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TECHNOLOGY GENERATION AND DISSEMINATION FOR SMALLHOLDER FARMERS IN SOUTHERN AFRICA: EXPERIENCES AND LESSONS

A Low

INTRODUCTION

The development of the traditional small-scale farming sector in Namibia will depend on the adoption of relevant productivity-increasing technologies by a majority of farm households. The World Bank has pointed to the difficulties and disappointing record of "harnessing technology" for the benefit of African farmers (IBRD, 1989). The structural adjustment programmes of the 1980s focused on improving incentives for small farmers to adopt improved technology by "getting prices right". But it is now recognised that methods developed to generate and disseminate technology for large-scale commercial farmers need to be adjusted to serve the interests of small resource-poor farmers.

This paper reviews the performance of two new approaches (on-farm research (OFR) and training and visit (T&V)) that have been introduced to respond better to the needs of traditional farm households. The experience suggests that adjustments in research approach and extension management could have a bigger impact if more attention is given to integration with other actors in the technology generation and dissemination process.

OFR AND T&V DEVELOPMENTS

In a number of Southern African countries (Zambia, Zimbabwe, Swaziland, Malawi), OFR and T&V have been incorporated into national research and extension systems. Each of these new methodologies was expected to overcome perceived weaknesses in the existing systems and to improve research/extension linkages as well.

OFR was introduced in response to the realisation that production recommendations are often not adopted by smallholder farmers because they are irrelevant or inappropriate. OFR methodology is designed to produce technology that is relevant (addresses priority production problems or opportunities) and appropriate (fits in with farmers' operational circumstances and objectives) (Byerlee et al., 1982). It is also expected to provide a link between research and extension.

T&V was introduced in response to the realisation that extension efforts were often poorly focused and loosely organised and managed. Farmers were not receiving relevant technical information on a timely and regular basis. The system aims at upgrading the technical content of field extension activities, while making the agents' contacts more predictable and thus more accessible to farmers (and more enforceable by Ministry supervisors) (Benor & Harrison, 1977; Moris, 1983).

TECHNOLOGY ADOPTION EXPERIENCE

A review of the generation of research thrusts and their utilisation in three provinces in Zambia, one communal area in Zimbabwe and in Swaziland is given in Table 1.

Table 1
Analysis of the progression of on-farm research thrusts through to farmer adoption

	Cases	Losses	Reasons
Thrusts developed	53	18 (34%)	5 = no followthrough by researchers 5 = no improvement over current practice 3 = suspended pending suitable seed 3 = inconclusive results obtained 1 = inputs not available 1 = wrong problem identified
Recommendation produced	35		
Recommendation produced	35	12 (34%)	5 = input supply problems 4 = poor research/extension communication 2 = no improvement on current practice 1 = system incompatibility
Extension message developed	23		
Extension message developed	23		
No adoption	5	16 (31%)	3 = poor research/extension communication 2 = input supply problems
Limited adoption	15		11 = input supply problems
Widespread adoption	3		

Sources: Waterworth & Muwamba (1989)
Seubert (personal communication)
Shumba (personal communication)

In Zambia and Swaziland both OFR and T&V systems were operational. In Zimbabwe, OFR was combined with group extension methods. In all areas these results reflect six or more years of work. In each case the first year concentrated on diagnosis of production constraints and the identification of research opportunities. In subsequent years attention was focused first on the field testing of potential innovations and then on the extension of the most promising ones.

From Table 1 it can be seen that only about one third of the original research thrusts formulated from identified opportunities were finally adopted by farmers. Of these most were adopted only partially or by limited numbers of farmers (less than 100, generally representing a proportion of the farmers cooperating in research). Of the three technologies widely adopted, two were crop varieties and the other a system of cultivation on receding flood waters in Luapula Province.

BUILDING ON THE EXPERIENCES

These outcomes from the introduction of the new approaches of OFR and T&V have not lived up to early expectations of widespread adoption of yield-increasing technologies within 3-4 years (Low & Waddington, 1990). Nevertheless progress has been made, especially in the diagnosis of production constraints and identification of research opportunities and in the understanding of existing crop production systems. Furthermore, there has been a discernable change in the approach and outlook of many research and extension staff. There has been a movement away from the largely technical perspective upon which the historical research/extension systems were based, towards a more management and problem oriented approach.

Practitioners in the region have suggested how these gains can be built on to make the new approaches more effective (Waterworth, 1989; Seubert, 1989). Two areas of improvement have been highlighted. The first has to do with the source of the technology that has been available for on-farm researchers to work with; the second with the delivery of adapted technology to extension and farmers. I will discuss each in turn below, though they are not unconnected.

Technology source: Need for integrated research

Type of technological intervention

A major reason for limited adoption of maize technology by farmers and for several identified research opportunities remaining unaddressed by on-farm researchers is the lack of suitable technology available for field testing. It is clear that historically most maize commodity research in Southern Africa has been geared towards larger-scale farmers with few constraining circumstances and has often neglected addressing smallholder needs directly. Thus OFR and T&V have had to work with a reduced portfolio of suitable technology, meaning whole problem areas have not been addressed by potential solutions.

Examples of maize technology not or only recently available, but with clear uses for farmers include: shorter season, drought-tolerant and flinty germplasm; maize suitable for intercropping or tolerant of weeds and termites; suitable plant population densities for semi-arid areas; planting guidelines on drying seedbeds; labour-saving fertilizer management on sandy soils.

Benefits from integrated research

One way of helping to ensure appropriate maize technologies are available for on-farm testing and extension, is for on-farm researchers to integrate their work more closely with that of component researchers. They can do this by participating in the development of those technologies, along with component researchers. Unfortunately, the introduction of OFR as an activity done by teams separate from the rest of already established research is a major reason why integration has proved difficult.

Cooperation is essential in two main ways. First, OFR has to adapt technologies developed by component research, mainly on-station, to the needs of smallholder farmers. Second, through explicit use of a production problem/circumstance approach and close contact with farmers and extension, OFR is in a unique position to help orientate component research agendas towards developing technologies that stand a good chance of being useful to target groups of farmers.

Technology delivery: Better research/extension linkages

Some of the outputs generated by OFR, such as better adapted varieties (shorter season maize for late planting) or recommendations adjusted for specific agro-ecological locations, pose no real conflict with traditional extension methods, based on demonstration of "the best way" to grow a crop.

But many of the outputs generated by OFR indicate recommendations that are either:
- sub-optimal, with input levels below and/or management less intensive than those shown to give good returns at high yield levels, or
- conditional on natural, economic or seasonal circumstances

Sub-optimal recommendations

Sub-optimal recommendations take account of farmers being unable to manage all factors of production at optimum levels because of resource constraints or priority conflicts. In these cases recommendations are not concerned with "the best way" to grow a crop, but with reducing management conflicts or improving management or resource use within the given constraints.

For example, a sub-optimal recommendation involving delayed application of basal fertilizer to maize was developed in Central Province, Zambia. Researchers found that farmers' maize management was being compromised due to labour shortages. Farmers were delaying weeding until the crop was about 70 cm tall, at which time they combined a single hand weeding with topdress fertilizer. On-farm research results showed that earlier weeding (at 20 cm) increased yields by 17% and that a further yield increase was obtained by bringing forward the timing of topdressing as well. Since the timing of basal fertilizer had no significant effect on yield, it was concluded that basal fertilizer application could be substituted by a combined (basal and topdress) fertiliser application in conjunction with weeding at 20 cm. Three seasons of trials confirmed that this practice increased yields and reduced labour requirements by six mandays per hectare during peak periods (Waterworth & Muwamba, 1989).

However, extension misinterpreted the results of these trials. In the extension demonstrations set up to verify the trial results and elicit farmer response over the next two years, basal fertilizer was applied at planting (as currently recommended), thus missing the additional labour saving of mixing basal and topdressing. Farmers were not enthusiastic about the demonstrations and formal recommendations were never issued on these OFR trial findings.

Conditional recommendations

Some argue that conditional type recommendations will become more common as we move away from the green revolution era, based on new varieties (see Byerlee, 1987 for Asia and Lele, 1989 for Africa), and as research becomes more farmer-focused and problem-orientated (Chambers, 1988; Baker & Norman, 1987). These types of research output do seem to generate conflicts with traditional TOT-based extension approaches in Southern Africa.

For example, OFR results in Luapula Province, Zambia led to the conclusion that maize variety recommendations should be conditional on whether fertilizer was applied or not. Consistent on-farm research results indicated the superiority of an open pollinated improved variety over hybrids when no fertilizer was applied (Waterworth & Muwamba, 1989). However, extension messages concerning maize varieties and fertilizer rates only related to hybrids and recommended 60 kg N/ha. The option of using no fertilizer and non-hybrids was not included.

These examples illustrate the problem technically trained and orientated extension staff have with handling management-based on-farm research findings that do not conform to accepted "technical" ideals.

Acceptance of the utility of sub-optimal and conditional recommendations tends to conflict with the technical training and in-service experience of most extension officers and requires the development of new skills in making conditional judgements about what input levels or management practices are appropriate for which farmers.

Around 40% (7/17) of the losses between research recommendations and adoption can be attributed to extension/research communication problems (Table 1). In order to build a stronger and more effective linkage between OFR and extension, adjustments are required on both sides.

Extension adjustments

Relating extension methods to message content

Under existing extension systems, and T&V in particular, demonstrations and crop production packages (Lima Recommendations in Zambia, AGRITEX Crop Packages in Zimbabwe, Crop Production Guidelines in Swaziland) are the standard extension tools. While demonstrations are an effective tool for extending new varieties and inputs to go with them (Russell, 1981), they do not allow for the flexibility required to impart information about sub-optimal enabling techniques or selection of options that depend on specific circumstances (Sutherland, 1988). There is a need to develop a wider range of extension methods that are geared to types of information being extended, as well as a diversity of clients (Sagar & Farrington, 1988; Gentil, 1989).

Alternative extension methods suggested by Sutherland (1988) in the Zambian context include field meetings at strategically selected local farms; group discussions focused on common problems; individual informal visits to innovative farmers and more focused T&V messages on priority crops and problems.

Training in the use of a problem-orientated approach to extension

Standard technical crop production packages still form the basis of most extension advice. Extension officer training at all levels has emphasized "correct crop husbandry methods". Extension methods have been geared to demonstrating and teaching these technical husbandry standards. In-service training focuses on upgrading and updating technical knowledge. It becomes difficult therefore to accept deviations from the accepted norms. In Zambia (Sutherland, 1988) and Botswana (Baker, 1988) it was observed that extension workers could not easily see how resource and socio-economic factors related to technical aspects of production. Training was advocated in a management perspective to enable extension workers to vary their advice, taking account of particular sets of circumstances such as competing demands for cash and labour among different crops.

In Swaziland researchers also recognized that extension workers need to have more experience with giving consideration to the farmer's resources, viewpoint and strategies in order to improve the relevance of advice given. The extension worker training sessions conducted by researchers, starting in 1988, included farmer participation. Extension workers, guided by farming systems researchers, used actual case studies of farmers to perform their own resource and constraints analyses.

In Zimbabwe, Agricultural Extension Specialists and Agricultural Extension Officers have been very receptive to training in field diagnosis techniques emphasizing a problem orientated approach. The idea of starting with an understanding of what farmers are doing, and why, and developing messages around identified problems and opportunities, though new, was well received. Informal field diagnosis is to become the standard technique used to develop the content of an officer's programme of work (M. Hakutangwi, personal communication).

Adjustments in OFR

It has been observed that OFR methodology is weak on the incorporation of its findings into the extension system (Moris, 1989). Ewell (1989) suggests that lack of good information about research findings has particularly limited the transfer of technologies other than improved varieties.

Attempts in the region to overcome this shortcoming in OFR has taken two broad forms. First, the introduction of formal structural or organizational changes designed to facilitate information flows from OFR to extension. Second, the development of information formats designed to make research findings more relevant and usable by extension.

Information flow structures

Three very different structures have been set up in Malawi, Zimbabwe and Zambia to facilitate information flows from OFR to extension.

In Malawi adaptive research teams have been located within and operate under the control of area-based extension programmes (Agricultural Development Divisions - ADDs). These adaptive teams are coordinated and administered by a section of the research department, located at the central research station, Chitedze. General professional support, training and guidance are provided from research, but the work programme and research content of the adaptive teams are agreed jointly with ADD management and research.

In Zimbabwe, the extension branch (AGRITEX) and research branch (DR&SS) of the Ministry of Agriculture and Lands both conduct on-farm trials and/or demonstrations. In order to improve coordination of this on-farm work by AGRITEX and DR&SS, a committee was established in 1986, with the title "Committee for on-farm research and extension" (COFRE). This committee appoints sub-committees (by commodity grouping), who have the responsibility of vetting all on-farm research or demonstration proposals by research or extension related to their commodity grouping.

In Zambia, adaptive research teams appointed research/extension liaison officers (RELOs) to improve information flows between adaptive teams and extension. RELOs were expected to: (1) monitor adoption of technologies, (2) train extension workers on new recommendations, (3) organize interactive meetings between adaptive researchers and extension, and (4) ensure that extension literature on the new recommendations is available.

The experience of the formal structures suggest that their success depends on a mutual appreciation of the need for research and extension to work together. Where this is lacking, it needs to be developed: through the formal structures themselves, through training and through providing appropriate incentives for research and extension to work together.

Information formats

In both Swaziland and Eastern Province, Zambia, most of the efforts to improve research extension communication have gone into devising information formats suited to the types of output being produced by the on-farm research teams.

The monthly T&V bulletin put out by Eastern Province started by being technically orientated and crop-specific. More recently there has been a need to include more economic information and to relate this to a management context. This is an attempt to provide some background and rationale behind the conditional recommendations to assist extension staff in applying them in different circumstances. Another attempt at this in Eastern Province is the Supporting Memo on Identified Prime Extension Messages (see Waterworth, 1989).

In Swaziland a similar need was recognized and researchers there developed Field Support Guides which have messages that differ from previous extension support materials in several ways: 1) they focus on a particular topic, often a constraint or part of the production system, rather than all of the recommended practices for a crop, 2) they give the extension worker a basic background on the topic (including social, economic and biological reasons) to help him or her understand why recommendations are made, 3) they also give guidance on when to apply the recommendation or how to modify it to suit the farmer's situation or resources.

The format of the Field Support Guides also differ significantly from previous materials in several ways: 1) they use simple language, 2) they fully explain new technical terms, 3) they are short and easy to read, 4) they use illustrations to help the reader understand better, and 5) they are easy to carry in the field because they are the size of a booklet (A5) (see Seubert, 1989).

CONCLUSIONS

What are the implications of this review of the performance and potential of new approaches to technology generation and dissemination for Namibia?

First, we need to note that the experience reviewed relates to areas of relatively high agro-climatic potential and largely relates to a well-researched crop: maize. The dearth of "on-the-shelf" technology that can be adapted to suit smallholder farmers is even more pronounced for most other foodcrops in the region and for semi-arid conditions (e.g. Norman & Collinson, 1985).

Second, I have focused on experiences with two of three important elements of "technology harnessing". Space has not allowed discussion of input supply services, but it has a significant influence on the adoption of improved technology. From Table 1 we see that of the 17 topics for which a research recommendation was produced, but didn't get adopted at all, 7 or 41% suffered from input supply problems.

A good example from the region of the importance of this element in technology adoption is that of post-independence maize production in the communal areas in Zimbabwe. Smallholder maize sales accounted for less than 5% of deliveries to formal national markets before 1980. By 1985 this figure had increased to 30%. The increase was facilitated by a rapid expansion of input and product-marketing infrastructure, by an increase in the availability of credit and a rise in realised producer prices relative to input prices. These developments enabled many farmers to utilise improved maize technology that had been developed over previous decades for commercial farmers operating in similar natural circumstances. But, as we have seen, further technical advances have been limited and there is increasing evidence that many farm households have been bypassed by the "maize revolution" in Zimbabwe (Jackson & Collier, 1988; Rukuni & Bernstein, 1988).

The experience with technology generation, dissemination and adoption in Southern Africa during the 1980s demonstrates above all the importance of taking an integrated approach to research, extension and support services. It is not just a question of developing appropriate technology, nor a question only of better management of extension methods, nor a question largely of the provision of adequate support services. These all need to be addressed in an integrated manner. The challenge for the 1990s is to devise ways of integrating the new research orientation of OFR with the extension management system of T&V. These then need to be effectively linked with component research at the one end, and support services at the other end, of the technology-generation and adoption continuum. This involves building on experiences to date, training practitioners at all levels and commitment from research, extension and supply service managers to more effectively integrate their activities.

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