Global Theme on Agro-Ecosystems

Report no. 14

# Impact of Farmer Field Schools on Adoption of Soil Water and Nutrient Management Technologies in Dry Areas of Zimbabwe

International Crops Research Institute for the Semi-Arid Tropics

**Citation:** Rusike J, Masendeke D, Twomlow SJ and Heinrich GM. 2004. Impact of Farmer Field Schools on adoption of soil water and nutrient management technologies in dry areas of Zimbabwe. Global Theme on Agro-Ecosystems, Report no. 14. PO Box 776, Bulawayo, Zimbabwe: ICRISAT. 24 pp.

## Abstract

Agricultural extension systems in sub-Saharan Africa are increasingly using participatory approaches to improve technology adoption by smallholder farmers. This approach has been successful particularly in low-rainfall areas, where adoption is traditionally slow. Crop productivity, farm incomes and food security have improved as a result. ICRISAT worked with Zimbabwe's Department of Agricultural Research and Extension to pilot-test the effectiveness and efficiency of one such participatory approach – Farmer Field Schools, FFS – for delivering extension messages on improved soil and water management technologies in drought-prone areas.

FFS are costlier to implement than traditional Master Farmer and community-based Participatory Extension approaches; but they provide more opportunities for experimentation, and collective learning-by-doing and learning-by-using. This improves farmers' understanding of new technologies, their capacity to effectively use the technologies and to make better decisions, and improves adoption rates. To introduce FFS more widely into national programs and make them sustainable, the study recommends that part of the government extension budget be re-allocated from Master Farmer training to FFS; and that NGOs and commercial agribusinesses be encouraged to target their investments towards developing a nation-wide FFS system.

This work is part of a project funded by the Government of Zimbabwe, the Rockefeller Foundation, the Food and Agriculture Organization of the United Nations (FAO), and the United States Department for International Development (USAID).

The authors record their appreciation for support from the various donors as well as project collaborators – national research and extension staff in Zimbabwe, CIMMYT, TSBF, CARE, COMUTECH, ITDG, and other NGOs.

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2004

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# Contents

# Introduction

During the past 50 years, governments, donors, and private sector organizations have invested in agricultural research and extension throughout sub-Saharan Africa. These investments have led to high rates of adoption of improved varieties of maize, sorghum and pearl millet; but despite the high adoption, farmers are achieving only limited yield gains. Average yields remain low, and crop and farm productivity and income have not increased. There is growing empirical evidence that for smallholders to increase yields, they must adopt improved crop management practices – especially soil water and nutrient management – in order to capture the yield gains that new varieties offer. But farmers have been slow to adopt improved soil water and nutrient management technologies. Researchers have hypothesized that farmers adopt these technologies much more slowly than they adopt new varieties, because with a new variety, the 'information' is embodied in seed – farmers can capture benefits simply by planting it. This is in sharp contrast with soil fertility technologies, where farmers need additional knowledge and experience: what product to use, when and how to apply it. In low-rainfall areas most recommended soil fertility technologies are risky and uncertain. This increases the risks of implementation failure and prevents adoption from expanding.

Researchers have also hypothesized that a range of low-cost crop management technologies are available – tillage, early planting, row planting and spacing, weeding, rainwater harvesting, and inorganic fertilizer micro-dosing. Smallholder farmers could greatly increase yields with these techniques, but they are not being used; partly because of poor extension systems and partly because of input and output market constraints. Because Farmer Field Schools (FFS) are characterized by learning-by-doing, learning-by-using, experimentation and peer learning, it has been hypothesized that FFS are more effective and efficient than traditional extension approaches, in stimulating adoption of knowledge-intensive technologies such as soil fertility and water management.

ICRISAT and the national Department of Agricultural Research and Extension (AREX) in Zimbabwe jointly pilot-tested the efficiency and cost-effectiveness of FFS for disseminating soil fertility and water management practices to smallholder farmers in the country's dry areas. Pilot FFS have operated in four drought-prone districts for four cropping seasons, 2000/01 to 2003/04. This pilot program differed from other FFS projects elsewhere in sub-Saharan Africa in one important respect: it linked advice on soil water and nutrient technologies with development of input and product markets, in order to overcome both information and market constraints.

The study evaluated the performance of FFS relative to two other approaches, the traditional Master Farmer approach and Participatory Agricultural Extension (PAE). The analysis focuses on the interaction between attributes of soil fertility and water management technologies, characteristics of extension services, characteristics of farmers and farms, and the resulting economic performance. The impact of each extension approach was tested by a number of indicators, including changes in farmer knowledge and practice, changes in extension knowledge and practice, farmer empowerment, and cost-effectiveness.

## Research Approach: Theory and Methods

The conceptual framework that guides this study is drawn from the literature on agricultural extension and technology adoption. This framework is applied to derive hypotheses for testing and to guide data collection and analysis.

## Conceptual framework

The literature on agricultural extension and technology adoption shows that different technologies are characterized by different levels of complexity; and thus require different levels of farmer learning before they can be adopted. Different extension approaches can be conceptualized as a spectrum ranging from linear 'top-down' technology transfer to 'bottom-up' participatory methodologies (Black 2000). In the linear approach, technologies are developed and validated by research scientists and extended to farmers by extension agents using various means – individual and group meetings, demonstrations, field days, pamphlets, posters, newsletters, radio, television, videos. In contrast, participatory extension approaches emphasize farmer participation in community-based extension and learning, especially during social mobilization, action planning, experimenting-while-implementing, sharing experiences, and self-evaluation. Different extension approaches have different transaction and transformation costs. Top-down technology transfer may be cheaper and logistically simpler for some technologies. But as technologies become complex and the knowledge gap between technology developer and technology user becomes wider, farmer- and community-based empowerment, education, and human development approaches offer lower transaction and production costs.

To analyze the impact of alternative extension approaches, one can draw on the pioneering contributions of Evenson and others. Evenson (1997) conceptualizes that extension achieves its ultimate economic impact by providing information and educational services to induce the sequence of farmer awareness-knowledge-adoption-productivity (AKAP) changes. To move along the sequence, extension staff and farmers need to invest in skills and activities. Knowledge requires awareness, experience, observation, and the critical ability to evaluate data and evidence. Knowledge leads to adoption, but adoption does not necessarily lead to increased productivity. For productivity to increase, farmers must adopt practices that are not only technically efficient but also allocatively efficient. Productivity also depends on infrastructure, eg community and market institutions. Extension impact can be measured by farmer awareness (and sources of awareness), knowledge (and testing of practices), adoption, and productivity.

Different extension approaches differ in frequency of contact and kind of interaction with farmers – for example, informing versus training and education, levels of knowledge exchange, and variety of learning. Farmers can obtain crop management information from numerous sources, including seed and fertilizer companies, their own experimentation, other farmers, and the mass media. If the technology is new and simple to evaluate and adopt (eg a new variety) then information-awareness leads fairly easily to knowledge and adoption. If the technology is complex and knowledge-intensive, farmers need training to proceed through the AKAP sequence. Repeated messages clearly stated, followed by field extension staff and community organization, are required.

Applying the framework to adoption of improved soil fertility and water management technologies in semi-arid areas generates two hypotheses that are tested in the study:

- Soil fertility and water management technologies are intangible, complex, knowledge-intensive, and difficult to adopt. The FFS approach is most appropriate for promoting their adoption.
- Adoption of the FFS approach by AREX increases the efficiency and cost-effectiveness of research and extension.

## Study areas and research design

Fieldwork was conducted in four pilot areas in Zimbabwe: Chivi, Gwanda, Tsholotsho, and Zvishavane. The areas were chosen to represent different agro-ecological conditions, population densities, and market conditions. AREX facilitators received a season-long practical Training of Trainers course on integrated production and pest management in the horticulture-based FFS model from May to Aug 2000. A national stakeholder meeting was organized in June 2000 to develop a program for introducing integrated soil water and nutrient management (ISWNM) into the national FFS program. The SADC Center for Communication Development led frontline extension staff, subject matter specialists and scientists from the Department of Soil Science and Agricultural Engineering, University of Zimbabwe, in participatory communication and rural appraisals to involve the rural communities in analyzing their problems, needs, existing knowledge and practices, and attitudes and perceptions about ISWNM issues. Scientists from the University of Zimbabwe developed a curriculum and materials for training of trainers and farmers. In Sep 2000 FFS facilitators received a week-long supplementary training on facilitating ISWNM principles in FFS. Scientists from the University of Zimbabwe, AGRITEX, and the Department of Research and Specialist Services (the latter two have now been merged into a single department, AREX) supplemented these with in-field training during the season.

Field activities were carried out for four seasons, 2000/01 to 2003/04. First generation FFS were conducted for two seasons, 2000/01 and 01/02. Second generation FFS were run in 2001/02 and 02/03, third generation FFS in 2002/03 and 03/04. AREX facilitators conducted awareness meetings with local community leaders in their working areas and engaged communities in meetings to select target villages and volunteers. Participatory research tools used included nutrient flow diagrams, transect walks, and gap analysis using problem tree diagrams. These techniques were used to dialog with farmers to understand their objectives, identify and prioritize cropping problems, identify what practices farmers wanted to learn about, identify which technology options should be tested, and agree on the experimental design.

Each FFS group then selected a host farmer, identified and marked out the field school plots, and prepared the land. During the first cropping season each FFS met once a week at the plot to conduct the experiments, carry out agro-ecosystem analysis, learn the scientific principles underlying the particular farming practices at each crop stage, and carry out crop management operations dictated by decisions agreed upon during presentations of the results of agro-ecosystems analysis. The experiments compared officially recommended practices versus farmer practice versus alternative technologies for water harvesting and soil fertility management. Farmers were also trained in communication and group dynamics. Field days were organized to share information on practices that farmers believed offered benefits and could be easily adopted by others in the community. Part of this information sharing was done through songs and dances. During the second season, FFS continued testing improved practices, but with less interaction and less frequent group meetings. Training modules were then revised based on feedback from facilitators and FFS farmers, and used for the third season. After ‘graduation’, groups were linked with commercial seed companies and grain traders. In the drier areas groups were trained to produce seed of improved varieties, for sale within the community.

## Data sources

The data used in the study were drawn from primary and secondary sources. Primary data were obtained through focus group discussions, farm surveys, and formal and informal meetings with farmers and facilitators. Focus group discussions were conducted during the 2000/01, 01/02 and 03/04 cropping seasons. A formal survey of participating and non-participating households was carried out at the end of the 2001/02 season. All graduates of the FFS, Master Farmer (MF) and Participatory Agricultural Extension (PAE) who could be located were interviewed. For control farmers, households were randomly selected from population lists and interviewed. The final sample included

369 farm households. These consisted of 97 households that had participated in both MF and FFS training programs, 126 households that had participated in FFS only, 15 PAE households, and 53 households drawn from control groups receiving normal extension. Extension agents in the four districts were also surveyed after the 2001/02 season to collect their perceptions of changes in practice resulting from dialog with farmers, and changes in crop management recommendations released to farmers. For the extension officers' survey, 100 questionnaires were distributed to all field extension officers through the District Agricultural Extension Officers for completion and return to ICRISAT. The return rate averaged 60%.

Secondary data were collected from farmers' notebooks, other documents, workplan budgets, and expenditure statements. Price data were obtained from district and national agricultural and statistical offices and input supply companies.

## Development of the Extension System in Zimbabwe

Agricultural extension evolved differently for large-scale commercial farmers and for smallholders. Large-scale farmers received extension advice directly from researchers through farm visits, lectures, and publications from research institutions. Agricultural research stations were established in the early 1900s. In 1948 the Conservation and Extension (CONEX) branch was established within the Department of Research and Specialist Services (Kennan 1971). The early extension system was based on farmer participation. Large-scale farmers collaborated with scientists to conduct experiments and establish demonstration plots. A scheme of farmer-to-farmer extension was developed, where new farmers were placed with experienced farmers for 2 to 5 years with the government paying the training farmer for the first year. CONEX used participatory extension methods: extension agents worked with local leaders, committees, opinion leaders and farmer cooperators, following the model of the United States Co-operative Extension Service (Kennan 1980).

Formal extension for smallholders started in 1926 following the appointment of Alvord, a US-trained missionary and agricultural educationist, as the first director of the Department of Native Agriculture. Alvord initiated recruitment and training of Zimbabwean agricultural instructors to demonstrate the benefits of improved crop management practices (Alvord 1956). Extension messages were formulated into ten principles focusing on better tillage practice using plows, harrows and cultivators; seed selection, manure application, separation of crops, planting methods, and simple rotations. Farmers who successfully adopted the ten principles were called Master Farmers. To earn a Master Farmer certificate and badge farmers had to undergo training for two years, pass examinations, and demonstrate that they were using good production practices. This meant that only those who could read and write could benefit from the extension program. The Master Farmer certificate was first awarded in 1934. It was believed that successful 'graduates' would be opinion leaders in their communities, able to influence other farmers more effectively than could government extension staff.

The Master Farmer training approach developed by Alvord still remains the dominant extension method for smallholders in Zimbabwe today. This is despite growing empirical evidence that it focuses on servicing the wealthiest 10% of households; that it provides irrelevant or impractical messages; and that it is too 'top-down', designed without farmer participation and not accountable to farmers, too bureaucratic and inflexible, too costly, and does not empower farmers (Chipika 1988, Rukuni 1996). The poor performance of the Master Farmer approach is summarized by one simple statistic. Over 70 years, 1935 to 1998, a total of 84,200 farmers have graduated. The number of graduates in 1998 constituted about 5% of smallholder households in the country.

Following Independence in 1980, the extension services pilot-tested several alternative methods to improve extension efficiency and effectiveness. These include the farmer extension promoter scheme, radio listening groups, the Training and Visit system, Participatory Agricultural Extension (PAE), and Integrated Production and Pest Management (IPPM) Farmer Field Schools. However, these have not been scaled out beyond the initial test areas. The farmer extension promoter scheme was tested in Wedza from 1982 to 1989 with support from the International Liaison Committee for Food Crops (CILCA). Farmers elected by the community, received intensive training on crop management, and would then train other farmers. The farmer extension promoters were paid a modest remuneration by the extension services. An evaluation survey in 1991 found that the scheme was instrumental in increasing awareness and adoption of recommended practices, and strengthening farmer groups (Sithole and Shoko 1991). The study found that payment for farmer extension promoters is critical in motivating them. When the allowances were withdrawn (because donor funding declined), the number of promoters dropped sharply and morale declined.

Radio listening groups and the Training and Visit system were tested from 1983 to 1991 as components of the National Agricultural Extension and Research Project, with financial support from the World Bank. In the radio listening scheme, 17 farmer groups in Rushinga and Nswazi were provided group-owned radios, through which they accessed agricultural information. The radio lessons were complemented with periodic visits by field staff to verify information, answer questions, and adapt the recommended practices to suit local circumstances. An end-of-project evaluation found that although participants had acquired a knowledge of improved practices, there was a high dropout rate because of long walking distances to listening sites, frequent breakdown of radios, lack of spares, and untimely and irrelevant messages (Sithole and Shoko 1993). The project was found to be unreplicable and unsustainable. However, extension services have continued broadcasting extension messages to farmers through national radio programs. The Training and Visit system was tested in Gweru and Shurugwi, and found to be difficult to replicate and institutionalize after the initial pilot phase.

Participatory Agricultural Extension was pilot-tested by different organizations in Masvingo province from 1991 to 1999. An evaluation in 2001 found that PAE increased farmers' knowledge of resource management technologies; participation in community-based projects such as reforestation, gardens, soil conservation and erosion control; strengthened farmers' groups; and increased demand for extension services (Chipanera et al 2001). PAE resulted in changes in extension practice, including recognition of farmers' experimentation and indigenous knowledge and a shift in role from teacher/ demonstrator to facilitator. However, PAE was not fully implemented because of inadequate resources, lack of technical backstopping by extension specialists, and the inability of middle and top management to make the organizational changes needed.

Integrated Production and Pest Management Farmer Field Schools were tested from 1997 to 2002 with support from the FAO's Global Integrated Pest Management facility. Between 1997 and 2002, 80 AREX officers underwent season-long, training-of-trainers courses on cotton and horticulture, following which 60 facilitators established FFS. In addition, farmers graduating from FFS led by government extension officers, also conducted their own FFS. A survey in 2002 found that FFS improved farmers' decision-making skills (eg response to changing crop, weather and field conditions), increased the use of inorganic fertilizer, area planted to cotton, and use of protective clothing; and reduced pesticide use (Kwaramba 2004). Although yields did not increase farmers increased their profits because of reduced input costs. FFS strengthened group activities and farmers' willingness to contribute towards running of their own groups.

Three conclusions can be drawn from the above review. First, the smallholder extension system evolved in a path-dependent way and chance events early in its development locked in the Master Farmer system and locked out alternative approaches. By contrast the extension system for large-scale commercial farmers evolved based on farmer participation, and no single approach achieved dominance at the expense of others. Second, AREX has pilot-tested several extension methods since Independence. Although these methods were successful during the pilot phase they were not replicated or scaled out because budgets were insufficient. Third, AREX budgets are declining; the department requires additional funding if it is to scale out promising extension approaches. NGO and private sector investments could help supplement government appropriations to AREX.

## Results and Discussion

This paper provides a comparative analysis of participatory versus traditional extension approaches. This section discusses characteristics of survey households and extension services and the impact of alternative extension methods. The analysis focuses on interaction between various factors – household typology, source of farming advice, contact with government extension staff, characteristics of extension services provided by government officers, and observed economic performance.

### Characteristics of households

Both participating and non-participating households were surveyed. There was considerable heterogeneity among sample households in characteristics of the household head, family size and labor, farming experience, members sending remittances, and farming assets (Table 1). Household size averaged 7 members, ranging from 1 to 33. The average age of the household head was 53, range 23–87. On average a household had access to 3.1 ha, range 0.4–9.7 ha.

Table 1. Descriptive statistics of variables used in the factor analysis, southern Zimbabwe, 2001/02

| | Mean | Std Dev | Min | Max |
|---|---|---|---|---|
| Household size | 7 | 3 | 1 | 33 |
| Family members working on crops | 4 | 2 | 1 | 16 |
| Family members working on household animals | 2 | 1 | 0 | 12 |
| Age of head of household | 54 | 13 | 23 | 87 |
| Household members away | 1 | 1 | 0 | 9 |
| Years household farming in area | 22 | 14 | 0 | 70 |
| Total farm size (ha) | 3.1 | 1.4 | 0.4 | 10 |
| Trained draft cattle | 3 | 2 | 0 | 12 |
| Trained draft donkeys | 2 | 2 | 0 | 9 |
| Plows owned | 1.1 | 0.6 | 0 | 4 |
| Harrows owned | 0.2 | 0.4 | 0 | 2 |
| Cultivators owned | 0.3 | 0.5 | 0 | 2 |
| Animal-drawn carts owned | 0.7 | 0.6 | 0 | 3 |
| Sprayers owned | 0.1 | 0.4 | 0 | 2 |
| Wheelbarrows owned | 0.8 | 0.6 | 0 | 3 |
| Bicycles owned | 0.6 | 0.8 | 0 | 6 |
| Radios owned | 0.7 | 0.8 | 0 | 6 |
| Cattle ownership | 6.9 | 8.7 | 0 | 75 |
| Goats ownership | 6.5 | 7.7 | 0 | 68 |
| Sheep ownership | 0.5 | 2.1 | 0 | 22 |
| Donkey ownership | 2.3 | 2.5 | 0 | 12 |
| Working capital US$ | 15.90 | 55.33 | 0 | 1115.87 |

To identify the factors determining household differentiation and evaluate how they interact with characteristics of extension services and result in different levels of performance, we first carried out factor analysis. Nonmetric variables were included using dummy variables. The procedure extracted 8 factors with eigenvalues greater than 1 (Fig 1). To interpret the factors the VARIMAX method was used to obtain orthogonal rotation of factors (Table 2). After rotating the factor axes, we found nine

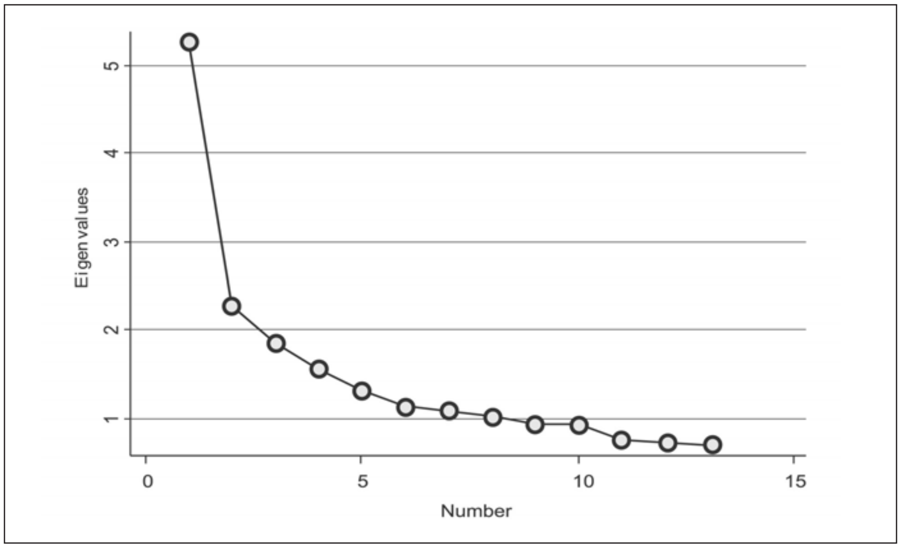


*Figure 1. Scree test for component analysis*

Table 2. VARIMAX – rotated component analysis factor matrix, southern Zimbabwe, 2001/02

| | Factor 1 | Factor 2 | Factor 3 | Uniqueness |
|---|---|---|---|---|
| Family members working on crops | 0.68808 | –0.03725 | –0.11600 | 0.51170 |
| Household size | 0.64468 | –0.10472 | –0.14982 | 0.55098 |
| Cultivators owned | 0.62445 | 0.06450 | –0.05644 | 0.60272 |
| Years household farming in area | 0.55666 | –0.42858 | 0.02962 | 0.50557 |
| Plows owned | 0.55132 | 0.11087 | –0.39051 | 0.53126 |
| Trained draft cattle | 0.54917 | 0.33146 | –0.26302 | 0.51937 |
| Harrows owned | 0.53369 | 0.31335 | –0.18665 | 0.58215 |
| Animal-drawn carts | 0.48901 | 0.18710 | –0.42028 | 0.54923 |
| Age of household head | 0.47972 | –0.43676 | 0.10874 | 0.56728 |
| Sprayers owned | 0.41106 | 0.12300 | –0.08316 | 0.80899 |
| Cattle ownership | 0.40906 | 0.35568 | –0.40408 | 0.54288 |
| Family members working on household animals | 0.33750 | –0.08203 | –0.20594 | 0.83695 |
| Wheelbarrows owned | 0.31904 | 0.32160 | –0.36185 | 0.66385 |
| Household members away | 0.21931 | 0.22782 | 0.00940 | 0.89991 |
| Bicycles owned | 0.16970 | 0.53035 | –0.17856 | 0.65804 |
| Goat ownership | 0.16375 | 0.26193 | –0.63383 | 0.50284 |
| Total farm size (ha) | 0.15742 | 0.18713 | –0.22334 | 0.89032 |
| Dummy: male–headed household | 0.14784 | –0.53857 | –0.43818 | 0.49608 |
| Sheep ownership | 0.14030 | 0.02323 | –0.32833 | 0.87197 |
| Working capital | 0.13402 | 0.22958 | –0.05455 | 0.92635 |
| Donkey ownership | 0.09599 | –0.06032 | –0.84658 | 0.27045 |
| Trained draft donkeys | 0.07610 | –0.09583 | –0.84546 | 0.27023 |
| Dummy: female–headed household | 0.07135 | 0.67665 | 0.35021 | 0.41441 |
| Radios owned | –0.00317 | 0.53887 | –0.33226 | 0.59921 |

variables that had highly statistically significant loadings on factor 1: number of members working on crops, household size, cultivators, farming experience, plows, draft cattle, harrows, carts, and age of household head. Factor 1 captures well-resourced households with adequate farm equipment. Variables that load very high on factor 2 include *de facto* female head, radio, bicycle, cattle, draft cattle, wheelbarrows, harrows, goats, and cash (in the positive direction); and farming experience, age of household head, and male head husband resident (in the negative direction). Factor 2 captures average households, mostly *de facto* female-headed households with access to salary incomes and remittances, cash for investing in farming and consumer durables such as a radio or bicycle. Variables that have significant loadings on factor 3 are mostly negatively associated: donkeys, goats, male-head husband resident, carts, cattle, plows, wheelbarrows, radio, sheep, and draft cattle. Therefore we interpret factor 3 as reflecting poorly resourced, mostly *de jure* female-headed households.

### *Wealth categories*

Focus group discussions with farmers revealed that they recognize three household typologies – wealthy, average and poor households – based on community-derived wealth criteria such as ownership of draft animals and farm equipment, landholding size, farming knowledge, and salary incomes and remittances. Wealthy households have adequate draft animals to inspan and a full set of equipment including plows, harrows, cultivators, and carts. They are generally male-headed with a resident husband and have access to pension, business income, or salaried employment in the rural area. They have grown-up children whose education has been completed, and are receiving assistance from them. They do not have major expenses such as school fees and health costs. Some can hire labor to help with domestic work and look after livestock. Average households have inadequate equipment and too few animals for inspanning. They share draft animals and implements with other households. They are mostly *de facto* female-headed households with the husband away, or headed by a retired or aged male. Poor households have land but no draft power or farm implements. They have to hire draft power from other farmers. They often sell labor (weeding, harvesting, herding cattle), trap termites for sale, and ask for help. Some households brew beer, produce poultry, make and sell clay pots, and exchange goods or services for someone to come and plow for them. They are usually female-headed.

### *Access to extension services*

All categories of farmers reported that government extension officers and NGOs were their most important source of information on new crops and varieties and soil fertility management (Table 3). Neighbors were a more important source of advice for *de jure* female-headed households compared to male-headed and *de facto* female-headed households. In contrast, male-headed and *de facto* female-headed households rated agribusiness firms as more important sources than did *de jure* female-headed households. These patterns reflect the severity of resource constraints among different categories. *De jure* female-headed households have fewer resources and are therefore less able to implement the advice provided by commercial companies. Consequently they seek advice from neighbors who may have adopted recommended practices, or may be able to suggest projects that offer good returns on investment. Proportionately more *de jure* female-headed households do not have contact with government extension staff, compared to male-headed and *de facto* female-headed households (Table 4). Among households with extension contact, *de jure* female-headed households have less frequent contact than male-headed and *de facto* female-headed households – even though proportionately more *de jure* households expressed a need to see extension staff more frequently.

Table 3. Main sources of advice on new technologies (% of farmers reporting receiving advice), southern Zimbabwe, 2001/02

| | Male head | De facto female head | De jure female head | All | Sig |
|---|---|---|---|---|---|
| New crops and varieties | | | | | |
| Public extension officer | 60 | 62 | 55 | 60 | ns |
| NGOs | 16 | 18 | 18 | 17 | |
| Other farmers | 7 | 6 | 17 | 7 | |
| Radio | 10 | 7 | 7 | 9 | |
| Other (firms, shops) | 5 | 4 | 1 | 5 | |
| None | 3 | 2 | 2 | 3 | |
| Soil fertility management | | | | | |
| Public extension officer | 59 | 61 | 55 | 59 | ns |
| NGOs | 17 | 20 | 18 | 17 | |
| Other farmers | 7 | 5 | 17 | 8 | |
| Radio | 9 | 7 | 7 | 9 | |
| Other (firms, shops) | 5 | 4 | 1 | 5 | |
| None | 3 | 3 | 2 | 3 | |

Clearly, *de jure* female-headed households have the least access to formal extension services. The question is: do Farmer Field Schools enable *de jure* female-headed households to gain better access to extension?

## Characteristics of extension methods

Government field extension officers reported they allocate roughly 80% of their time to extension activities and the balance to administrative and regulatory duties (Table 5). Of this 80%, three-fourths is spent on group discussions, Master Farmer training, individual farm visits, and demonstrations. Because most group activities and direct visits are part of the Master Farmer program, the bulk of extension time is spent on the Master Farmer scheme. Around 7% of extension time is on Participatory Extension and 5% on FFS. Of the time used for administrative and regulatory duties,

Table 4. Extension contact during the cropping season by type of household, Zimbabwe, 2001/02

| | Male head | De facto female head | De jure female head | All | Sig |
|---|---|---|---|---|---|
| % households without extension contact | 30 | 28 | 54 | 32 | 0.00 |
| Frequency of extension contact for households with contact (%) | | | | | |
| Less than once per month | 57 | 53 | 62 | 57 | 0.01 |
| Monthly | 30 | 11 | 24 | 29 | |
| Fortnightly | 5 | 16 | 2 | 5 | |
| Weekly | 7 | 20 | 12 | 8 | |
| Frequency household would like extension contact (%) | | | | | |
| Less than once per month | 43 | 46 | 44 | 43 | 0.02 |
| Monthly | 32 | 13 | 21 | 30 | |
| Fortnightly | 3 | 12 | 1 | 4 | |
| Weekly | 21 | 29 | 34 | 23 | |

| Table 5. Allocation of government extension staff time (%), southern Zimbabwe, 2001/02 | | | |
|---|---|---|---|
| | Crop season (Oct-Apr) | Winter (May-July) | Before rainy season (Aug-Sep) |
| Extension | 77 | 77 | 79 |
| Regulatory and administrative | 23 | 23 | 21 |
| % of extension time used on | | | |
| Group discussions | 21 | 26 | 27 |
| Master Farmer training | 20 | 23 | 20 |
| Individual farmer visits | 18 | 16 | 17 |
| Demonstrations | 14 | 11 | 12 |
| PAE | 9 | 8 | 8 |
| NGO-related activities | 7 | 7 | 6 |
| FFS | 5 | 5 | 7 |
| Field days | 6 | 4 | 4 |
| % of admin time used on | | | |
| Regulatory duties | 31 | 45 | 36 |
| Water conservation | 23 | 27 | 22 |
| Crop forecasts | 25 | 10 | 11 |
| In-service training | 8 | 5 | 14 |
| Training other extension staff | 7 | 7 | 13 |
| Teaching in schools | 6 | 6 | 5 |

37% was spent on regulatory activities (land resettlement, control of migratory pests, firearms processing, farm input scheme), 24% on water conservation, 14% on crop forecasts, and the balance on in-service training, training other extension staff, and teaching in schools.

The Master Farmer, FFS and PAE approaches have different mixes of methods and tools, and use different criteria for targeting households. The Master Farmer approach uses classroom teaching, written notes and examinations, and individual farm visits more extensively. In contrast, FFS uses more group building exercises, experiments and trials, energizers, and look-and-learn visits. PAE involves heavy use of training-for-transformation and look-and-learn visits. However, all three approaches employ to a similar extent field demonstrations, practical training, and group meetings. Farmers have a limited say over what they study under the Master Farmer approach, a moderate say in FFS, and a large say in PAE. This is because the Master Farmer model has a prescribed syllabus and farmers look up to the extension officer as the expert and teacher. However, farmers are given a list of topics and – after discussing as a group and in consultation with the trainer – can select topics and crops they would like to study. In FFS farmers learn by doing, the curriculum is largely selected by farmers, based on problems they commonly face; and farmers take trial results into their own plots. Extension (ie the FFS facilitator) only guides farmers to make decisions. In PAE the trainer asks for participation from farmers, farmers select topics and crops, the curriculum is based on farmers' problems, farmers are able to organize field demonstrations, and look-and-learn exercises are used to broaden the options available to farmers.

### *Targeting criteria*

Extension officers reported that the Master Farmer approach targets better resource-endowed households with livestock, implements and land, especially those who can read and write. FFS targets all interested households in a community on a voluntary, first-come-first-served basis. PAE targets existing farmer groups and clubs that are mostly self-selected. To graduate as a Master Farmer, farmers explained they have to attend at least 24 lessons, pass written tests, and build a 'model' home – hygienic (toilets, rubbish pits), and with granaries, a shed for farm implements, cattle pens, goat kraals, and fruit orchards. They also have to implement the practices taught by extension officers, especially winter plowing, contour ridges and sole-cropping; and obtain marketable surpluses and sell crops to commercial outlets such as the Grain Marketing Board. Although requirements are less stringent for PAE, households still need to demonstrate they have understood whatever has been taught, and implement the practices in their fields. By contrast, FFS farmers 'graduate' when they think they are ready – provided they continuously attend lessons. The logic is that farmers are always learning new technologies and practices, even outside the FFS.

Because of stringent requirements for participation and graduation, the Master Farmer approach is mostly for better-off, male-headed households (Table 6). PAE has less stringent requirements and greater participation by poorer households, but self-selection still results in domination by male-headed households. FFS has flexible requirements and hence broader participation, including *de facto* and *de jure* female-headed households. We conclude that FFS does indeed expand *de jure* female-headed households' access to extension.

## Comparing impact of the three approaches

This section discusses the impact of alternative extension approaches in terms of farmers' knowledge of practices, changes in farmer practice, changes in extension practice, farmer empowerment, and cost-effectiveness.

Table 6. Characteristics of households (% of households reporting) targeted by different extension approaches, southern Zimbabwe, 2001/02

| | MF | MF+FFS | FFS | PAE | Control | All | Sig |
|---|---|---|---|---|---|---|---|
| Household head | | | | | | | |
| Male | 85 | 62 | 60 | 93 | 74 | 69 | 0.040 |
| De facto female | 10 | 20 | 17 | 0 | 11 | 15 | |
| De jure female | 5 | 19 | 23 | 7 | 15 | 16 | |
| Landholding (ha) | | | | | | | |
| < 2 | 17 | 16 | 26 | 16 | 54 | 24 | 0.041 |
| 2.1-3.5 | 32 | 47 | 37 | 25 | 25 | 36 | |
| > 3.5 | 52 | 37 | 38 | 59 | 22 | 40 | |
| Full-time workers | | | | | | | |
| < 3 | 24 | 24 | 45 | 19 | 53 | 34 | 0.004 |
| 3-5 | 31 | 46 | 33 | 22 | 28 | 34 | |
| > 5 | 45 | 30 | 23 | 59 | 19 | 32 | |
| Draft cattle | | | | | | | |
| Zero | 15 | 19 | 32 | 34 | 43 | 26 | ns |
| 1-3 | 15 | 25 | 16 | 15 | 23 | 19 | |
| > 4 | 70 | 56 | 52 | 51 | 34 | 55 | |
| Cash to purchase inputs | | | | | | | |
| < US$ 14 | 33 | 19 | 38 | 12 | 46 | 32 | ns |
| US$ 14-24 | 25 | 25 | 19 | 49 | 29 | 25 | |
| > US$ 24 | 42 | 56 | 43 | 39 | 25 | 43 | |

MF = Master Farmer, FFS = Farmer Field School, MF+FFS = farmers who participated in both programs, PAE = Participatory Agric. Extension
US$ 14 = Z$ 3000 approx

### *Farmers' knowledge of soil fertility and water management technologies*

During the interviews farmers were given a knowledge test: questions on improved practices for soil conservation, rainwater harvesting, soil fertility management, and working together in groups, with a maximum score of 100. PAE graduates had the highest mean score for soil conservation (Table 7). The joint Master Farmer and FFS graduates and pure FFS graduates had the highest scores for rainwater harvesting; the Master Farmer + FFS and the PAE graduates for questions on working together in groups. Differences between extension groups (Master Farmer, PAE, FFS, Master Farmer + FFS) were not statistically significant, but all groups scored better than the control (untrained) group. Mirror interviews with extension agents show that they perceived FFS as the most effective for improving farmer knowledge and skills on soil and water conservation, soil fertility management and pest control; PAE for collective action; and Master Farmer training for general livestock and crop management. This is consistent with farmer interviews.

The knowledge patterns reflect partly the difference in curriculum between different approaches, and partly the processes used to communicate with farmers. Farmers were asked what they learnt in the three approaches (Table 8). Their responses show that Master Farmer training places most emphasis on general knowledge of livestock and crop production, new varieties, and planting methods. In contrast, FFS emphasizes soil and water conservation followed by new varieties and planting methods, general knowledge of crops, and soil fertility. PAE places equal emphasis on new varieties and planting methods.

### *Change in farmer practice*

Farmers were asked if they changed their farming practices as a result of what they learnt. The proportion of farmers changing their practices was highest for the joint Master Farmer-FFS and pure Master Farmer graduates (Table 9). Compared to the control farmers, the Master Farmer and joint

Table 7. Farmer knowledge scores (0-100) by extension approach, southern Zimbabwe, 2001/02

| | MF | MF+FFS | FFS | PAE | Control |
|---|---|---|---|---|---|
| Soil conservation | 54.6 a | 65.3 a | 54.5 a | 77.3 b | 51.9 a |
| Rainwater harvesting | 64.2 a | 74.9 b | 74.7 b | 80.2 a | 49.7 a |
| Soil fertility improvement | 82.2 a | 82.5 a | 81.7 a | 89.3 a | 62.5 |
| Working together in groups | 45.2 a | 52.2 ab | 41.8 a | 61.5 ab | 37.7 a |

MF = Master Farmer, FFS = Farmer Field School, MF+FFS = farmers who participated in both programs, PAE = Participatory Agric. Extension
Numbers followed by the same letter are not statistically significantly different

Table 8. Knowledge acquired (% of farmers reporting) through different extension approaches, southern Zimbabwe, 2001/02

| | MF | FFS | PAE | All | Sig |
|---|---|---|---|---|---|
| General knowledge on livestock | 29 | 2 | 11 | 15 | 0.000 |
| General knowledge on crops | 25 | 17 | 22 | 21 | |
| New varieties and planting methods | 21 | 28 | 22 | 25 | |
| Soil and water conservation | 14 | 37 | 22 | 26 | |
| Soil fertility improvement | 8 | 15 | 16 | 12 | |
| Other (buildings, farm mgmt, marketing) | 3 | 1 | 8 | 3 | |

MF = Master Farmer, FFS = Farmer Field School, PAE = Participatory Agric. Extension

| Table 9. Change in farmer practice (% of farmers reporting) under different extension approaches | MF | MF+FFS | FFS | PAE | Control | Sig |
|---|---|---|---|---|---|---|
| % reporting they changed practices | 91 | 92 | 71 | 81 | 51 | ns |
| Area of change | | | | | | |
| Soil fertility | 36 | 25 | 42 | 28 | 27 | |
| Soil and water conservation | 33 | 40 | 38 | 72 | 45 | |
| New varieties and planting methods | 20 | 16 | 7 | 0 | 9 | |
| General knowledge on crops | 9 | 11 | 10 | 0 | 10 | |
| Other (buildings, farm mgmt, marketing) | 2 | 5 | 0 | 0 | 9 | |
| General knowledge on livestock | 0 | 3 | 4 | 0 | 0 | |

MF = Master Farmer, FFS = Farmer Field School, MF+FFS = farmers who participated in both programs, PAE = Participatory Agric. Extension

Master Farmer-FFS approaches make the largest impact on new varieties and planting methods, pure FFS on soil fertility, and PAE on soil and water conservation. These results must be interpreted with caution. Master Farmers explained that most of the changes they made were compulsory in order to graduate and obtain a certificate – which in turn meant they received priority in land resettlement, agricultural credit, extension, and input distribution programs. By contrast the changes under FFS and PAE were voluntary.

Multinomial logistic regression analysis was used to estimate the impact of alternative extension approaches on adoption of various technologies – soil and water conservation, soil fertility, new varieties, general crop and livestock management – controlling for factors including the household's access to labor and draft power (Table 10). The coefficients for the dummy variables for FFS and PAE are statistically significant for soil and water conservation, and for general crop and livestock management practices. Only the coefficient for the PAE dummy variable is statistically significant for new varieties and planting methods. Likewise only the coefficient for the FFS dummy is statistically significant for adoption of soil fertility technologies. This provides cumulative evidence that FFS are instrumental for improving farmers' soil fertility management practices.

When asked why they made changes in their farming practices, FFS and joint MF-FFS graduates reported they now understood the difference between the old and new practices. The new practices are easy to follow and implement, work well under some conditions, and are more profitable. PAE graduates explained they were primarily applying water conservation practices. Master Farmer graduates said they were following extension recommendations because the extension officer makes periodic checks, and farmers get punished if they are found not implementing recommended practices. Clearly, the greater impact of FFS on soil fertility practices is because learning-by-discovery and carrying out experimental trials gives farmers additional skills and confidence, and convinces them that the new technologies give high rates of return on investment. The likelihood of failure is also reduced because farmers have better skills and decision-making ability. The greater impact of PAE on soil and water conservation is that households are able to resolve labor constraints through collective action and labor-sharing work parties, facilitated by the PAE process.

### *Change in practice by extension agents and researchers*

Extension agents interviewed for this study were asked if they had made changes in their practices as a result of the extension approach they used. About 95% of extension staff involved in Master Farmer

Table 10. Multinomial logistic regression results of kind of changes in farmer practice under different extension approaches, southern Zimbabwe, 2001/02

| | Coefficient | Std Err | t | P>t |
|---|---|---|---|---|
| Soil and water conservation | | | | |
| dummy male | 0.542399 | 1.216883 | 0.45 | 0.6650 |
| dummy MF+FFS | 0.132456 | 1.089562 | 0.12 | 0.9060 |
| dummy FFS | 21.49876 | 0.924561 | 23.25 | 0.0000 |
| dummy PAE | 22.14644 | 1.358533 | 16.3 | 0.0000 |
| members working on crops | –0.10054 | 0.074219 | –1.35 | 0.2050 |
| draft cattle | 0.313522 | 0.189152 | 1.66 | 0.1280 |
| constant | 1.717338 | 0.504717 | 3.4 | 0.0070 |
| Soil fertility | | | | |
| dummy male | 1.070342 | 1.399082 | 0.77 | 0.4620 |
| dummy MF+FFS | 0.158438 | 1.221862 | 0.13 | 0.8990 |
| dummy FFS | 22.10835 | 0.62804 | 35.2 | 0.0000 |
| dummy PAE | 21.62638 | | | |
| members working on crops | –0.07564 | 0.121043 | –0.62 | 0.5460 |
| draft cattle | 0.329348 | 0.182198 | 1.81 | 0.1010 |
| constant | 1.0615 | 0.908109 | 1.17 | 0.2700 |
| New varieties and planting methods | | | | |
| dummy male | 1.663346 | 1.461556 | 1.14 | 0.2820 |
| dummy MF+FFS | 0.820901 | 1.324555 | 0.62 | 0.5490 |
| dummy FFS | 21.3921 | | | |
| dummy PAE | –8.22939 | 1.683441 | –4.89 | 0.0010 |
| members working on crops | –0.08152 | 0.073257 | –1.11 | 0.2920 |
| draft cattle | 0.334467 | 0.209104 | 1.6 | 0.1410 |
| constant | –0.07389 | 1.419156 | –0.05 | 0.9590 |
| General crops | | | | |
| dummy male | 0.88873 | 1.124595 | 0.79 | 0.4480 |
| dummy MF+FFS | 0.456793 | 0.748225 | 0.61 | 0.5550 |
| dummy FFS | 21.76226 | 0.906093 | 24.02 | 0.0000 |
| dummy PAE | –8.45539 | 1.299555 | –6.51 | 0.0000 |
| members working on crops | –0.01246 | 0.101476 | –0.12 | 0.9050 |
| draft cattle | 0.149445 | 0.181774 | 0.82 | 0.4300 |
| constant | 0.105951 | 0.722185 | 0.15 | 0.8860 |
| General livestock | | | | |
| dummy male | 21.5319 | | | |
| dummy MF+FFS | 23.34417 | 2.126604 | 10.98 | 0.0000 |
| dummy FFS | 44.6978 | 2.66645 | 16.76 | 0.0000 |
| dummy PAE | 14.50025 | 2.183418 | 6.64 | 0.0000 |
| members working on crops | 0.193173 | 0.21165 | 0.91 | 0.3830 |
| draft cattle | –0.21041 | 0.209694 | –1 | 0.3390 |
| constant | –24.217 | 2.626554 | –9.22 | 0.0000 |

MF = Master Farmer, FFS = Farmer Field School, MF+FFS = farmers who participated in both programs, PAE = Participatory Agric. Extension

and PAE training programs reported that they had changed their practices, compared to 70% for FFS. However, the differences were not statistically significant.

We also examined what kinds of changes were made in extension practice. FFS most often led to the following changes: more trials and demonstrations, getting farmers to do extension themselves, and using group discovery and group building methods (Table 11). PAE caused changes inducing extension

Table 11. Changes in extension practice under different extension approaches (% of responses), southern Zimbabwe, 2001/02

| | MF (n = 91) | FFS (n = 25) | PAE (n = 53) | All (n = 169) | Sig |
|---|---|---|---|---|---|
| Encouraging farmers to do extension | 9 | 12 | 9 | 10 | 0.000 |
| Facilitate not teach, learn from farmers' experience | 30 | 36 | 47 | 36 | |
| Extension in groups | 23 | 40 | 42 | 31 | |
| Trials/demonstrations increased | 9 | 12 | 2 | 7 | |
| Other (plow setting, planting methods, using harrow, cattle dosing, pests) | 30 | 0 | 0 | 16 | |

MF = Master Farmer, FFS = Farmer Field School, PAE = Participatory Agric. Extension

staff to become facilitators and not teachers, to learn from farmers' experiences, use a bottom-up approach, and use group extension. Master Farmer training led to changes in extension of general farm management messages such as farm budgeting, plow setting, planting methods, and livestock dosing.

### *Empowerment*

Farmers were asked whether, as a result of the trials, households in the area were better positioned to solve local agricultural problems on their own; and whether they were making new demands on extension agents and researchers. The difference in responses between Master Farmer, FFS, and PAE farmers was not statistically significant. But all three groups gave a significantly more positive response (ie, a higher proportion said 'yes') compared to control farmers (Table 12).

Farmers who reported that households were better positioned to resolve local problems argued that this was mostly because they now had new farming skills. After testing improved practices in the trials, farmers were now applying them on their own fields, and are able to carry on with implementation, and to teach each other, even without extension officers. They explained that participating households had improved yields and improved the probability of harvest despite low rainfall. If the season is good, farmers expect to sell surplus output and buy livestock. In contrast, farmers who felt that households had *not* yet been empowered indicated that most farmers did not have enough knowledge and were still learning. Other reasons were also cited for non-empowerment: rains have been unfavorable hence benefits are limited or not yet visible to everyone (although they note that benefits clearly exist); farmers are not well organized; farmers undermine each other and are reluctant to share knowledge.

But there were marked differences in new demands made on extension officers and researchers. Overall (all extension approaches) only 20% of the graduates reported making new demands on extension officers and researchers. But more than half of PAE graduates – and none of the control

Table 12. Farmer empowerment by extension approach, southern Zimbabwe, 2001/02

| | MF | MF + FFS | FFS | PAE | Control | Sig |
|---|---|---|---|---|---|---|
| No. of households | 91 | 92 | 71 | 81 | 51 | |
| % reporting better position to solve local agricultural problems on their own | 85 | 83 | 83 | 79 | 49 | 0.001 |
| % reporting making new demands on extension staff | 23 | 21 | 23 | 53 | 0 | 0.000 |

MF = Master Farmer, FFS = Farmer Field School, MF + FFS = farmers who participated in both programs, PAE = Participatory Agric. Extension group – said they made new demands. The increased demand from PAE households is because they have been trained in transformational leadership skills, which reduce dependency on donors and external support and increase self-reliance. Farmers who reported making demands explained that this was because they realized their knowledge was inadequate. They wanted to work with extension agents to carry out more trials and practice new techniques; so that they get seed of the best varieties and better access to complementary inputs to increase yields; farmers were now used to interacting with researchers and extension staff, and want to make maximum use of extension; they feel they have the right to make such demands. Farmers who reported *not* making demands gave several reasons: they did not know how to make demands and had no power; they were satisfied with the advice they were receiving; they did not often see researchers or extension staff; and they believed that it does not help because extension officers lack capacity to meet their demands.

Most of the demands were to redo variety trials; provide seed of drought-resistant varieties suitable for their area; provide crop management advice; improve seed and fertilizer supply systems; expand FFS, farmer-participatory trials and demonstrations; organize field days; provide study materials and farming magazines; make more individual visits to fields; and peg fields for construction of dead level contours.

Mirror interviews with field extension officers generally confirmed farmers' responses. Extension officers reported that PAE resulted in the greatest degree of farmer empowerment. More farmers were now applying to join, new groups were being formed, farmer-to-farmer visits were increasing, as was the sense of solidarity at farmer meetings. Farmers were willing to comply with the group rules and accept fines for transgressions, willing to organize input purchase and crop marketing in groups, and participate in field competitions and trials. Farmers were better able to identify their own problems and solutions and more self-reliant in planning and implementing their programs, acquiring loans, and more confident of carrying out farming operations. Farmers do not accept everything brought by extension agents; they can now demand extension services, select their own leader, organize their own meetings and field days, and liaise with other agencies and NGOs. Farmers do not accept top-down decisions; they were trying out new ideas; making better decisions on what crops and varieties would best suit their area; able to understand the value of maize open-pollinated varieties in addition to hybrids. There was better crop spacing, use of rain gauges, maintenance of dead level contours; better farm management and budgeting; better soil management, manure conservation, and field pegging – and thus improved yields and food security. Acting as a group, farmers were able to successfully market their crops and negotiate better prices.

### *Cost-effectiveness*

Because FFS are labor- and knowledge-intensive, they demand more time, skills, and training materials than traditional Master Farmer and PAE approaches. Consequently, FFS have lower throughput as measured by groups per extension officer per year. Because extension officers spend more time traveling and working per group, FFS have higher operating and salary costs per farmer. During the 2001/02 cropping season, total operating and salary costs for FFS led by government extension officers averaged US$17 per farmer, compared to $14 per farmer for PAE and $7 per farmer for the Master Farmer approach (Table 13).

The higher costs for extension-led FFS are mostly due to higher costs for travel, staff allowances, and stationery. Because travel and allowances constitute the largest share of the total, costs can be drastically reduced and effectiveness improved by establishing FFS led by farmers rather than

Table 13. Costs per farmer 'graduate' (US$) with different extension approaches, southern Zimbabwe, 2001/02

| | MF | Extension-led FFS | PAE | Farmer-led FFS |
|---|---|---|---|---|
| Transport mileage | 1.68 | 7.08 | 1.83 | 0.00 |
| Bus fare | 0.50 | 0.84 | 1.48 | 0.84 |
| Subsistence allowance | 2.02 | 4.03 | 5.85 | 0.00 |
| Stationery | 0.29 | 1.49 | 1.10 | 1.49 |
| Training aids | 0.55 | 0.66 | 0.72 | 0.66 |
| Training materials | 0.56 | 1.00 | 0.93 | 1.00 |
| Operating costs per farmer | 5.60 | 15.11 | 11.90 | 3.99 |
| Salary costs per farmer | 1.41 | 2.10 | 2.01 | 2.10 |
| Total costs per farmer | 7.01 | 17.20 | 13.90 | 6.09 |

MF = Master Farmer, FFS = Farmer Field School, PAE = Participatory Agric. Extension

government extension officers. Focus group discussion and interviews with key informants suggested that the costs of farmer-led FFS are 65% lower, at around US$6 per farmer; and that quality of training also improves.

### *Comparative advantage*

Field extension officers report that FFS are most effective when farmers are not convinced that a new technology, being promoted by extension, will work under their conditions. By encouraging farmers to experiment and discover on their own, technology adoption is faster and more lasting. FFS are also highly effective in improving decision-making skills for day-to-day crop management in response to changes in rainfall or prices; and making manure and fertilizer use more efficient. Master Farmer training is best suited for disseminating information on basic farming practices, particularly to well-resourced, literate households capable of investing in crop and livestock production. The Master Farmer approach is also superior when extension officers have adequate resources for training (teaching aids, training materials, financial support), extension agents can make individual field visits to some farmers, and when farmer participation is encouraged by incentives such as seeds, fertilizer, and training certificates. The PAE approach is best suited in situations where equity is an issue (eg land resettlement), partly because it engages the whole community in all stages of project design and implementation. PAE is also superior for spreading new innovations being developed by a few farmers, for conducting training-for-transformation and group building, for farmer empowerment. Extension agents argued that AREX should adopt PAE as the primary extension approach, and all department staff should receive training for implementing PAE methods.

## Sustaining and institutionalizing FFS

So far, FFS and PAE pilot programs have been mostly donor funded. But support from donors and the private sector is declining – raising the question of how FFS can be sustained and scaled out. The government's extension budget is declining in real terms, and extension agents are unable to operate effectively. Poor salaries and working conditions are resulting in declining staff morale, loss of staff to NGOs and the private sector, and loss of community respect. There also have been substantial staff losses due to AIDS deaths. Yet demand for extension services is growing rapidly, especially to serve newly resettled farmers. How can AREX expand FFS in order to meet demand and generate more impact with dwindling resources?

Focus group discussions and farmer and extension interviews showed that there are three points of leverage. The first is reallocating the national extension budget at provincial level to directly support FFS. AREX recognizes FFS as one of the main extension approaches for smallholders, but performance appraisals for field extension officers emphasize Master Farmer Training. A key objective for each field officer is “to recruit 100 Ordinary Master Farmers at the beginning of the year and continue to provide effective training services to old trainees by slavishly adhering to the AGRITEX Master Farmer Curriculum throughout the year” (AGRITEX 2001). Extension officers suggested in interviews that the Master Farmer approach needs to be revamped to make it more farmer-driven, permit farmers to choose their syllabus and how they want to be trained, assess the performance of old graduates and new trainees, and improve its relevance to farmer needs. Provincial budgets are now activity and performance-based. Consequently FFS, which are bottom-up, can be supported by allocating most of the funds to extension, not to administrative and regulatory duties. But travel and allowances constitute the major share of costs and the requirements far exceed available funds. Integrating FFS in the Master Farmer training scheme will help exploit complementarities and simultaneously reduce travel and allowance costs.

The second point of leverage is expansion of farmer-led FFS and community-based PAE groups. FFS graduates reported that with a few exceptions, most graduates are willing to share information with other farmers and facilitate the formation of more FFS in their communities if given financial support to procure seeds and fertilizers, and to pay allowances to farmer facilitators for travel expenses and maintenance of their bicycles. Investments are also required to train farmers on how to share knowledge most effectively, to start new FFS groups, to strengthen farmer groups and make them financially viable and self-sustaining.

The third area of leverage is targeting investments by NGOs and agribusiness firms to complement public investments. AREX has a limited budget and requires additional resources to scale out FFS and other innovative extension methods. Funding from NGOs and the private sector (channeling their investments to better complement government spending) can significantly assist in the process of scaling out.

## Conclusions and Recommendations

Public and private sector investments in agricultural research and extension in Zimbabwe in the past 50 years have resulted in the development of improved varieties and crop management technologies that can greatly increase yields and improve welfare in smallholder farming areas. Smallholders have widely adopted improved varieties, but have been slow to adopt improved crop management practices. Consequently, average yields remain low, per capita food production and farm incomes are declining, and food security is worsening. Many analysts have argued that farmers are not adopting improved crop management practices because of information and market constraints. AREX and ICRISAT pilot-tested the efficiency and cost-effective of the FFS approach to resolve these constraints. FFS were compared with the traditional Master Farmer and PAE approaches.

We compared the impact of each approach on adoption of improved soil water and nutrient management technologies. Impact was measured using a number of indicators including improved farmer knowledge, change in farmer practice or extension practice, degree of farmer empowerment, and cost-effectiveness. Results show that FFS training had a positive impact. FFS graduates have better knowledge (higher scores in a knowledge test) of rainwater harvesting and soil fertility management, compared to non-FFS farmers. They also have higher adoption rates of improved soil fertility management practices and higher average yields: 5% higher for sorghum, 32% higher for maize.

FFS graduates interviewed in this study indeed expressed their strong preference for FFS over the traditional Master Farmer training and group approaches. They cited various reasons for this preference. FFS increase knowledge sharing through farmers visiting each other's fields and evaluating whether or not to apply in their own fields what they learn in FFS plots. Learning-by-doing develops farmers' confidence to apply the techniques on their own fields. The main role of government extension officers is to facilitate rather than to teach – farmers decide almost everything themselves, including the curriculum; no decisions are imposed on them. Observing crops through the season as a group builds the confidence of individual farmers to solve farming problems and eventually apply the knowledge in their main fields. The FFS approach promotes farmer-farmer and farmer-extension interaction. Farmers contribute feedback and suggestions as a group and therefore nobody feels inferior or superior. The FFS concept makes farmers feel what they do is theirs, and they do it themselves and for their own benefit. Even illiterate and elderly farmers are capable of doing practical work, although they may struggle with theory. Field days and trials help promote adoption of yield-enhancing technologies even in low-rainfall areas. FFS build group cohesion and sharing of responsibilities. There is no time for witchcraft.

The study makes three recommendations:

- Restructure the Master Farmer approach and integrate it with the FFS approach
- Expand investments for the development of farmer-led FFS
- Target investments by NGOs and agribusiness firms to complement public investments in FFS.

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## About ICRISAT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political, international organization for science-based agricultural development. ICRISAT conducts research on sorghum, pearl millet, chickpea, pigeonpea and groundnut – crops that support the livelihoods of the poorest of the poor in the semi-arid tropics encompassing 48 countries. ICRISAT also shares information and knowledge through capacity building, publications and ICTs. Established in 1972, it is one of 15 Centers supported by the Consultative Group on International Agricultural Research (CGIAR).

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674-2004