FARMING SYSTEMS RESEARCH
IN THE INSTITUTE OF AGRICULTURAL RESEARCH, ETHIOPIA:
EVOLUTION, IMPACT, ISSUES

WORKING PAPER No. 3/87

Department of Agricultural Economics and
Farming Systems Research
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MULUCETTA MEKURIA
STEVEN FRANZEL

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DEPARTMENT OF AGRICULTURAL ECONOMICS AND
FARMING SYSTEMS RESEARCH

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Prelace

The Department of Agricultural Economics and Farming Systems Research has initiated departmental publication of a working paper series in the area of agricultural economics and farming systems research. Working papers are made available in limited numbers for comments and discussion and to inform interested colleagues about work in progress in the department's area of research.

This report describes the evolution of Farming Systems Research in the IAR, the initial results of the effort and the impact it has made. 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 emanated from the development of the program in the IAR.

The Department would appreciate receiving comments and suggestions and they should be directed to the author(s).

Mulugeta Mekuria
Head, Department of Agricultural Economics & Farming Systems Research
Farming Systems Research in the Institute of Agricultural Research, Ethiopia: Evolution, Impact, Issues (1)

by Mulugetta Mekuria and Steven Franzel (2)

Introduction

Ethiopia is predominantly an agricultural country. Of the 42 million people, 85% earn their living from this sector. Agriculture contributes almost 50% to the GDP and 90% to the foreign exchange earnings of the national economy.

To accelerate the development of agriculture the Government of Ethiopia realized the need for a national agricultural research institution and in 1966 established The Institute of Agricultural Research (IAR) as a semi-autonomous public organization to undertake and coordinate agricultural research in the country. Prior to the establishment of the IAR, agricultural colleges (Alemaya, Jima) and their experiment stations were carrying out research.

In the last two decades the IAR has expanded its research network to cover the country's major agricultural development zones, and has strengthened its research manpower and infrastructure. To date the IAR has 18 centers and sub-centers covering all the agricultural development zones of the country. In addition, institutions of higher learning, of which the Alemaya University of Agriculture is the most prominent, also undertake agricultural research.

In most 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. Inspite of all the efforts of national and international research centers, the problem of technology adoption and hence low agricultural productivity is still a major concern. The problem of low rates of technology adoption by the small farmer is partly attributed to the lack of understanding of the farmers' problems and the conditions under which they operate.

(1) This paper is a revised version of a paper presented at the "Senior Research/Extension Administrators Workshop," International Maize and Wheat Improvement Center (CIMMYT), Llongwe, Malawi, May, 1987.

(2) Mulugetta Mekuria is an agricultural economist and Head, Department of Agricultural Economics and Farming Systems Research, Institute of Agricultural Research. Steven Franzel is an agricultural economist and Farming Systems Research advisor to the Institute of Agricultural Research, on secondment from the Agricultural Development Service, World Bank.
Today there is a significant change in the attitude of the scientific community towards small farmers and their problems. New perceptions of the small farm situation have resulted in the development of the farming systems research (FSR) approach. FSR evolved in the post green revolution era with the growing perception of the failure of agricultural research and extension institutions to generate and disseminate technologies adopted on a wide scale by peasant farmers.

The following sections describe the evolution of FSR in the IAR, and report on preliminary results and their impact. Finally, we present several critical issues concerning the refinement of the approach and its institutionalization in Ethiopia.

Evolution of FSR in the Institute of Agricultural Research

Historical Perspective

The history of FSR in Ethiopia dates back to 1976/77, when the Department of Socio-Economics and Farm Management Studies initiated demonstration programmes around Holetta and Bako research stations. The objective of the programme was to demonstrate available recommendations from the research stations 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 very crucial to chart future research strategies. Second, it was evident that our knowledge and understanding of the peasant farmer and his circumstances was far from complete. With these rationales the Department initiated multidisciplinary surveys and package testing programmes.

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 and Bako Farming System Zones in 1977/78 and was later extended to Nazareth 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 stations and sub-stations. 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 programme has been conducted on individual producers', Producer Cooperatives' and Peasant Associations' communal farms. Farmers provided land, labour and purchased inputs, such as fertilizers. Improved varieties and technical advice were provided by the respective research station staff.

From the packages developed on the research stations 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 stations. 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 (informal and formal surveys [1]) were found appropriate. Second, the need was recognized to go beyond testing already developed packages to developing technologies with greater farmer participation on farmers fields.

Diagnostic Surveys and On-Farm Experiments

Diagnostic surveys to describe the different farming systems found around the research centers and sub-centers have been initiated. The informal surveys have been conducted with the involvement of social and biological scientists and local extension personnel. Through farmer interviews and secondary data, information was collected on the natural and biological circumstances of the areas, farmer problems, circumstances, enterprise patterns and resource use. Formal surveys to quantify and verify the informal survey findings were conducted and

[1] Informal 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. A formal survey is a survey of randomly chosen farmers who are interviewed by trained interviewers using a written questionnaire in order to provide quantitative data on farmer circumstances (Byerlee and Collinson, 1980).
reports were made available to research scientists. As a result of the findings of the diagnostic surveys, different types of on-farm experiments (OFE) on crop varieties, fertilizers and other management practices have been initiated. The on-farm experiments vary according to the nature of the problems, the available recommendations and the potential of the experiments to give immediate impact. Because of these considerations, the OFEs are either exploratory, determinative or verification type and have varied degrees of farmer involvement. [1].

The diagnostic surveys and OFE's started in the 1984/85 crop season initially at two research centers i.e., Bako (Western Zone) and Nazareth (Central Zone) with an International Development Research Center (IDRC) grant for an FSR project. In 1985/86 the program was extended to Holetta (Central Zone) and Awassa (Southern Zone) and in 1986/87 to three additional centers (Adet, Sinana and Jimma) in the North Western, South Eastern and Western Zones.

Currently the Agricultural Economics & Farming Systems Research Department (DAEFSR) has programs at seven major research centers located in five of the eight agricultural development zones of the country. The staff consists of 1 expatriate advisor, 3 research officers, (M.Sc level), 11 assistant research officers (B.Sc level) and 8 technical assistants. Two of the members are agronomists while the rest are agricultural economists. The staff are benefiting from the International Maize and Wheat Improvement Center (CIMMYT) - University of Zimbabwe Regional Training Workshops in FSR and a series of IAR-CIMMYT in-country training workshops held from 1985 to 1987 (Mulugetta, 1987).

The number of surveys and on farm trials done at each center are shown in Tables 1 and 2. As of mid-1987, 9 informal surveys and 2 formal surveys have been completed and written reports on these surveys are available. Another 1 informal and 3 formal surveys are currently under way. The number of on-farm trials grew from 7 trials at 32 sites in 1984 to 27 trials at 120 sites in 1987. The increase in the percentage of trials managed by departments other than DAEFSR, from 0 in 1984 to 46% in 1987 reflects the growing interest in on farm trials within the commodity/disciplinary departments. In general, DAEFSR conducts verification trials whereas the other departments manage determinative trials.

[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, researchers verify the results of the exploratory trials on larger plots and across a greater number of sites.
Table 1: Surveys completed in the Institute of Agricultural Research

<table>
<thead>
<tr>
<th></th>
<th>Informal</th>
<th>Formal</th>
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<tbody>
<tr>
<td>Bako</td>
<td>1</td>
<td>2 (1*)</td>
</tr>
<tr>
<td>Nazreth</td>
<td>2</td>
<td>2 (1*)</td>
</tr>
<tr>
<td>Holetta</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Awassa</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Adet</td>
<td>2 (1*)</td>
<td>1 (*)</td>
</tr>
<tr>
<td>Jimma</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Sinana</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>10 (1*)</td>
<td>6 (3*)</td>
</tr>
</tbody>
</table>

* indicates survey is currently underway

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

<table>
<thead>
<tr>
<th></th>
<th>1984 Trials</th>
<th>1985 Trials</th>
<th>1986 Trials</th>
<th>1987 Trials</th>
</tr>
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<tbody>
<tr>
<td>Sites</td>
<td>Sites</td>
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<td>Sites</td>
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<tr>
<td>Bako</td>
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<td>4</td>
<td>6</td>
<td>7</td>
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<td>Nazreth</td>
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<td>29</td>
<td>4</td>
<td>23</td>
</tr>
<tr>
<td>Holetta</td>
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<td>0</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Awassa</td>
<td>0</td>
<td>2</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>Jimma</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>7</td>
<td>33</td>
<td>17</td>
<td>74</td>
</tr>
</tbody>
</table>

% of trials mgd. by:
- DAEPSR: 100% 88% 88% 54%
- Other depts: 0 12% 12% 46%

* Does not include package testing trials, which compare the performance of crop packages with farmer practices.

Initial Results and Their Implications

The preceding section outlined the efforts made to initiate, expand, and institutionalize the FSR approach in the Institute of Agricultural Research. The research programs carried out in the above mentioned areas have benefited from the collaborative efforts of the commodity and disciplinary research staff. Informal and formal survey results were brought to the attention of the research scientists and used to identify...
suitable practices for verification and to design on-station and on-farm trials. The impact of the FSR program on the other research programs will be discussed by referring to initial results from two selected study sites where both diagnostic surveys and on-farm experiments have been in progress for the last three years. In addition, survey results from one of the new sites will be presented.

Nazreth 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, teff, sorghum and haricot beans, 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 FSR survey included (1) the erratic nature of the rainfall causing moisture stress problems on maize, and (2) quela 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, sorghum research emphasized early maturing, high yielding, high nutritional quality varieties in their testing. But their varieties were highly susceptible to bird attacks; they expected the farmers to guard against birds. The FSR survey found that intensive guarding was neither acceptable nor feasible to farmers in the area.

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

On-station experiments indicated that the tie-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.

6
Early maturing maize varieties which avoid moisture stress were tested and are now recommended for the area. They have a high level of acceptance and are replacing the long cycle local maize cultivars which have had recurrent crops failures due to the changing weather pattern.

Feedback from surveys and on farm haricot bean trials is also leading to new research thrusts and proposed 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 in order to suppress weeds. Station experiments are now exploring the relationship between variety, seed rate and weeding requirements in order to propose new recommended varieties and seed rates which have the dual objectives of high yield and low weeding requirements.

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, teff, noog, and pepper 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 weeding (Legesse, et.al., 1987)

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

(1) Family food shortages, June through August, before the maize harvest. Previous to the survey, maize improvement focused exclusively on the development of long cycle varieties to take full advantage of the long rainy season. Short cycle varieties, tested on farmers' fields with the close collaboration of the maize improvement program, are giving promising results. They are in great demand, as evidenced by one farmer who took the thinned plants from the trial and transplanted them on his own field.

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

Other farmer problems that DAEFSR, Bako, in collaboration with other departments at the Center, is addressing include:
1. Weed control problems. Researchers have compared the center's weed control recommendation for maize, two hand weeding, with farmers' weeding practice, which involves hoeing, oxen cultivation, hand weeding and slashing. There were no significant differences in yields between the two practices. Since farmers' own practices required lower labor inputs during peak periods than the center's recommended practices, they strongly preferred their own practices. 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 nitrogen/phosphate, the on farm experiments have shown 41/46 to be economically optimal for farmers in the recommendation domain around the center.

3. 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.

3.3 Sinana Farming System Zone

The IAR is in the process of establishing new research centers in different agroecological zones of the country. The role of the FSR approach in guiding research programs in such new research centers is imperative.

The Sinana Agricultural Research Center is being established in the South Eastern Zone of the country. The Sinana zone is characterized by a bimodal rainfall, namely the belg season (February-June) and the meher (main) season (July-November). The area receives about 750-950 mm rainfall per annum or 375-475 mm per season. The elevation ranges between 2400-2500 m and the area is a plain and slopes gently. Generally the terrain is suitable for arable farming, as a result the very nature of this flat land has facilitated the expansion of large scale state farms which occupy 25% of the cultivated area in the zone. Major crops grown are barley and wheat while other crops include field peas, faba beans and potatoes (Alemayehu and Franzel).

An informal survey has been launched in the area which examines farmer circumstances, enterprise pattern and end use, resource availability and use, crop and livestock practices, principal farmer problems and possible interventions. The high priority problems include aphid damage on meher barley and wheat, shortage of dry season feed, shortage of fuelwood, and weed damage on belg barley. Medium priority problems include family food shortages (May/June), peak period labor shortages (July-August), and low soil fertility. Based on these problems possible solutions and opportunities were identified in consultation with
concerned national research program commodity coordinators. Several on-station and on-farm trials of short-term and medium term nature are proposed. The on-station and on-farm experiments proposed are in response to their possible contribution in alleviating the high and medium priority production constraints mentioned earlier. The experiments cover the fields of agronomy, soils, crop protection and forage agronomy.

**Issues**

Several issues concerning the institutionalization of farming systems research in IAR have arisen as the program has expanded.

**Agronomists and staff from other disciplines in the DAEFSR**

Two of the seven centers with DAEFSR divisions have agronomists. Having a full-time agronomist on the team ensures that agronomic considerations are taken into account at all stages: diagnosing farmer problems and designing, implementing, and evaluating the results of on farm experiments. Moreover, the agronomist in DAEFSR is in a better position technically to communicate with staff of other departments. The disadvantage of including an agronomist in the division, in theory, is that this may serve to drive a wedge between the Agronomy department and DAEFSR, leading to wasteful overlapping of activities.

Our experience thusfar at IAR is that it is desirable, but not essential, that a core FSR team composed of an agricultural economist, an agronomist, and an animal production specialist be stationed within DAEFSR at each research center. Due to the shortage of agronomists and animal production specialists and the needs of their respective departments for their services, it has usually not been possible to include them in DAEFSR. However, this has not posed insurmountable problems; strong collaboration between departments has permitted agronomists and livestock scientists to take an active role in both surveys and on farm experiments. Moreover, collaboration with the Agronomy department is not greatly affected in one way or another by the presence of agronomists in the DAEFSR.

The progress in the area of collaboration between DAEFSR and other departments is due to activities at six different levels. First, the General Manager is directly addressing the issue of the importance of collaboration in workshops and meetings with staff. Second, research center managers are insisting that scientists work together in diagnosing problems and implementing on farm trials. Third, exchanges between the DAEFSR head and other department heads and center managers are important in bringing about collaboration. Fourth, individual scientists from different departments at a center develop close working relationships and collaborate on surveys and trials. Fifth, expatriates from international organizations working with DAEFSR and other departments promote interaction between the two
only conduct verification trials; of course, DAEPFR can collaborate with other departments conducting on farm trials.

This policy will hopefully serve to strengthen linkages between DAEPFR and other departments. For example, if a DAEPFR survey indicates that weeds are the principal constraint and no technologies to solve the problem are available, DAEPFR staff must collaborate with the weed scientists, who will lead any weed control trials to solve the problem. The onus is on the DAEPFR staff to provide the weed researcher with the information on farmers' weeding practices and other circumstances required to plan experiments which will help farmers to solve their weed problems. Involvement of the weed scientist in the informal farmer survey, even for a very brief period, can help build a common strategy acceptable to both DAEPFR and weed scientists for overcoming the weed problem.

Three other important issues related to farming systems research that the DAEPFR is currently addressing are as follows:

1. How does one decide which, and how many, improved technological components to include in a package for testing in a verification trial? Some scientists claim that the package should include all practices required to achieve the maximum yield. Others claim that only one component should be tested at a time. In DAEPFR, researchers seek to test improved packages that increase productivity, that address farmer problems, and that are acceptable and feasible for farmers. Generally, two to three technological components are included in a single package, though there is no rule concerning the number of components.

2. How can the FSR build stronger linkages with the Ministry of Agriculture's extension service? Recently, Research Extension Liaison Committees have been formed and are helping to develop research programs and to formulate extension recommendations. How can extension staff, both at the specialist level and at the field agent level, participate more effectively in surveys and on-farm trial management?

3. How can the work being done in farming systems research contribute to more effective policy design and implementation. How can better links be created with policy makers so they can benefit from the information being generated at the micro level in FSR surveys and trials?

Conclusion

The problems of technology non-adoption and FSR's approach to solving these problems 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 us 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.

References


