

TRAINING IN FARMING SYSTEMS RESEARCH: REVIEW AND PROSPECTS

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SUMMARY

A wide variety of training activities has been carried out related to farming systems research (FSR). The majority have had one or more of the following objectives: to introduce the farming systems perspective, to teach new research methods, and to promote the institutionalization of FSR. Many of these objectives are important, but FSR training is not usefully seen as a separate field of endeavour. The goals of FSR training will be better served by reconsidering the roles of universities, national research institutions, and international institutions.

Robert Tripp y Jonathan Woolley: *Capacitación en la investigación en sistemas agrícolas: revisión y perspectivas futuras.*

RESUMEN

Se ha ejecutado una amplia gama de actividades de capacitación relacionadas con la investigación en sistemas agrícolas (ISA). La mayoría ha tenido por lo menos uno de los siguientes objetivos: presentar la perspectiva de la ISA, enseñar nuevos procedimientos de investigación y promover la institucionalización de la ISA. Muchos de estos objetivos son importantes, pero la capacitación sobre la ISA no debe considerarse una actividad independiente. Las metas de la capacitación en ISA se lograrán mejor por medio de una reevaluación de la función que desempeñan las universidades, institutos nacionales de investigación e instituciones internacionales.

INTRODUCTION

Farming systems research (FSR) has occupied an important place in the conduct of agricultural and rural development for well over a decade. It has been the focus of a large number of agricultural research and extension activities managed by national and international organizations, donor agencies, universities, and others (CGIAR/TAC, 1978; IARCs, 1987). An important part of the FSR movement has been the development of a wide variety of training programmes, aimed primarily at members of national agricultural research institutions. As the future of FSR and its contributions to agricultural research are the subject of current debate (e.g. Tripp *et al.*, 1990a), we review here some of the major efforts in FSR training and suggest some future directions.

An immediate challenge for any discussion of FSR training is to decide what constitutes FSR. There are several useful classifications of the activities that fall within the FSR rubric (Merrill-Sands, 1986; Simmonds, 1986) and it is not our purpose to attempt further explication of the term. Indeed, we argue later that the conception of FSR training as a separate field of endeavour should be reconsidered. Nevertheless, it is necessary to identify those skills and concepts

that have generally been the objectives of FSR training. For this purpose, FSR can be described on at least three different but interrelated levels, each of which has presented opportunities for training: a perspective on small-farm agriculture, a set of research methods, and a way of organizing research.

The farming systems perspective

A common element in virtually all types of FSR is the conviction that improving the productivity of small-farm agriculture depends on an understanding of the interactions characteristic of farming systems. This farming systems perspective (Byerlee *et al.*, 1982) recognizes that most small farms involve the integration of multiple enterprises and require the management of diverse household resources to meet a range of subsistence, income and community goals. Such complexity requires a different approach or attitude (Stoop, 1987) to research than that usually found in traditional commodity or disciplinary research programmes. This perspective also implies a commitment to the inclusion of farmers' criteria and goals in setting research priorities. A considerable amount of training in FSR has been devoted to introducing and explaining this farming systems perspective, and to promoting an interdisciplinary, problem-solving approach to research that includes client farmers' perceptions.

FSR methods

FSR is associated with the development of a wide range of research methods (e.g. Shaner *et al.*, 1982). These include diagnostic techniques for describing farming systems and identifying production problems; methods for planning, designing, and executing on-farm experiments; and procedures for analysing research results, deriving recommendations, and developing messages for extension. The great variety in these methods has caused some confusion about FSR, but on the whole they represent an innovative set of tools for carrying out location-specific adaptive research. A major emphasis of FSR training activities has been on developing researchers' skills in using these methods.

Research organization

FSR has also been responsible for encouraging significant organizational changes within national agricultural research institutions. The adoption of a farming systems perspective and the utilization of new research methods has had important consequences for the way in which research institutions deploy personnel, plan research, and organize communications. The effect of these changes has only recently been examined (Merrill-Sands *et al.*, 1989) and relatively little FSR training to date has consciously addressed research organization and management. Nevertheless, the relationship of training methods to the institutionalization of FSR deserves attention.

These three aspects of FSR - perspective, methods and organization - would seem to offer a logical sequence for the development of FSR and for a parallel

Table 1. *Examples of FSR training activities, classified by training objectives*

Introduce farming systems perspective	Teach FSR methods	Institutionalization of FSR
Introductory workshops	Short courses on research methods	Workshops for administrators
Classroom simulations	In-service courses at international centres	
Courses of instruction organized around systems perspective		
<i>Introduce perspective and teach FSR methods</i>	<i>Institutionalization and teach FSR methods</i>	
Introductory courses on diagnostic surveying, economic analysis, etc.	Orientation in field methods for new members of research service	
Postgraduate courses in FSR methods	Long-term training and follow-up for national programmes and extension agents	

training strategy. Acquaintance with the farming systems perspective is necessary for an appreciation of FSR methods, and the adoption of particular methods has consequences for research organization. But addressing such a variety of educational objectives often requires a combination of approaches. The objectives of some training activities can be precisely defined and narrowly delimited (e.g. Shute and Moore, 1982), while other training activities may be designed to have both direct and implicit effects on the learner (Joyce and Weil, 1986). In FSR training, activities that present FSR methods may have both direct and implicit objectives. Training in FSR methods has been used not only to develop particular research skills but also as a means to introduce the farming systems perspective and as a stimulus to considering alternatives for research organization.

Although it is often difficult to separate the three aspects of FSR in particular training activities, the following three sections of the paper are organized around these objectives (Table 1). We describe some of the FSR training activities that have addressed each of these objectives. Examples are used for illustration, but are not intended to provide a thorough inventory of all FSR training programmes. Emphasis must perforce be on a review of formal, well-established training activities and materials that are described in published sources, although learning about FSR also takes place in many informal situations. This review is followed by an attempt to re-examine the contributions of FSR and FSR training and to suggest how the concerns of FSR might best be addressed by improvements in the stock of knowledge, university training, and the activities of national agricultural research institutions and international organizations.

TRAINING IN THE FARMING SYSTEMS PERSPECTIVE

The farming systems perspective has been included in numerous training activities. Researchers and extension agents, as well as administrators, have

been introduced to the systems concept in short courses, in-service training, and degree training. Both classroom activities and field work have been used. A variety of classroom techniques present the concept of a farming system, including those that make use of formal systems theory. The University of Western Sydney (formerly Hawkesbury Agricultural College) in Australia has introduced an entire agricultural degree programme based on a systems approach to problem solving, with emphasis on the study of systems rather than on subjects or disciplines (Bawden *et al.*, 1984). Some of the postgraduate training at the Tropical Agricultural Centre for Research and Training (CATIE) in Costa Rica is also organized around systems concepts (Hart, 1980).

Other classroom techniques develop a familiarity with the situations of resource-poor farmers. An innovative approach to acquainting students with the complexities faced by farmers has been the development of several simulation games for classroom use that focus on decision-making in small-farm agriculture (Oxenham, 1982).

In addition, a wide range of short courses and workshops has been developed to introduce the perspective. The Farming Systems Support Project at the University of Florida organized a number of one-week seminars to introduce the farming systems perspective to staff and administrators associated with farming systems projects sponsored by the United States Agency for International Development (USAID). Short courses have included such topics as the concept of farming systems, the use of farmers' circumstances as a basis for setting research priorities, and the identification of target groups. The CIMMYT Economics Programme has offered a number of workshops on the economic analysis of on-farm experiments to research leaders and administrators. The primary objective for this audience has not been to teach analytical techniques but rather to reinforce the importance of understanding the constraints and conditions that farmers face when they consider a new technology.

In many cases where FSR training has sought to introduce the farming systems perspective, field exercises have been used (Gilbert *et al.*, 1980). This is often done through the use of an informal survey, in which participants spend at least several days in the field informally discussing a series of themes with farmers and observing their fields. Such techniques are part of a wider effort in 'rapid rural appraisal' (Carruthers and Chambers, 1981) that has been developed parallel to the FSR movement. The experience of describing, analysing and interrelating the activities of a farming system serves both to introduce a valuable diagnostic technique and to bring course participants face to face with the decisions and constraints faced by farmers. Such survey training is also an excellent way to stimulate interdisciplinary communication (Conway, 1985).

Longer courses designed to introduce the farming systems perspective also rely on field survey experience. The six-month International Course for Development Oriented Research in Agriculture (International Agricultural Centre, undated), features approximately 13 weeks of fieldwork in a developing

country. Participants are expected to use various diagnostic techniques to develop a detailed report and a set of research proposals for improving the farming systems of their study area.

As FSR gained importance with USAID, several US land grant universities began to offer courses in FSR in order to introduce the perspective. Cornell University developed a one-semester course for postgraduates that included classroom work on systems description and research methods and a field exercise with local farmers (Casey and Barker, 1982). The University of Florida established a programme in FSR for both MS and PhD candidates. This programme features two core courses and students are supervised by a multi-disciplinary faculty committee.

TRAINING IN FSR METHODS

Most of the International Agricultural Research Centres (IARCs) offer courses in farming systems research or on-farm research (TAC/CGIAR, 1986). These courses often last several months and cover various research methods, including diagnosis, experimentation and analysis. IRRI's Cropping Systems Training Programme introduces participants to the methods of cropping systems research, and includes both fieldwork and classroom instruction. CIMMYT's training programmes in maize and wheat production are centred on a set of on-farm experiments that are the responsibility of course participants. The CIAT bean programme gives instruction and practice in on-farm research in an eight-week intensive course by teaching diagnosis and planning, and trial planting, management and analysis in areas of Colombia with different cropping cycles.

A farming systems research workshop for research and extension personnel from eastern and southern Africa has been carried out at the University of Zimbabwe since 1983. The workshop introduces participants to the methods and concepts of FSR, and is divided into a three week session on diagnostic and planning techniques, and a two week session on experimentation and analysis. An annual three-week training course on farming systems research and extension for West Africa is to begin in 1990 at the University Centre of Dschang in Cameroun.

Many shorter courses that focus on particular FSR methods are also offered. Courses on diagnostic surveying offered by IITA include experience of converting diagnostic data to plans for on-farm experiments (Mutsaers, 1985). IRRI offers a two-week field course that includes farming systems diagnosis and the development of farmer participation in the design of new technologies (IRRI, 1987). In eastern and southern Africa, CIMMYT has established advanced courses for practitioners on survey design and analysis, and on the economic and agronomic analysis of on-farm experiments. The United States Department of Agriculture (USDA) currently sponsors a five-week course at the University

of Florida on FSR methods, including a field project, for developing country researchers.

A number of publications on FSR methods are available to support these training efforts. The IRRI cropping systems methodology is presented in Zandstra *et al.*, 1981. Training texts are available on diagnostic techniques (Byerlee and Collinson, 1980), planning an on-farm experimental programme (Tripp and Woolley, 1989) and economic analysis of on-farm experiments (CIMMYT, 1988). Diagnostic, experimental and analytical methods are summarized in Mutsaers *et al.* (1986) and Fakki (1988). A manual on the diagnosis and design of agroforestry research has recently been published (Raintree, 1987). Teaching materials are also being developed that demonstrate how to include gender concerns in research planning (Feldstein and Poats, 1990). A comprehensive collection of training materials on FSR methods has been produced by the Farming Systems Support Project (FSSP, 1987). IRRI has compiled the materials used for their Farming Systems Socioeconomic Training Course (IRRI, 1986).

FSR TRAINING AND INSTITUTIONALIZATION

Many of the early approaches to FSR training gave little consideration to their institutional implications, concentrating instead on introducing the philosophy and concepts to ill-defined 'FSR teams' (e.g. Shaner *et al.*, 1982). There seemed to be an assumption that FSR methods could be easily accommodated in the operating procedures of agricultural research institutions. This of course was not the case, and integrating FSR activities within research organizations is still very much an issue (Merrill-Sands and McAllister, 1988).

There are two challenges that need to be addressed. First, FSR concepts and methods need to be introduced to research and extension organizations in a way that allows local institutions to accommodate the procedures to their own circumstances and encourages a wide range of staff to participate in the process. Second, research and extension administrators need specific training in the management requirements for FSR. The latter has only been addressed through occasional workshops and meetings, but there are a number of examples of the former initiative.

Several national research institutions offer training and orientation to newly recruited members of the research service. The national research institution of Guatemala (ICTA) offers a 10-month course, including diagnostic work and on-farm experimentation, for its staff (Ruano and Fumagalli, 1988). Scientists joining the Indian Agricultural Research Service must undergo a five-month foundation training course that includes two months at a research station where participants propose a research project based on their interactions and discussions with local farmers and extension agents (Raman, 1987).

Donor projects aimed at developing FSR capacity at the national level have at times taken a comprehensive approach to training. A USAID-sponsored

project with the Senegal Agricultural Research Institute involved Michigan State University providing technical assistance in FSR in Senegal and offering summer workshops to Senegalese researchers who were in the US for post-graduate training.

Another way of addressing the institutionalization of FSR is through training activities that involve a long-term commitment to individual research organizations. The on-farm research courses in bean cropping systems run by CIAT teach procedures and also aim to establish FSR within institutions. Roughly equal numbers of researchers and extensionists are included. Economists, plant protectionists and breeders are found alongside agronomists. The practical work is conducted at locations where there is already a strong institutional relationship between CIAT and the researchers and extensionists of the Colombian Agricultural Institute (ICA). Participants are carefully selected, either to strengthen an existing FSR effort or to encourage an institutional interest in FSR. Preference is given to those who are responsible for both the design and execution of research programmes. After learning the procedures of on-farm research, the participants develop and present work plans that take account of the resources available to their own institutions. After the course, participants receive follow-up visits from CIAT staff, especially during research planning activities.

CIMMYT has offered a number of long-term in-country training courses in on-farm research, using a 'call system' of teaching (Tripp *et al.*, 1990b). The participants are researchers and extension agents who have been assigned on-farm research duties by their respective institutions. They are brought together for 'calls' of one to two weeks to carry out particular activities (conducting an informal survey, planning an experimental programme, taking data from on-farm experiments, etc.) as part of an actual on-farm research project in one area of the country. The course usually covers two agricultural seasons, including between four and six calls over approximately a year and a half. Participants are expected to carry out and apply the methods they have learned in their own areas between calls. The course leaves a viable on-farm research activity in the hands of the participants, designed and executed by national staff. It serves a team-building function for the local institutions and provides a framework for researchers and extension agents to plan and review their own work.

CIAT has applied a similar approach in various Latin American countries, using three calls spread over 12 to 18 months (CIAT, 1988). Compared with the intensive single-phase courses held at CIAT headquarters, in-country courses helped establish FSR within a country, allowed participants practice and follow-up by tutors between phases, were cheaper to execute, and were closer to the participants' own conditions. On the other hand, the headquarters courses permitted more discussion among practitioners from different countries and provided access to more teaching staff and well-established examples of FSR programmes.

Finally, institutionalization of FSR can be promoted by the formation of networks that grow out of training activities. Such networks may be established among former participants of training courses, as in the case of the Asian Farming Systems Network originally established by IRRI and now managed by participating countries.

FUTURE NEEDS

Despite the tremendous amount of effort invested and the wide variety of activities that have been developed, FSR training has not had the impact that might be expected. There is still a large gap between theory and practice; while many people have some notion of the farming systems perspective, relatively few are able to put it into practice. FSR training has not been very effective at institutionalizing the approach in national research programmes. In addition, a continuing proliferation of courses and methods has contributed to inefficiencies in training. FSR, in short, is losing some momentum.

In the previous sections we have treated FSR training as if it were a distinct field of learning, because many training activities of the past decade have been so denominated. But consideration of future training needs requires a different approach. Rather than representing a separate discipline, FSR comprises a perspective, a set of research methods, and implications for the organization of adaptive research and extension. The challenge is to decide how best to take advantage of these potential contributions of FSR, to agree on the skills and concepts that are deemed important, and to propose efficient ways of transferring them. It is easy simply to call for more training in answer to this challenge, but we present an outline that sees formal training as only one element in a broader strategy.

The concept of the 'agricultural knowledge system' (TAC/CGIAR, 1986) is used to organize the discussion. This system comprises the stock of knowledge currently available, plus the means of increasing, evaluating, applying and disseminating new knowledge. The following discussion attempts to assign responsibilities for achieving the goals of FSR training among various components of the agricultural knowledge system (Table 2). First, we briefly examine the stock of knowledge in FSR, focusing on the methods and materials that need to be developed. We then look at the range of institutions that may contribute to training and dissemination strategies, concentrating on developing country universities, national agricultural research institutions and international institutions. There are other institutions that form part of the agricultural knowledge system, but we focus only on those that have been major actors in formal FSR training activities. The important role of intermediate organizations, such as farmer groups, in stimulating and channelling relevant agricultural research is not treated here (Roling, 1988).

Table 2. *Future responsibilities to achieve objectives of FSR training*

Elements of agricultural knowledge system	Training objectives		
	Perspective	Methods	Institutionalization
Stock of knowledge	Descriptions of farming systems and how they change	<p>Syntheses of research methods</p> <p>Adaptations of methods to local situations</p> <p>Summaries of technological innovations useful to resource-poor farmers</p>	Applications of management science to agricultural research and extension
Developing country universities	<p>Introduction to local agricultural problems and priorities</p> <p>Use of local examples in teaching</p> <p>Emphasis on interdisciplinary problem-solving</p> <p>Field research opportunities for students</p>	Training in practical field research methods	Interaction with local research and extension institutions
National agricultural research institutions	<p>Encouragement of interdisciplinary research</p> <p>Clear definition of clientele and goals</p>	<p>Training in local modifications to research methods</p> <p>Well defined operating procedures for adaptive research</p> <p>Provision of reference materials in research methods</p> <p>Organization of short courses on research methods</p>	<p>Rewards for problem-solving research</p> <p>Joint training and planning activities with extension</p> <p>Clear conception of how adaptive research activities fit into career development</p> <p>Improved planning and reporting procedures</p>
International institutions	<p>Provision of examples of interdisciplinary, problem-solving research</p> <p>Technology development for resource-poor farmers</p>	<p>Training in advanced topics</p> <p>Applied research to refine research methods and develop technology</p> <p>Development of training materials</p> <p>Coordination of training activities</p>	Identification of training opportunities in research and extension management

THE STOCK OF KNOWLEDGE IN FSR

The farming systems perspective is well established as an organizing principle for description and analysis in various agricultural fields (Ruthenberg, 1980; Turner and Brush, 1987). Much has been learned about how farmers have adapted to the difficult and varied conditions that characterize developing country agriculture. But analyses of farming systems are not sufficient. They must be complemented by descriptions of improvements in farming systems achieved by research and extension. More information is also required on methodologies for developing components for complex farming systems, such as breeding and selection of varieties for multiple cropping systems (Francis, 1986).

More attention must also be given to descriptions of research methods. Although much has been written about FSR, and various training materials and texts are available, there is still a need to order and summarize much of what has been learned. The history of FSR, with a wide variety of approaches sponsored by different institutions in various settings means that the literature of FSR is uneven, dispersed and overwhelmingly 'grey'. More effort needs to be placed on synthesizing the advances that have taken place in research methods (Harrington *et al.*, 1989).

Although diagnostic techniques such as informal surveying are well described in the literature, other methods require more development, testing and synthesis. One example is the recent interest in evaluating various techniques that provide closer interaction between researchers and farmers (e.g. Ashby *et al.*, 1987). Another priority area is the development and description of efficient techniques for agronomic diagnosis under farmers' conditions. Better guidelines are also needed for applying the statistical principles of experimental design and analysis to the varied conditions of farmers' fields.

The work of ordering and synthesizing the experiences of FSR to produce useful guidelines on research methods needs to be balanced by the equally important challenge of tailoring methods and materials to local needs. The production of training materials and texts appropriate to particular regions or countries is well underway in a number of national research programmes (e.g. Sharma and Mathema, 1988) and should be encouraged.

UNIVERSITY TRAINING

A number of universities in developing countries have been involved in FSR through research programmes (e.g. Khon Kaen University, 1987) and include FSR courses as part of the regular curriculum. There are also some degree programmes in FSR such as the MSc programmes in FSR at the Asian Institute of Technology in Thailand and at the Institut Pertanian Bogor in Indonesia. A new Swedish/FAO initiative in FSR for eastern and southern Africa includes a

focus on local university teaching staff. Involvement in FSR offers universities the opportunity to address national agricultural and rural development problems (Rathberger, 1988). But because FSR is not a separate discipline, it is probably better to explore how the procedures and concepts can strengthen the university curriculum than to establish separate academic programmes or departments in FSR.

One contribution to instilling a farming systems perspective in students of agriculture is the use of local examples in teaching. Fertilizer response functions can be illustrated just as easily by reference to a maize field under local management practices as by a soyabean field in a developed country. Farm budgets can be illustrated using data from a small farm household just as easily as from a commercial enterprise. The use of local examples of agricultural practices and a stress on their rationale will help to produce graduates familiar with local farming problems and better prepared to enter national research and extension institutions.

Classroom training should be complemented by relevant field experience, both for thesis research and for training in research methods. For reasons of both economy and relevance, university field projects concerned with adaptive research should be carried out in conjunction with ongoing work of either national research and extension institutions or of non-government organizations that offer the possibility of reaching large numbers of farmers. There are a number of examples of such interactions; several universities in the Philippines provide FSR training for researchers from the Bureau of Agricultural Research, for instance.

University training can also provide experience with interdisciplinary research. A balance must be struck, however, between providing an appreciation of various fields and building disciplinary competence. Experience in how to work creatively in an interdisciplinary setting is more useful as part of a course of farming systems study than a superficial sampling of a wide range of disciplines. Given the continuing shortage of personnel in many developing countries, however, interdisciplinary thinking by individuals (Simmonds, 1986) will also be important, complemented by good judgement in knowing when and how to consult disciplinary experts.

NATIONAL RESEARCH INSTITUTIONS

The institutionalization of FSR concepts and procedures at the national level depends both on the provision of relevant training opportunities and on the ability of national institutions to provide clear goals and career structures to the staff they recruit. One reason for the limited efficiency of FSR training in national institutions has been the exceptionally high staff turnover rates. Much more attention needs to be placed on human resource development in national research and extension institutions (Bingen and Poats, 1990).

The organization of in-house training for national institutions, including the

training of trainers, is an important consideration. It is unlikely, however, that any but the largest institutions will find it efficient to establish and staff permanent training programmes. This implies as an alternative the identification and training of senior staff who can offer occasional seminars or workshops on particular topics. Researchers must, however, be provided with opportunities to keep abreast of new research methods and to improve their training skills. Other training opportunities can be developed through networks of national institutions.

The nature of formal training in topics related to FSR provided by national institutions will depend on the experience of staff and the type of research being conducted. The farming systems perspective should be evident in the operations of the national institution, in areas such as the conduct of informal surveys, interdisciplinary planning procedures, and in the integration of adaptive research. If there is a continual need to 'reintroduce' these concepts, then something is wrong. Apprenticeships for new junior staff or exchange visits among more senior personnel should obviate the need for much formal introductory training. More advanced training in design, analysis or monitoring techniques may require formal presentations by national staff, using local data and research problems wherever possible.

Whatever training strategies are adopted to address the interests of FSR, the entire national institution is the appropriate focus. Although some institutions may have separate FSR or adaptive research units, the establishment of the farming systems perspective and the utilization of FSR methods must not be restricted to such units. Similarly, although FSR includes a strong contribution from social science, occasional FSR training activities should not be seen as a substitute for the establishment of strong social science capacity within national programmes (Byerlee and Tripp, 1988).

Probably the most important factor in assuring that the concerns of FSR are incorporated in the work of national programmes is the establishment of clear operating procedures, which is a question of research management. The difficulties that research and extension organizations have had in accommodating FSR, even when there was a strong commitment to the approach, provide an indication of broader problems facing agricultural research management. Training managers in such areas as interdisciplinary communication, team building and priority setting is particularly important for the interests of FSR. Techniques such as 'action learning' (Paul, 1983) that provide in-service training using actual management problems and situations should be emphasized.

INTERNATIONAL INSTITUTIONS

Much short-term training is offered to national programmes by donors, IARCs and others. In many countries national research programme staff spend a remarkably high proportion of their time on such courses, which argues for better coordination by both national and international institutions. Training

offered by international institutions on introductory aspects of FSR should decline as these ideas become accepted and national programmes make them part of their established operating procedures. Such introductory training will be gradually replaced by training in more advanced aspects of adaptive research.

To the extent that effective adaptive research requires improvements in the management of research and extension systems, international organizations can help by encouraging the application of management science training to the problems of national programmes (Felton and Hobbs, 1989).

While IARCs remain active in training related to FSR, there is a need for better coordination among them. Early efforts in FSR training saw a profusion of approaches, methods and jargon. Up to a point, this resulted in healthy competition among IARCs, but the competition has taken its toll in terms of contradictory messages, duplication and inefficiency in training. A meeting of IARCs in September 1988 on human resource development addressed the issue and resolved that they collaborate on regional on-farm research training activities and work together to produce training materials.

There is evidence that IARCs are moving in this direction. An annual meeting brings together international institutions offering training in eastern and southern Africa to coordinate their plans. CIAT and CIMMYT have collaborated on training publications (e.g. Tripp and Woolley, 1989) and on joint training activities in Latin America. A number of training activities in Africa and Asia now draw on several IARCs working in the region. A recent short course for economists in Ethiopia was organized by CIMMYT, CIAT and ILCA; and IRRI and CIMMYT jointly led a review of on-farm research activities at the University of Southern Mindanao in the Philippines. Future training activities should include joint programmes, where that is effective, or the identification of lead centres for particular training activities if that is more appropriate.

Finally, the lessons from experience with FSR training should not be lost when international institutions consider new initiatives. If FSR was the fashion of the past decade, sustainable agriculture is likely to replace it in the 1990s. Like FSR, sustainability research addresses critical problems in agricultural development, but like FSR it is susceptible to hyperbole and lack of focus. Research to identify sustainable production technologies will demand more of agricultural research and extension personnel than most of the adaptive research carried out under FSR. Thus if international organizations, in pursuit of the latest fashion, abandon their commitment to fostering good adaptive research with a farming systems perspective, it is unlikely that they will successfully address sustainability.

CONCLUSIONS

The ideas outlined in the previous section place considerable demands on universities, national programmes and international institutions. Progress will be slow, but efficient agricultural research and extension systems cannot be

developed as long as universities turn out inadequately trained graduates, national institutions are unable to manage or maintain staff, and the majority of training needs are addressed by an overlapping patchwork of courses offered by international institutions.

This review has argued that although FSR training has been a major force over the past decade, it is probably not advisable to continue treating it as a separate entity. A reorientation of future activities implies not so much a dismantling of FSR training as a careful examination of how its contributions can be made more effective. Suggestions include some redefinition of training responsibilities, emphasis on developing better sources of information for practitioners, exploration of alternatives to formal training, and the encouragement of clear strategies for staff management and development by national programmes.

The farming systems perspective should make national programmes much more efficient in identifying their clientele and defining their objectives. The diversity of the farming systems managed by the majority of the world's farmers demands good diagnostic, experimental and analytical techniques, no matter what terminology is used to describe them. And the increasing complexity of agriculture in developing countries, combined with severely limited budgets for agricultural research, mean that those responsible for national research programmes will have to learn to be better organized to apply the knowledge and skills of their staff to the problems of their nations' farmers.

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REFERENCES

- Ashby, J., Quiros, C. A. & Rivera, Y. M. (1987). Farmer participation in on-farm varietal trials, ODI Agricultural Administration (Research and Extension) Network Discussion Paper 22, Overseas Development Institute, London.
- Bawden, R. J., Macadam, R. D., Parkham, R. J. & Valentine, I. (1984). Systems thinking and practice in the education of agriculturalists. *Agricultural Systems* 13:205-225.
- Bingen, R. J. & Poats, S. (1990). *The Development and Management of Human Resources in On-Farm Client-Oriented Research*. The Hague: ISNAR. (In press.)
- Byerlee, D. & Collinson, M. (1980). *Planning Technologies Appropriate to Farmers: Concepts and Procedures*. El Batan, Mexico: CIMMYT.
- Byerlee, D., Harrington, L. & Winkelmann, D. (1982). Farming Systems Research: issues in research strategy and technology design. *American Journal of Agricultural Economics* 64:897-904.
- Byerlee, D. & Tripp, R. (1988). Strengthening linkages in agricultural research through a farming systems perspective: the role of social scientists. *Experimental Agriculture* 24:137-151.
- Carruthers, I. & Chambers, R. (1981). Rapid rural appraisal for rural development. *Agricultural Administration* 8:407-422.
- Casey, F. & Barker, R. (1982). *A Course in Farming Systems Research: The Cornell Experience*. Cornell International Agricultural Mimeographs No. 93. Ithaca, NY: Cornell University.

- CGIAR/TAC (1978). *Farming Systems Research in the International Agricultural Research Centers*. Rome, Italy: Technical Advisory Committee to the Consultative Group on International Agricultural Research.
- CIAT (1988). *Bean Program Annual Report for 1987*. On-farm agronomy. Cali, Colombia: CIAT.
- CIMMYT (1988). *From Agronomic Data to Farmer Recommendations*. El Batán, Mexico: CIMMYT.
- Conway, G. (1985). Agroecosystem analysis. *Agricultural Administration* 20:31-55.
- Fakki, H. (1988). *Methods of Crop On-Farm Trials in Farming Systems Adaptive Research*. (Draft manual.) Aleppo, Syria: ICARDA.
- Feldstein, H. S. & Poats, S. V. (1990). *Gender and Agriculture: Vol. 1. A Casebook, Vol. 2. Teaching Notes*. West Hartford, Conn.: Kumarian Press. (In press.)
- Felton, E. L. & Hobbs, S. H. (1989). *Management Perspectives for Agricultural Research*. ISNAR Training Series No. 1. The Hague: ISNAR.
- Francis, C. A. (1986). *Multiple Cropping Systems*. New York: Macmillan.
- FSSP (Farming Systems Support Project) (1987). *Diagnosis, Design and Analysis in Farming Systems Research and Extension*. (4 vols.). Gainesville, Florida: University of Florida.
- Gilbert, E. H., Norman, D. W. & Winch, F. E. (1980). *Farming Systems Research: A Critical Appraisal*. Michigan State University Rural Development Paper, 6. East Lansing, Michigan: Michigan State University.
- Harrington, L., Read, M., Garrity, D., Woolley, J. & Tripp, R. (1989). Approaches to on-farm and client-oriented research: similarities, differences, and future directions. In *Developments in Procedures for Farming Systems Research* (Eds. S. Sukmana, P. Amir, and D. M. Mulyadi). Jakarta: Agency for Agricultural Research and Development.
- Hart, R. D. (1980). *Agroecosistemas: Conceptos Basicos*. Turrialba, Costa Rica: CATIE.
- IARCs (International Agricultural Research Centers) (1987). *Proceedings of the Workshop on Farming Systems Research*. Patancheru, AP, India: International Crops Research Institute for the Semi-Arid Tropics.
- International Agricultural Centre (undated). Outline of the International Course for Development Oriented Research in Agriculture. Wageningen, the Netherlands: International Agricultural Centre.
- IRRI (1986). *Farming Systems Socioeconomic Research Training Course. Training Materials*. (2 vols.). Los Baños, Philippines: IRRI.
- IRRI (1987). *How to Conduct the Farming Systems Research Practicum*. Los Baños, Philippines: IRRI.
- Joyce, B. & Weil, M. (1986). *Models of Teaching*. Englewood Cliffs, NJ: Prentice-Hall.
- Khon Kaen University (1987). *Proceedings of the 1985 International Conference on Rapid Rural Appraisal*. Khon Kaen, Thailand: Rural Systems Research and Farming Systems Research Projects.
- Merrill-Sands, D. (1986). Farming Systems Research: clarification of terms and concepts. *Experimental Agriculture* 22:87-104.
- Merrill-Sands, D. & McAllister, J. (1988). *Strengthening the Integration of On-Farm Client-Oriented Research and Experiment Station Research in National Agricultural Research Systems (NARS): Management Lessons from Nine Country Case Studies*. OFCOR Comparative Paper No. 1. The Hague: ISNAR.
- Merrill-Sands, D., Ewell, P., Biggs, S. & McAllister, J. (1989). Issues in institutionalizing on-farm client-oriented research: a review of experiences from nine national agricultural research systems. *Quarterly Journal of International Agriculture* 28:279-300.
- Mutsaers, H. J. W. (1985). *An Approach to the Organization of On-Farm Research Training Workshops*. OFR Bulletin No. 3. Ibadan, Nigeria: International Institute of Tropical Agriculture.
- Mutsaers, H. J. W., Fisher, N. M., Vogel, W. O. & Palada, M. C. (1986). *A Field Guide for On-Farm Research*. Ibadan, Nigeria: International Institute of Tropical Agriculture.
- Oxenham, J. (1982). *Simulations and Adult Learning for Development*. IDS Discussion Paper 172. Brighton, UK: Institute of Development Studies.
- Paul, S. (1983). *Training for Public Administration and Management in Developing Countries. A Review*. World Bank Staff Working Papers No. 584. Washington, DC: World Bank.
- Raintree, J. B. (1987). *D & D User's Manual. An Introduction to Agroforestry Diagnosis and Design*. Nairobi: International Council for Research in Agroforestry.
- Raman, K. V. (1987). Scientists' training experiences in promoting interactions with the farmer. Paper presented at the workshop 'Farmers and Agricultural Research: Complementary Methods', Institute of Development Studies, Brighton, UK, July.
- Rathberger, E. M. (1988). A tenuous relationship: the African university and development policymaking in the 1980s. *Higher Education* 17:397-410.
- Roling, N. (1988). *Extension Science*. Cambridge: Cambridge University Press.
- Ruano, S. & Fumagalli, A. (1988). *Organizacion y Manejo de la Investigacion en Finca en el Instituto de Ciencia y Tecnologia Agricolas (ICTA)*. OFCOR Case Study No. 2. The Hague: ISNAR.
- Ruthenberg, H. (1980). *Farming Systems in the Tropics*. Oxford: Clarendon Press.

- Shaner, W. W., Philipp, P. F. & Schmehl, W. R. (1982). *Farming Systems Research and Development: A Guideline for Developing Countries*. Boulder, Colorado: Westview Press.
- Sharma, A. R. & Mathema, S. B. (1988). *Handbook of Socio-Economic Survey Methods: Compilation of Training Materials*. Khumaltar, Nepal: National Agricultural Research and Services Centre.
- Shute, J. C. M. & Moore, G. A. B. (1982). *Teaching and Workshop Methods in Agriculture*. Guelph, Ontario: University of Guelph.
- Simmonds, N. W. (1986). A short review of farming systems research in the tropics. *Experimental Agriculture* 22:1-13.
- Stoop, W. A. (1987). *Issues in Implementing Research with a Farming Systems Perspective in NARS*. ISNAR Working Paper No. 6. The Hague: ISNAR.
- TAC/CGIAR (1986). *Training in the CGIAR System*. Rome, Italy: Technical Advisory Committee to the Consultative Group on International Agricultural Research.
- Tripp, R., Anandajayasekeram, P., Byerlee, D. & Harrington, L. (1990a). Farming systems research revisited. In *Agricultural Development in the Third World*, Second Edition (Eds C. K. Eicher and J. Staatz). Baltimore, MD: Johns Hopkins University Press. (In press.)
- Tripp, R., Anandajayasekeram, P & Sain, G. (1990b). *The Design and Management of Call System Training*. CIMMYT Economics Program Working Paper. El Batán, Mexico: CIMMYT. (In press.)
- Tripp, R. & Woolley, J. (1989). *The Planning Stage of On-Farm Research: Identifying Factors for Experimentation*. El Batán, Mexico: CIMMYT and CIAT.
- Turner, B. L. & Brush, S. B. (1987). *Comparative Farming Systems*. New York: Guilford Press.
- Zandstra, H., Price, E., Litsinger, J. & Morris, R. (1981). *Methodology for On-Farm Cropping Systems Research*. Los Baños, Philippines: International Rice Research Institute.