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INITIATING APPLIED FARMING SYSTEMS RESEARCH IN DEVELOPING COUNTRIES*

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1.0 Introduction

Farming systems research (FSR), in its various manifestations, is receiving increased attention as a means to stimulate agricultural development. During the last several years, donors, international agricultural research centers (IARC's) and a number of national research programs have developed alternative methods for conducting FSR. There has recently been a substantial effort on the part of these "practitioners" to pool their knowledge and share their experiences. The result has been a remarkable degree of consensus on procedures for FSR, at least when the scope and purpose of research are carefully specified, e.g., applied FSR conducted by national programs versus basic FSR conducted by IARC's (Harrington, 1980).

Although research on FSR procedures continues, a related issue is gaining prominence: implementation of applied FSR in national research programs. The issue is clearly one of feasibility. How feasible are FSR procedures for national programs, given the various constraints under which they operate? What are the basic decisions that must be taken to initiate FSR? What steps are necessary to make FSR operational? The purpose of the present paper is to address some of these questions.

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In order to comment on the feasibility of implementing applied FSR in national programs, however, a characterization of FSR is needed. Applied FSR is viewed as research that is:

1) problem-oriented -- research focuses on the solution to production problems that promise to have a considerable effect on farmer goals (e.g., increased income at reasonable levels of risk).

2) on-farm -- experimentation is planned and conducted in light of farmer circumstances and under farmers' conditions.

3) multi-disciplinary -- the effective collaboration between biological and social scientists is needed in the design and testing of new technology.

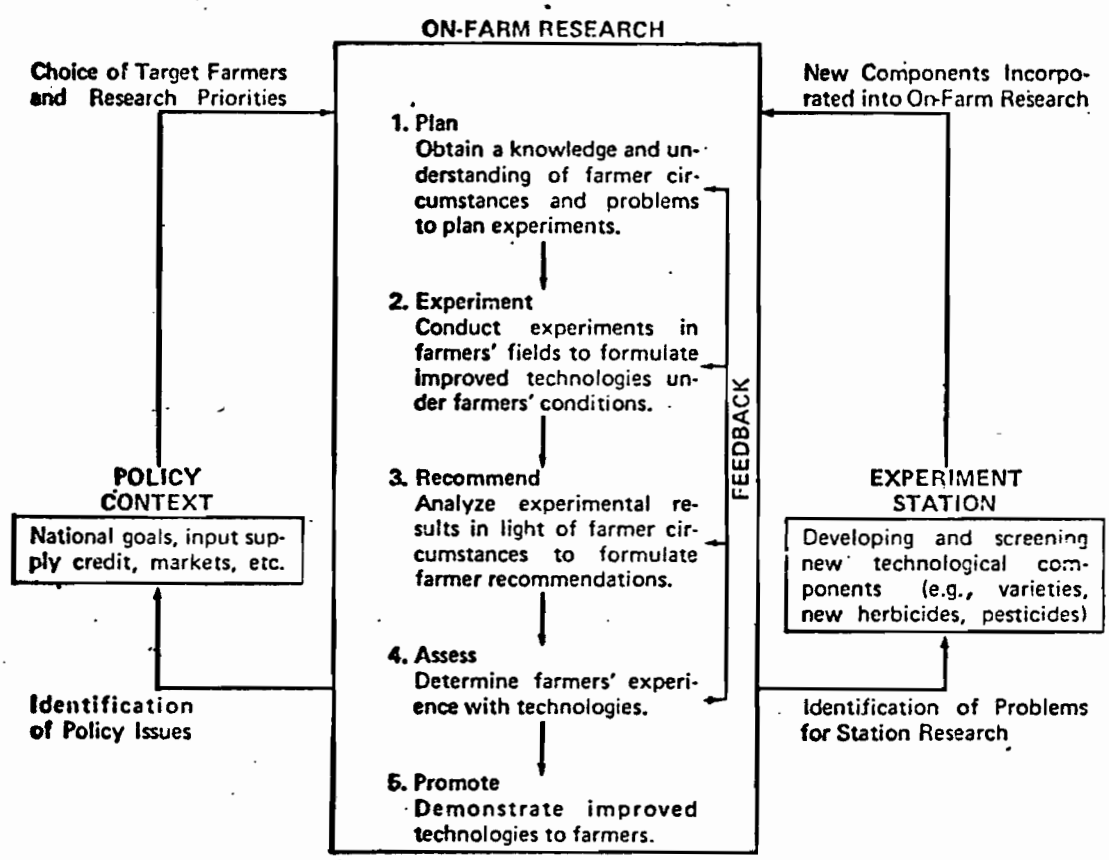
The approach to applied FSR used at CIMMYT may be seen in Figure 1. On-farm experiments are planned in light of farmer problems and circumstances. Experimental results are analyzed in order to formulate recommendations. Those recommendations are subjected to farmer assessment before being promoted among target farmers (Byerlee, Collinson et al, 1980).

The very characteristics of applied FSR (farmer-oriented, on-farm, multi-disciplinary), of course, lead to many of the issues and difficulties in implementation that will be discussed in subsequent sections.

2.0 National Research Programs: Constraints and Circumstances

There exists a great diversity among developing countries with regard to the structure and operation of their agricultural research programs. Nonetheless, the majority of national programs share at least two salient characteristics: (1) an institutional environment that is not entirely sympathetic to the introduction of FSR, (2) a scarcity of research resources.

Figure 1. Overview of an Integrated Research Program



The institutional environment often constitutes a major obstable for the initiation of FSR. The agricultural research system itself, usually organized along disciplinary or commodity lines, often resists the introduction of FSR because of the consequent need to re-define institutional jurisdiction. Individual researchers, having been trained as disciplinarians, frequently see FSR as a threat to traditional research activities. Even researchers who see a need for FSR have little incentive to push for its introduction. The current structure of incentives (salary increases, promotions, peer approval) normally favors those who excel as disciplinarians.

Other institutions, outside of the established agricultural research system, may also prove to be obstacles. On-going rural development programs may frown on the introduction of FSR into their areas of influence, foreseeing that FSR may discredit some of their past efforts. Even extension services may see FSR as an usurpation of their traditional prerogative of linking with farmers.

Institutional difficulties are made more acute by financial constraints. FSR can be expected to produce superior results when the research teams are composed of highly-skilled personnel who control a budget adequate for survey and experimental field work. Mobility is especially important: researchers must be able to visit experiments and farmer-collaborators frequently.

Skilled personnel and funds for recurrent expenses are, however, especially scarce in LDC agricultural research programs. In many countries there are few social scientists available for work on FSR. There are even fewer (and in many cases, none) who have either training or experience in collaborating with agronomists in problem-solving research. Similarly, resource limitations can strongly affect the conduct of FSR. In Ghana, fuel for staff vehicles was extremely scarce during the initiation of an FSR project. Researchers had to use

considerable ingenuity to obtain a modest fuel allowance for on-site visits. In the face of resource limitations, then, the demands of an FSR program must either be met by diverting resources from on-going research activities or by obtaining special-project funding.

Researchers engaged in traditional, on-station research can point, in defense of their budgets, to recent studies indicating a high rate of return to their past activities (e.g., Arndt et al, 1977). However this may be, FSR practitioners believe that their approach is far more cost-effective in terms of "technology adopted per monetary unit spent" and that FSR deserves a chance in most national programs.

3.0 Initiating Applied FSR

A decision by a national agricultural research program (or by individual researchers in such a program) to "give FSR a chance" leads directly to other decisions on organization. These decisions focus on the institutional character of FSR, the proper scope of research and the choice of target area for the initial FSR enterprise. As the organization of FSR takes shape (at least for initial efforts), increased attention may be paid to operational questions, such as training researchers in FSR procedures, insuring effective multi-disciplinarity and getting research onto farmers' fields.

3.1 Institutional Character of FSR

An important decision that must be addressed early is that of "program versus project". As described in the CID Draft Guidelines (Consortium for International Development, 1980), the "program versus project" choice is one of scale. Initiating FSR as a project merely entails the assignment of a team of researchers to conduct FSR in a given target area. It is not necessary that the supporting agency make any large changes in research philosophy or organi-

zation. The project approach to FSR can be especially painless (in a budgetary sense) because special-project funding may be available for initial FSR efforts.

The program approach is more ambitious, requiring a major commitment to FSR from the beginning. An FSR program may be carried out through the re-orientation and co-ordination of the activities of existing agencies or through the creation of a new agency with a mandate for FSR.

The decision made on the "program versus project" issue will depend on the specific circumstances of the case. However, the project approach to FSR is more attractive under conditions of institutional neutrality or hostility, and scarcity of research resources. Given that these are the very conditions that most national programs must face, the project approach to FSR has proven to be relatively popular. Within national programs, it is possible to "start small", without major institutional rearrangements.

3.2 Scope of Research

Whatever the scale of FSR organization that may be adopted, another issue must immediately be faced: the appropriate scope of research. It is patently impossible to consider everything as variable at the commencement of research: some things must assumed as fixed, outside the scope of research. The phrase "farming systems research" carries with it a connotation of wholeness, a feeling that all management practices in the farming system must be considered as variable. However, there is no reason why some of these management practices may be not also be classed as fixed. The issue, then, is how many practices should be allowed to vary during research -- many or few?

One alternative is to allow many variables, considering for example the selection of crop or livestock enterprises for a farming system (and the management of each) as variable. This has been called "FSR-in-the-large". Another alternative is to focus research on the management of one (or few) enterprises in the context of the current farming system. This has been called "FSR-in-the-small". The point of importance is that this focus on one or few enterprises is still a valid form of FSR. This is because the design and analysis of research on these few, selected enterprises takes into account effects of technological change on other components of the farming system.

A focus on one (or few) enterprises in FSR is likely to be particularly wise under the following conditions:

(1) The bulk of farmers' resources are used in one enterprise (e.g., maize in much of Central America, wheat in N. Africa) so research on this enterprise is likely to have the best leverage on such system problems as deficient income, excessive risk, or seasonal variability in the employment of farmer-owned resources (Collinson, 1980).

(2) There appears to be some scope for improvement in the management of the pre-dominant enterprise. In fact, our experience indicates that, in the case of maize or wheat, improvements in crop management can have substantial impacts on production and farmer income.

(3) Land-use is not highly intensive (although even here a single enterprise focus will often lead to useful innovations as long as system interactions are carefully considered).

A focus on the most important enterprise(s) will, in addition, normally lead to lower research costs. The amount of information on farmer practices and circumstances needed to plan research (describe representative practices, identify

priority production problems, pre-screen potential solutions to these problems) is less when research is well-focused. Similarly less data is needed for evaluation of experimental results. Even farmer assessment of new technology is facilitated because recommended improvements on the current farmer practice tend to be relatively uncomplicated, making it easier for farmers themselves to evaluate these improvements.

Needless to say, the specific choice of target enterprise(s) will vary from target area to target area. The issue to which reference is being made is one of scope: in general, should researchers try to improve the management of one (or few) major enterprises in a farming system or should they attempt a broad-brush re-design of that system? National research programs interested in FSR should consider a relatively simple and inexpensive form of FSR -- that of "FSR-in-the-small".

3.3 Choice of Target Area

Another major decision in the initiation of FSR concerns the target area, or region where initial research efforts are to be carried out. While it is conceivable that an FSR program may wish to initiate research in many areas simultaneously, FSR is usually initiated in one or few target areas, both because of resource limitations and to allow researchers to gather experience in FSR procedures. The characteristics of the initial target area, however, may influence the success of the FSR activities therein and, consequently, can affect the probability that FSR will be extended to other regions, as well as the form it may take.

Several criteria may be considered in the selection of an initial target area: (1) The possibility of gaining tangible results in a reasonable period of time. This is particularly important when the credibility of FSR is at stake.

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Later, more difficult areas can be selected -- when greater researcher experience can help compensate for more difficult research problems. (2) The presence or absence of major bottlenecks (human resources, logistics) to the implementation of FSR. At least initially, accessible areas are preferred. (3) The likely effect of a success in FSR on such national objectives as lower food prices for urban consumers, rural development, income distribution, etc. For example, when food prices are of primary concern, a different target area may be chosen than when the welfare of small farmers is given top priority (Byerlee, Collinson, et al, 1980).

3.4 The Incorporation of Social Scientists in FSR

A key step in the initiation of FSR is the formation of research teams with effective collaboration between biological and social scientists. The role of the social scientist in FSR is now widely regarded as essential. The social scientist is responsible for incorporating the "human element", or socio-economic problems and circumstances that affect farmers' decisions, into the design and evaluation of new agricultural technology. He must take as much responsibility as breeders or agronomists for such research activities as choice of representative farmer-collaborators, selection of high-priority experimental variables, selection of the level of non-experimental variables, and evaluation of experimental results.

Effective multi-disciplinary is not, however, easy to achieve. An effective multi-disciplinary research team is composed of researchers who enjoy a sound base in their respective disciplines but who nonetheless work to meet a common objective: the development of new technology useful to farmers. That is, they must be "task-oriented". Collaboration is facilitated when one disciplinarian is aware of the questions that fruitfully may be asked of another (Bartlett and Akorhe, 1980).

Team effectiveness can be influenced by experience (or its surrogate, training) and team organization. The more experience researchers have in multi-disciplinary, problem-solving research, the easier subsequent collaboration becomes. In the initial stages of FSR, however, such experience is in short supply. Training team members in FSR philosophy and methods can help overcome this initial hurdle. Although some IARC's have begun FSR-related training programs, there is still a scarcity of such programs that focus on the practical, multi-disciplinary aspects of FSR. (See Gilbert et al, 1980, Chapter 7 and CIMMYT, 1978).

Team organization can influence the quality of multi-disciplinary collaboration by pre-determining both the role and status of social scientists. In one country, economists of a junior level were recruited to work as staff members on experiment stations, in order to encourage and collaborate in research on farmers' fields. Their relatively low status in comparison with their agronomist colleagues, however, proved to be a serious obstacle to their attempts to initiate FSR off-station. In another country, social scientists were involved in the planning and evaluation of on-farm research -- but as a "support unit", not as full-fledged members of a target area research team. Although useful information on new technology was produced, the absence of social scientists during the experimentation stage led to inadequate contact with farmers during that stage, with a considerable loss of farmer feedback on the characteristics of new technology.

In yet another case, agronomists and economists were organized as a target-area-specific research team, with joint responsibility for research decisions. This is normally regarded as the best form of team organization. Nonetheless, effective multi-disciplinary collaboration proved to be elusive because the

relatively inexperienced economists demonstrated a preference for independent projects. While formally sharing responsibility for team decisions, in practice they preferred to work alone in conducting extended farm surveys that were only marginally related to on-farm experimentation.

In summary, a trained, experienced and task-oriented team of biological and social scientists, with joint responsibility for research decisions in a given target area appears ideal. Frequently, however, national program circumstances and policies will not allow the use of this ideal. In extreme cases, agronomists may be specially trained to provide a social science input. When a few social scientists are available, they may be either attached to experiment stations or placed into a "support unit" to back-up several research field teams. In these cases, however, the social scientist will usually be forced to cope with status problems and with an increased difficulty in acquiring an intimate acquaintance with farmer circumstances for a given target area.

3.5 Moving Research Onto Farmers' Fields - Farmer Collaboration

With few exceptions, research whose purpose is to provide useful new technology to farmers within a reasonable period of time must be conducted on-farm. This is because experiment station circumstances (e.g., soil fertility, weed and insect population, irrigation and drainage) are normally unlike those faced by target farmers.

Within a target area, then, the primary responsibility of the selected multi-disciplinary research team is to plan, conduct and analyze on-farm experiments. Armed with a knowledge of farmer problems and circumstances, researchers are in a good position to field-test promising solutions to important production problems. However, the team must avoid the temptation to conduct "experiment-station research" on farmers' fields -- i.e., in isolation from farmers.

On-farm research begins with a review of secondary data on the target area and surveys of target farmers, to ascertain their agro-climatic and socio-economic circumstances. This information can be used in a variety of ways in planning on-farm experimentation: farmers may be pooled into roughly homogeneous groups, or recommendation domains. For each domain, important production problems can be identified and possible solutions to these problems pre-screened for compatibility with the current farming system and for effect on farmer welfare.

A wide variety of experiments can be used in on-farm experimentation. Complete factorials (and in some cases "super-imposed trials") aid in identifying production limiting factors. Economic levels of inputs and practices that affect production can be estimated through researcher-managed, replicated experiments. Large-plot, unreplicated trials can verify the attractiveness of an innovation when compared to the current farmer practice (Palmer et al, 1980). Finally, farmer-managed trials allow farmers themselves to assess the attractiveness of new technology.

The key to effective on-farm research, however, is the maintenance of close contact with farmers. During the initiation of FSR, research teams often lose sight of this point.

During on-farm research, farmers should collaborate in various ways: respond to surveys, loan their fields, provide a reference point from which the effects of innovations may be measured (farmers' practice), comment on alternative experimental treatments, completely manage fields in which promising innovations are added to their current practice, and provide feedback on the reasons for liking or disliking proposed new technology.

Clearly, on-farm research without effective farmer collaboration can easily degenerate into a series of sterile exercises. Continuous contact with

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farmers is usually needed to maintain the "farmer-orientation" that characterizes applied FSR.

4.0 Low-Cost FSR

The feasibility of FSR for national research programs is a question that is currently attracting considerable attention. This question frequently takes the form of the cost-effectiveness of FSR, given its apparent expense. Some ways in which resource-poor research programs can initiate FSR activities have already been presented: (1) FSR can be initiated as a small-scale project instead of a large-scale program, (2) FSR can focus on important issues in the management of major crops (in the context of the farming system) instead of attempting the wholesale re-design of that system, (3) FSR can be initiated in an accessible target area in which prospects for success within a reasonable period of time are high, (4) FSR researchers can practice effective multi-disciplinary collaboration and close collaboration with farmers.

FSR practitioners claim that their approach is more "cost-effective" than traditional research in terms of "technology adopted per unit of money spent". They believe that traditional, on-station research in developing countries has led to relatively little adoption of new technology by small farmers. Nonetheless there is still a current of concern about the expense of FSR. It may be a worthy exercise, then, to list more ways in which FSR expense can be reduced.

A principal way to increase the effectiveness and reduce the cost of FSR is to stratify the farmers within a target region into relatively homogeneous target groups or "recommendation domains". A recommendation domain is merely a group of farmers facing similar problems and circumstances, operating similar farming systems, and for whom similar recommendations will be appropriate (Byerlee,

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Collinson et al, 1980). By placing all on-farm research in this context, one avoids the two extremes that serve as alternatives: (1) assume that research results will be appropriate for all farmers in a target area, heterogeneity in circumstances notwithstanding, (2) formulate separate recommendations for individual farmers.

The acquisition of data on farmer problems and circumstances provides another area of possible cost reduction. Informal, non-probabilistic surveys and well-focused, single-visit small-sample formal surveys are preferable to large-sample surveys or frequent visit surveys in this connection. The criterion for the selection of survey instrument should be that of "the lowest cost commensurate with the degree of understanding that is necessary." (Norman, 1980).

Another area of possible cost reduction is that of expanding the universe for which FSR results are applicable. This may be performed by determining the transferability of one set of results to other similar environments (i.e., extrapolating recommendation domains into new target areas). In this fashion, some (but rarely all) of the steps in FSR may be skipped.

Finally, it should be pointed out that it is unnecessary for FSR to produce the "best" new technology for farmers. Insofar as it discovers anything "better" than the current farmer practice, it will be useful. That is, FSR need not engage in the fine tuning of the farming system, but rather may concentrate on seeking the best of readily available solutions to important problems.

5.0 Conclusions

FSR procedures have been seen as fairly adaptable to the varying circumstances of national research programs. As a consequence, national programs wishing to commence FSR are faced with serious decisions. Among these are the questions addressed in this paper:

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- Should FSR be initiated as a large-scale program or a small-scale project?

- Should FSR focus on the management of major existing enterprises in the context of the current farming system or should it attempt large changes in that system?

- What are the desirable characteristics of a target area for the initiation of FSR?

- To what extent should effective multi-disciplinary collaboration be a priority objective? How can it be achieved? How should training be organized to prepare field team researchers?

- To what extent should FSR be conducted on-farm? How, and to what extent, should farmers collaborate in FSR?

- How may FSR be made more cost-effective?

No single methodology for FSR can be defined for use by all national research programs. However, even resource-poor national programs operating in an institutional environment not wholly sympathetic to FSR can and must afford to "give FSR a chance".

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