WORKING PAPER No.6

JUL 13 1987

ISSUES IN IMPLEMENTING RESEARCH WITH A FARMING SYSTEMS PERSPECTIVE IN NARS

International Service for National Agricultural Research

The International Service for National Agricultural Research (ISNAR) began operating at its headquarters in The Hague, Netherlands on September 1, 1980. It was established by the Consultative Group on International Agricultural Research (CGIAR), on the basis of recommendations from an international task force, for the purpose of assisting governments of developing countries to strengthen their agricultural research. It is a non-profit autonomous agency, international in character, and non-political in management, staffing, and operations.

Of the 13 centers in the CGIAR network, ISNAR is the only one that focuses primarily on national agricultural research issues. It provides advice to governments, upon request, on research policy, organization, and management issues, thus complementing the activities of other assistance agencies.

ISNAR has active advisory service, research, and training programs.

ISNAR is supported by a number of the members of CGIAR, an informal group of approximately 43 donors, including countries, development banks, international organizations, and foundations.

Citation:

International Service for National Agricultural Research. Issues in Implementing Research with a Farming Systems Perspective in NARS. 1987. The Hague, Netherlands.

WORKING PAPER No.6

ISSUES IN IMPLEMENTING RESEARCH WITH A FARMING SYSTEMS PERSPECTIVE IN NARS

W.A. Stoop

May 1987

isnar

International Service for National Agricultural Research

ISNAR WORKING PAPERS

The ISNAR working papers series is a flexible instrument for sharing analysis and information about relevant organization and management problems of the agricultural research systems in developing countries.

In the course of its activities - direct assistance co national agricultural research systems, training, and research - ISNAR generates a broad range of information and materials which eventually become the formal products of its publications program. The working papers series enhances this program in several important ways:

1. These papers are intended to be a rapid means of presenting the results of work and experiences that are still in progress, but are already producing results that could be of use to others;

2. They are intended to be an effective vehicle for widening the discussion of continuing work, thereby increasing the quality of the final products; critical comment is welcomed;

3. The series provides an outlet for diffusing materials and information that because of their limited coverage, do not meet the requirements of general audience publication.

The series is intended mainly for the diffusion of materials produced by ISNAR staff, but it is also available for the publication of documents produced by other institutions, should they wish to take advantage of the opportunity.

ACKNOWLEDGMENTS

This paper was prepared, in consultation with other ISNAR colleagues, for the Inter-Center Workshop on Farming Systems Research held at ICRISAT, India, in February 1986. In particular, the valuable comments made by M. Dagg, W.K. Gamble, J. Murphy, and D. Merrill-Sands are acknowledged, as well as the suggestions made by D. Byerlee (CIMMYT) and his encouragement to publish an unabridged version of this paper.

The views expressed in this paper are those of the author and therefore do not represent official ISNAR policy.

TABLE OF CONTENTS

I. INTRODUCTION 1

II. SOME MAJOR ORIENTATIONS FOR AGRICULTURAL RESEARCH AND THE RELEVANCE OF FSP IN SETTING RESEARCH PRIORITIES 2

III. MAJOR FORMS OF FSP; ITS ROLES AND INTEGRATION INTO A NARS 6

IV. ISSUES IN THE ORGANIZATION OF NATIONAL FSP PROGRAMS 9

- Technology Development and Transfer Issues and Their Implications 9
- Organizational Issues of FSP 12
- Managerial Issues of FSP 17

V. SUMMARY AND CONCLUSIONS: IMPLICATIONS OF FSP STRATEGY FOR NATIONAL PROGRAMS 23

BIBLIOGRAPHY 27

I. INTRODUCTION

Farming systems research (FSR) has received greatly increased emphasis and funding over the last two decades. As a result, national programs have been encouraged to introduce an adaptive, mostly on-farm, research component. The major objective of these efforts has been to create a linkage between research and its various clients (i.e., policymakers, the private sector, extension, farmers, etc.), through which feedback information about farmers' conditions and needs can be channelled and new technologies can be tested and adapted, with eventual transfer to farmers.

The domain of FSR covers a wide and varied range of activities involving studies of existing systems and the improvement and/or transformation of these systems as a result of interdisciplinary research in both on-station and on-farm environments. Because of the vastness of this research area, different organizations have tended to emphasize different aspects and have used different terminologies, thereby causing considerable confusion. All of the activities together could be termed "FSR sensu lato" (Simmonds, 1984) or "Research with a Farming Systems Perspective" (FSP), which includes on-farm research (Byerlee et al., 1982; Merrill-Sands, 1985). The FSP terminology is favored in this paper, since it signifies "an approach", and a "scientist's attitude" towards agricultural research, rather than thinking of it as a separate science.

In the past, FSP activities have been focussed mostly on technical issues and in particular on the development of methodologies for the on-farm research component. The need to institutionalize the FSP approach and integrate on-farm research (OFR) into the national research structures has received less attention. Instead, OFR has often been implemented as a seperate activity through externally funded special projects. Consequently, the managerial and organizational implications, including the essential linkages to on-station research, of decentralized, interdisciplinary OFR efforts, were frequently misjudged and underestimated. The often disappointing impact of such relatively short-term projects may thus eventually discredit the "FSP strategy" in spite of its sound objectives.

Therefore, this paper will draw attention to various organizational and managerial issues associated with the implementation of FSP, particularly its on-farm component. Since national programs differ greatly in their research capacities and needs, there will be no single model for institutionalizing FSP. This paper will therefore explore various alternatives for dealing with the organizational issues in a general way.

II. SOME MAJOR ORIENTATIONS FOR AGRICULTURAL RESEARCH AND THE RELEVANCE OF FSP IN SETTING RESEARCH PRIORITIES

In industrialized countries, the agricultural research effort is generally shared between universities and the public and private sectors, and there is often a fair degree of communication among these partners (Figure 1). Moreover, each of them will have linkages to the extension services

or even directly to farmers. Consequently, an effective two-way flow of information occurs, through which farmers are informed about new technologies, and scientists about the most urgent farmer problems. The information exchange is further enhanced by the considerable commercial interest involved.

By contrast, the situation in many developing countries, particularly in Africa, is very different. Extension services and private-sector research are often weak or non-existent, causing serious linkage problems between farmer needs and research, and a relative isolation of research programs from their major clients. To overcome this isolation, and thereby make research more effective, "Research with a Farming Systems Perspective" (FSP) has developed into a major strategy.

An important asset of FSP has been its holistic perspective, through which technical, biological, socioeconomic, and institutional aspects of agricultural production can be considered. Consequently, FSP serves technical research as well as the development services and institutions. It facilitates the integration of increasingly specialized, and thereby frequently fragmented, research efforts, while simultaneously providing a feedback channel from producers to scientists, policymakers, and developers.

Though these aspects apply to any farming systems work, the complexity of FSP will be much greater for diverse, mainly subsistence and rainfed, farming systems, than for irrigated (e.g., the Asian irrigated rice systems), commercial, and/or highly specialized commodity systems.

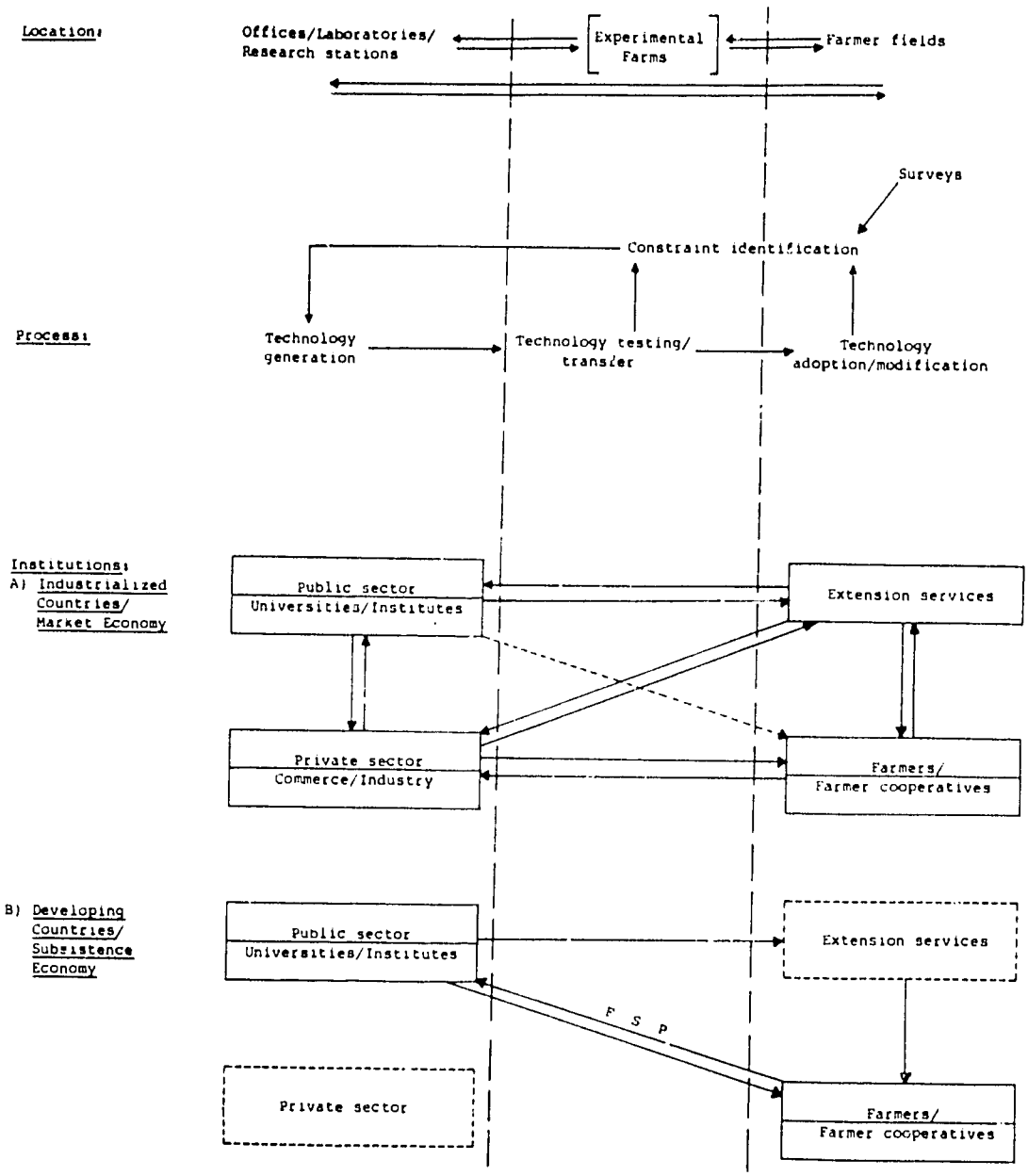

Figure 1. Comparison between the linkages involved in technology generation and transfer, and constraint identification for A) an industrialized (market economy) and B) a non-industrialized subsistence type economy.

Therefore, most rainfed and/or subsistence systems are more difficult to tackle and pose different demands on any strategy.

For instance, in rainfed systems the strategy of increased production and labor productivity aimed at producing surpluses will mainly benefit the larger farms on the most fertile lands, since they can accept greater risks. But mounting population pressures force increasing numbers of small farmers to cultivate marginal lands, often on steep slopes. As a result, vast areas are presently over-cultivated and threatened by land degradation, with potentially very serious social and ecological consequences. For such environments, research on increased sustainability at low input levels should therefore be emphasized as a vital complement to the research for increased productivity.

As a result of these dual research objectives the research system will become more effective in serving different categories of clients (see Inter-Center Seminar on Women and Agricultural Technology; Rockefeller Foundation/ISNAR, 1985). Also, this increases the emphasis on other production criteria, which may be as critical in technology adoption as the yield and biological potential criterion (see also Collinson, 1982).

The elements of productivity, stability, sustainability and equitability associated with various technologies, as discussed above, are utilized in the Agro-ecosystem Analysis and Development (AAD) approach proposed by Conway (1985). Contrary to the mainly productivity-oriented FSR, the AAD approach is based on agricultural ecology and human ecology. Therefore, it complements FSR by emphasizing the need to adapt technologies to various regional-scale agro-ecosystems, a task for which research and extension can provide the elements, but which farmers must implement.

Because of the diversity and complexity of many rainfed systems, a client orientation, and therefore some degree of on-farm involvement, is essential for research institutions serving these systems. While international and regional research organizations would limit their on-farm efforts to a few contrasting agro-ecological situations, national programs may aim for more on-farm sites that are managed in collaboration with the extension services. In such a way, FSP contributes directly to setting realistic priorities for national and international research, and to developing a wide range of technological options adapted to the needs and means of major categories of farmers working in different agro-ecological environments.

III. MAJOR FORMS OF FSP; ITS ROLES AND INTEGRATION INTO A NARS

Because of its holistic approach and its environment specificity, many different activities and approaches to FSP have evolved. Likewise, many research institutions have often limited their efforts to those components of the farming system in which they have special expertise. In response there have been several attempts (Simmonds 1984, Merrill-Sands 1985, Fresco 1985) to better define the various types of FSP and to formulate a unifying concept. As proposed by Simmonds (1984), one could recognize within "research with a farming systems perspective" -- FSP -- three major approaches:

* FSR sensu stricto, i.e., the description and base data analysis for existing farming systems in a holistic way to obtain an understanding

of the interactions between various components of the system, involving technical, biological, socioeconomic, and institutional aspects.

* On-farm research with a farming systems perspective (OFR/FSP), which is complementary to on-station research and should be directly linked to it. This type of research assumes that production increases are more likely to be achieved by stepwise changes in the components of the farming systems than by a revolutionary change in the entire system.

* Development of new farming systems (NFSD) which would involve a radical restructuring of the entire system (e.g., the changes from shifting and/or fallow cultivation to permanent cultivation).

Each of the three approaches can be pursued with varying intensities. A strict separation between approaches is, however, often irrelevant, because they are closely interrelated and highly complementary. For instance, NFSD would initially be conducted on-station, but its findings require on-farm verification. While technical, biological, and economic criteria will be emphasized at first, successful introduction of new systems at the farm level will generally also involve institutional and infrastructural changes (see francophone "Recherche-Développement" approach). Moreover, in practice the separation between NFSD and "on-station agronomic" research may not always be very distinct. However, all the approaches have an agro-systems (ecological) perspective and a client orientation in common, and should be implemented through interdisciplinary and inter-commodity research teams.

In theory, FSP serves to focus discipline- and commodity-oriented research efforts on immediate problems (generally of an interdisciplinary scope) of major client groups. The major roles of FSP, and on-farm research in particular, are the forging or strengthening of linkages between researchers of different disciplines and linkages of researchers with farmers/extension services and with policy-makers/commercial sector. Consequently, research scientists' interests are directed towards more practical problems, perceived in a systems context. Discipline- and commodity-oriented scientists would thus become more aware of the farm-level interactions between commodities and between commodities and the socioeconomic environment. Moreover, on-farm research activities would contribute to a greater decentralization of research efforts, through a flexible multilocation network which is complementary to the station network.

In principle, FSP and its OFR component should be an integral part of any national agricultural research system (NARS). In this context a NARS is composed of several components, including the public and private sector research institutes and the universities, as well as their linkages to government institutions, extension services, producers, consumers, international research, and donor organizations. Thus a NARS covers all the aspects of agricultural research that are relevant to a country's needs. However, in many NARS the linkages between the different components and with the clients are rather weak. Often this causes unnecessary duplication of activities and a poor flow of information, in particular between research, farmers, and extension services. To resolve some of these constraints, on-farm approaches have been developed, but their integration into the national research efforts has often remained problematic, for major organizational and managerial reasons which will be discussed next.

IV. ISSUES IN THE ORGANIZATION OF NATIONAL FSP PROGRAMS

Linkages between different research sections and between research and its various clients are vital for efficient technology development and technology transfer processes. An inadequate understanding of the very diverse technical, biological, and socioeconomic conditions of major groups of farmers can often be blamed for unrealistic assumptions about the needs and scope for improved technologies and subsequently for poorly conceived research programs. Consequently, most NARS will have two conflicting requirements: a) for decentralized on-farm activities to serve diverse production environments; and b) for concentrating the scarce human and financial resources. The reconciliation of these two requirements has substantial managerial and organizational consequences and even policy implications.

Technology Development and Transfer Issues and Their Implications

In Figure 1, the various institutions and communication channels important to the generation and transfer of technology were compared for industrialized and developing countries. Weaker institutions and less-prominent formal communication linkages to farmers are often typical for developing countries. Therefore, FSP has been developed as a mechanism to link research and farmer, while simultaneously strengthening the role of extension.

However, farmers and research scientists (not to speak of policymakers and administrators) generally have quite different perspectives about farming. To overcome these gaps, the use of multidisciplinary research teams and a continuous farmer participation in the research, for instance through a "farmer-back-to-farmer" strategy (Rhoades, 1984) have been developed. These approaches basically acknowledge that agricultural development is a step-by-step process. In this context socioeconomic and anthropological disciplines have drawn attention to three important aspects in the adoption and transfer of improved technologies (or technological packages) by most farmers:

1. Farmers generally adopt one, or at most two, components of the proposed improved package at the same time (Walker, 1981 a, b; Byerlee and de Polanco, 1986).

2. Farmers conduct their own local experiments to fine-tune the technological components to their farm environment and needs (Johnson, 1972; Rhoades, 1984).

3. There is considerable exchange of information and materials among farmers through informal communication channels (Biggs, 1984).

Certainly in the very variable and diverse environments of rainfed agriculture, common to many developing countries with weak formal institutions and communications, it would be desirable to emphasize much more the relevance and importance of these informal processes, which are all-too-often ignored (Biggs, 1984).

Against this background, the ongoing institutionalization and improvement of formal communication systems, though of major importance to many developing countries, frequently involve a "top-down" image of the Research ----> Extension ----> Farmer technology transfer process which is unjustified. In many countries, the large diversity in environments and clients, the huge size of target areas, the limited trained research manpower (Table 1), and limited facilities simply do not permit the use of highly standardized recommendations. This is underscored by the frequent modification or outright rejection of proposed technologies by farmers, mentioned above. In particular, there are reasons for concern when inappropriate recommendations (based on an inadequate understanding of the physical, biological, and socioeconomic environment) are centrally enforced by extension services to meet government policy. Increased farmer risks and major environmental and economic damages may be the result.

Under those conditions, non-uniform regional trials, supported, however, by standardized data-collection systems, will be more effective than routine multilocation implementation of standardized trials (Carangal, 1985; McIntosh, 1984). Furthermore, strengthening of both informal and formal communication systems, an emphasis on farmer participation in research, and on flexible recommendations developed through FSP programs, would constitute slower but more reliable approaches to technology development and transfer than some of the more aggressive, commodity-based extension programs. In this respect, the tailoring of new technologies and of technology transfer systems to the needs and available resources of different countries has often proved more problematic than anticipated.

Organizational Issues of FSP

Increased donor awareness of the need for adapted technology and the problems with its development, testing and transfer to farmers, has greatly stimulated donor support for FSP-type projects/programs (see also Figure 1). Implementation of the on-farm component is, however, frequently constrained by organizational and managerial factors, as well as a lack of adequately trained personnel. These have been common problems for the large and costly externally funded on-farm research projects; which in addition often suffered from uncertainties about their long-term funding prospects.

In order to avoid and/or overcome these organizational constraints it is useful to formulate the major functions of an FSP program. The first need would be to enhance the communication among researchers from different disciplines and from different on-station and on-farm programs, as well as between researchers and their major clients (i.e., policymakers, extensionists, and farmers). Second, the structure should be able to eventually support decentralized multi-locational research, both in technical and logistical matters, by providing flexible management and by attracting and retaining high-quality staff.

In analogy to the technology adoption process by farmers, one could also see the institutionalization of FSP by national programs as an evolutionary, step-by-step process (Heinemann and Biggs, 1985) in which,

theoretically, the following three major stages could be distinguished:

Stage 1 -- "Minimum FSP": This involves the introduction of a "Farming Systems Perspective", including some "on-farm research" (as a complement to the on-station research) by discipline- and commodity-oriented research scientists who, however, retain their major responsibility for experiment station work, as was discussed earlier in more detail (Stoop, 1984). Obviously, the incorporation of a "Farming Systems Perspective" can be incremental to the national research effort, without requiring a major reorganization of the institutes, nor large investments. A useful example of such a program and its expected interactions with extension is given by Palmer et al. (1982). In addition, however, the scientists need to recognize the value of face-to-face dialogues with farmers (Chambers and Jiggins, 1985).

Frequently, the greatest and most difficult changes will be the increased need for interdisciplinary collaboration, notably the integration of socioeconomic disciplines (mostly active in the on-farm situation) into institutes and/or programs which previously had a purely technical and disciplinary orientation. To achieve this integration and to bridge the gap between research and farmers, it is rather immaterial initially whether the OFR program is implemented near the experiment station or hundreds of kilometers away. The decision where to conduct OFR has, however, major implications for the organization and management (e.g., operating costs!) of these activities (see chapter 4.3).

The gap between research and extension could be narrowed in this stage by assigning subject-matter specialist duties to the research scientists. Another common solution has been the creation of small extension liaison units.

Stage 2 -- Special Coordinator for FSP: With the expansion of on-farm programs to include different commodities and different agro-ecological zones, it soon becomes necessary to coordinate the "minimum FSP" activities; hence the need for a leader/coordinator. Depending on the size of the country, and its agricultural diversity, the coordinator(s) could carry a national or regional responsibility and be attached to either the central national program or to a regional station or institute. Certainly in small national programs and for a "minimum FSP" program the coordinator/leader could be in charge of both on-station and on-farm activities. For large national programs with separate on-farm FSP teams (see stage 3), a special coordinating unit, also responsible for the linkage to extension, would be desirable. Since such a unit would have to deal with the representatives of various disciplinary and commodity programs as well as the extension services, the leader of the unit will have to occupy a senior position in the management hierarchy; i.e., probably above and certainly at the same level as leaders of major commodity programs.

Stage 3 -- A Separate On-farm FSP Team: This interdisciplinary and intercommodity FSP team would operate almost exclusively on-farm, and its activities would be complementary to on-station research. The

on-station research should retain, however, some of the "minimum FSP" involvement as described for Stage 1 (for an example, see the organization at Samaru, ABU, Nigeria, as described by Abalu, 1984, or for Indonesia, by McIntosh, 1984). The on-farm FSP team(s) would nevertheless require an experimental area which is under full control of the scientists, to test hypotheses and/or long-term technologies, which may be difficult to handle adequately in a less-controlled farm environment (McIntosh, 1984). As experience is gained, it might become desirable to create more than one on-farm research team, each team being oriented towards a major agro-ecological production zone. Consequently, the role of the coordinator becomes increasingly important in ensuring effective linkages among research groups as well as between research and extension, enhancing the multiplier effect of on-farm research, and between research and policymakers in signalling information on institutional and economic policy constraints.

The first two stages would be most effective for smaller national programs and as the initial response to introduce a client-oriented research approach in large systems. In this case the communication lines between research and its clients will be more direct than for a separate on-farm team. In any case, the role of the coordinator, or of the coordinating unit for large systems, is vital in creating effective linkages. Separate on-farm FSP teams, in order to maintain a long-term momentum, will always require support from relatively strong research systems which are able to utilize the feedback information as well as generate a continuous flow of new technology for testing by farmers. Consequently, stage 3 is particularly relevant to the stronger

and larger national programs and only after a "minimum FSP" has been successfully introduced. These points emphasize the necessity of a gradual development of these programs, particularly in the initial "minimum FSP" stage. Thus national programs should adopt - from the beginning - an organizational structure which is realistic with respect to their needs and capacity, in terms of, preferably, locally available resources of funding and trained manpower. As the national capacity and needs increase, this structure might be expanded to more complex and costly organizational forms which, for instance, occurred in Indonesia.

In Sub-Saharan Africa, however, large-scale donor support has often led to the creation of separate units for OFR on a project basis, thereby bypassing the initial two stages. This creation of relatively autonomous OFR projects, institutes, or departments should be considered undesirable because (a) the smaller NARS will often have insufficient trained manpower, even for their existing institutes; and (b) formal institutions often create communication barriers and fragmentation -- something FSP is supposed to alleviate. In this respect, national research efforts are frequently already constrained by excessive fragmentation and insufficient and uncertain availability of financial and human resources, all of which are critical to an effective organization of FSP programs.

It is hardly surprising, therefore, that most FSP programs will be relatively weak and poorly focussed, initially. Consequently, only limited impact and considerable shifts in scope and number of activities should be expected in any FSP program during the early stages. Failure by donors and host countries to appreciate these initial problems has led to unrealistic expectations and disappointments and in some cases even early termination of projects.

The DRSPR South-Mali Farming Systems project forms a useful example. It was started in 1978 as a rather isolated on-farm research project working in a few villages, emphasizing mostly socioeconomic aspects. Following an evaluation after the first five-year project period, it was almost terminated. Subsequently, by utilizing the experience gained in the first phase, and by changing its orientation, it became an important collaborative partner of both the extension service and national research. Presently it contributes greatly in training extension personnel, developing a typology of major farm households, and in pre-extension testing of various recommendations for livestock, animal traction, crops and cropping systems, fertility, land conservation, and farmer counseling by group meetings. It took about seven years for the project to become really effective as a linking mechanism between research, extension, and farmers. However, if donor funding were to be stopped, continuation of activities on local funding would be very doubtful, which is typical for the "seperate on-farm FSP team" approach in many African countries.

Managerial Issues of FSP

Obviously the successful organization of on-farm research depends most critically on the availability of a sizeable and competent staff. But certainly for most African countries, the number of available scientists is low (Table 1), which by itself will be a reason for poor communication with clients and between the various research components. The problem is further accentuated when the few experienced scientists are excessively specialized and little concerned about the practical, on-farm applications of their research. As a result, inexperienced junior

scientists, often without adequate leadership and supervision, are being assigned to complex on-farm research programs located in remote parts of a country. Moreover, to many national scientists, on-farm research does not offer the same attractive rewards in terms of academic prestige and recognition as station-based disciplinary research. The on-farm work environment, as compared with an air-conditioned office and laboratory, is frequently an additional adverse factor. Consequently, it is often difficult to motivate and/or retain scientists and technicians for on-farm work, even when providing additional incentives through the service conditions and reward systems.

Besides these human resource problems, on-farm research programs have a number of specific implementation requirements. These include:

- the selection of a realistic number of representative sites which are accessible at all times;
- the identification of major categories of farmers;
- the creation of a basis of confidence with collaborating farmers and their active participation in managing trials (this might take more than a year!);
- the need for timeliness in planning and implementing trials; use of appropriate experimental designs;
- the extent of data collection in relation to needs and analytical capability of the program.

In their survey of problems in FSR projects, Barker and Lightfoot (1985) confirmed that many projects were over-extended, lacked the proper interdisciplinary mix, followed a top-down approach without proper

involvement of either the extension service or farmers, and collected much data which in the end could not be analyzed because of faulty design or procedures. In this context major criteria in evaluating the efficiency of on-farm programs could be the extent to which collected data (from surveys and field experiments) are analyzed, interpreted, and utilized by various clients (research, policymakers, extention, and farmers).

To overcome these various problems in the short term, skillful management of the scarce human and financial resources is critical to successful implementation of on-farm research. In addition to a gradual introduction of FSP along the stages discussed earlier, this would involve:

- proper technical backstopping and regular supervision of the frequently young and inexperienced field staff;
- provision of adequate and properly maintained transportation (ranging from vehicles to motorbikes and bicycles) to ensure the mobility of field staff and thereby timeliness in the excecution of field operations;
- simple administrative procedures facilitating the timely availability of operating funds;
- realistic and stable budgets which are commensurate with the desired scope of the on-farm involvements.

It should be emphasized that OFR programs involve relatively minor capital investments but major recurrent operating costs. Consequently, proper budgeting and financial management tend to be even more critical for on-farm than for on-station research (ISNAR/CIMMYT, 1984). Certain policy and management decisions at the national program level may also contribute greatly to creating a favorable environment for OFR, notably:

* A recognition at the highest levels that improved linkages between farmers, researchers, and support services are vital to an effective national research capacity, and that FSP, including on-farm research, is a major tool for achieving this linkage. However, maintaining this linkage will require a national commitment to providing stable, long-term support in staff and funding to the research system as a whole; and also a commitment to resisting excessive fragmentation of the research system stemming from too many donor-funded projects.

* The need to link on-farm research closely to on-station research. As reported for a study in India, this may be achieved by organizing both activities under the same decision-maker (Biggs, 1983), which may be relatively easy for commodity programs and/or in small research institutes.

* The need for flexible management in a decentralized research structure to allow local teams a reasonable degree of technical and administrative independence (Banta, 1982) in order to focus on specific local needs and constraints, and to handle the most common operating costs efficiently.

It should be obvious that many of the earlier mentioned problems associated with OFR can be resolved in the short run through improved management and by aiming for a realistic program size.

However, longer-term solutions to some of the manpower problems should be found in a modified university curriculum, other more field-oriented training programs, and modified career development patterns and reward systems. These might be achieved by emphasizing:

* commodity-oriented interdisciplinary courses at the undergraduate level;
* introductory courses on farming systems (essentially interdisciplinary and intercommodity) and on the interrelationships between research and its various clients;
* practical field training which brings students of different disciplines together in an on-farm situation;
* assigning young graduates to the extension service for an initial one-year or two-year period, prior to a research assignment or studies for advanced degrees.

A greater emphasis on on-the-job training would focus attention on local problems and on solutions adapted to the local conditions (see Eicher, 1986). Moreover, thesis research for advanced degrees could also be conducted to a larger extent in-country on problems that are directly relevant to national agricultural development, with students spending relatively shorter periods abroad to attend certain complementary courses and to finalize their thesis.

Table 1: Comparison of numbers of agricultural research scientists with total population and total surface of arable land for some selected countries.

Countries	Total population (millions)[1]	Arable land (1,000 ha)[2] (1982)	Number of research scientists[3] (1982)	Inhabitants/ scientists (1980)	Arable area/ scientists (ha)
Asia					
Bangladesh	92.9	9,135	1,642	57,000	5,500
Sri Lanka	15.2	2,174	422	36,000	5,200
Indonesia	152.6	19,600	1,473	103,000	13,300
Malaysia	14.5	4,335	822	18,000	5,300
Latin America					
Ecuador	8.0	2,625	276	29,000	9,500
Honduras	4.0	1,739	60	67,000	29,000
Costa Rica	2.3	635	75	31,000	8,500
Argentina	28.4	35,800	1,064	27,000	34,000
Africa					
Madagascar	9.2	3,000	68	135,000	44,000
Senegal	6.0	5,227	105	57,000	50,000
Tanzania	19.8	5,200	256	77,000	20,000
Nigeria	90.6	30,435	1,084	83,000	28,000
Europe					
Italy	56.3	12,415	4,042	14,000	3,100
United Kingdom	55.8	6,978	2,554	22,000	2,700
Netherlands	14.3	862	1,471	10,000	600
USA	231.5	190,624	10,305	22,000	18,500

1 From: The World Bank "World Development Report 1984"
2 From: 1983 FAO Production Yearbook
3 Oram and Bindlish, 1981

V. SUMMARY AND CONCLUSIONS: IMPLICATIONS OF FSP STRATEGY FOR NATIONAL PROGRAMS

The realization that much agricultural research in developing countries has been conducted on experiment stations in isolation from the "real farming world" has greatly contributed to the increased emphasis on FSP as an effective tool in linking research with farmer needs (see Figure 1). Consequently, the cost-effectiveness of research might be improved by focussing on adaptive and applied research for farmer-level problems, and by shifting part of the research effort from on-station to on-farm situations. In theory, these arguments are sound, but the reality is often more complicated.

In adopting the FSP strategy, national research leaders and donors have tended to underestimate the implications of several key constraints. First of all, the regionalized and decentralized nature of on-farm activities creates greater demands on the national organizational and managerial capabilities than for centralized on-station research. Second, FSP serves, in particular, a linkage function between research and its various clients and, therefore, its success greatly depends on the quality of the support it receives from conventional commodity and disciplinary research programs. Thus, to ensure a maximum effectiveness of the FSP effort, national programs should consider the following:

* The national FSP capacity, in particular the on-farm research

component, is built up gradually and in a way which is commensurate with the available national scientific manpower and financial resources, thereby avoiding the common problem of over-extended on-farm programs.

* On-farm research is integrated into the existing commodity and disciplinary research, which means that it is backed by, and feeds into, on-station research programs, and contributes to the formulation of research and agricultural policies at the national level, as well as to recommendations useful to the extension service at the local level.

* FSP is conducted on a permanent basis and by an interdisciplinary group of scientists, including socio-economists, in which the different disciplines have sufficiently broad interests to allow effective communication and collaboration among disciplines.

* Because of the interdisciplinary nature of FSP, effective communication and collaboration between different scientific departments and/or institutions (even belonging to different ministries) will be required. To avoid duplication and confusion from on-farm activities conducted by different commodity programs, FSP needs to be organized eventually across these programs and to be focussed on major production systems.

In addition, agricultural research programs, in general, and on-farm research programs, in particular, make specific demands on management which should ensure that:

* Adequate administrative and organizational structures are present which provide the essential logistic and professional support to the field staff, while allowing for a maximum of flexibility and independence in handling day-to-day administrative activities. This would also involve:

  1) realistic budgets and timely availability of funds to cover the considerable operating costs;

  2) the availability of adequate transportation, critical to the timely execution of field operations and regular supervision of field staff and technicians;

  3) effective communication between on-farm and on-station research and with other clients, involving joint trials, field visits and program committees at national and regional levels.

* Adequate scientific and support personnel are trained and hired; and that the conditions of service and reward systems are such that the turnover in scientific and technical personnel is minimized, in spite of sometimes difficult on-farm working conditions.

The various issues discussed above would indicate that national programs could best introduce on-farm research and FSP in a gradual, step-by-step fashion guided mainly by the availability of manpower and funds. For successful implementation and to maintain a long-term momentum, this type of research depends most critically on adequately trained scientific

and support staff and its effective linkage to strong commodity and disciplinary (on-station) research, as well as to extension and farmers. However, in many African countries, where on-farm research has been introduced on an externally funded project basis, these conditions have basically not been fulfilled; which often leads to relatively disappointing results (Harwood, 1985). In this respect, on-farm research should be seen as an essential, though small, component of an overall national research program (Eicher, 1986). Consequently, there is a large need to be flexible in tailoring on farm research programs, and FSP in general, to the needs and capabilities of national programs.

External project support may play an important catalytic role in institutionalizing FSP. Often, however, the required financial support will be modest at first. Only when the "minimum FSP" capability has been built up, and in most cases only for relatively strong national programs, would it be justified to create "separate on-farm FSP teams" on a project basis.

BIBLIOGRAPHY

ABALU, G.O.I. 1984. Organization and Management of Farming Systems Research: Experiences from Nigeria. pp. 29-38. Proc. of a Workshop. Issues in Organization and Management of Research with a Farming Systems Perspective Aimed at Technology Generation. CIMMYT/ISNAR, The Hague, Netherlands.

BANTA, G.R. 1982. Asian Experience in Cropping Systems Research. pp. 126-130. In: Intercropping. Proc. 2nd Symp. Intercropping in Semiarid areas. Morogoro, Tanzania, 4-7 August 1980. IDRC, Ottawa, Ontario, Canada.

BARKER, R., and C. LIGHTFOOT. 1985. Farm Experiments on Trial. Paper prepared for Symp. FSR/E Management and Methodology, 13-16 October 1985. Kansas State University, Manhattan, Kansas, USA.

BIGGS, S.D. 1983. Monitoring and Control in Agricultural Research Systems: Maize in Northern India. Research Policy 12:37-59.

BIGGS, S.D. 1984. Awkward but Common Themes in Agricultural Policy pp. 59-74. In: Room for Manoeuvre -- An Explanation of Public Policy in Agriculture and Rural Development. E.J. Clay and B.B. Schaffer Editors; Heinemann Educational Books, London, England.

BYERLEE, D., L. HARRINGTON, and D. WINKELMANN. 1982. Farming Systems Research: Issues in Research Strategy and Technology Design. Amer. J. Agric. Econ. 64:897-907.

BYERLEE, D., and E.H. de POLANCO. 1986. Farmers' Stepwise Adoption of Technological Packages: Evidence from the Mexican Altiplano. Submitted to: Amer. J. Agric. Econ. Febr. 1986.

CARANGAL, V.R. 1985. Collaborative Research on Rice-Based Farming/ Cropping Systems in Asia: Workshop on Indonesia's Farming Systems Research. SARIF, Dec. 10-14, 1985.

CHAMBERS, R. and J. JIGGINS. 1985. Agricultural Research for Resource-poor Farmers: A Parsimonious Paradigm. Institute of Development Studies, University of Sussex, Brighton, England. 44pp.

CIMMYT/ISNAR. 1984. Issues in Organization and Management of Research with a Farming Systems Perspective Aimed at Technology Generation: Proceedings of a Workshop. ISNAR, The Hague, Netherlands.

COLLINSON, M.P. 1982. The Use of Farming Systems Research for Understanding Small Farmers and Improving Relevancy in Adaptive Experimentation. pp. 121-125 In: Intercropping: Proc. 2nd Symp. on Intercropping in Semi-Arid Areas. IDRC, Ottawa, Canada.

CONWAY, G.R. 1985. Agricultural Ecology and Farming Systems Research. In: Remenyi, J.V. (ed) Agricultural Systems Research for Developing Countries. Proc. Intern Workshop Hawkesbury Agric. College Richmond Australia: pp. 43-59

EICHER, C.K. 1986. Transforming African Agriculture. The Hunger Project Papers No. 4. The Hunger Project, 1338 Sutter Street, San Francisco, CA 94109, USA. 35 pp.

FAO. 1984. 1983 FAO Production Yearbook. FAO Statistics Series No. 55.

FRESCO, L.O. 1984. Issues in Farming Systems Research. Neth. J. Agric. Sci. 32:253-261.

HARWOOD, R.R. 1985. A Winrock Perspective on the Evolution of FSR/E: Lessons for Indonesian Consideration: Workshop on Indonesia's Farming Systems Research. SARIF Dec. 10-13, 1985.

HEINEMANN, E. and S.D. BIGGS. 1985. Farming Systems Research: An Evolution Approach to Implementation. J. Agric. Econ. 36(1):59-65.

JOHNSON, A.W. 1972. Individuality and Experimentation in Traditional Agriculture. Human Ecol. 1:149-159.

McINTOSH, J.L. 1984. Institutionalizing FSR/E: The Indonesian Experience: Farming Systems Research Symposium, Kansas State University, Oct. 7-10, 1984.

MERRILL-SANDS, D. 1985. A Review of Farming Systems Research. TAC/CGIAR Secretariat, FAO, Rome, Italy.

ORAM, P.A., and V. BINDLISH. 1981. Resource Allocations to National Agricultural Research: Trends in the 1970s. ISNAR, The Hague, Netherlands and IFPRI, Washington, D.C., USA.

PALMER, A.F.E., A.D. VIOLIC, and F. KOCHER. 1982. Relationship Between Research and Extension Services and the Mutuality of Their Interests in Agricultural Development. Paper presented at Third FAO/SIDA Seminar on Field Food Crps in Africa and the Near East held in Nairobi, Kenya, June 6-24; 1982. CIMMYT - Mexico D.F. 21 pp.

RHOADES, R.E. 1984. Breaking New Ground -- Agricultural Anthropology. International Potato Center (CIP), P.O. Box 5969, Lima, Peru, 71pp.

ROCKEFELLER FOUNDATION AND ISNAR. 1985. Women and Agricultural Technology: Relevance for Research. Vol. I. Analyses and Conclusions. ISNAR, The Hague, Netherlands.

SIMMONDS, N.W. 1984. Farming Systems Research: The State of the Art. Agriculture and Rural Development Department, World Bank, Washington, D.C., USA.

STOOP, W.A. 1984. Interdisciplinary and Intercommodity Aspects in the Organization of Farming Systems Research Programs. Paper presented at the INTSORMIL Workshop held at CIMMYT, Mexico, September 17-21, 1984.

WALKER, T.S. 1981 a. Risk and Adoption of Hybrid Maize in El Salvador. Food Res. Inst. Studies 18:59-88.

WALKER, T.S. 1981 b. A Package Versus a Gradient Approach in the Development and Delivery of Technology in Dryland Agriculture. ICRISAT Econ. Prog. Patancheru P.O., Andhra Pradesh 502 324, India.

WORLD BANK. 1984. World Bank Development Report 1984. Oxford Univ. Press. New York, U.S.A.

B:4066S/was,co