thus, the number of clients who need to be covered by extension services is large, and the cost of reaching them is high. Adding to the challenge, farmers' information needs vary even within a given geographical area because of variations in soil, elevation, microclimate, and farmers' means and capabilities. The large size of the clientele means that only a small number of farmers can interact directly with extension agents. Because direct contacts are rationed, agents often select the farmers they will interact with, preferring larger-scale, better-endowed, and more innovative farmers who can provide some in-kind payment and are likely to exhibit better performance (Feder and Slade 1993). This sort of supply-side rationing is exacerbated by self-selection by farmers. Those who attach a higher value to (larger demand for) information tend to be large-scale farmers with better opportunities for taking advantage of information.

This selectivity of contacts has ramifications for the diffusion of information through farmer-to-farmer communications. Because the farmers who tend to have more extension contacts are often not typical of the farming population, other farmers are less inclined to follow the example of contact farmers or to seek their advice (despite some positive experiences, such as in Israel; Keynan, Olin, and Dinar 1997). On the supply side, the reaction to the large clientele is to deploy large numbers of extension agents, which presents a management challenge for national organizations or organizations managed by large geographical administrative units (states or provinces). When there are large numbers of field personnel, there is a tendency to adopt a centralized, hierarchical, top-down management system. Such bureaucracies are not generally receptive to participatory approaches to information delivery and priority setting (Fleischer, Waibel, and Walter-Echols 2002), and by distancing decisionmaking from the field level, they often lead to suboptimal decisions.

Dependence on the broader policy environment. The effectiveness of extension work is crucially dependent on complementary policies and institutional actions over

which extension management has limited influence. These involve credit, input supplies, price incentives, marketing channels, and human resource constraints, among others. Although extension agents can adjust their advice to the overall policy and institutional climate, the value of the information is diminished when the terms of trade are tilted against agriculture, rural infrastructure investment is inadequate, and input supplies are irregular due to imperfections in input markets. Coordination between the agencies that influence these complementary factors and extension management is costly and difficult, and extension agencies generally have little leverage. Particularly detrimental are the weak linkages to the knowledge generation system, especially the national agricultural research system.

Interaction with knowledge generation. In contrast to the situation in the United States, where the cooperative extension service is embedded in the university system, in most developing economies the information on which extension advice is based is not generated within the extension organization itself but in separate systems (national agricultural research institutes and universities and, increasingly, private research firms). Under separate management structures and incentive structures, research systems give little weight to the extension service's opinions and priorities. Because the performance of research systems is often assessed according to the recognition it receives within the scientific community, research priorities are not necessarily aligned with those of extension managers or the farmers they come in contact with.

Public research and extension organizations often compete for budgets. Researchers typically enjoy a higher status (they are often better educated and have greater independence), and this produces tension in interactions with extension services that is not conducive to two-way feedback or to effective extension services (see Mureithi and Anderson forthcoming on the situation in Kenya). A World Bank review (Purcell and Anderson 1997) of a large portfolio of extension projects found that research-extension links were generally weak and that neither research nor extension was sufficiently conscious of the need to understand the constraints and potentials of different farming systems as a basis for determining relevant technology and technology-development requirements. These inadequate research-extension links led to undesirable outcomes in a large proportion of the projects reviewed. More recent World Bank extension operations, building on the lessons of experience (including the importance of support for business development services for small and medium-size enterprises), have had more positive outcomes.

Difficulty in attributing impact. Because many factors affect the performance of agriculture in complex ways, it is difficult to attribute specific impacts at the farm level to extension services. This difficulty weakens political support and exacerbates

problems of budget allocation and staff incentives and accountability, both upward (to managers) and downward (to clients).

Evaluating the impact of extension involves measuring the relations between extension and farmers' knowledge, adoption of better practices, and use of inputs; farm productivity and profitability; and related improvements in farmers' welfare. But farmers' decisions and performance are influenced by many other systematic and random effects (prices, credit constraints, weather, other sources of information), so distinguishing the impact of extension advice requires careful use of econometric and quasi-experimental methods.

The inability to attribute impact unambiguously undermines the incentives of extension staff to reach out to farmers or even update their skills and knowledge. Instead of assessing outcomes and performance, time is spent collecting and reporting on input indicators, which are easier to obtain and measure.

Weak accountability. Because the effectiveness of extension activities cannot be easily established and performance is measured in terms of input indicators, field staff are generally not held accountable for the quality of their extension work and are often able to shirk on quantity as well. The same impact attribution problems mean that higher-level managers, though nominally accountable for extension performance to the political level, are monitored mainly in terms of budget spent, staffing levels, and other bureaucratic indicators. Accountability to clients is only nominal, as typically there are neither mechanisms nor incentives to make extension services accountable to farmers—who are the only ones who can easily observe the quality and effectiveness of extension services. Little attention is given to systematic participation by the farming community in problem definition, problem solving, and extension programming. Without mechanisms for accountability to farmers, incentives are distorted. Extension agents divert time and energy to other activities, which earn them extra remuneration, such as promoting inputs for which they earn a commission, or helping farmers access credit.

Weak political commitment and support. Even in countries where agriculture is still a large economic sector, public policies and investments have traditionally favored urban areas (Binswanger and Deininger 1997). Within agriculture, extension tends to be a weak claimant on agricultural budgets. In nearly half the extension projects examined in a mid-1990s World Bank study, lack of commitment and support by senior government officials adversely affected implementation and funding (Purcell and Anderson 1997). Feder, Willett, and Zijp (2001) posit that a plausible reason for the lack of adequate support (and the resulting limited funding) by politicians and senior officials to extension investments is the absence of the kind of political payoffs that can be earned from other public outlays that have visible impacts, such as the

double cropping that follows from an irrigation investment or the reduction in transport cost following construction of a bridge or road.

Public duties other than knowledge transfer. Because extension services typically employ large numbers of public servants at the rural community level, governments are often inclined to assign other duties to extension staff, such as collecting statistics, administering loan paperwork and input distribution (for government-provided inputs), implementing special programs (such as erosion control), and performing regulatory duties (Feder and Slade 1993; Purcell and Anderson 1997). Many of these duties are easier than extension services for supervisors to monitor, as there are clear and quantifiable performance criteria (number of loan applications returned, number of statistical reports submitted). As mentioned, there may also be monetary incentives for performing some of these other activities (such as input distribution) that have a clear cash value to farmers. This misallocation of extension agents' time at the expense of information dissemination can go undetected because the outcomes of core extension duties are so difficult to attribute and because accountability to farmers is weak or absent.

Fiscal sustainability. An outcome of many of the shortcomings of public extension systems is persistent funding difficulties. The public goods nature of many extension services makes cost recovery at the individual beneficiary level difficult, whereas the dependence on public funding is problematic because of weak political commitment. When budgets shrink, fixed staff costs claim a large share of available funds, and field operations are curtailed, along with other recurrent costs (such as vehicle purchase and maintenance). Scaling down field operations reduces not only the quantity of extension inputs but also their quality, as feedback from farmers is reduced and with it timely follow-up on farmers' issues.

Fiscal inadequacy and the unsustainability of extension operations are common themes in the extension literature (see Feder, Willett, and Zijp 2001; Hanson and Just 2001). More than 70 percent of extension projects in a sample of World Bank-supported operations faced "unlikely" or "uncertain" sustainability (Purcell and Anderson 1997). More recently, this shortcoming has received critical attention in the wider agricultural development literature (Kydd and others 2001).

Extension Modalities as Induced Institutional Innovations

This section applies the framework developed in the previous section to analyze several extension modalities that have emerged in the past three decades. These newer approaches, which depart from the traditional public service model, reflect attempts to overcome some of the weaknesses inherent in the public extension systems of

recent decades (Anderson, Clément, and Crowder 1999; Anderson 1999; FAO and World Bank 2000).

Training and Visit Extension

The training and visit model of extension organization was promoted by the World Bank during 1975–95 in more than 70 countries (Umali and Schwartz 1994). The system stressed a single line of command, with several levels of field and supervisory staff; in-house subject matter specialists to provide training to staff and tackle technical issues reported by field staff; exclusive dedication to technical information dissemination; a strict and predetermined schedule of village visits over a two-week cycle, with contacts with selected “contact farmers”; mandatory biweekly training emphasizing the key set of messages for the forthcoming two-week cycle; a seasonal workshop with research personnel; and better remuneration and transport for extension staff. Although the training and visit design attempted to tackle some of the weaknesses of the public extension service, it also exacerbated other weaknesses. In the end, most of these new structures collapsed.

The problems of scale and complexity were tackled by a heavy reliance on formally selected contact farmers within an identifiable farming group. By working with a small number of contact farmers, who were expected to pass on what they learned to the rest of the farming group, agents were to maximize coverage. But the required staff-farmer ratios implied a significantly larger extension staff, and thus the training and visit extension systems cost some 25–40 percent more than the systems they replaced (Feder and Slade 1993; Antholt 1994). The design intended to deal with accountability by improving management’s ability to monitor staff activities, taking advantage of the strict visit schedule, identifiable contact farmers, intensive hierarchy of supervisory staff, and other quantifiable measures. The monitorable daily schedule also eliminated most activities other than information dissemination. The interaction with research was improved through seasonal meetings, but little influence was gained over research priorities.

Several features of the design could not stand up to practical realities, however. The quality of extension services remained mostly unmonitorable, and the lack of accountability to farmers was not resolved. Biases in the selection of contact farmers led to diminished diffusion as contact farmers were often replaced by “contact groups.” The strict biweekly visit schedule could not be maintained because agents often lacked new messages to convey and farmers had limited interest in frequent visits. The training and visit system appeared to have little impact over time. Although a 1986 study by Feder and Slade (1993) found a positive impact on yields in Haryana, India, three years after project initiation, studies in Pakistan (Hussain, Byerlee, and Heisey 1994) and Kenya (Gautam 2000) found no significant impact after a longer period.

Many observers, including early skeptics such as Moore (1984), agree that what eventually brought about the dismantling of the training and visit extension system was lack of financial sustainability, a general problem of large public extension systems made worse by the higher cost of the training and visit structure. As the ability to demonstrate impact was not improved, there was no significant change in the political commitment to support extension. In country after country, once the World Bank ceased funding (assuming that the new system had been “mainstreamed”), funding returned to the lower levels of the past, which could not sustain the training and visit system. Hard-pressed governments have struggled with downsizing options, in some cases supported by bilateral donors and inevitably coupled with other extension reforms (Sulaiman and Hall 2002).

Decentralization

Decentralization retains the public delivery and public funding characteristics of traditional centralized extension but transfers responsibility for delivery to local governments (district, county). This approach was tried by several Latin American governments in the 1980s and 1990s (Wilson 1991) and by Uganda (Crowder and Anderson 2002) and other African countries later. Decentralization is intended to improve accountability by moving services closer to the people who use them. Local governments (if democratically elected) are eager to receive positive feedback on services from the clientele-electorate. This was expected to improve extension agents' incentives and induce better service. The costs of coordination with the activities of other agencies are also generally lower for local agencies operating in smaller geographical areas. Political commitment may be stronger as well because the clientele is closer to the political leadership.

But decentralized extension agencies also face a multitude of additional problems. There is greater potential for political interference and the use of extension staff for other activities (such as election campaigns). Economies of scale in updating staff skills can be lost, and extension-research links are more difficult to organize. Analysis of Colombia's experience with the decentralization of extension confirms these concerns and documents a significant increase in the number of staff and thus in costs (Garfield, Guadagni, and Moreau 1996). Problems of financial sustainability, rather than being resolved, may merely have been transferred to the local level.

A related reform was the devolution of extension functions to farmers associations rather than to local governments, a strategy pursued in several West African countries with some notable successes (Guinea). This approach is likely to have a greater impact on accountability, because the employer is even closer to the clientele. There is also greater potential for financial sustainability, because the farmers' association that provides the public good is better able to recover costs from its members (through general membership fees, for example), although government funding is

generally also provided to the associations. Extension agents may be permanent employees of the associations or contract employees of private entities, nongovernmental organizations, or universities. Conceptually, their incentives for better service are fairly similar regardless of their standing. Remaining problems include difficulties maintaining agent quality due to loss of economies of scale in training and more difficult linkages with research.

Fee for Service and Privatized Extension

Fee for service extension programs in developing economies can reduce the fiscal burden of public extension services, though they usually entail considerable public funding even when the provider is private. Government-funded vouchers or other public support is common (Keynan, Olin, and Dinar 1997; Dinar and Keynan 2001). Small groups of farmers typically contract for extension services to address their specific information needs. Because this solves the accountability problem, the quality of service is likely to be higher. Farmers determine the type of information that is important to them, so the impact of extension advice is likely to be high (Lindner 1993). Defining the public good at the small group level and having the whole group share in the cost resolve the free-rider and nonrivalry problems. Tracing extension impact is much less of a problem than in other types of extension service provision, although issues of asymmetric knowledge of the value of information and identifiability of benefits remain and raise design challenges (Hanson and Just 2001). Another drawback is the loss of economies of scale in agent training, because agents will generally have to update their skills individually.

An important role for public extension policy is to facilitate the development of private provision of extension services and the gradual withdrawal of the public sector (Keynan, Olin, and Dinar 1997; van den Ban 2000; Dinar and Keynan 2001; Holloway and Ehui 2001). The potential for conflict of interest in contracting arrangements may warrant public regulation and monitoring backed by public information for checking on the quality of the information supplied (Mullen, Vernon, and Fishpool 2000; Rivera and Zijp 2002).

A key drawback of fee for service modes of extension is that less commercial farmers—poorer farmers, women farmers, farmers with smaller or less favorable plots—for whom the value of information is lower, may purchase fewer extension services, because the price of the service will tend to be market-determined. This may have undesirable social implications and may also be an inefficient outcome if poor farmers undervalue information because they have less ability to prejudge its value. One way around this problem is stratification of extension systems by types of clients (Sulaiman and Sadamate 2000). Smaller-scale and poorer farmers may be served by public extension or by subsidized contracted extension services (for example, an association of small-scale farmers would receive public funds to hire extension

staff). Commercial farmers, meanwhile, would be expected to pay a higher share of extension costs in a fee for service system (Wilson 1991; Dinar and Keynan 2001). A fully privatized extension system may result in inefficiencies, however, if there are externalities, such as concerns about soil conservation (Hanson and Just 2001).

Farmer Field Schools

Farmer field schools were originally introduced to teach irrigated-rice farmers in Asia about integrated pest management. After being implemented in Indonesia and the Philippines, the programs were replicated in other countries and for other crops, usually with significant donor funding. A typical farmer field school educates farmers on agro-ecosystems analysis, including practical aspects of “plant health, water management, weather, weed density, disease surveillance, plus observation and collection of insect pests and beneficials” (Indonesian National IPM Program Secretariat 1991:5). The approach uses participatory training methods to educate field school participants to make farmer pest observers into “confident [integrated pest management] experts, self-teaching experimenters, and effective trainers of farmers and extension workers” (Wiebers 1993:32).

A program consists of 9–12 half-day sessions of hands-on farmer experimentation and informal training to a group of 20–25 farmers during a single crop-growing season. Initially, paid trainers lead this village-level program, delivering diagnostics and practical solutions for overall good crop management practices. Through group interactions, attendees sharpen their decisionmaking abilities and their leadership, communication, and management skills (van de Fliert 1993). Some participating farmers are selected to receive additional training that qualifies them as farmer-trainers, with official backup support, such as training materials.

The farmer field school approach seeks to rectify the problem of accountability. The trainers who conduct the field school are bound by a strict timetable of sessions and a prespecified curriculum, which can be easily verified by supervisors. Continuous interaction with a cohesive group of trainees creates accountability to the group, which is enhanced by the participatory nature of the training methods. Later, when the training is administered by farmer-trainers who are members of the community, accountability to farmers is presumed to be even greater.

A key drawback of the former field school approach is its cost, which is likely to raise problems of financial sustainability. The intense training activities are expensive per farmer trained (Quizon, Feder, and Murgai 2001a,b), so the amount of service actually delivered (the number of farmers trained) on a national level would be small. Cost-effectiveness and financial sustainability could be improved if farmer-trainers were to become the main trainers, perhaps with significant community funding, and if informal farmer-to-farmer communications were used to facilitate knowledge diffusion.

In practice, however, farmer-trainers have been a minor factor in national farmer field school initiatives in Indonesia and the Philippines (Quizon, Feder, and Murgai 2001a). A study in the Philippines found little diffusion of knowledge from trained farmers to other farmers, presumably because the content of the training is difficult to transmit in casual, nonstructured communications (Rola, Jamias, and Quizon 2002). Recent analysis of field farmer schools in Indonesia found no significant impact on yields and pesticide use by trained farmers or members of their communities (Feder, Murgai, and Quizon 2004). This suggests that both the curriculum and the training approach need to be rethought.

The Impact of Extension

Over the past four decades, extension operations have been one of the largest institutional development efforts the world has ever known. Hundreds of thousands of technicians have been trained, and hundreds of millions of farmers have had contact with extension services. As countries struggle with declining public budgets, a key question must wonder how effective these extension investments have been. Many studies have analyzed the impact of extension and reported impressive results, but the data challenges and econometric difficulties in the analyses suggest that many of the results must be interpreted with caution.

In principle, the economic analysis of extension projects is similar to that of any investment appraisal (see Belli and others 2001, for example), but inevitably challenges arise in appropriately valuing and attributing benefits. For projects that deliver agricultural knowledge products to producers, effectiveness in enhancing productivity can be quantified by estimating the economic benefits to producers (or consumers) and computing a rate of return to the investment (Maredia, Byerlee, and Anderson 2001). Rates of return can be estimated econometrically by relating productivity changes to investment in research and extension or by applying the economic surplus method, which builds benefits from the bottom up based on estimated productivity changes at the field level and adoption rates for each technology.

More comprehensive studies may also seek to trace the wider economic benefits of research and extension through factor and product markets. Economic analysts are increasingly being asked to address objectives beyond efficiency, such as equity and poverty alleviation, environmental quality, food safety, and nutrition (see, for example, Alston, Norton, and Pardey 1995). But there is still no consensus on how far research and extension organizations should depart from their traditional efficiency objective to guide policy analysts concerned with the relevance and effectiveness of investment in research and extension.

In econometric studies, a production function, cost function, or total factor productivity analysis is used to estimate the change in productivity resulting from

an investment in extension. A production function incorporates conventional inputs (land, labor), nonconventional inputs (education, infrastructure), and the stock of technical knowledge (perhaps represented by investment in extension). Recent efforts have expanded the specification to include resource quality variables (soil erosion, nutrient status) and weather variables. The estimated coefficients on extension (measuring marginal product) are then used to calculate the value of additional output attributable to the respective expenditures (holding other inputs constant) and to derive marginal rates of return to the investments.

There are many technical areas of debate in the literature on econometric methods, such as the length and shape of time-lag structures, the appropriate method of determining the rate of return from the estimations, and the quality of indices used as the dependent variable (Alston, Norton, and Pardey 1995). However, the main constraints on the wider application of econometric approaches in developing economies are data availability and quality. The econometric approach requires good-quality time-series data, which are difficult to obtain below the national or state level in most developing economies. Therefore, this approach is generally best for ex post evaluations of entire agricultural research and extension systems over a long period (say, 25–30 years), if the quantity and quality of data allow the use of statistical methods. Much of the work in this area in developing economies was pioneered by Robert Evenson (see, for example, Evenson and Pray 1991).

One good approach is to use panel data to capture both cross-sectional and time-series variability (Gautam 2000). Secondary panel data are increasingly available for many variables at the district level, especially production and input data, and some recent studies have even included districtwide data on resource quality (for a review of such studies, see Maredia, Byerlee, and Anderson 2001). Most of the studies have focused on the impact of research rather than extension. Indeed, in studies based on time-series data, it is often difficult to separate the effects of research from those of extension. As panel data become more widely available, the use of econometric analysis of extension impact will expand.

Birkhaeuser, Evenson, and Feder (1991) provided an early review of studies of extension impact and found few studies that systematically compared costs and benefits with and without an extension project. Although early evaluations of extension investments criticized the observed low levels of efficiency and frequent lack of equity in service provision, they reported relatively high benefit-cost ratios (see Perraton and others 1983). More recent studies have also found significant and positive effects (Bindlish, Evenson, and Gbetibouo 1993; Bindlish and Evenson 1993), with internal rates of return on extension investments in developing economies ranging from 5 percent to more than 50 percent (Bindlish and Evenson 1997; Evenson 1997).

The overriding lesson of Evenson's (1997) review of 57 studies of the economic impact of agricultural extension is, however, that impacts vary widely—many programs

have been highly effective, whereas others have not. A recent meta-analysis of 289 studies of economic returns to agricultural research and extension found median rates of return of 58 percent for extension investments, 49 percent for research, and 36 percent for combined investments in research and extension (Alston and others 2000).¹ Similar economic performance has been documented for Sub-Saharan Africa alone (Oehmke, Anandajayasekera, and Masters 1997).

However, although economic analysis seems to provide fairly strong justification for many past extension investments, it does not tell the full story. Concern about data quality and difficult methodological issues of causality and quantification of benefits must be important qualifiers to the prevailing evidence of good economic returns from extension. In Kenya, perhaps the most closely studied case in developing areas (from Leonard 1977 to Gautam 2000), early evaluations had indicated remarkably high positive economic returns to extension investments, but a comprehensive evaluation based on new and improved data found disappointing performance—an ineffective, inefficient, and unsustainable training and visit system and no measurable impact on farmer efficiency or crop productivity (Gautam 2000). Such findings do little to dispel the skepticism of policymakers (reinforced by observations such as those of Hassan, Karanja, and Mulamula 1998) about the returns to investment in public extension. More evaluative work is clearly called for to assist policymaking and investment decisions.

Conclusion

Agricultural extension can play an important role in development. The public goods character of much extension work underpins the extensive public investment in extension services. But although public extension organizations are common in developing economies, they are often inadequately funded and their effectiveness is limited by many administrative and design deficiencies and challenges. Chief among these are the large scale and complexity of extension operations, the important influence of the broader policy environment, weak links between extension and knowledge generation institutions, difficulties tracing extension impact, problems of accountability, weak political commitment and support, the frequent encumbrance of extension agents with public duties beyond those related to knowledge transfer, and severe difficulties of fiscal unsustainability.

Among these general problems of extension organization, the difficulty of attributing impact weakens political support, leading to small budgets and problems of fiscal sustainability. Ironically, this same difficulty may explain why international development agencies continue to heavily support extension activities, financing some \$10 billion in public extension projects over the past five decades. The economic justification for the project is rarely based on solid *ex ante* cost-benefit analysis, because

parameters are typically not available from past projects because of the difficulties of attributing impact. Attribution problems also imply that it will be difficult to establish failure once a project is completed (completion is the artificial point in time when donor funding is fully disbursed but farming and extension activities continue).

Several other factors also account for the popularity of extension projects among donors. Extension projects are relatively easy to design, typically involving a small number of recipient government agencies, often just the ministry of agriculture. This reduces bureaucratic complexity. The activities funded by the project are well-defined inputs: constructing and refurbishing extension offices, training agents, providing transport and budgets for field operations, and funding additional personnel. If the project is national in scale, it is easy for donors to build its budget to a significant size—a positive attribute for a development agency striving to maintain its own cost-effectiveness per dollar granted or loaned.

There is thus some tension between domestic decisionmakers, who are reluctant to invest heavily in extension, and development agencies, which enthusiastically promote investment in extension. The availability of external funds minimizes the need for tradeoffs between investments in extension and investments in more politically rewarding undertakings, such as irrigation systems. But it also simply postpones the day of reckoning. Once the externally funded project is over, the lack of political support resurfaces and extension budgets are again cut. The more expensive features of the foreign-funded effort are abandoned, and the size of the extension service is cut way back (Purcell and Anderson 1997).

Several lessons for future extension systems emerged from this review, including some reflections on the pros and cons of different models of extension delivery that were developed in the past few decades. Each situation calls for suitable extension provision methods, but this review emphasizes the efficiency gains that can come from locally decentralized delivery and incentive structures based on largely private provision. Most extension services will remain largely publicly funded, however, especially in impoverished developing economies.

Much remains to be done to bring appropriate extension services to poor farmers around the world. But investors need to be cautious in designing public extension systems and to draw lessons from experience. Informed by these lessons, governments should be able to increase the returns to their investment and successfully assist farmers in boosting their productivity and income, thereby contributing to stronger economic growth.

Notes

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Feder is research manager in the Development Research Group at the World Bank; his e-mail address is gfeder@worldbank.org. The authors have drawn on the considerable World Bank experience with extension, including the work of many of their colleagues, notably Gary Alex, Derek Byerlee, Ariel Dinar, David Nielson, Dina Umali-Deininger, and Willem Zijp. Seniority of authorship is not assigned.

1. The sample of studies was strongly oriented toward research. Only 18 of 1128 estimates of rates of return were for “extension only,” whereas 598 were for “research only” and 512 for “research and extension combined.”

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