FARMING SYSTEM RESEARCH

PROGRESS AND CHALLENGES

Mulugetta Mekuria
Steven Fransson
Hailu Beyene

WORKING PAPER NO. 8

INSTITUTE OF AGRICULTURAL RESEARCH
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FARMING SYSTEMS RESEARCH
IN THE INSTITUTE OF AGRICULTURAL RESEARCH:
PROGRESS AND CHALLENGES

MULUGETTA MEKURIA
HEAD, DEPARTMENT OF AGRICULTURAL ECONOMICS (ON STUDY LEAVE)
INSTITUTE OF AGRICULTURAL RESEARCH

STEVEN FRANZEL
FARMING SYSTEMS ADVISER
INSTITUTE OF AGRICULTURAL RESEARCH

HAILU BEYENE
ACTING HEAD, DEPARTMENT OF AGRICULTURAL ECONOMICS
INSTITUTE OF AGRICULTURAL RESEARCH

WORKING PAPER NO. 8
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PREFACE

This publication is the eighth of the Working Paper Series of the Institute of Agricultural Research. Working papers are designed to present findings of the different research activities carried out by the IAR staff. Working papers are made available in limited numbers for comments and discussion and to inform interested colleagues about research in progress.

This working paper is a revised and updated edition of Working Paper No. 3, Farming systems research in the Institute of Agricultural Research: evolution, impact and issues. It describes the development of farming systems research (FSR) in the IAR and the results achieved thusfar. The institutionalization of the FSR approach as an integral part of the national agricultural research service has been very encouraging. As there is a need to further refine the FSR approach to suit IAR's needs, the final section of the paper addresses some of the relevant issues that have come up as the program has developed.

The Institute would welcome any comments and suggestions on the report; they should be directed to the authors.

Seme Debela
General Manager
SUMMARY

The objective of this paper is to examine the experience of the Institute of Agricultural Research in implementing farming systems research (FSR) and to propose recommendations for the future.

On-farm research activities began in IAR in 1977, when multidisciplinary surveys were conducted and improved packages were tested around several research centers. Recommendations were evaluated from farmers' point of view and packages were modified to make them more feasible for farmers.

The first diagnostic surveys (informal and formal surveys to describe farming systems and plan experimentation) and on-farm trials were initiated in 1984 at Bako and Nazret. Survey results were used to plan on-farm and on-station experiments. Based on the results, IAR decided to extend the program to other research centers. By 1989, 24 surveys had been completed by staff at 7 research centers. During 1988, researchers from 8 centers conducted 39 on-farm trials on 255 sites.

Researchers from many different disciplines participate in the FSR activities. Most surveys are led by economists from the Department of Agricultural Economics (DAE), with staff from other departments participating. Of the on-farm trials, about two-thirds are verification trials conducted by DAE and about one-third are exploratory or determinative trials conducted by the Department of Agronomy and Crop Physiology and other departments.

Initial results and their impact are presented from three research centers. For example, at Nazret Research Center, in a semi-arid zone, quelea bird attack on sorghum was identified as a priority problem by the team conducting the survey. In collaboration with the sorghum team, on-farm variety trials were conducted to screen sorghum varieties less susceptible to birds. In 1987, the variety most appreciated by farmers was approved for release.

At the Bako Research Center, previous to the diagnostic survey, maize breeders focussed on developing late-maturing varieties to take advantage of the available rainfall. The survey pointed to the important role that an early-maturing variety could play, by providing food for the family during the period of acute food shortage just before the main maize harvest. In 1988, the best performing early-maturing variety was approved for release. Farmers use the variety for early food; in addition some farmers are using it for double cropping (maize followed by tef) or for late planting.

In the Holetta zone, staff are testing the oxen-drawn broad bed and furrow maker, which facilitates drainage and allows
farmers to plant earlier on Vertisols. Economists work closely with the Highland Pulse team to identify farmers' problems and conduct on-farm trials.

The impact of FSR in the IAR has been in several areas. First, interdisciplinary diagnostic surveys provide center researchers with information on farmers' problems and ways to address these problems. Second, DAE verifies the recommendations of the center scientists in on-farm verification trials and evaluates these recommendations from the farmer's viewpoint. Third, DAE researchers provide feedback from verification trials to center scientists concerning the performance of recommended technologies as well as related problems that arise. Fourth, economists conduct economic analysis of agronomic data to formulate farmer recommendations. Fifth, DACP and scientists from other departments conduct determinative trials on farmers' fields. Sixth, special surveys provide policy makers and researchers with information and recommendations concerning such topics as marketing systems, agricultural implements, and consumer preferences for different varieties.

The most important impact concerns the information and feedback provided to center scientists in formulating their own programs. In general, IAR scientists understand the role of diagnostic surveys and on-farm trials and use information from them in planning their research programs and experiments. In recent years, IAR's research has become more farmer-oriented, that is, more focused on farmer problems, and on solving those problems in ways acceptable and feasible for farmers. We feel that much of the change in approach has come about as a result of the adoption of the FSR approach.

Several issues concerning the institutionalization of FSR in IAR have arisen. Linkages among departments in conducting surveys and on-farm trials have been strengthened through several means, ranging from informal contacts between scientists to formal memoranda of collaboration between departments. IAR management has delineated responsibilities in on-farm experimentation; DAE conducts verification trials and other departments conduct exploratory and determinative trials. It was initially thought that FSR activities should be conducted within a single multidisciplinary department. However, it was later found that FSR activities could be effectively conducted by researchers from several departments.

Several issues concerning FSR need to be addressed in the near future. First, clear procedures are needed for formulating research recommendations. Second, the role of the department head of DAE in the commodity team approach needs to be clarified. Third, linkages should be established between IAR and MOA for the collaborative implementation of surveys and on-farm trials.
Farming Systems Research in the Institute of Agricultural Research: Challenges and Issues

Mulugetta Mekuria
Steven Franzel
Hailu Beyene

In many developing countries it has become apparent that the generation of new technology alone has not provided solutions for helping poor farmers increase agricultural productivity and achieve higher standards of living. Despite the efforts of national and international development organizations, the problem of technology adoption and hence low agricultural productivity is still a major concern.

Today there is a significant change in the attitude of the scientific community towards small farmers and their problems. Whereas researchers in past years tended to focus only on technical relationships in developing technologies, they are now incorporating an understanding of farmers' circumstances in their approach. The problem of low rates of technology adoption by small farmers is partly attributed to the researchers' lack of understanding of the farmers' problems and the conditions under which they operate (Fresco 1984). New perceptions of the small farm situation have resulted in the development of the farming systems research (FSR) approach. The term FSR has been applied to a broad range of activities. In this paper, we use FSR in the following sense (Byerlee et al. 1982).

1. FSR aims to generate technology to increase resource productivity.

2. FSR is conceptually based on a systems perspective, that is, a view of the farm in a holistic manner and considering interactions in the system.

3. Much of the diagnosis of problems and testing of solutions involves farmers and takes place on farmers' fields.

The objective of this paper is to examine the experience of the Institute of Agricultural Research (IAR) in implementing farming systems research and to discuss selected issues concerning how the FSR approach can be used to contribute to IAR's research program. The following sections describe the evolution of FSR in the IAR and present initial results and their implications, focusing on three IAR research centers. Finally, we present several critical issues which IAR is addressing concerning the refinement of the approach and its institutionalization in Ethiopia.

This paper is adapted, with revisions, from Mulugetta and Franzel 1987. The authors are grateful to Ann Stroud and Roger Kirkby for reviewing a draft of this paper.
1. EVOLUTION OF FSR IN THE INSTITUTE OF AGRICULTURAL RESEARCH

The history of FSR in Ethiopia dates back to 1976/77, when the Department of Socioeconomics and Farm Management Studies (renamed the Department of Agricultural Economics and Farming Systems Research in 1986 and the Department of Agricultural Economics (DAE) in 1989) initiated demonstration programs around Holetta and Bako research centers. The objective of the programs was to demonstrate available recommendations from the research centers to the nearby farming community. It was soon realized that the recommendations gave no superior results over the traditional practices and farmers were justifiably reluctant to accept the recommendations.

Two lessons were learned from this exercise. First, the need to study why farmers do not adopt what the scientists recommended for them was considered crucial to chart future research strategies. Second, it was evident that researchers' knowledge and understanding of the peasant farmers and their circumstances was far from complete. With these rationales the department initiated multidisciplinary surveys and package testing programs.

Multidisciplinary Farming Systems Surveys and Package Testing

The first multidisciplinary survey was different from the conventional farm management survey in that it emphasized the identification of farmers' problems as perceived by farmers. It was launched in the Holetta (Central Zone) and Bako (Western Zone) Farming System Zones in 1977/78 and was later extended to Nazret (Central Zone) in 1979/80.

These surveys helped to fill the gap in the understanding of the systems. Information on resource utilization and allocation was collected. Major production constraints were identified. Farmers' assessment of available technologies was evaluated. The feedback to the disciplinary and commodity researchers was also valuable.

Preliminary analysis of the surveys indicated the need for testing available technological packages under farmers' management levels and for evaluating the farmers' assessment of the packages to get the necessary feedback. Accelerating the interaction of researchers, farmers and extensionists to understand the farming system was also found imperative.

The multidisciplinary surveys were used to plan "package testing," that is, the testing of appropriate packages of innovations on farmers' fields near the research centers and sub-centers. The packages of innovations developed included improved varieties, recommended cultural practices, and fertilizer types and rates for each major crop. The packages were planted on areas of 0.5 ha to 1 ha on selected farms.
The package testing program was conducted on the farms of individual producers, producer cooperatives, and peasant associations. Farmers provided land, labor, and purchased inputs, such as fertilizers. Improved varieties and technical advice were provided by the research center staff.

From the packages developed at the research centers and tested on farmers' fields, some innovations have been adopted by farmers. However, in some areas, technologies tested were not accepted by farmers, although they had shown good performance in the research centers. The lessons learned were first to modify the surveys to make them more interdisciplinary in order to focus more directly on farmer problems and opportunities. Hence, the diagnostic survey techniques were found appropriate. Second, the need was recognized to go beyond testing already developed packages to developing technologies on farmers' fields with greater farmer participation.

Diagnostic Surveys and On-Farm Experiments

Diagnostic surveys to describe the different farming systems found around the research centers and sub-centers were initiated in 1984. The informal surveys are conducted with the involvement of social and biological scientists and local extension personnel of the Ministry of Agriculture (MOA). Through farmer interviews and secondary data, information is collected on the natural and biological circumstances of the areas, farmer problems, enterprise patterns, and resource use. Staff of varied disciplines who participate in the field work coauthor the informal survey reports. The reports include a list of proposed experiments, both on-farm and on-station, that address the farmers' problems. Formal surveys to quantify and verify the informal survey findings are then conducted. Survey reports are published in an IAR report series and are distributed to research scientists.

DAE staff begin their work at a research center by conducting an informal survey in collaboration with other center researchers. Following this survey, there are no specific rules on the kinds of surveys that should be conducted; rather, DAE staff make the decision in collaboration with the center manager and staff. For example, some centers focus on informal surveys, others do informal surveys followed by formal ones. After completing a cycle of an informal and formal survey in a specific area, some teams conduct a special survey on a particular topic.

1 Informal surveys (also called rapid reconnaissance surveys) are field studies in which informal farmer interviews and direct observation are used to develop an understanding of farming systems and to plan experimentation (Farming Systems Support Project 1986). A formal survey is a survey of randomly chosen farmers who are interviewed using a written questionnaire in order to provide quantitative data on farmer circumstances (Byerlee and Collinson 1980).
(e.g., marketing or management of a specific crop) whereas others conduct informal and formal surveys in new areas.

As a result of the findings of the diagnostic surveys, different types of on-station and on-farm experiments on crop varieties, fertilizers and other management practices have been initiated. The experiments vary according to the nature of the problems and the potential of the experiments to give immediate impact. Because of these considerations, the experiments are either exploratory, determinative or verification type and have varied degrees of farmer involvement. In general, DAE conducts verification trials whereas the other departments manage exploratory and determinative trials. Most trials are researcher-designed and farmer-managed, that is, researchers design the trials in consultation with farmers and the farmers are responsible for carrying out the field operations.

Proposals for new experiments are reviewed at annual meetings attended by all center researchers. At these meetings, participants discuss the relevance of proposed experiments to farmers' problems and circumstances; the survey results and the opinions of staff participating in the surveys often play an important role in the discussions.

The diagnostic surveys and OFEs started in the 1984/85 crop season at two research centers, Bako and Nazret, with an International Development Research Center (IDRC) grant for an FSR project. In 1985/86 the program was extended to Holetta and Awasa (Southern Zone) and in 1986/87 to three additional centers (Adet, Sinana and Jima) in the Northwestern, Southeastern and Western Zones.

As of September 1989, the DAE has programs at seven major research centers. The staff consists exclusively of agricultural economists: 1 expatriate adviser, 1 research officer (M.Sc. level) 11 assistant research officers (B.Sc. level) and 9 technical assistants. Three staff members are currently in post-graduate training. Economists and agronomists from the International Maize and Wheat Improvement Center (CIMMYT) and the International Center for Tropical Agriculture (CIAT) provide technical assistance.

1 Exploratory trials are trials which test a number of variables, in order to better define and characterize a production problem. In determinative trials, possible solutions to the problem are tested; these trials usually include less variables, each at more levels, than exploratory trials. In verification trials, the results of the determinative trials are verified on larger plots and across a greater number of sites.
The number of surveys and on-farm trials conducted at each center is shown in Tables 1 and 2. As of September 1983, 14 informal surveys and 4 formal surveys have been completed and written reports on these surveys are available. Another 4 informal and 3 formal surveys were currently underway. In addition, 6 special surveys have been completed, on such topics as marketing systems, labor use, and consumer taste preferences. Another 11 are underway. The number of on-farm trials grew from 7 trials at 33 sites in 1984 to 39 trials at 265 sites in 1988. The percentage of trials managed by departments other than DAE, has increased from 0 in 1984 to 35% in 1988. This reflects the growing interest in on-farm trials within the commodity/disciplinary departments, particularly the Department of Agronomy and Crop Physiology (DACP).

2. INITIAL RESULTS AND IMPLICATIONS

The impact of the FSR program on IAR’s other research programs and on farmers is discussed below. Results are presented from three zones where both diagnostic surveys and on-farm experiments have been in progress for the last four years.

Nazret Mixed Farming Systems Zone

This zone is a semi-arid area in the Rift Valley at an altitude of 1400-1600 m characterized by low and erratic rainfall (600-800 mm per year). The topography is mainly flat with small hills, and the soils are brown, clay loam and sandy with low organic matter. Major enterprises include maize, tef (Eragrostis tef), sorghum and haricot beans (Phaseolus vulgaris), which are produced for consumption and as a source of cash. Livestock are a source of draft power and can be sold during times of crop failure. The average arable land holding per family is about 2.6 ha and family size averages 5 persons. The average number of oxen per family is 1.6; they are used for land preparation and cultivation (Tilahun and Teshome 1987).

Major constraints identified in the diagnostic survey included (1) the erratic nature of the rainfall causing moisture stress problems on maize, and (2) quelea bird attack on sorghum. Research results on early-maturing varieties of sorghum and maize and soil and water conservation practices were identified as available and possible solutions to the constraints.

Previous to the survey, research on new sorghum varieties emphasized varieties that were early-maturing, high-yielding, and high in nutritional quality. But the selected varieties were highly susceptible to bird attacks; the sorghum researchers expected the farmers to guard against birds. The diagnostic survey found that intensive guarding was neither acceptable nor feasible for farmers in the area.
Table 1: Surveys conducted in the Institute of Agricultural Research

<table>
<thead>
<tr>
<th>Survey Location</th>
<th>Informal Current completed</th>
<th>Informal Current completed</th>
<th>Formal Current completed</th>
<th>Formal Current completed</th>
<th>Special Surveys* Current completed</th>
<th>Special Surveys* Current completed</th>
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<td>0</td>
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<td>0</td>
<td>1</td>
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<td>1</td>
</tr>
<tr>
<td>Awasa</td>
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<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Adet</td>
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<td>1</td>
<td>1</td>
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<tr>
<td>Jima</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
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<td>14</td>
<td>3</td>
<td>4</td>
<td>11</td>
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* These include surveys of market systems, labor use, consumer taste preferences, agricultural implements, and adoption of new technologies.

Table 2: On-farm trials conducted in the Institute of Agricultural Research

<table>
<thead>
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<th>Survey Location</th>
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</tr>
<tr>
<td>Holetta</td>
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<td>0</td>
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<td>Awasa</td>
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<td>4</td>
</tr>
<tr>
<td>Jima</td>
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</tr>
<tr>
<td>Sinana</td>
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</tr>
<tr>
<td>Adet</td>
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</tr>
<tr>
<td>Kulumsa</td>
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</tr>
<tr>
<td>Total</td>
<td>7</td>
<td>33</td>
<td>24</td>
</tr>
</tbody>
</table>

% of trials managed by:
- DAE: 100% 88% 65%
- Other departments: 0 12% 35%


As a result, on-farm variety trials on early-maturing, bird-tolerant sorghums were carried out from 1964 through 1986 with the active participation of sorghum breeders and farmers. Farmers contributed to the assessment in terms of taste, color, height preference and tolerance to bird attacks of the varieties tested. Twenty-two varieties were tested on farmers' fields in 1984; of these, five were selected for testing in 1985 and 1986. In 1987, Seredo, the variety most appreciated by farmers for its low susceptibility to bird damage, its early maturity, and its yield and economic performance, was approved for release (Yilma 1987). Distribution of seed to farmers began in 1988.

Early-maturing maize varieties that avoid moisture stress were also tested by the DAE with the objective of replacing a recently introduced early-maturing variety, Katumani, which has a high level of acceptance in the area. Katumani is replacing the farmer's long-cycle maize cultivars which have had recurrent crop failures due to the changing weather pattern. Following two years of testing, with the collaboration of the maize improvement program, the DAE has identified an early-maturing variety that is preferred by farmers and that significantly out-yields Katumani. The variety's performance is being reviewed by the National Variety Release Committee.

On-station experiments indicated that the tied-ridge system proved to be effective in the conservation of available soil moisture and was recommended for on-farm testing. The three year on-farm testing data revealed that the practice required excessive labor input which the farmer was not able to provide. This feedback is being used by small farm implements researchers to develop appropriate tools for tied-ridging.

Feedback from surveys and on-farm haricot bean trials is also leading to new research thrusts and modifications of current recommendations. Surveys showed that the period of bean weeding overlaps with the farmers' busiest period; on-farm trials showed that farmers use high seed rates and broadcast seed in order to suppress weeds. Thus, agronomists have initiated experiments exploring the relationship between variety, seed rate, spacing and weeding requirements in order to propose new recommended varieties, seed rates, and spacing which have the dual objectives of high yield and low weeding requirements. Recommended seed rates have been adjusted upwards reflecting the effectiveness of high seed rates in suppressing weeds.

**Bako Mixed Farming Systems Zone**

The Bako zone is at an altitude of 1500 to 2000 m and receives 1200 mm of rainfall, most of which falls from May to September. The topography is undulating and Nitosols predominate. Major crops are maize, tef, noug (Guizotia abyssinica), and pepper (Capsicum spp.) and average cultivated area in 1985 was 1.5 ha per family. Maize is the primary food staple and most important crop in the system. Two-thirds of the
farmers own one or more oxen, which are used for land preparation and cultivation (Legesse, et al. 1987).

Two examples of the most important problems affecting farmers as identified in the diagnostic survey, and the responses of DAE and the research center, are as follows:

1. **Family food shortages, June through August, before the maize harvest.** Previous to the diagnostic survey, maize improvement focused exclusively on the development of late-maturing varieties to take full advantage of the long rainy season. The survey pointed to the important role that an early maturing variety could play, by providing food for the family during the period of acute food shortage. Testing of early-maturing varieties on farmers' fields began in 1986 with close collaboration of the maize improvement program. In 1988, the best performing early-maturing variety, Guto, was released (Benti 1988). In a "farmer-designed" trial beginning in 1988, researchers distributed Guto seed to farmers and monitored their use of it. Nearly all of the farmers replanted the seed in 1989; aside from using it for early food, some farmers used it for doublecropping (maize followed by tef) while others used it for late plantings.

2. **Dry season feed shortage for livestock.** DAE staff, in collaboration with the Animal Feed and Nutrition Division, are testing the intercropping of permanent fodder legumes into maize on farmers' fields. Results show that the fodder intercrops have no negative effect on maize yields and that establishment of two of the forage species, Desmodium uncinatum and Rhodes grass (*Chloris gayana*) is satisfactory.

DAE is addressing other farmer problems, in collaboration with other departments at Bako Research Center. These include:

1. **Weed control problems.** Researchers have compared the center's weed control recommendation for maize, two handweedicings, with farmers' weeding practice, which involves hoeing, oxen cultivation, handweeding and slashing. There were no significant differences in yields between the two practices. Farmers strongly preferred their own practice, since this required lower labor inputs during peak periods than the center's recommended practice. Future work on weeds will thus be based on seeking improvements in weed control that are more effective and at the same time compatible with the farming system.

2. **Low soil fertility.** Here, researchers are evaluating the economic response of maize yields to nitrogen and phosphate under farmer conditions. Non-experimental variables are fixed at farmers' levels. Whereas the center's recommendation for maize is 75/75 kg of N/P_{2}O_{5} per ha., the on-farm experiments have shown 41/46"to be economically optimal for farmers in the recommendation domain around the center.
3. Marketing problems. A study of the agricultural marketing system in the Bako zone was initiated to identify marketing problems and propose solutions. Researchers collected market prices and interviewed traders, consumers, transporters, local administrators, and other participants in the marketing system. A farmer survey was conducted to better understand farmer marketing decisions and practices. The principal audience for the study is policy makers; there is also important information for IAR researchers concerning such topics as consumer preferences and storage practices and problems.

4. Poor performance of local sorghum varieties. Researchers are evaluating the performance of improved sorghum varieties under high and low systems of management, to evaluate their performance as compared to local varieties.

Holetta Mixed Farming System Zone

The Holetta area has a sloping topography with an altitude of 2200-2500 m and receives an annual average rainfall of 1086 mm (1969-1987). The main rainy season is from June to September when more than 70% of the rain falls. The mean maximum and minimum temperature are 21.5 degrees Centigrade and 5.9 degrees Centigrade respectively. There are about 48 days with early morning frost between October and March. The soils are Mollisols, Nitosols and Vertisols.

There are two target groups of farmers in the area; delineations are based on soil type and crops grown. The first target group includes farmers who grow tef, bread wheat, barley and faba bean on red soils; the second target group consists of farmers who grow tef, durum wheat, noug, chickpeas and rough pea (Lathyrus sativus) on black soils. The average arable land holding per family is 2.6 ha while the average number of oxen per family is 1.8 (Hailu and Mohammed 1986).

The major crop production constraints identified in the diagnostic survey include (1) waterlogging in the Vertisols, and (2) pests and diseases such as aphids, chocolate spot and rust on faba bean and field peas. To overcome the drainage problem farmers practice late planting of durum wheat, chickpea, and rough pea. DAE in collaboration with the International Livestock Center for Africa (ILCA), initiated an on-farm trial testing the broad bed and furrows (BBF) system, which facilitates drainage and allows early planting of bread wheat. The BBF maker is drawn by draft oxen and is used to make furrows and cover the broadcast seed and fertilizer. This resulted in a yield increment of 170% for bread wheat. However, farmers complained that the implement was too heavy for the oxen; ILCA is working on the implement.

For technology generation on farmers' fields there is a joint activity on faba bean agronomy by the DAE and highland pulse team at Holetta. The DAE is responsible for identification
of farmers' problems while the highland pulse team is responsible for studying the effects of agronomic practices on yield. The major factors under investigation are variety, sowing date, fertilizer and weed control. The agronomist in the team studies the biological aspects of the experiment while the economist evaluates the economic advantage and resource compatibility.

In addition the team visits the experiments on farmers' fields to evaluate the performance of each factor and combination of factors. Extension agents, farmers and team members interact through field days and field visits. This arrangement gives a good opportunity for the team members to understand the reaction of farmers to the new technologies.

Summary of Impact

In summary, the impact of FSR in the IAR has been in several areas: (1) Diagnostic surveys provide center researchers with information on farmers' problems and ways to address these problems. (2) DAE verifies the recommendations of the center scientists in on-farm verification trials and evaluates these recommendations from the farmer's viewpoint. (3) DAE researchers provide feedback from verification trials to center scientists concerning the performance of recommended technologies as well as related problems that arise. (4) Economists conduct economic analysis of agronomic data to formulate farmer recommendations. (5) DACP and scientists from other departments conduct determinative trials on farmers' fields. (6) Special surveys provide policy makers and researchers with information and recommendations concerning such topics as marketing systems and consumer preferences for different varieties.

The most important impact concerns the information and feedback provided to center scientists in formulating their own programs. In general, IAR scientists understand the role of diagnostic surveys and on-farm trials and use information from them in planning their research programs and experiments. In recent years, the research of IAR scientists has become more farmer-oriented, that is, more focused on farmer problems, and on solving those problems in ways acceptable and feasible for farmers. We feel that much of the change in approach has come about as a result of the adoption of FSR concepts and procedures.

Whereas the FSR approach entered IAR through the DAE, it can now be said to have been adopted by the institute as a whole.
3. ISSUES

Several issues concerning the institutionalization of farming systems research in IAR have arisen as the program has expanded. The first four issues have been addressed by IAR management. Issues 5 through 8 are ones which the institute should address in the near future.

1. Linkages Between DAE and Other Departments

The effectiveness of linkages between DAE and technical component research (TCR) depends on the understanding of the basic principles of FSR by leaders of TCR teams. Some TCR team leaders and department heads understand the need to base their research and recommendations on diagnostic survey results; in this case the linkage between DAE and TCR is strong and more relevant technologies are being developed for specific farmer target groups. On the other hand, some TCR team leaders and department heads still insist that packages designed to maximize yield on station be recommended to farmers regardless of farmers’ circumstances. In such cases there is a very weak linkage between DAE and TCR and on-farm trials serve the same purpose as multilocalational testing.

Much progress has been made in the area of collaboration between DAE and other departments in conducting surveys and on-farm trials. The progress is the result of activities at seven different levels.

a. The General Manager is directly addressing the issue of the importance of interdepartmental collaboration in workshops and meetings with staff. In 1988, IAR management issued guidelines on on-farm experimentation explaining the roles of different departments in conducting on-farm trials (IAR, 1988, Guidelines for on-farm experiments, unpublished).

b. Research center managers are insisting that scientists work together in diagnosing problems and implementing on-farm trials.

c. Exchanges between the DAE head and other department heads and center managers are important in bringing about collaboration.

d. IAR has adopted a formal memorandum of collaboration detailing the responsibilities of economists and agronomists conducting different types of surveys and on-farm trials (IAR, 1988, Mode of collaboration between Department of Agronomy and Crop Physiology and Department of Agricultural Economics, unpublished). The document was drawn up by the heads of the DAE and the DACP and was approved by IAR management. The memorandum has helped increase collaborative work between agronomists and economists.
e. Individual scientists from different departments at a center develop close working relationships and collaborate on surveys and trials.

f. Expatriates from international organizations working with DAE and other departments promote interaction between the two departments.

2. Members of Other Disciplines in DAE

From 1984 to 1988, two of the seven DAE divisions had agronomists. Having a full-time agronomist on the team ensured that agronomic considerations were taken into account at all stages: diagnosing farmer problems and designing, implementing, and evaluating the results of on-farm experiments. Moreover, the agronomist in DAE was in a better position technically than the economist to communicate with staff of other departments. However, there were three disadvantages; including agronomists in the department (1) may have served to drive a wedge between DACP and DAE, leading to wasteful overlapping of activities; (2) weakened DACP, which was short of staff itself, and (3) isolated the DAE agronomists from DACP, which affected their morale.

Our experience at IAR is that it is not necessary that a multidisciplinary FSR team be stationed within DAE. Strong collaboration between departments has permitted agronomists, livestock scientists and other researchers to work closely with DAE economists in surveys and on-farm experiments. The above-mentioned memorandum of collaboration between DACP and DAE details the responsibilities of staff of the two departments in conducting different types of surveys and on-farm trials. Whereas inclusion of agronomists in DAE in the initial years of the program was important to ensure interdisciplinary interaction, inclusion is no longer required. Thus in 1988, the two agronomists in DAE were transferred to DACP.

In summary, it is not necessary that a range of disciplines be housed within DAE for effective interdisciplinary work to take place. Strong interdisciplinary collaboration can be established by building effective working relationships among departments.

3. The Division of Labor Between DAE and Other Departments

Previously, DAE was conducting trials to address whatever problems were identified in surveys. The advantage of this approach was that the department had a free rein in conducting experiments; the disadvantages were that commodity/disciplinary researchers might not be involved in a DAE trial which concerned their field. Moreover, in a few cases there was even a wasteful duplication of effort. Current policy is that DAE conduct only verification trials; DAE also collaborates with other departments conducting other types of on-farm trials.
This policy serves to strengthen linkages between DAE and other departments. For example, if a DAE survey indicates that weeds are the principal constraint and no technologies to solve the problem are available, DAE staff must collaborate with the weed scientists, who will lead any weed control trials to solve the problem. The onus is on the DAE staff to provide the weed researcher with the information on farmers’ weeding practices and other circumstances required to plan experiments that will help farmers to solve their weed problems. Involvement of the weed scientist in the informal survey, even for a very brief period, can help build a common strategy acceptable to both DAE and weed scientists for overcoming the weed problem.

4. Conducting Exploratory, Determinative and Verification Trials on Farmers’ Fields.

There is a consensus in IAR that new technologies should always be verified on farmers’ fields before they are recommended for use by farmers. An important issue facing the institute is whether, and under what conditions, exploratory and determinative trials should be conducted on farmers’ fields. The advantages of conducting such trials with farmers is that the natural and biological conditions of the trial are likely to be more representative of the farm community than are those at the station. Moreover, our experiences show that farmer participation in the trial and evaluation of the treatments can help guide researchers in modifying the technology at an early stage of development. The disadvantages of conducting such trials on farmers’ fields is that it is difficult to control experimental and non-experimental variables; thus coefficients of variation may be high and significant differences among treatments may be difficult to obtain. Furthermore, many exploratory and determinative trials are large and complicated; these may be confusing for the farmer to evaluate and difficult for both researchers and farmers to manage properly.

The above-mentioned guidelines on on-farm experimentation, distributed to all research centers, have helped clarify policy on on-farm experiments (IAR, 1988, Guidelines for on-farm experiments, unpublished). Exploratory and determinative agronomy trials may be conducted on farmers’ fields in instances where representative sites on station cannot be found. Concerning varietal testing, varieties are evaluated by a breeder, who then submits promising varieties to the National Variety Release Committee (NVRC). The committee oversees one to three years of on-station verification trials, after which it decides whether to recommend and release the variety. At the same time the varieties go to the NVRC, they may be tested by DAE in on-farm verification trials. Results from these trials are submitted to the committee for use in evaluating the variety.

Concerning verification trials, DAE researchers seek to test improved packages that increase productivity, that address farmer problems, and that are acceptable and feasible for farmers. Two
different technological packages may be tested in the same trial, e.g., a high-input package for producer cooperatives and a modified package for limited-resource farmers. In some cases, DAE also conducts “farmer-designed” trials. In these trials, a technology is given to the farmer and the researchers monitor how he uses it on his own farm.

5. Formulating Recommendations

There is a clear procedure for the recommendation and release of new varieties. Breeders nominate new varieties for recommendation and the varieties’ performance is evaluated by the NVRC, which decides whether the varieties should be released or not. But for other cultural practices there is no systematic procedure for formulating recommendations. Thus, different departments make different, and at times contradictory, recommendations concerning the same cultural practice.

For example, for the Holetta area, there are three different recommendations concerning fertilizer levels for tef. The tef team recommends 60/60 kg of N/P₂O₅ per ha., based on on-station trial results from Debre Zeyit Research Center. This rate was the one in the trial that maximized tef yields. DAE, Holetta, has determined, based on the results of on-farm trials in the Holetta area, that 0/23 kg of N/P₂O₅ per ha. is the optimal rate. This rate gave the highest economic returns, with an acceptable marginal rate of return to capital. Meanwhile, MOA recommends 41/46 kg of N/P₂O₅ per ha., based on the nationwide results of MOA’s on-farm fertilizer trials.

Clearly, a formal procedure is needed for formulating agronomic recommendations. It is imperative that MOA representatives be involved in the process. Perhaps a recommendation release committee needs to be established to clear new recommendations just as the National Variety Release Committee clears new varieties. Each center could have a recommendation release committee since recommendations will differ from center to center and even within areas served by a single center. Alternatively, the zonal Research Extension Liaison Committee could undertake this function.

It should also be recognized that recommendations must be based on profitability and risk to the farmer, not just on maximizing yields. Similarly, it must be recognized that recommendations are not the same for all farmers in an area; for example, individual farmers and producer cooperatives face different prices for their inputs and outputs; thus it is likely that the fertilizer recommendations for each will differ. Also, recommendations cannot be viewed as permanent; they should be reviewed periodically to take into account changes in the cost of inputs and prices of outputs.
6. Farming Systems Research in the Commodity Team Approach

Recently, IAR has adopted a commodity-oriented approach to research; previously more emphasis was given to departmental and disciplinary orientations.

It is likely that the FSR approach will play an important role in the commodity-oriented approach, which is also multidisciplinary in nature. Whereas in the past department heads and center managers have played a crucial role in institutionalizing the FSR approach, it is likely that commodity team leaders will play the same role. Most of the commodity team leaders have served as center managers or department heads; hence they have experience in FSR.

The importance of department heads will be reduced under the commodity team approach. However, there are several critical functions which the head of the Department of Agricultural Economics should play:

a. Ensuring disciplinary excellence. The department head should be responsible for ensuring that the work done by economists in IAR is of high quality. This might involve setting up committees to review reports written by economists.

b. Planning and coordinating training opportunities. The department head should be responsible for (1) drawing up and monitoring a training plan in the department, (2) planning and organizing training workshops for department staff, and (3) organizing on-site training for new staff members.

c. Liaising with economists of expatriate organizations. The department head should be responsible for liaising with economists of expatriate organizations in planning their activities in support of the activities of the economists of IAR. These activities include on-site training, scholarships, joint workshops, and proposing and implementing projects.

7. Linkages Between DAE and MOA Extension

Currently, there is little interaction between DAE and MOA in the implementation of FSR activities. Development agents often assist IAR researchers in assembling background information about an area and in selecting farmers for surveys and on-farm trials. However, there is little MOA involvement in the planning or implementation of IAR diagnostic surveys and experiments.

A direct working relationship needs to be established between DAE and MOA in the conducting of surveys and on-farm verification trials. Such a linkage could be useful for both institutions in the effective undertaking of their work. In addition, it would be useful for further integrating research and
extension in the effort to successfully develop and disseminate new technology (Sungusia and Lev 1986). Specific areas of collaboration and the possible benefits are discussed below 1.

In the diagnostic surveys conducted by IAR, subject matter specialists can make important contributions. First, they often have much experience in the survey zone and can contribute to developing an understanding of farmer practices. Second, they have knowledge about the past and present efforts of the extension service, other development organizations working in the area, and results from MOA trials and demonstrations. The SMSs can also benefit from participating in the survey in several ways. First, they can learn from the researchers who have more knowledge about research results and potential solutions to identified problems. Second, the surveys can be useful to the SMSs in planning their own extension programs. Moreover, since the team consists of members of different disciplines, each benefits from the others' different disciplinary perspective.

In the diagnostic surveys conducted by IAR, there has been very limited participation by SMSs. This is not because the SMSs are not interested; many have been exposed to farming systems surveys in IAR and MOA workshops and are keen to get involved. The reason they do not participate is because participation is outside their terms of references.

Several advantages to close IAR-MOA interaction in the implementation of on-farm verification trials can also be shown:

1. Both DAs and SMSs need to be involved in the verification of new technology, so they can judge for themselves its effectiveness. Currently, it sometimes happens that MOA and IAR have different recommendations for the same crop in the same area; ensuring that both are actively involved in the verification of new technology can help to develop a single view on recommendations for both institutions.

2. SMSs can make important contributions to the planning of experiments and the fine tuning of new technology for specific groups of farmers, based on their experience in the area. They can assist in such areas as suggesting levels of treatments and non-experimental variables. DAs can assist in site selection and selection of representative farmers.

1 In the discussion that follows, the term "researchers" refers to IAR research officers, who have B.Sc. degrees or above. The term "subject matter specialists (SMSs)" refers to MOA staff with B.Sc. or above, these are usually working at the wereda or awraja level. The term "development agents (DAs)" is used for MOA field staff, who have junior college diplomas or lower, and are usually operating at the wereda or service cooperative level.
3. The implementation of on-farm experiments can also be made much more efficient and extensive with MOA participation. Currently, an FSR team composed of two researchers, one Technical Assistant, and having one vehicle can only manage about 35 sites. The literature on on-farm verification trials suggests that 20 sites per trial per year are required, thus currently staff can manage less than two trials. Furthermore, much fuel and time is wasted visiting sites to record data that could be collected more cheaply and more efficiently by a local DA. During 1987, the Holecetta Research-Extension team composed of two researchers planted 185 demonstrations of similar complexity to verification trials; they were able to plant so many sites because they involved DAs in the planting and monitoring of trials. With effective extension collaboration, DAE divisions should be able to manage a similar number of trials. DAs could be trained to lay out the trials and monitor them and SMSs could assist with the supervision duties.

Currently a significant number of IAR staff are involved in planning and laying out demonstrations for the purpose of acquainting MOA extension agents with new technologies. If these agents were involved in verification trials testing the new technologies there would then be no need for IAR to demonstrate those technologies to them.

It is recommended that one MOA SMS be assigned to work with the DAE at each research center where the DAE operates. The SMS should be from a wereda or awraja office and should allocate half his time to work with the FSR team. The SMS's terms of reference should be to work with the FSR team as a full member in conducting surveys and planning and implementing on-farm trials. The team will train DAs in the planning and monitoring of on-farm trials.

8. Linkages with Policy Makers

DAE survey reports include information useful to a wide range of government organizations active in technology diffusion and rural development. For example Kassahun et al. (1988) makes proposals concerning land tenure and the management of common holdings in coffee areas. Franzel et al. (1989) makes proposals concerning grain marketing regulations and the AMC quota system.

Several questions can be raised concerning the department's work and its usefulness for other development organizations. How can the work being done in farming systems research contribute to more effective technology diffusion, policy formulation, and project design and implementation? How can better links be created with institutions involved in technology diffusion, e.g., seed production, input supply, produce marketing? How can policy makers and planners benefit from the information being generated at the micro-level in FSR surveys and trials? Currently, the
main audience for nearly all DAE research is the IAR research establishment. Should DAE conduct research for which the main client is another organization, e.g., research on price policy or marketing systems?

CONCLUSION

FSR’s approach to solving the problems of technology adoption has helped make it an integral part of national and international agricultural research institutions. Our experiences indicate that the continued use of FSR in agricultural research in Ethiopia is highly justified. FSR has helped IAR in problem identification and technology development and evaluation. It has strengthened the interaction between researchers, extensionists and farmers. The flexibility of the approach to serve specific local circumstances is also found desirable.

Action in several areas is required to consolidate the contributions that FSR can make to IAR’s research program:

1. Training in FSR. Whereas DAE staff have adequate training in FSR concepts and procedures, the same cannot be said for staff of other departments. Workshop and on site training is required to acquaint scientists with the FSR approach, the services DAE provides, and how scientists can best make use of these services. This should contribute towards improving the linkages between technical researchers and FSR researchers as mentioned above. Practical training in on-farm research procedures is also important for staff participating in surveys and conducting on-farm trials.

2. Formulating Recommendations. A formal procedure is needed for formulating farmer recommendations. This could be done by RELCs or by zonal recommendation committees. MOA representatives must be represented.

3. Clarifying the role of department heads. The role of department heads should be clarified in the new commodity team system. Whereas department heads have a secondary role to play in deciding on the research problems staff address, they should play an important role in ensuring disciplinary excellence, coordinating the training of their staff, and liaising with expatriates.

4. Involving MOA in FSR activities. Linkages between IAR and MOA should be formalized so that diagnostic surveys and on farm verification trials become joint activities of both organizations. An agreement is required between the two organizations formalizing the participation of staff from both institutions in on-farm research.
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