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Maize Adaptive Research: Achievements and Prospects in Southern Africa

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Abstract

In the last six to eight years, farming systems adaptive research has contributed much to the understanding of maize production constraints on smallholder farms in southern Africa. It has contributed less to the development of more appropriate maize technology and improved maize productivity.

The potential production impact of farming systems adaptive research (FSAR) has been constrained by the often inappropriate technology available to FSAR from component research and the ineffective use of results of FSAR by extension. However, FSAR has demonstrated the utility of a problem (client) oriented approach to technology development. This approach is now extending into some maize commodity research and extension programmes. Truly effective linkages have still to be developed in most instances, but if these developments can be fostered and both formal and informal linkages encouraged, then the prospects for building on the lessons learned and results achieved through FSAR so far are good, provided that the resulting input supply implications are adequately addressed. The latter is something that FSAR has yet to do.

Introduction

Farming systems adaptive research (FSAR) (Sands 1986; Collinson 1987) has been adopted by most national agricultural research systems (NARSs) in southern Africa, with the assistance of donor agencies and international agricultural research centres, as a complement to traditional station-based research. Farming systems adaptive research is expected to improve the capacity of NARSs to effectively respond to the production problems and opportunities of smallholder farmers, who are not well placed to make their needs known to researchers directly and who operate under a diverse set of circumstances.

Farming systems adaptive research teams have two major roles:

• To identify research opportunities for improving the productivity of target groups of smallholder farmers. This goal is achieved through an understanding of production problems, current production practices, and the circumstances influencing farmers' current choice of enterprise and production techniques.

• To test and develop improved technologies that will be adopted by target groups of farmers. This goal is accomplished mainly through on-farm trials and demonstrations.

An early expectation of FSAR was that it would facilitate the rapid adaptation of appropriate technologies. That expectation derived from experiences in Latin American countries, such as Panama (e.g., Martínez and Arauz 1984) and Colombia (Woolley et al. 1988), where technologies tested and modified through FSAR were adopted by most target farmers within four years of the start of the research programme. Farming systems adaptive research became a key aspect of donors' strategies for increasing food production in sub-Saharan Africa in the early 1980s. The FSAR approach was seen as providing a way to overcome the poor record of agricultural research for smallholders in the past (USAID 1983). High payoffs were anticipated from FSAR projects. For example a USAID report indicated that a five-year FSAR project for Swaziland should increase the proportion of farmers producing marketable surpluses by 30% in 10 years, or provide 75% of small farmers with appropriate recommendations yearly (USAID 1985).

Many FSAR teams in southern Africa have been operational for six years or more. Two questions increasingly asked by donors and directors of agricultural research and extension are, 'What results
have been achieved so far by adaptive research? and How can adaptive research be made more effective? This paper attempts to look at those questions.

We focus on maize (Zea mays), the staple food crop in the region. After reviewing types of research opportunities that have been identified for improving maize productivity, we conclude that FSAR has done a good job at identifying a range of opportunities for improving maize productivity for different groups of farmers, based on the particular circumstances faced by those farmers.

We then go on to examine whether those research opportunities have been turned into technologies that are being adopted by the targeted farmers. Here the record is not so encouraging. We suggest two reasons for this. First, even for a well-researched crop like maize, opportunities for straight adaptation of existing technologies from component (that is, commodity and disciplinary) research have been limited. Second, extension services experience difficulties in using the products of FSAR. Despite these drawbacks, there are grounds for optimism. The problem oriented approach pioneered by FSAR has much wider potential if it can be more fully integrated into component research as well as into extension. We end our paper by presenting some ideas on how this integration might occur and thus allow us to build on past achievements and open up opportunities for advancement with integrated research and extension.

Maize Research Thrusts Developed by FSAR

Table 1 summarises the maize technologies typically employed at present by the three major types of farmers in southern Africa. Adaptive research has focussed on improving the productivity of smallholder ox and hand-hoe cultivation systems, which is often low. This section reviews the major research thrusts developed in that effort over the last six to eight years.

Improved germplasm--Long season (140 days or more when grown at elevations 1,200 m above sea level or higher), high yield potential hybrid maize, and to a lesser extent open pollinated varieties, have been widely adopted by smallholder farmers in some parts of southern Africa (e.g., in Zimbabwe, Swaziland, and parts of Zambia). However, improved maize has not been universally preferred over 'local' unimproved varieties for four major reasons:

- Improved varieties have a long cycle of development, which means that most hybrids do not perform well in zones where the rainy season is short and/or erratic (Whingwiri and Harahwa 1985; for Zimbabwe, Mataruka and Whingwiri 1988) or in more favourable areas when planted late (Shumba 1988, 1989b; Waddington and Kunjeku 1989).

- Improved varieties often yield no higher than 'local' maize when grown by smallholder farmers under their generally low levels of inputs and management (little or no fertiliser and late weeding). This disadvantage is especially marked in Malawi, where only 3-4% of the maize area is reported to be planted to improved maize seed and the fertiliser input is very low (Kydd 1989).

- Because of their soft endosperm (dent grain), most hybrids currently available are unsuitable for the processing methods employed in Malawi and eastern Zambia, where maize is pounded to de-hull the grain before food preparation (Kydd 1989).

- Most hybrids store poorly in traditional facilities and so are not preferred for storage and consumption on the farm in Malawi (Kydd 1989) and parts of Zambia (Waterworth and Muwamba 1989).

Late planting--Traditionally, maize production practices and input levels have been developed by researchers on the assumption that farmers will plant early. However, some FSAR has shown that many farmers are and will continue to be constrained to plant late and, as a consequence, to suffer reduced grain yields (for examples from Zimbabwe, see Shumba 1984, 1988, 1989b). In a survey and trial over four years (1982/83-1985/86) in Mangwende Communal Area, Zimbabwe, Shumba (1989b) found that the grain yield of hybrids such as SR52 and R215 was reduced by 1.3% per day for the period extending from the first effective planting rains until some 50 days later.

Given that farmers are often constrained to plant late, FSAR has suggested that researchers should devote some effort to developing maize materials and practices specifically for later planting (Waddington and Kunjeku 1989). Suggested research topics include breeding maize varieties with shorter development cycles and the ability to tolerate 1) deep or shallow seeding associated with rushed planting,
Table 1. Maize technologies by farmer type, southern Africa

<table>
<thead>
<tr>
<th>Farmer type</th>
<th>Large-scale commercial farmers</th>
<th>Hand-hoe cultivators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent of maize area (ha)</td>
<td>8</td>
<td>30</td>
</tr>
<tr>
<td>Average yield (t/ha)</td>
<td>60</td>
<td>0.3-4</td>
</tr>
<tr>
<td>Variables used</td>
<td>100% hybrids</td>
<td>30% hybrids</td>
</tr>
<tr>
<td>Land preparation</td>
<td>Tractor plow and 2-3 harrowings taking 20 main days/ha</td>
<td>1-2 weeks from start of rains</td>
</tr>
<tr>
<td>Seeding time</td>
<td>1-2 weeks from start of rains</td>
<td>1-12 weeks from start of rains</td>
</tr>
<tr>
<td>Seedbed</td>
<td>Fine and even</td>
<td>Cloddy and heavier</td>
</tr>
<tr>
<td>Planting time</td>
<td>1-4 weeks from start of rains</td>
<td>2-6 weeks from start of rains</td>
</tr>
<tr>
<td>Planting method</td>
<td>Mechanical planter</td>
<td>Hand (various)</td>
</tr>
<tr>
<td>Emergence percentage</td>
<td>80-90%</td>
<td>50-70%</td>
</tr>
<tr>
<td>Intercropping</td>
<td>Less than 1% of area</td>
<td>1-5% of area</td>
</tr>
<tr>
<td>Fertiliser use</td>
<td>Area receiving (%)</td>
<td>100</td>
</tr>
<tr>
<td>Average application rate</td>
<td>20 kg N/ha, 5 kg P/ha</td>
<td>15</td>
</tr>
<tr>
<td>Area receiving manure/compost in any year (%)</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Weed control</td>
<td>Early trash burial, hand application of chemical</td>
<td>Mechanical spray</td>
</tr>
<tr>
<td>Stemborer control</td>
<td>30% hand application of chemical</td>
<td>20% hand application of chemical</td>
</tr>
<tr>
<td>Cutworm control</td>
<td>10% hand application of chemical</td>
<td>10% hand application of chemical</td>
</tr>
<tr>
<td>Harvesting</td>
<td>By hand, maize dried in the field or sun dried at the homestead</td>
<td>By hand, maize dried in the field or sun dried at the homestead</td>
</tr>
<tr>
<td>Storage</td>
<td>Most of harvest retained, maize stored shelled or on cobs, in bags, or cribs</td>
<td>95% sold within 2 months of harvest</td>
</tr>
</tbody>
</table>

Notes: 60% sold within 6 months of harvest; maize stored shelled or on cobs, in bags, or cribs (weight loss = 10-20%).
2) weedy seedbeds, 3) low radiation levels, 4) waterlogging early in crop development, and 5) low soil fertility. Research has also identified the need to examine likely benefits from bringing forward the time of first weeding and time of topdress to accommodate the faster rate of crop development with late planting.

Draught power shortage/tillage—In ox-cultivation systems in southern Africa, draught power shortages are common (see, for example, Shumba 1994; Seubert 1988; Masi et al. 1988; Baker 1988) and result in delayed and hurried land preparation after the onset of the rains. Before they can hire animals, households without their own draught capacity are often forced to wait until draught owners have completed their own initial land preparation. This results in delayed planting and hurriedly prepared seedbeds, which give low emergence percentages, increase early competition by weeds, and lower maize yields, especially yields of the longer season commercial hybrids. Reduced or zero tillage options have been examined to address these problems.

Plant population density—In sub-humid areas where the potential for maize production is high, optimum maize plant population densities are well known (around 40,000 plants/ha). However, for semi-arid areas or for late planting or low input situations in the subhumid areas, optimal plant populations and how they interact with variety and soil fertility have not been established (Waddington and Kunjeku 1989). Surveys and observations on smallholder farms indicate that achieving target plant population densities is a widespread problem even in high potential areas. Commonly, densities of 15,000-20,000 plants/ha are achieved where farmers are aiming at the recommended 35,000-44,000 plants/ha. Poor seedbeds, insect attack, dry spells, soil capping, and inappropriate planting equipment and methods are among the reasons for such low plant populations.

Fertiliser management—Current recommendations on fertiliser rates have been based on responses from improved varieties, usually commercial hybrids, that are planted early. However, a significant proportion of the smallholder maize area is planted on sandy soils to local and improved varieties between 30 and 60 days after the ‘recommended’ planting dates. Adaptive research is needed to establish appropriate fertiliser inputs for these conditions.

Most smallholder farmers apply basal fertiliser one to three weeks after maize crop emergence, rather than at planting as is currently recommended on the basis of experiment station research for commercial farmers. Reasons given by farmers for delayed applications of basal fertiliser include the shortage of labour at planting time, the risk of wasting fertiliser if maize does not emerge, and the fear that fertiliser burn or ‘salt’ damage will inhibit germination (for Zimbabwe, see Shumba 1988, 1989).

Fertiliser topdressings are usually applied late, often just before or even after tasselling, also because of time constraints (mainly weeding of other crops or other maize plantings).

Weed control—Late and inadequate weeding is widely recognised as a common feature of smallholder maize production in southern Africa. Priority given to expanding the area planted, the considerable time demanded for hoe weeding, and the shortage of draught power for ox-cultivation all contribute to the weed management problem.

The importance of reducing early weed competition over the first 20 days after emergence is established from experiment station research and generally holds on the farm. Farming systems adaptive research in Zambia has found weed competition to be especially critical if it coincides with early dry periods and occurs in the absence of inorganic fertiliser (Waterworth 1989).

Farming systems adaptive research has also looked at ways of combining fertiliser application with mechanical weed control to reduce labour and draught requirements in Central and Eastern Province, Zambia (Waterworth and Muwamba 1989; Waterworth 1989).

Mixed cropping—In hoe-plant systems on ridges (particularly in Malawi) many farmers plant grain legumes between maize plants on the ridge. However, farmers often vary the placement and number of grain legume plants between maize plants. Generally farmers aim to achieve some yield of the legume without sacrificing yield from maize. Farming systems adaptive research recognised the need to assess the effect of intercropping with grain legumes on maize yield and establish the best legume arrangement within the maize crop on the farm, given farmers’ resource constraints.
Aside from problems of implementation, there are more fundamental limitations to the exploitation of research opportunities in FSAR which will continue to operate unless they are addressed. These limitations are imposed by the content of component research on the one hand and by traditional extension attitudes and input supply problems on the other. Here we call these problems:

- Limitations of the 'pull-down' approach; and
- Output use constraints.

Limitations of the 'pull-down' approach--Collinson (1982) describes how the role of FSAR as introduced into eastern and southern Africa is to assess the potential for improving production and 'pull down' and adapt technologies from component research to fit niches in smallholder cropping systems. Although adaptive researchers now rarely talk of 'pulling down' technologies, the major source of solutions for use in adaptive research is still commodity-based technologies developed on experiment stations mainly for large-scale commercial farmers (see Collinson 1987; Merrill-Sands and McAllister 1988). For a well-researched crop like maize, it was thought that this pool of available, suitable technologies was large and complete. However many of the technologies have been found to be inappropriate and the adaptive research experience has been that the opportunities to utilise existing technologies to address the production problems identified on smallholder farms are limited.

It should be noted that these limitations operate less severely in two special situations. The first special situation is when maize is expanding into a new geographic area, for which the most appropriate variety, plant population density, fertiliser use, etc., have to be newly established. An example is Luapula Province in Zambia, where the most suitable variety and fertiliser recommendations were selected quickly and effectively by adaptive research teams (Waterworth and Muwamba 1989). But this situation is encountered on a negligible proportion of the area on which maize is grown in southern Africa. Maize has already expanded into many semi-arid areas of the region where it is not well adapted but is in high demand by farmers (Waddington and Kunjaku 1989).

The second special situation occurs when commodity teams have developed technologies specifically with smallholder farmers in mind. An example is the maize variety development programme in Zambia. A range of hybrids and improved varieties of maize were developed with varying maturity lengths and grain types (Ristanovic et al. 1986). Through on-farm testing with farmers, provincial adaptive research teams in Zambia have been able to choose improved maize hybrids and varieties to suit specific areas, farmers' objectives, or resource circumstances (Kean and Singogo 1988). But this success has depended on the availability of a wide range of improved maize materials from which to select germplasm with characteristics suited to small farmers' needs (which in Zambia included early maturity, good performance under low input levels, and storability of grain and seed).

For most FSAR programmes in the region, neither of these special situations applies. What then? Adaptive research is obliged to 'pull down' yield-maximising
'ideal technology sets' that have been designed over time with commercial farmers in mind but are still thought to be relevant (when modified) for most smallholder farmers. In this situation, adaptive research for maize has pursued one or more of the following directions:

- Reduce yield-maximising input levels 1) to better coincide with other non-ideal levels that farmers follow perforce or 2) to better coincide with conflicting objectives.

- Adjust ideal management practices to fit with smallholders’ circumstances and operational constraints.

- Devise ways of enabling smallholder farmers to move from their current practices towards the known ‘ideals’.

A few examples of results from these types of research are given below.

Reduce yield-maximising input levels. Fertiliser recommendations generally have been developed under the assumption that associated practices will also be carried out in accordance with recommendations. Early planting is one such practice that many farmers are unable to follow. In the Central Province of Zambia on-farm trials compared nitrogen and phosphorus responses for early and late planting. No response to P was obtained and no N x P interaction observed. Nitrogen was profitable at up to 200 kg N/ha for early planting (the recommended rate), but was unprofitable above 100 kg N/ha on maize planted 30 days later (Waterworth and Muwamba 1989).

Similarly, localised studies on N response of maize composites in marginal areas such as the Symon area near Mwanza in Blantyre Agricultural Development Division (ADD), Malawi, indicated that the most economic response was 40 kg N/ha, that is, around half the current recommendation (communication from Adaptive Research Team Coordination Unit).

Recommendations to plant maize varieties with differing maturity periods are generally based on a region’s rainfall characteristics. However FSAR teams are finding that maize varieties with short maturity periods may also be suitable for farmers in good rainfall areas. In cooperation with the Maize Commodity Team in Malawi, Adaptive Research Teams (ARTs) in Kasungu, Mzuzu, Lilongwe, and Blantyre ADDs have tested two recently released composite maize varieties: CCC (flint grain, 140-150 days to maturity) and CCD (semi-flint, 110-120 days to maturity). Variety CCD performed well in the marginal rainfall areas. The trials also highlighted some uses for early maturing materials in areas with good rainfall, including the ability to provide mature maize grain earlier in the season to relieve hunger; the potential to grow chickpea as a relay crop with maize; and the possibility of partly compensating for yield losses caused by late planting (communication from Malawi ART Coordination Unit).

In Zambia farmers indicated a preference for early maturing varieties over higher yielding alternatives because of their flintier grain type and their ability to mature in time to provide food during a mid-rainy season hunger period (ARPT-EP 1987).

Adjust ideal management practices to fit with smallholders’ circumstances and operational constraints. Farmers make management compromises to overcome labour shortages. A common compromise is to delay weeding and fertiliser application. On the basis of results from earlier station trials, which showed no yield loss from applying nitrogen up to six weeks after planting (compared to applying N before planting), the Eastern Province AR team in Zambia tested a mixed basal and topdress fertiliser application two weeks after emergence compared with a split application of basal fertiliser at planting and a topdress at four and six to eight weeks after emergence. The mixed fertiliser application was combined with the first weeding and gave a 25% yield advantage over the late (six to eight weeks after emergence) top dressing on demonstration plots over 58 sites (Waterworth 1989).

Again in Eastern Province, plant population density and fertiliser interaction trials indicated that local maize without fertiliser should be planted at 25,000-28,000 plants/ha. Little response to fertiliser was obtained beyond half the recommended rate for hybrids of 132 kg N/ha. A higher plant population of 30,000-35,000 plants/ha was appropriate with 66 kg N/ha.

Devises ways of enabling farmers to move towards known ideal practices. In Swaziland on-farm trials looked at ways of helping farmers achieve higher plant population densities. Modifications of an ox-drawn planter were tested which increased seedling emergence from 60% to 80-100% under low
rates of basal fertiliser (11 kg N/ha), and from 20% to 80% under higher basal applications (22 kg N/ha) (Seubert et al. 1988b).

Associated trials demonstrated that economic benefits of higher fertiliser applications depended on achieving high plant population densities. Other tests provided guidance to farmers on how to calibrate the fertiliser hopper to deliver the required amount of basal fertiliser at planting and how to match seed size with planter plates to minimise seed damage at planting (Seubert et al. 1988b).

Since shortages of oxen contribute to late planting and poor seedbed preparation, reduced and zero tillage options have been tested to help farmers plant earlier and overcome problems associated with poor seedbeds.

On-farm trials in Mangwende, Zimbabwe, compared reduced tillage (use of a ripper tyne) with conventional mouldboard ploughing. The tyne treatment gave no significant yield difference but resulted in increased weed competition (Shumba 1989a and b). However, use of the tyne reduced oxen and labour time for ploughing by 11 h/ha and reduced planting time by 22 h/ha. The time needed for hand weeding was increased by around 106 h/ha. When the use of herbicide was added to the reduced tillage practices, the extra weeding time was eliminated and farmers could expect a marginal rate of return of 1,680% on the extra cash investment required (Shumba 1989a and b). The influence of this technology on earlier planting is dependent on oxen owners using the tyne to speed up their ploughing operations.

In Central Province, Zambia, zero tillage gave no yield advantage but released 14 man days/ha and provided opportunities for earlier planting by those farmers without oxen for ploughing (Waterworth and Muwamba 1989).

Output use constraints—The examples given, and others (see Low and Waddington 1989), provide evidence that imaginative adaptations of current recommendations, based on a good understanding of farmers’ circumstances, have the potential to raise maize productivity above current levels in a wide range of situations. However, there is also evidence that the types of results from the research described above pose certain difficulties when it comes to recommendation and extension.

For example, results for the reduced fertiliser application on late planted maize in the Central Province of Zambia were never included in formal recommendations. The mixed basal and topdressing option was not successfully demonstrated in Zambia’s Eastern Province. The tyne technology in Zimbabwe has not been adopted by more than a handful of cooperating farmers.

Two major problems seem to exist:

- Extension capacity to handle output of the three types of adaptive research activities we have just described; and
- Input supply problems

Extension orientation. Much of the output generated from FSAR trials has three characteristics that extension services find difficult to handle.

First, many results of FSAR require extension officers to make conditional judgements about which input levels or management practices are appropriate for which farmers. This activity conflicts with the perceived role of extension in ‘teaching the farmers how to do it the correct way’. Thus FSAR results get simplified towards the ideal. For example in Luapula Province, Zambia, the recommendations formulated on varieties and fertiliser rates only mentioned hybrids at 60 kg N/ha. Consistent adaptive research results indicating the superiority of an open-pollinated improved variety when no fertiliser was applied were totally omitted from the recommendations. In Central Province, Zambia, adaptive research results showing the advantage of combining the application of fertiliser after emergence with an early weeding was turned into a demonstration of early weeding with fertiliser applied at planting (the standard commercial recommendation for timing of basal fertiliser).

A second complication with extending the results of adaptive research is that less than ideal management recommendations conflict with the technical training extension officers have had on how best to grow a crop and the technical orientation that is inculcated in service. For that reason, results from a number of adaptive research programmes showing that the application of basal fertiliser after planting and the mixing of basal and topdressing as a single application of fertiliser results in little or no yield loss, have not been accepted as recommendations.
A third problem is that changes in practices that save resources or indirectly benefit other crops or farmers, but do not raise yields per unit of land of the target crop, are difficult to extend through demonstrations and require a farming system or community approach. Research results that suggest the use of lower input levels often reflect what farmers are already doing and therefore are seen to have no extension implications.

Supply constraints. Even where technologies get to the stage of being demonstrated by extension, problems with supplying inputs or equipment can block any effective adoption. In southern Africa, some maize production technologies developed originally for large-scale commercial farmers were found to be appropriate in some smallholder farming situations. These technologies included zero tillage and chemical weed control in Central Province, Zambia. However they have not been recommended or extended because of chemical and equipment supply problems. In three provinces of Zambia, 44% of adaptive research trials that got as far as extension demonstrations got no further because of input supply problems (Waterworth and Muwamba 1989).

Figure 1 attempts to summarise the preceding discussion by indicating the relationship between the 'limitations of the pull-down approach' and the 'output use constraints' experienced with extension and policy.

Future Directions for Problem Oriented Research

Figure 1 also indicates three emerging areas of agricultural research and extension activity that will help alleviate some of the problems with 'pulling down' technologies, the receptivity of extension, and insufficient policy support. We call these areas:

- Integrated research planning;
- Problem oriented approach to extension; and
- Recognition of policy makers as new clients for research findings.

Over the longer term, the most important contribution of FSAR to improving the productivity of smallholder crop enterprises may not be by adapting or fine tuning technologies developed on experiment stations. There is increasing evidence that adaptive research has generated an awareness among commodity/disciplinary researchers and among extension services of farmers' decision making criteria and the importance of non-technical factors in the adoption of technology. Among research scientists and extension officers alike, there is now a better appreciation of the variation in circumstances between groups of farmers, which makes nonsense of 'standard, technically ideal' recommendations. The notion that it can be useful to develop a range of 'sub-optimal' technical options to fit different circumstances, priorities, or capacities of farmers is beginning to gain ground. There is a need to capitalise on the acceptance of these ideas through increased support to three types of activities: developing integrated research planning, developing a problem oriented approach to extension, and including policy makers as clients of research. Each of these activities is discussed in the sections that follow.

Integrated research planning--Developing strong links between FSAR and component research is essential for effective research, yet in practice such cooperation has proved difficult to establish and maintain. Improving links was the subject of a recent comprehensive review by Merrill-Sands and McAllister (1988) which included Zambia and Zimbabwe in its analysis. Unfortunately, a major reason why integration has proved difficult is that FSAR has been introduced mainly as an activity of teams which are separated from the already-established research organisation.

Through its explicit use of a production problem/production circumstance approach and close contact with farmers and extension, AR is in a unique position to help orient component research agendas towards developing technologies that stand a good chance of being useful to farmers. By providing appropriate information and guidance to component researchers on research needs, adaptive research and extension can ensure a flow of appropriate new technologies for adoption and dissemination. This has long been recognised as one of the main roles for FSAR (e.g., Collinson 1986; Merrill-Sands and McAllister 1988; Tripp and Woolley 1989) but has been neglected. Indeed, of five FSAR-component research linkage functions identified by Merrill-Sands and McAllister (1983), the one involving feedback from FSAR to component research was considered the least successfully implemented. The need for orientation is urgent, given the long lead time involved in researching most new technologies.

The information to be shared between FSAR and component research needs to cover more than just the problem(s) to be addressed and how serious and widespread they are. Information from AR on the
Problem oriented approach to extension—In general, links between farming systems adaptive research and extension services remain largely ineffective (Ewell 1989). Currently, extension involvement in FSAR is restricted to helping implement diagnostic and trial activities and attempting to use the results. There has been little attempt to orient extension to understand and work with the problem based approach used by AR. Experience from the region (e.g. Seubert 1989; Kean and Singogo 1988; Chipika 1987) suggests that with their technical training and background extension staff find it difficult to understand why different sets of recommendations are needed for different target groups of farmers.

Research has taken the lead in using an approach based on farmers’ problems to develop and test improved technologies. While training and visit methods for extension are supposed to have a problem oriented, ‘adaptive’ philosophy, it seldom gets introduced in practice (Howell 1983). For understanding farmers’ production situations, circumstances, and priorities, extension is better placed than research. And with regard to having staff and facilities for working on farmers’ fields, extension has a much greater capacity than research. Some would argue that the larger part of adaptive research would be better done by extension than research (Johnson and Claar 1986).

Whatever the balance struck between research and extension in on-farm research, more of a partnership needs to be developed between the two. Extension needs to be more fully involved in diagnosis, problem identification, activity planning, and evaluation as well as in the implementation of adaptive research. Extension officers need to be trained, as researchers have been, in the problem oriented approach to research and extension (Cernea, et al. 1984).

A start has been made in this direction by AGRITEX in Zimbabwe (Low 1988) and by the Department of Field Services and Research in Lesotho. In Zimbabwe five provinces have run field diagnosis courses for their specialist staff and agricultural extension officers with CIMMYT assistance. These courses teach the farmer problem-based approach in a practical setting and have begun to reorient the way AGRITEX staff view their roles. In Lesotho an on-farm research programme in one district has been planned jointly and is being implemented jointly by a team of 20 extension staff and five researchers (all Basotho), in cooperation with CIMMYT.

The Swaziland Cropping Systems Research and Extension Training Project is one well-established adaptive research programme in the region that recognised extension as the major client for its research output. Their Field Support Guides are written directly to extension officers, and their extension training has focused lately on developing a problem oriented approach to extension (J. Diamond, personal communication).

Kean and Singogo (1988) and Ewell (1989) describe considerable interaction at many levels between the Adaptive Research Planning Teams (ARPTs) and Extension in Zambia. The establishment of Research Extension Liaison Officers and use of Extension Workers as trial assistants by ARPT have been important. Reports and newsletters have been developed by ARPT specifically for extension.

A better partnership between research and extension in adaptive research will go a long way to overcoming the present constraint to using results from adaptive research. In such a partnership both research and extension would view their roles as diagnosticians and doctors who ‘make things better’ as opposed to teachers and preachers who ‘proclaim the one and only true word.’

Policy makers as new clients for research—Farming systems adaptive research is acquiring (again) a new name. It is OFCOR (On-Farm Client-Orientated Research) (see Merrill-Sands and McAllister 1988). The ‘client’ refers particularly to farmers, but the acronym is appropriate at this time because it is becoming apparent that farming systems adaptive research needs to have clients other than farmers, component research, and extension.

Although input supply problems have been recognised as a constraint to the use of some technologies adapted by FSAR (e.g., Waterworth and Muwamba 1989 for Zambia), FSAR teams have not been adept at orienting their research results and reports to convincing senior executives in government, parastatals, and the private sector of the need to change input supply policies (or showing the costs of not changing them). It is clear that AR will need to address agricultural policy makers more directly in the future. This is a role that economists, as members of FSAR teams, should increasingly be able to take a lead in as they gain experience and reduce their involvement in diagnostic studies.
Also, until it becomes better integrated with commodity/experiment station research and with extension, FSAR will have these two groups as key clients who need to be convinced about the worth of making changes in conventional research agendas or recommendations.

References


