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CONDUCTING ON-FARM RESEARCH IN FSR - MAKING A GOOD IDEA WORK

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Over the past decade a widespread interest has developed in Farming Systems Research (FSR) in the International Agricultural Research Centers (IARCs), in the national agricultural research and extension systems of developing countries, and in academic circles in many developed countries. Among practitioners there has been general agreement on the broad philosophical approach. In fact, it has been often stated that FSR is a philosophy rather than a methodology. As a consequence, nearly any research activity that is seen as farmer oriented and interdisciplinary is labeled FSR if for no other reason than to attract donor funding. Wooed by the rhetoric, donor agencies such as the World Bank and USAID have made substantial investment in FSR projects.

Major attempts have been made in the literature to clarify the concepts of FSR. This, for the most part, has led to more acronyms (FSR&D, FSR/E, FSIP, and OFR/FSP to name a few) and more confusion, as various authors have given us their own perceptions. Most recently the World Bank hired Norman Simmonds to tour the world and unravel the mysteries of FSR. Simmonds's report makes an important contribution in that it presents the broad perspective of FSR with great clarity. But, as with most of the literature, the methodological issues are scarcely addressed. With most of the attention devoted to clarifying the philosophy and concepts and a lack of focus on development of methodology, it is not surprising to find a growing concern among the donors and practitioners alike that FSR is not improving the efficiency of our research extension effort. FSR is not leading to more rapid adoption of new technology and significant gains in agricultural production, productivity and farm family welfare. Indeed, many of the problems experienced arise from this lack of focus which in turn explains the weak development of methods that exploit the comparative advantage of FSR. It is the experience of many projects that initial methodological approaches to FSR, both surveys and experiments in farmer's fields, have been for the most part inappropriate.

FSR methodologies are slowly evolving in a number of projects and institutions, which take into account the limited resource endowments and exploit the comparative advantage of national research and extension networks. Our objective in this paper is to identify a set of methods and procedures that allow FSR projects to immediately increase their efficiency in terms of developing technologies that farmers adopt. In doing this we glean from the works of others and our own experiences. This task has been made difficult by the paucity of material submitted to academic journals. Agreed there have been reviews on FSR, notably Shaner et al 1979, Norman 1979, Gilbert, Winch and Norman 1981, and most recently Simmonds 1983; also some IARCs' have produced training manuals, notably Collinson, 1980, Perrin et al 1979, and Zandstra et al 1982. We make no grandios claims for these procedures since we are still at the point of testing them. Unfortunately, like most other practitioners in

the field we are more familiar with what does not work than what does work.

UNDERSTANDING THE EXISTING FARMING SYSTEM AND IDENTIFYING PROBLEMS

An important first step in FSR is to select sites in which the research will have a significant impact. The recommendation domain and target group of farmers must be identified and the farming systems described in order to be able to understand and identify the important problems.

Site selection is frequently not accomplished by those who are to carry out the research but rather by those who prepare the project proposals. It normally involves a rather unsystematic mixture of political, socioeconomic, and technical judgement. The governments usually mandate the beneficiaries of research in broad general terms such as "subsistence farmers," "small farmers" or "resource poor farmers." The task of characterizing and selecting research participants should begin with site selection. It should involve the systematic use of secondary data including soil maps and census data to consider in both geographic and demographic terms the potential beneficiaries based on site selection. In short, at the very conception of the project an effort should be made to define in general terms the recommendation domains and target beneficiaries.

In many farming systems (and cropping systems) projects, the site selection has been followed by detailed in-depth benchmark and/or multiple visit surveys to obtain the necessary information to fully describe the farming system. Eicher and Baker (1982) have the following comment on the efficiency of this approach: "Moreover, it often requires 6-12 months to plan a cost route study, a year to carry it out, and sometimes 2-3 years to analyze and publish the results. Concern with the cost of cost route surveys and the need to generate rapid results has led to a search for survey methodologies which can produce results in a few months rather than 2-3 years."

The failure of the large survey approach led to the development of shorter and more informal survey procedures, of which CIMMYT's exploratory surveys and ICTA's sondeo are perhaps the most popular. These procedures come under the heading of a class of activities known as "rapid rural appraisal" and frequently earn the additional title "quick and dirty." The problem suggested by this latter title is that these approaches do not provide adequate information on which to design appropriate research activities. The problems are identified at too general a level, i.e., soil fertility, soil erosion, or livestock nutrition.

Much more must be known about the current range of farmer knowledge and experience and resource potentials and constraints. Here, we propose a diagnostic procedure which combines the quick survey approach with a much more detailed monitoring and measurement in specific problem areas or areas that appear to offer potential for research. These two levels of investigation are described in the sections that follow.

Level one is the sondeo or exploratory survey activity. The sondeo is a survey conducted by an interdisciplinary group without the use of a formal survey lasting a period of several days. The details of this procedure are fully described by Hildebrand (1979). The purpose is to more clearly define the recommendation and target group of farmers and to identify the major problems and potentially researchable issues. While the sondeo team normally represents several disciplines, even more important than the disciplinary composition is the choice of individuals. Two types of people are needed: those who are capable of identifying research problems and issues and those who know the region. While the latter group is likely to be composed entirely of the FSR team the former group may include people outside the project with on-farm research experience. Many of these experienced individuals are busy with other work but are able to commit a few days to participate in a sondeo.

We should emphasize the fact that the success with which the sondeo can identify key problem areas depends a great deal on the quality and experience of the team. The usual project situation is one of doing the sondeo with a fresh group of people who spend as much of their time trying to work together as they do learning about the system.

How do we know that from the sondeo that we have identified the right problem areas? At the end of the sondeo when the report has been completed, a dialogue must be held with farmers, probably on a group basis, to discuss the sondeo team findings. It is very important at this early stage in the project that the farmers and scientists agree on the problems.

Level two is the diagnostic, monitoring and measurement activities. We have already learned from the failure of the large survey approach that we cannot gather and analyze data in a reasonable time period in all aspects of the farming system. The informal survey work has helped us to identify the major livestock and crop activities and the major problem areas. We must now limit the number of data gathering activities and see that they are clearly focused.

First on the agenda is the need for a survey to describe the target group of farmers in more quantitative terms. This survey should concentrate on about a dozen key variables such as farm size and tenure, family size and occupation, land use including crops grown, and livestock enterprises. While the survey procedures can be standardized across sites, in our view, the formal questionnaire must be kept extremely short and when possible should be analyzed at the site. The advent of the microcomputer unfortunately, once again, has strengthened the notion that the size of the survey can be increased and the data brought to a central location for rapid processing and analysis. A more appropriate alternative is to strengthen the capacity of the site team to conduct their own analyses' using calculators, sorting strip etc. Site researchers need such information quickly, for example, to assist them in selecting farmer co-operators who are representative of the target group.

The survey information provided in the above activities should be adequate to allow the researchers to identify the major problem areas.

It is, however, unrealistic to expect that after only a few short months on location, the research team is prepared to design experiments. The experiments conducted in the first year of the project are normally of little value because they do not, or more correctly cannot, address the important issues. More formal monitoring activities are needed. Once the two or three key areas are identified, an in-depth investigation must be undertaken with a view to understanding the farmers' knowledge and experience, the range of environmental variability, and the factors explaining variability in performance among farmers. The specific purpose of this analysis is to quantify the production and management experience across farms and to identify potential areas of research impact. This requires a careful monitoring of both physical and socioeconomic factors.

For example, if improvement in cattle production is identified as a likely area for technical impact, one must examine the existing production system on a sample of farms. Information must be gathered throughout the year on feed supplies and feeding practices, animal health, labor requirements, and purchase of inputs if any. We need to know why some farmers are doing better than others and what researchable topics might lead to significant gains in cattle production.

How is the monitoring to be organized? Approximately 20 farms should be adequate for the task. Monitoring activities might combine occasional surveys to establish labor requirements, livestock inventories, animal health etc. with frequent visits to monitor feeding practices and seasonal variations in feed supplies. It might be necessary to obtain laboratory analyses of indigenous forages to establish their nutritive value. At the end of the monitoring period, a report could be prepared on "potentials for increasing cattle production in the farming system - researchable issues." Knowing that this report is the objective of their efforts will help the site team researchers to focus their work. One could visualize a similar type of monitoring activity for other problem areas such as crop production, erosion control, or soil fertility.

The danger of reducing the monitoring to say a single enterprise such as cattle production is that we may fail to emphasize the linkage of the enterprise to other components of the farming system. We must be careful to guard against this, spelling out clearly the way in which the cattle enterprise competes for feed supplies, labor, and other inputs within the farming system. Alternatively, the failure to sharply focus our monitoring activities also has its price. If we choose to monitor all livestock activities, then it will be difficult or impossible to obtain the depth of understanding we need to identify the researchable issues.

In summary, through the diagnostic analysis, every effort should be made to quantify the parameters to minimize subjectivity in identifying and specifying researchable areas. The site staff have to take an active role in the diagnostic measurements, monitoring, and other forms of data collection. An assessment must be made of those problems which can be solved by carrying out simple experiments conducted on farmers' fields by the site teams in conjunction with farmers, and those problems which

require more complicated in-depth investigation. Selecting and designing the innovations for on-farm investigation is the subject of the next section.

SELECTING AND DESIGNING THE INNOVATIONS WORTHY OF ON-FARM INVESTIGATION

In the usual framework of farming systems research, design is recognized as the second stage. The selection of innovations to be tested on farms and their design usually falls to the technical scientists working on the research stations. Typically, the influence of the information gathered during the initial surveys on selection and design is weak. Consequently what ends up being tested are largely the current interests or recommendations of the research institutions. For example, where soil fertility is seen as the problem, researchers will want to run tests on chemical fertilizers even when these cannot be purchased by farmers. This is not to say that these scientists are disinterested in the relevance of work to the farmer, but that they do not have enough detailed information to do the job properly. The point here is that these recommendations are seen to be relevant because any innovation can be said to address the general problem of low production described by the surveys. The cursory nature of this process that is customary in FSR springs also from a confusion about this stage in the overall framework of research.

The stage of design as presented in Norman's four stages of FSR can and has been interpreted in two ways. The original and intended interpretation was that design be a process of refinement of technology packages to fit the farming conditions by on-farm researcher managed experiments. When practiced in the field it did not take long before the stages of design and testing became impossible to distinguish. Now that experience has indicated farmers' disinterest in packages, a second interpretation has emerged, primarily through the work of Collinson. He interprets design to be an intellectual process where all possible technical solutions are screened and 'prioritized' by technical and social scientists. Farmers also should be included in this process.

Five steps are enumerated in the CIMMYT manual for the conduct of design (Byerlee, Collinson, et. al 1980). The first step is identification by technical scientists of the biological problems encountered in the initial surveys. Each problem is then examined to define the possible causes which, for example, may be related to the farmers' objectives or limited resources. In the third step a wide a range of apparent solutions to each problem are generated. Typically a narrow range of direct solutions are entered here when the farmer needs a wide range of direct and indirect (i.e. solutions that exploit system interactions) solutions. These solutions are then screened by technical scientists who pose the questions: Will this biological relationship hold in the farm situation? What are the husbandry requirements for success? Concurrently the economists ask: Are the infrastructural support requirements feasible? Do the farmers have sufficient resources? Will it use resources more profitably?

Step five, prioritizes the technical options in terms of potential

impact, ease of adoption, and ease of research effort. When establishing priorities the adoption concern should be the single most important criteria. The importance of this final step cannot be overemphasized because it controls in large measure the successful implementation of experiments, the degree of adoption, and thus the validity of this approach to research. By this token it is essential to involve the farmer in all the steps outlined above and especially the screening process. Here, it may be useful to present a wide range of possible solutions to the farmers so that they can pick those most suited to their circumstances. This will be especially true where researchers have difficulty in answering the questions posed in step four and even more so when assessing step five's ease of adoption.

USING FARMERS TO CONDUCT THE ON-FARM INVESTIGATIONS

The range of on-farm experiments found in FSR programs encompass the most complex replicated factorials to simple two plot demonstrations. This broad range has been divided into three types by the level of researcher and farmer involvement. The most complex trials such as the IRRI component tests or CIMMYT exploratory and levels tests are classified as researcher managed and executed. Intermediate levels such as IRRI's superimposed cropping patterns are classified as researcher managed and farmer executed. The least complex trials often termed demonstrations or by CIMMYT, verification tests are classified as farmer managed and executed. The intention is that technologies move from the most complex type one to the least complex type three which implies that on-station basic research occurs before type one. Thus, type one tests research generated technologies for biological performance in the farm setting. The second type of trial exposes the technologies to farmer levels of management and farmer opinion. Finally, predictable technologies are tested in the type three trials for performance over a wide range of farming conditions. Although this wide range of trials are talked about in practice, most of the research manpower, particularly at the IARCs, is tied up in the complex trials and with intermediate level trials which although simple in design are costly in terms of supervision and management.

FSR recognizes two distinctly different bodies of knowledge - the knowledge which comes from basic scientific research and the knowledge which is acquired through time by farmer experience. This latter body of knowledge is not formalized nor does it appear in the literature. It can only be captured through direct interaction between researchers and farmers. Even though feedback loops are built into the conceptual diagrams of FSR, in practice the ability to draw on the farmers traditional body of knowledge remains weak. This is in large measure because FSR remains very top-down in its methodologies

FSR field workers typically have borrowed designs wholesale from conventional on-station experiments. Most programs expend all their energies on the more complex types of research-managed work because they are very demanding to implement. These conventional experimental methods were primarily developed to determine "site effects" on largely unknown biological parameters. They are largely miniaturized research station

experiments having randomized block designs of two or more replicates with four or more treatments which in the case of CIMMYT, levels trials are factorially structured. The analytical procedure is to conduct analysis of variance or response functions analysis and to apply standard statistical tests of significance. Adequate precision in the data are guaranteed by enormous research input into the management and implementation of each experiment; a resource level that IARCs command but that is rarely found in national institutions.

Researchers in the national level programs, despite the great difference in resource endowments, have generally followed the lead of the IARCs adopting the same methodological procedures. While economists have struggled to analyze the benchmark survey, agronomists have borrowed the IARC designs and set out component and cropping pattern trials. The project researchers have been overwhelmed by the sheer magnitude of the problems involved in managing data and controlling experiments. Only a few experiments are conducted at each site on a handful of farms. In the variable farm environments these few observations stand little chance of detecting real effects, even if one were to assume that the experiments have been properly managed, which is normally not the case. These facts notwithstanding, standard statistical tests typically are applied to the data and recorded in the results. The farmers' involvement in these experiments only extends to the lending of land, and perhaps land preparation with some weeding. In the experiments, yield per hectare is taken as the principle criterion of evaluation, and the most commonly used test inputs are variety, chemical fertilizers, and insecticides. Inputs such as seeds and chemicals are supplied by the researchers and for this the farmers are only too willing to cooperate. But, as one project manager observed when asked to write the "success story" of his project, "when we withdrew the farmers withdrew."

The methods and procedures described above are inappropriate for FSR. The primary goal of our research is to enhance adoption of new technology, not to define biological input-output responses at each site. The following on-farm experimental method is presented to illustrate a more appropriate procedure for FSR. Briefly, the experimental method entails the over-laying of treatments onto the appropriate existing crop or soil conditions. The procedure for over-laying treatments onto the farmers own crops is similar to the superimposed trials mentioned by Shaner et al. 1982, Kirkby et al. 1981, and CATIE. For example, to test the benefit of nitrogen top-dressing of maize, an area of healthy maize, that is a crop that farmers would be advised to top-dress, is identified on a participant's farm. The farmer is given the fertilizer with instructions to apply it over half the identified area demarcating the treatment and control plots after implementation. By contrast, a conventional experimenter would select the experimental area prior to land preparation, mark out the plots, and implement the treatments in the appropriate plots.

The simplicity of this experimental method permits farmer implementation. Ideally the innovation, for example, improved seed, or fertilizer is given to the farmers for them to implement the treatments. The researchers' involvement extends to the selection of area, instruction on implementation, and some checking on the accuracy with

which the experiments were conducted. Of course, all measurements and data collection are the responsibility of the researchers.

The shift in level of involvement from researcher to the farmer in the over-laid method increases the scope of farmer participation and gives time for the researchers to contact many more farms. Testing in appropriate conditions and the use of many more farms can only increase the rigor and precision with which innovations are assessed. In addition, farmer participation could be deepened by soliciting their reactions to the innovations. The depth of such questioning is likely to be greater when conducted by researchers trained specifically in this area, which also affords greater interaction among the disciplines.

There are important implications of this methodology for quantitative analysis. We have shifted from a few researchers' managed experiments (usually on just four or five farms) to many trials (twenty or thirty) in which the farmer applies the input. Although our treatments are set out in a single recommendation domain, this new procedure introduces the variability in treatment management among farmers. But at the same time, we have increased the rigor of the test and precision of the trial by adding many more replications across the farm. The performance of an innovation across the variety of environmental and management conditions experienced provides important information about the range of outcomes farmers might expect.

Such information is provided by the analysis of the distribution of the observations. This analysis should include the mapping of performance data and the use of scatter diagrams to provide the researcher with a visual image of the data and make it easy to associate the level of performance with the location of the trial. Using simple statistical measures such as mean and standard deviation, the degree of overlap in performance of the two treatments (farmers level and superimposed) can be estimated, and where appropriate significance tests can be employed.

Farmers are also interested in knowing about the likely performance of innovations over a run of years. Some indication of this is provided by the calculation of confidence intervals. Here farmers can learn the range of likely outcomes of a particular new technology. The fact that the trials are run across so many farms with varying conditions strengthens the utility of this analysis. However, caution must be exercised in interpreting these results, since factors causing variability in performance across locations in a given year, and factors explaining variability on a given farm through time may be very different.

As with the socioeconomic surveys, the analysis of the data is at the level of the site teams. Thus, the site teams as well as the farmers are more directly involved in the research process. We have improved the capacity of both groups to access the utility of a new innovation. In the final analysis, the results of our quantitative analysis notwithstanding, farmers will be the judge of appropriateness of the innovation.

In short, the procedure suggested above provides more time for the site team researchers to be engaged in the data collection and analysis. However, greater sensitivity to the analysis and interpretation of data is a product of more education. Researchers must be willing and able to assume a certain freedom from the rigidity of traditional scientific procedures. If the approach we have outlined is to work, it will require developing capabilities at the overall project level and at the site team level that do not normally exist.

CONCLUDING REMARKS

In this paper we have focused on methodological issues associated with farming systems research. We believe that if it is to be effective FSR must be based not only on a philosophy, but also on an efficient methodology. The methodologies used in most projects to date have been borrowed from research stations. They were designed not to enhance the speed of adoption, but to improve our understanding of physical and biological relationships (e.g. fertilizer response). These procedures, while useful in their own right, do not effectively incorporate the experiential knowledge of farmers regarded as essential in FSR.

Given the objectives of FSR, traditional research procedures appear to be inappropriate. Furthermore, the site research teams in the national programs have had neither the trained manpower capacity nor the resources to successfully manage the experiments in farmers' fields. For those who have been involved in national farming systems programs, the problems we have discussed in using existing methodologies and trying to manage experiments in farmers' fields undoubtedly has a familiar ring. We have been struck by the similarity of these problems in locations as far apart and as different environmentally and culturally as Botswana, Ecuador, and the Philippines.

We should be quick to acknowledge that despite these problems much has been learned from FSR to date. Our argument is that it has been learned at a very high cost, a cost higher than developing countries and donor agencies may be willing to pay in the future.

An alternative methodology has been described. To a large extent it is not new. Various components have been described and tested by others who like us have been concerned with the need to develop more appropriate procedures. In the descriptive problem identification phase, we suggest the use of the sondeo coupled with a more indepth diagnostic analysis of the key problem areas identified in the sondeo. In the design we emphasize the need to explore in conjunction with farmers the range of relevant alternatives in order to pick out those to include in the research design. Of critical importance in these early phases is the need for farmer participation. In the testing phase, we suggest that where possible, treatments be superimposed by the farmers themselves, and that 20 to 30 farmers be included in a single trial. The researchers will then be free to concentrate on the collection and analysis of data.

Development of site team research capabilities, of course, will be a major task.

In closing, we stress the need to develop a more efficient FSR methodology. We are, however, in the unfortunate position of knowing what doesn't work. We will need to test the procedures described above in order to determine whether what we have proposed is an appropriate alternative.

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