Agricultural Extension Policy: A 2020 Re-Vision

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Abstract: This paper reconsiders an earlier review of the organizational and political attributes that govern the performance of extension systems. It emphasizes the efficiency gains that can come from digitally-connected delivery systems with incentive structures tuned to contemporary digitalized capabilities. Globally, extension will increasingly be delivered by private providers but in many countries it will still be largely publicly funded.

1. Introduction

An earlier review of policy issues surrounding agricultural advisory services that is revisited here argued that it has been widely accepted that farmers' performance is affected by their human capital, which encompasses both innate and learned skills, including especially the ability to process information (Anderson and Feder, 2007 [herein "AF"]). This re-review takes that review of literature earlier than around 2006 as "given" (and accordingly for brevity most of those previously published pearls are not re-cited), and reiterates how extension services are still an important element within the array of market and non-market entities and agents that provide human capital-enhancing inputs, as well as flows of information that can improve farmers' and other rural peoples' welfare. The goals of extension include the transferring of knowledge from good sources such as researchers to farmers, advising farmers in their decision making and educating farmers on how to make better decisions, enabling farmers to clarify their own goals and possibilities, and stimulating desirable agricultural development and adaptation. Those laudable goals are now more readily achieved through use of digital technologies and implications of this rapidly developing reality are explored. While extension agents often also provide services that are not directly related to farm activities (e.g., health, non-farm business management, home economics and increasingly nutrition), the focus in this paper is on agricultural and farm management knowledge dissemination (which will often include financial and marketing information).

The literature considered by AF reported cases with high rates of return on extension investment, as well as those of negligible achievements, implying misallocations of public resources. Inevitably, the formats through which extension services are rendered, as well as the circumstances in which recipients of extension services operate, affect the extent of impacts. Productivity improvements are possible only if a differential exists between the actual

[1] My thoughts about extension, such as they are, have been forged through collaboration with a wide circle of old friends, some sadly deceased such as Joan Tully early, Hans Binswanger much later and Burt Swanson in April 2020, but the words presented in this reconsideration were largely beaten out with one in particular, Gershon Feder, who, however, must not share guilt for any errors in their compilation and reinterpretation here.

productivity on the farms and what could potentially be produced with better know-how, subject as always, to farmers' attitudes, preferences and resource constraints (e.g., Hardaker et al., 2015). These gaps are, in the first instance, a manifestation of the difference in the knowledge that farmers possess and the best-practice knowledge that exists at any point in time. Best practice is often, though not always, an embodiment of the latest science-based developments addressed to overcoming the limitations imposed by traditional technology and practices, and thereby enhancing productivity. To realize their potential impact, however, the scientific advances must be well aligned to the local agroecological and socioeconomic characteristics of the target areas.

Extension helps to reduce the differential between potential and actual yields in farmers' fields by accelerating information transfer (i.e., to reduce the technology gap) and helping farmers become better farm managers (i.e., to reduce the management gap). It also has an important role to play in helping the research establishment tailor technology to the agroecological and resource circumstances of farmers. Extension thus has a dual function in bridging oft-blocked channels between scientists and farmers: it facilitates both the adoption of technology and the adaptation of technology to local conditions. The first involves translating information from the store of knowledge and from new research to farmers, and the second by helping to articulate for research systems the problems and constraints faced by farmers.

The adoption of technology by farmers is affected by many factors.[2] Adoption can be influenced by educating farmers about such things as improved cultivars and digital techniques, optimal input use, prices and market conditions, more efficient methods of production management, storage, nutrition, etc. To do so, extension agents must be capable of more than just communicating messages to farmers. They must be able to comprehend an often complex situation, have the technical ability to diagnose problems and master digital technologies, and possess insightful economic-management skills in order to advise effectively on more efficient use of resources. Needless to say, such a demanding set of skills may not be readily available in developing-country circumstances, with strong implications for appropriate investment in education systems.

Effective extension involves adequate and timely access by farmers to relevant advice. However, while access to information is usually necessary to improve agricultural productivity, it is not sufficient. In general, farmers will adopt a particular technology if it suits their socioeconomic and agroecological circumstances. The availability of improved technology, access to "modern" inputs and resources, and profitability at an acceptable level of risk are among the critical factors in the adoption process. Further, farmers often get information from a number of sources. Public extension was often one such source in the modern era, but not necessarily the most efficient. Extension can increase the rate at which adoption occurs, but the extent and form that an extension service takes should be guided by considerations of cost-effectiveness and the nature of extension products. Thus, while extension, including that done in the public sector, can play an important role in improving the productive efficiency of the agricultural sector, the virtues and limitations of the alternative mechanisms need to be considered in assessing the cost-effectiveness of delivering information.

[2] As was elaborated, for example, by the highly cited review of Feder et al. (1986).

Extension usually has maximal impact in the early stages of dissemination of, say, a new technology, when the informational disequilibrium (and the "productivity differential") is the greatest.[3] Over time, as increasing numbers of farmers become aware of a specific technological thrust, the impact of such extension diminishes, until the opportunity and need for more information-intensive technologies arise. The dynamic resolution of the information disequilibria associated with specific extension messages makes observing the impact of extension difficult. At the same time, the uneven flow of benefits from any particular extension message has significant implications from a policy and program-design point of view. The cost-effectiveness of information delivery should thus be established in the light of current and future benefits and costs in order to justify the resources allocated to explicitly delivering the information. The experience of recent years, especially with emerging digitalized technologies, has thrown much light on and brought insight to better understanding these issues; it is the purpose here to draw from that experience (such as assembled by USAID at AgriLinks), and pertinent reviews of it (e.g., Deichmann et al., 2016; Burton et al., 2017; Klerkx et al., 2019; Fabregas et al., 2020; Fielke et al., 2020).

2. Conceptual Aspects

2.1 Information to Facilitate Productivity Growth

Information is a rather special type of input in many respects. Some information will have quite enduring value, such as when transferred managerial skills are embodied in the human capital of the farm manager, and such values are generally increasing over time as more complex and increasingly integrated managerial challenges are faced. Clearly, different types of information can thus have many different inherent valuations to concerned farmers. It is not surprising then that the delivery systems for supplying information can have diverse values for different client farmers, as well as does information itself (e.g., Anderson et al., 1977, pp116-9; Hardaker et al., 2015, p. 228), so getting a handle on the value of extension to farmers is not a trivial task, which may explain why it has so seldom been tackled, according to AF. The task is made more challenging by the multitude of alternative suppliers of information; from friends and neighbors, to input supply firms and specialized consulting services, to media, or to a government extension service. The complexity of the situation was graphically and instructively illustrated by Gautam (2000, p. 3), Taken together, the information delivery systems supporting farming should constitute something of a growth industry if, as is regularly argued by agricultural analysts, farming is becoming more information intensive. How the demands are met by supplies surely varies greatly around the world, depending as it does on market and institutional conditions, but almost everywhere digitally-enabled methods are becoming more prevalent (e.g., Burton et al. 2017; Schroeder and Lampietti, 2019).

[3] AF note that this view of extension has its roots in the insights of Schultz (1964, 1968) about traditional farmers being poor but economically efficient, as well as good risk managers (Dillon and Anderson, 1971). The Shultzian position taken here is also that "traditional" farmers make their contribution to economic growth and their own escape from poverty largely through being able to cope with disequilibria presented by the availability of new technology and new information.

2.2 Economic Considerations Regarding Providers

Knowledge delivered by extension may be information embodied in inputs or equipment (e.g., seed of improved cultivars or machinery) or more abstract, disembodied information on agricultural practice**.** Information embodied in inputs or equipment has high rivalry and tends to be a private good when the input or equipment must be purchased or rented, and a common pool good when the input is locally available. There are two broadly applicable types of disembodied agricultural information: general, non-excludable information (e.g., market information, cropping patterns, etc.), which tends to be a public good, and specialized, excludable information (e.g., a fertilizer recommendation for a specific field, or particular farm operation), which tends to be a toll good.

The diverse types of knowledge and information can be provided by the public or private sector, or by civil society, another often important player in service provision, as explored by Feder et al. (2010) in their review of community-based extension. Different mechanisms are available for coordinating the supply of services—private-sector markets, public-sector hierarchies with state authority, and collective action by civil society. The characteristics of a particular information service influence whether it is best supplied by the private, voluntary or public sectors, as reviewed at length by AF.

(i) Private Extension Services and Cost Recovery

The private-good nature of many extension services has raised interest in privatizing extension services, as reviewed by Feder et al. (2011) at more length than space permits here. In recent times most information services are provided outside of government, and farmers see public extension as only one option—perhaps even a last resort—in obtaining needed information services. The government has, however, a major role in establishing policies and programs to encourage development of private extension services, along with continued sustenance of public provision in some cases such as for remote areas underserved by private providers, and extension systems need to be designed with the understanding that they will be useful investments only if the public role is defined so as to sensibly complement what the private sector can and will fund and deliver.

Private consulting or advisory services generally address needs of commercial farmers. Developing private services for small-scale farmers often necessitates public investment to develop capacities of service providers and establish markets for services. Veterinarians and para-vets have pioneered private service provision in some countries and, in crop agriculture, pest control services present analogous opportunities for private service delivery. Contracting schemes are another popular private-sector mechanism for providing services to small-scale farmers. The potential for conflict of interest in such arrangements may warrant a public regulatory and monitoring function backed up by "public" information, for instance, for quality-checking on information supplied (e.g., Ali et al., 2018).

Several financing mechanisms are used to obtain private financing to cover at least a portion of the cost of public extension services. Mechanisms include levies, direct user charges, or subsidies for services procured by users. Levies are most easily assessed on commercial crops

with a highly centralized marketing system and a limited number of producers or processors. User charges are more feasible for highly commercial operations such as intensive livestock production, for more "sophisticated" producers, and for services that provide a clear and immediate benefit. AF described how Latin America pioneered extensive experimentation with co-financing and private extension service provision, and how small-scale farmers in various countries have indicated a willingness to pay for extension services that meet their needs. Practical issues that emerge in such changing private-public provision of services include an effective crowding out of public provision to the more remote clients when, by losing much of their traditional core business, such public providers incur diseconomies of size (such as for training) and scope for the provisioning task they are left with. Fortunately, digital technologies can, in principle, diminish the costs of remote reach (e.g., Fielke et al., 2020), once digital access is available in such remote areas!

(ii) Public Provision of Extension

Public investment in extension can be justified when the general public benefits more than the direct extension clients, when government can provide services more cheaply or better, when extension services directly facilitate other programs, or when the private sector does not provide needed services. These conditions apply when there are positive externalities to innovation or market failure in service provision. Market failure is often due to: unorganized demand (small farmers do not recognize potential benefits, have limited purchasing power, and are not organized to access services readily) or unorganized supply (few individuals or institutions are capable of providing technical services, or there is limited opportunity for private firms to charge for provision of easily disseminated information). The most important externalities are: positive environmental and health (human, livestock and crop) impacts of appropriate technology use; improvements in political stability and poverty reduction resulting from improved equity in access to information; and improved national security, economic development and food security resulting from increased agricultural, competitiveness and sustainability productivity (e.g., Marsh and Pannell, 2000; Pannell and Marsh, 2013). AF also made the important observation that consumers often benefit more from increases in productivity than do farmers.

Despite the fact that public financing for extension services is often justifiable, the general trend towards fiscal restraint and a reduced role for the public sector has led to financial crises in many extension services. Two general options for improving financial sustainability of public extension involve scaling back public programs or improving cost-effectiveness. **Scaling back public programs** might involve: reducing coverage to specific target farmer groups, reducing intensity of coverage (less frequent in-person visits, fewer services), devolving service provision to private organizations or requiring cost sharing by users. State withdrawal from service provision might entail strategic reduction of some programs and shifting of service responsibilities to others—requiring commercial farmers to arrange their own services; encouraging producer organizations to provide services; or promoting private extension by input suppliers (notwithstanding potential conflicts of interest in the content of advice), produce buyers, NGOs, environmental groups, or others. **Improving cost-effectiveness** can be achieved through improvements in program management, targeting and priority setting, and choice of appropriate extension delivery methods (e.g., greater use of mass media, social networking and

increasingly diverse digital linkage mechanisms). Most recent reviewers are generally enthusiastic and largely positive about the digital prospects (e.g., Fielke et al., 2020).

Sustainability of an extension service depends crucially on its ability to provide benefits and generate support from internal and external stakeholders. Improving efficiency and quality of service provision and client involvement in setting priorities help to generate needed support. True farmer ownership of programs ("empowerment") adds significantly to program sustainability (e.g., as discussed extensively by Swanson. and Rajalahti, 2010).

(iii) Public-Private Partnerships

There is growing recognition that, even where public financing of extension can plausibly be justified, private service delivery may often be more efficient in serving clients. This leads to strategies for contracting extension services—delinking funding from service delivery. Contracted extension strategies take many different approaches to division of responsibilities for financing, procurement, and delivery of services, but many reforms still involve public funding for private service delivery, as has been variously tried and rejigged in Uganda (Benin et al., 2011; Rwamigisa et al., 2018). Competitive contracting in principle instills a private-sector mentality of cost-consciousness and results-orientation, even in public institutions when they are forced to compete in providing services (e.g., Feder et al., 2011).

The economic rationale for farmers to pay for extension services is generally clear and the trend toward such user payment is well established in OECD countries. In developing countries, many producers are yet unable or unwilling to pay for services, especially when they have not seen examples of effective, responsive private extension. Another constraint limiting private extension is that many countries have few extension service providers outside the public sector. Furthermore, few public institutions have incentives and institutional arrangements in place to encourage program cost recovery. Encouragingly, however, the rise of digital capabilities in extension systems of all types has significantly reduced the costs of such cost recovery.

2.3 Past Persistent Problems May Be Less So in a Digitalized Future

Public extension systems have long demonstrated weaknesses hampering their effectiveness. AF summarized such critical appraisals around eight interrelated characteristics of public extension systems, characteristics that jointly had been found to be strongly associated with deficient performance. Following a contemporary reflection by Anderson (2020a), those characteristics of extension systems are reconsidered here in the light of emerging experience in an increasingly digital world of extension to examine whether the future will perhaps be different from the past, and thus breaking from Weinberg's (1975) generalization (of problematic inertia).

(i) Scale and Complexity

In countries where the farm sector comprises a large number of relatively small-scale farmers (as is common in most developing countries), the clients of extension services live in geographically dispersed communities, where the transport links are often of low quality, adding

to the cost of reaching them in physical terms. The incidence of illiteracy and the limited connections to traditional electronic mass media can further limit the ability to reach clients via means that do not require face-to-face interaction (e.g., written materials, radio and television).

Thus, the number of clients who need to be covered by extension is large, and the cost of reaching them is high. The challenge is complicated further by the fact that farmers' information needs vary even within a given geographical area due to variations in soil, elevation, microclimate and farmers' means and capabilities. The large size of the clientele (all of whom are entitled to the public service in the common case of nominally free public extension) inevitably leads to a situation where only a limited number of farmers have direct interaction with extension agents. Since direct contacts are rationed, agents often exercise selectivity as to which farmers they interact with, and such selectivity often manifests preference for larger scale, better endowed, and more innovative farmers, especially those who can provide some in-kind payment, as well as reflect better performance. This sort of supply-side rationing is exacerbated by self-selection on the part of farmers, where those with a higher value (larger demand) for information tend to be medium-scale farmers, with better opportunities to take advantage of information.

This selectivity of contacts has ramifications in terms of the likely extent of diffusion of information through farmer-to-farmer communications. As those who tend to receive more extension contact are often not typical of the farming population, there is often a lesser inclination of other farmers to follow the example of contact farmers. This reluctance thus often diminishes the potential impact of extension services across the farm population. On the supply side, the reaction to the large clientele is the deployment of large numbers of agents, which presents a management challenge for national organizations or organizations dealing with large geographical-administrative units (e.g., states or provinces within a federal system). In organizations with a large number of field personnel, there was for several decades a tendency to adopt a hierarchical centralized management system, exemplified by the Training and Visit System discussed below, so as to facilitate the monitoring of the large and dispersed field-level labor force. The resulting large and hierarchical bureaucracy was often characterized by a top-down management style and was thus not conducive to participatory approaches to information delivery and priority setting that emerged in the 1980s. Furthermore, AF and later Swanson and Rajalahti (2010) argued that the many layers in the hierarchy distanced the decision making from the field level, and were likely to contribute to suboptimal decisions.

Such distancing is, however, effectively reduced in an era where field workers armed with smart phones can be instantly in touch with both their administrative managers, as well as specialist colleagues and with agents in the private sector, such as those engaged in farm input provision. Similarly, when many farmers themselves also have good access to smart phones (or even just mobile phones to some extent), they can make "face-to-face" contact, and share visual images (such as of diseased plants or animals) with advisory service workers, public and private, without the need for physical presence of such workers on the farm. Such reduced transaction costs of extension contact clearly have great implications for improved reach of advisory services into relatively remote parts of agricultural landscapes. Just how much this can make the future different from the past depends on the extent of access to digital services in historically remote areas, and that in turn depends on investment in technologies from solar and other

sources of electric power at farm level, to networks supported by terrestrial towers or satellites. Such infrastructural matters depend on policies and investments well beyond what might be regarded as "agricultural" per se, which naturally takes us to the second AF theme.

(ii) Dependence of Extension on the Broader Policy Environment

The effectiveness of extension work is crucially dependent on complementary policy and institutional actions on which it has very limited influence. Thus, limiting factors such as credit, input and seed supplies, price incentives, marketing channels and human resource constraints determine the impact of the information that extension agents convey to farmers. While extension agents can adjust their advice, given the overall policy climate, the value of the information is diminished when the terms of trade are tilted against agriculture, rural infrastructure investment is inadequate, and farmers have irregular input supplies due to absent input markets. The coordination between agencies that influence these complementary factors and extension management was argued by AF to have been costly and difficult.

But that situation has surely altered in many parts of the world through the advent of "information and communication technologies" (ICTs) and farmer access to them (e.g., Aker, 2011; Aker et al., 2016; World Bank, 2017). Improved telecommunications through wide use of mobile phones is one aspect that has significantly changed the relationship between extension workers and farmer clients, as noted in #i above; direct access by farmers to the internet and global knowledge systems is arguably even more significant in making the knowledge environment for future farming greatly different from that of the past. Just how different will depend importantly on the extent of provision of appropriate infrastructure serving remote rural areas (e.g., Klerkx et al., 2019).

(iii) Interaction with Knowledge Generation

In contrast to the situation in the US, where the cooperative extension service is embedded in the university system, the information on which extension advice is based in most developing countries is not generated within the extension organization itself but rather largely with separate systems (national agricultural research institutes and universities, and increasingly also private research firms), under separate management structures and subject to incentive systems where extension opinions and priorities often do not carry a significant weight. Because the performance indicators for research systems are often related primarily to recognition within the scientific community, the areas of priority are not necessarily aligned with what extension managers and agents perceive as priorities, given their farm-level feedback.

Public research and extension organizations have often competed for budgets (especially when they are located within the same ministry). Researchers typically have enjoyed a higher status and this has often produced tensions in the interactions between research managers and extension, certainly not conducive to coordination and to two-way feedback. Such an outcome has surely been detrimental to extension effectiveness. Inadequate research-extension have doubtless contributed to the many past situations where observers have claimed development failures driven by "insufficient" relevant technology being brought to bear (e.g., IFAD, 2016, chapter 8).

Development interventions such as World Bank operations in the current century have naturally built on the lessons of experience, so the contemporary landscape of extension-type interventions (including support for business development services assisting small and medium enterprise) differs greatly from that of earlier decades. Typically, interventions are increasingly designed under the banner of Agricultural Innovation Systems (AIS) enhancement (e.g., World Bank, 2012), although not all concerned have yet brought into the concept (e.g., Bangladesh in its 2014 agricultural technology project) and linkage problems unfortunately persist.

Fortunately, the rise of ICTs in the developing world generally (e.g., CTA, 2017, 2019), and in various aspects of the agricultural sector, including in research and extension, as well as other subsectors such as credit and marketing (e.g., Tata and McNamara, 2017), has had fortunate results for improving advisory services of all types. The many positive dimensions of these parts of the contemporary digital reality are well captured in a 2011 World Bank Group Sourcebook on *ICT in Agriculture* updated in 2017 (World Bank 2017). In this regard, the future should hopefully be less like the past but, as wise commentators such as Klerkx et al. (2019) have noted, digitalization of extension services alone is not a silver bullet that can kill all the problems of extension.

(iv) Difficulty in Tracing Extension Impact

Because many factors affect the performance of agriculture in complex and contradictory ways, it has been difficult to trace the relationship between extension inputs and their impact at the farm level. This difficulty, in turn, has exacerbated other inherent problems related to political support, budget allocation, incentives of extension employees, and their dual accountability to managers and clients.

The economic evaluation of extension impact (AF section 4) involves measuring the relationship between extension and farmers' knowledge, adoption of better practices, utilization of inputs, and ultimately farm productivity and profitability and the related improvement 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, etc.), and thus ascertaining of the impact of extension advice to farmers requires fairly sophisticated econometric and quasi-experimental methods variously well illustrated by the good works of Gautam (2000), Birner et al. (2006, 2009) and IFPRI work in Malawi and elsewhere summarized by Ragasa (2018). The decision makers who allocate funds, and even the direct extension managers, face great difficulties in assessing the impact of extension and in differentiating it from other contributing factors, or making allowances for the effects of countervailing factors. The inability to attribute impact and thus assess performance has, as argued by AF, also adverse impact on the incentives of extension staff to exert themselves in outreach to farmers.

But, with the rise of ICTs in agriculture, the issues just sketched should become less problematic. It seems yet too early to conclude that in this regard the future will be greatly different from the sketched past, as studies based on the "big data" that will be available in the digital footprints of modernized extension services have yet to be conducted. Some degree of

optimism seems reasonable, even though the difficulties inherent in untangling the complex interaction of information flows and farm outcomes will surely persist.

(v) Weak Accountability

As in any public bureaucracy, extension personnel are accountable to the managerial cadres, but because the effectiveness of their activities cannot be easily established, their performance has, according to AF, traditionally been measured in terms of input indicators that are easy to provide and confirm. The field staffs were thus practically not accountable for the quality of their extension work, and often even the quantity could have been compromised with impunity. The senior managers were nominally accountable for extension performance to the political level but, due to the same impact attribution problems, the extension system's performance was largely monitored in terms of budgets, staff levels, and other bureaucratic rather than substantive indicators. As is common in other large bureaucracies that are fully publicly funded, the accountability to the clientele (i.e., to the farmers) was only nominal, as typically there were neither mechanisms, nor incentives, to actually induce accountability to farmers.

As farmers themselves are the only ones who can relatively easily observe the quality and effectiveness of the extension service they receive, once they are digitally connected to service providers it should be possible to readily capture their opinions and assessments of what they experience. Managers of an extension service can, in principle, use such farmer feedback to understand better effectiveness of offered services and adjust them accordingly, as is claimed for instance, by extension managers in Punjab Province of Pakistan (Ali et al., 2018).

Students of extension practice should also be able to take advantage of digital data on aspects of the contact between extension workers and farmers in order to measure effects and effectiveness. So, it is likely still too early to argue that the future will not be like the past, but optimism for this can reasonably be held.

(vi) Weak Political Commitment and Support

Urban-bias has traditionally made agriculture a weaker contender for public investment resources in countries where agriculture is a large sector (e.g., Binswanger and Deininger, 1997). But even given this situation, extension tends to be a less powerful claimant for budgets. AF were convinced that a plausible reason for the lack of adequate support (and the resulting limited funding) by politicians and senior officials is the inability to derive political payoff that can be earned from a public outlay that has a visible impact Such a payoff cannot be obtained from an expenditure that has an unclear cause-effect nature, such as has sometimes been said of extension. In addition, as argued by AF, it is possible that awareness of the deficient accountability, and the overall impression of ineffectiveness, have deterred policy makers from allocating budgets to extension services.

So, will all this change in the digital era? If managers and analysts of extension efforts, public and private, can draw instructive information such as suggested in above sections will likely be the case, the future may not be like the past, although it is yet too early to declare this.

(vii) Encumbrances with Public Duties in Addition to Knowledge Transfer

Because the extension service typically has a large number of public servants functioning at the rural community level, governments have often been inclined to utilize extension staff for other duties related to the farming population. Such duties include collecting statistics, administering loan paperwork and input distribution (for government-provided inputs), implementing special programs (e.g., erosion control), and performing regulatory duties.

Many of these duties are easier to monitor by supervisors than the information dissemination function, as there are clear and quantifiable performance criteria (e.g., the number of loan applications returned or the submission of statistics reports). Consequently, extension workers naturally place greater attention on the accomplishment of these duties. Furthermore, there may be an extra monetary incentive in performing these other duties (such as input distribution) as some rents can be derived from handling services that have a clear cash value to the recipient farmer. The allocation of an inordinate amount of an extension agent's time to these duties, at the expense of time for technological information dissemination, can go undetected because the outcome of the core extension duty is so difficult to attribute, and because accountability to farmers has been so deficient.

It is not just information flow that can be facilitated by application of digital tools, whether they are crude mobile phones or fancy video equipment such as pioneered by Digital Green (see, e.g., Gandhi et al., 2015; Gandhi, 2017; and the 2018-19 Annual Report). So, since it seems likely that all the multi-tasking of extension workers can be made more efficient, the negative consequences of the classical information provision duties of workers will likely be reduced.

(viii) Fiscal Sustainability

Some of the preceding characterizations of public extension systems have led to persistent funding difficulties. The public-good nature of many extension services makes cost recovery at the individual beneficiary level difficult. The dependence on public funding, in turn, is problematic because weak political commitment has implied lower budgets, relative to the large clientele that needs to be served. The image of ineffectiveness and of unenforceable accountability is possibly another reason for the reluctance to direct large budgets to extension. As pointed out by Howell (1985) and reiterated by AF, a cyclical pattern may be observed, whereby, in years when budget is relatively large (such as when a foreign donor infuses funds for extension), large numbers of staff are recruited, imposing a large fixed cost on the extension service (public employees typically are tenured). When budgets dwindle, the fixed staff costs claim a large share of available funds, and field operations are curtailed, along with other recurrent costs (vehicle maintenance, replacement of agents' modes of transport, etc.). The scaling down of field operations reduces not only the quantity of extension inputs, but also their

quality, as the extent of feedback from farmers is reduced, and thus timely follow-up on farmers' issues is hampered. References to fiscal inadequacy, and the consequent unsustainability of extension operations, were common in the extension literature reviewed by AF.

Will this change in the future is a good question for which no definitive answer is offered here. If extension services can be provided more efficiently and effectively through application of digital technologies and ICTs in general (as optimistically reviewed by Fielke et al., 2020), and if private advisory services proliferate as is also expected, it seems likely that governments will be better able to afford the needed public services, and it will thus mean that this aspect of the future will not be so much like the past!

(ix) So, will persistent problems persist?

AF pointed out the many administrative and design failures that have proved so problematic in public extension effort in the past. From the re-review of such problems in the above sections, as well as due consideration of emerging positive experience such as marshalled by Fielke et al. (2020), the efficiency gains that can come from increasing adoption of digital tools seem likely to overcome many of the problems going forward. There is clearly much yet to be done in bringing needed extension services to the poor around the world. Investors need to be clever in designing and adjusting ICT provision and public extension systems to exploit the new digital tools that are becoming available (e.g., Burton et al., 2017). Governments should be able to increase the chance of reaping high returns to their investment and successfully assisting farmers to adapt to climate change, to boost their productivity and income, and to contribute more strongly to economic growth. Time will tell, however, if Anderson (2020) and this revisitation are justified in their expressed optimism. The optimistic guess is that the conduct and efficiency of agricultural extension will be much better in the future, and thus will not o be too much like the past in several important respects.

3. Extension Modalities

Most of the history of agricultural extension, as agriculturalists of today know it, took place in the past couple of hundred years and involved a wide diversity of approaches over space, culture and time. The history is well recorded in many sources (e.g., as succinctly overviewed by Gwyn Jones and Chris Garforth (ca1995) and more extensively by authors such as Jones, 1981: Hayward, 1990; Rivera and Gustafson, 1991; Swanson and Rajalahti, 2010), and its continuing story is increasingly being told on line at sites such as IFPRI's https://www.ifpri.org/topic/agricultural-extension and Ag Reach's https://agreach.illinois.edu/

AF describe a number of specific arrangements of extension operations that have emerged in the recent decades. These newer approaches, which depart from the earlier "traditional" public service models, may be viewed as induced institutional innovations and reforms, often pluralistic (e.g., Anderson 1999; FAO/WB, 2000), where specific design features reflect attempts to overcome some of the above-discussed weaknesses inherent in public extension systems. A question for today's policy makers is what the advent of digital technologies means for various institutional developments in extension.

3.1 Training and Visit (T&V) Extension

The T&V model of extension organization was vigorously promoted and supported by the World Bank over the period 1975-98 as a national public extension system, and was deployed in more than 70 countries (Hayward, 1990; Feder et al., 2006). AF summarized the key design features as: (i) a single line of command, with several levels of field and supervisory staff; (ii) in-house technical expertise, whereby subject matter specialists provide training to staff and tackle technical issues reported by field staff; (iii) exclusive dedication to information dissemination work; (iv) a strict and predetermined schedule of village visits where contacts are to be made with selected "contact farmers"; (v) mandatory bi-weekly training emphasizing prioritized messages; (vi) seasonal workshops with research personnel; and (vii) improved remuneration to extension staff, and provision of transport (especially motorcycles and bicycles).

Several features of the design could not stand up to practical realities, however. The "contact farmer" approach was often replaced by a "contact group" approach because biases in the selection of contact farmers led to diminished diffusion. The strict bi-weekly visit schedule could not be maintained because often there were no important new messages that needed to be conveyed, and the farmers had limited interest in frequent visits. The consequences for extension impact were apparently negative with often little significant impact being measurable. Had the digital revolution occurred during the T&V era, cost-effective adaptations to better needs-based advisory services may have reduced costs sufficiently to make the approach more affordable? We will likely never know.

But in their absence, many observers including Feder et al. (2006) feel that the single most crucial factor that eventually brought about the dismantling of the T&V extension system was the lack of financial sustainability. Accordingly, policy makers have sought less costly alternative systems that have naturally benefited from the advances in ICT and rising digital capabilities flagged in section 2.

3.2 Decentralization

The decentralization of extension services was considered by AF as one of the "newer" approaches. In one version of it, public delivery and public funding is retained but responsibility for delivery is transferred to local governments. The main expected advantage is in improving accountability (e.g., Kyle and Resnick, 2019). This was expected to improve extension agents' incentives, and induce better service. Political commitment may be stronger as well since the clientele is closer to the political leadership, although there are increased risks of political interference. Colombia, for instance, has been actively decentralizing for longer than most countries but AF note that its experience with the decentralization of extension has merely transferred financial sustainability problems to the local level.

Another version discussed by AF involves the devolution of extension functions to farmers' associations, rather than to local governments. This approach is likely to have a greater impact on accountability, as the employer represents even more closely the clientele, and thus the incentives for higher quality of service are better. There is also a better potential for financial sustainability, as the farmers' association that provides the public good is better able to recover

costs (say, as general membership fees) from its members, although typically government funding is also provided to the associations. Extension agents may be permanent employees of the associations, or contract employees from private entities, NGOs, or universities; conceptually, their incentives for better service are fairly similar regardless of their standing. Cogent studies have seemingly yet to be conducted but it seems that greater use of ICT and improved digital connectivity will likely reduce costs of training and access to information for extension workers working in decentralized modes, so such arrangements are likely to proliferate and contribute to more effective advisory services for many farmers.

3.3 Fee-for-Service and Privatized Extension

The AF review acknowledged the poor performance of public agricultural extension systems in developing countries that had stimulated interest in adopting a pluralistic concept of extension where a variety of service providers attend to an expanding set of rural and agricultural communities' needs, somewhat paralleling what has been happening in agricultural research (e.g., Fuglie, 2016). Within the wider reform agenda, extension modalities where the private sector is relied upon to provide some extension services were perceived as an improvement over traditional agricultural extension. In follow-up work, Feder et al. (2011) discussed the conceptual underpinnings of several extension approaches that incorporate the private sector, highlighting theoretical and practical challenges inherent in their design, and assessing the evidence then available on their performance. A number of case studies and experiences were reviewed, covering examples of a range of public extension partnerships with the private sector as well as cases with no public-sector involvement. A wider and deeper analysis of such initiatives was subsequently undertaken by Suresh Babu and Yuan Zhou (Zhou and Babu, 2015) and accordingly for brevity the AF-update discussion here is minimized. The AF conclusion that, while private-sector participation can overcome many of the deficiencies that characterize the services provided by public extension systems, there are, however, many challenges to be faced as policy makers consider how private elements can best function in extension provision. One detailed consideration of how these challenges may be practically met in the digital era is available for Punjab Province, Pakistan (Ali et al., 2018).

3.4 Farmer Field Schools

AF summarized the history of the FAO-driven development of the farmer field school (FFS) approach to extension. It was designed originally as a way to introduce knowledge on integrated pest management (IPM) to irrigated rice farmers in SE Asia. Subsequently, FFS activities have been implemented in many developing countries, although only a few operate FFS as a nationwide system. The FFS approach relies on participatory training methods to convey knowledge to field school participants to make them into effective trainers of other farmers. AF argued that the FFS seeks primarily to rectify the problem of accountability, and they described the various methods used to heighten accountability. They went on to draw lessons from the several studies managed by Gershon Feder to evaluate the FFS experience, concluding that the key drawback of the FFS approach is its cost, which is thus likely to raise problems of financial sustainability, a conclusion echoed by Anderson (2007) and other neutral observers such as 3ie in a major systematic review completed in 2014, a quotation from which is now used to close this short section.

"FFS seem unsuited to solve the problems of large-scale extension. The approach may not be cost-effective compared with agricultural extension in many contexts, except where existing farming practices are particularly damaging, for example due to overuse of pesticides. This is because of the highly intensive (and therefore relatively costly) nature of the training programme, the relative successes in targeting more educated farmers as compared with disadvantaged groups, and failures in promoting diffusion of IPM practices." (Waddington et al., 2014, p. 19)

3.5 Digitalized Extension

AF continued their review by addressing issues in studying the impact[4] of extension effort and, regrettably, did not explicitly consider the ramifications for extension of the rising engagement with ICT and adoption of various digital technologies, which is why so much attention has been brought to this aspect in foregoing sections of this revisiting story. The AF lack of attention to matters digital, only partly corrected in the Anderson (2007) review, now seems unforgivable, especially in insufficiently acknowledging the pioneering strong efforts of their then colleague Willem Zijp (Zijp, 1994). The digital revolution has accelerated since then and extension is being, and will surely continue in many ways to be, transformed and even "disrupted" (to use a term increasingly popular in development dialogues, e.g., WBG/Dalberg/KWPF, 2019, with its own fresh acronym, DAPs for "disruptive agricultural technologies"). The process is less than smooth, and can sometimes be remarkably slow, even in places such as South Africa, where a recent survey report surprisingly notes in low-key terms that: "Increasing the use of mobile phones and internet in rural extension may contribute to the increase in its effectiveness and efficiency." (Davis et al., 2019, p. 161) Innovation is actively underway using diverse novel methods around the developing world (for a convenient compilation for several countries in Africa see Malabo Montpellier Panel, 2019), including the earlier-mentioned video techniques of Digital Green in East Africa (e.g., World Bank, 2018) and elsewhere.[5] Useful initiatives to evaluate the effectiveness of such innovation are being undertaken to help inform future investment (e.g., Van Campenhout et al., 2018 and others on the IFPRI website, which naturally includes cogent video resources).

To set something of a cautionary tone, consider a recent blog on AgriLinks (Payne et al., 2018): Today, almost every effort to provide agriculture extension and advisory services involves digitally-enabled tools or services and there is plenty written on the topic. There is even some evidence of what approaches work. But **there are still many questions to answer**, such as which digital tools or services are cost-effective, work best for reaching women and youth, give farmers voice, or can be sustained and scaled organizationally and financially. [JRA bolding]

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[4] The review of impact assessment of extension is not revisited here for reasons of space and purpose but the difficulties have not gone away, although as noted earlier in the paper, future such analyses may be greatly aided by the availability of data collected as part of the digital trails of contemporary extension effort.

[5] The on-line world hosts myriad video resources relevant to extension services around the world and no systematic review of any these at attempted here. By way of concrete illustration, however, the example of *Access Agriculture* on Newcastle Disease is noted in passing: https://www.accessagriculture.org/download-request/16500/video

Digitalization of agriculture offers far-reaching opportunities for accelerating agricultural development and transformation (e.g., Deichmann et al., 2016; World Bank, 2016; Birner et al., 2019; CTA, 2019; Klerkx et al., 2019; Malabo Montpellier Panel, 2019; World Bank Group, 2019), A myriad of digital "solutions" (e.g., Trendov et al., 2019; Wikipedia, 2019) will help crop and livestock production to become more efficient and environmentally friendly, although there are many risks to be faced by all actors, particularly concerning intellectual property ownership and privacy (e.g., Birner et al., 2019). Extension will surely play many important roles in helping farmers come to grip with new digital technologies and availing themselves of the benefits of exploiting them, from drones to robots and beyond. For brevity and focus, attention here is limited just to the digitalization of extension-related aspects (where risks are likely fewer but still prevalent, as well noted by Spielman and Glatzel, 2019), what some have termed "digitally-enabled advisory services", as also have other recent reviewers (e.g., Burton et al., 2017; Fabregas et al., 2019). In their review, Fielke et al. (2020) focused on unresolved governance issues related to growing connectivity and transparency of digital innovations, particularly regarding privacy (Wiseman et al., 2019 focus on Australia but also beyond).

For this present short review, the judgment is made that, as noted at several points in the update, for digitalized extension the biggest "risk" relates to socially equitable access to extension services. In this regard the conclusions of WBG/Dalberg/KWPF (2019, p. xiii) are pertinent: "Policy opportunities to promote digital innovation include policies to promote competition; effective intellectual property protections; incentives for technology diffusion; innovation in public-service provision related to e-vouchers or e-extension; investments related to digital skills; open science initiatives; research infrastructure; and ongoing dialogue with the private sector to adapt to evolving needs." Among a long list of useful government actions stipulated are: "Invest in enabling policies for telecommunications infrastructure and payment systems in rural and remote areas to enable good quality and predictable rural connectivity. Access to connectivity for smallholder farmers and service providers would enable better access to services and digital solutions"; and "Invest in an Agriculture Technology (AG Tech) start-up policy to enable innovators in the digital space to operate and grow. In parallel, invest in the enabling ecosystem for AG Tech innovations to enable country-level, regional and international innovators to invest." (p. xiv)

To answer a question addressed by Anderson (2020b) as to "Realizing the Full Potential of Digital Extension", the short answer thus seems to be to try to avoid deepening a "Digital Divide" by means of adopting some targeted investment policies. In particular:

1. Invest in telecommunications infrastructure for rural and remote areas, perhaps through making greater use of long-standing but seemingly much underused institutional innovations such as Universal Service and Access Funds (USAFs) (Thakur and Potter, 2018; Alliance for Affordable Internet, 2019). Birner et al., (2019, p. 66) revive the UNCTAD (2011) suggestions about USAFs, and note the general vexed question of political will and the potential strong role of farmers' organizations in generating such will.
2. Invest in digital skills development for most people but especially for those engaged in enhancing agricultural knowledge platforms, including research organizations, extension managers and agents, would-be rural entrepreneurs, traders and farmers, and, of course, the young who in due course will move into these roles.

3. Invest in oversight mechanisms that can monitor digital developments in the food and agriculture sectors with an eye to ensuring authenticity of information in digital systems (especially those used by farmers and extension services, public and private) and the privacy and safety of all engaged in such systems.

Digitalization of agricultural advisory services is happening rapidly in much of the world but agricultural policymakers must devote imagination and effort to ensure that **all** rural residents can benefit from emerging digital technologies, and that farmers everywhere can be better served by digitally-enabled extension work.

4. Conclusion

AF began by charting the important role that agricultural extension can play in development, and especially highlighted the public-good character of much actual and potential extension effort, as this underpins the extensive public investment in this domain. AF pointed out the many administrative and design failures that have proved so problematic in public extension effort in the past, most notably those associated with: the scale and complexity of extension operations; the dependence of success in extension on the broader policy environment; the problems that stem from the less than ideal interaction of extension with the knowledge generation system; the difficulties inherent in tracing extension impact; the profound problems of accountability; the oftentimes weak political commitment and support for public extension; and the difficulties of fiscal unsustainability faced in many countries. This revisiting has argued that the increasing digitalization of extension is serving to diminish such problems and their costs, and is generally contributing to greater cost effectiveness. The evidence for this optimistic stance is yet sparse but growing, as noted in the new review in section 3.5.

Extension in many parts of the world will increasingly be a privately delivered service and, especially in the more-developed countries, also largely privately funded. For relatively impoverished developing countries it will, however, likely remain largely publicly funded and in many cases still mostly publically delivered.

There is clearly much yet to be done in bringing needed extension services to the poor around the world. Investors still need to be cautious in designing and adjusting public extension systems if they are not needlessly to re-learn the lessons of the past. But they also need to be innovative in employing modern technologies in designs that can be more cost-effective and wider and more inclusive in reach. The private sector can lead the way if ICT infrastructure is in place and there is freedom to operate, both depending on government policy being set favorably. When private initiatives are unlikely to fill needs of some farming and farm-supply communities, public provision will be necessary. Governments should be able to design and create any required public advisory systems in such a way that their investment successfully assists farmers to boost their productivity and income, and thereby contribute more strongly to broad-based and environment-friendly economic growth. This will be easier to do in the digital era but will continue to be challenging.

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