FARMING SYSTEMS APPROACH TO RESEARCH IN THEORY AND PRACTICE/A

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INTRODUCTION

The last ten years have seen an increasing commitment to Farming Systems Research (FSR) as a "new" tool of agricultural research./1 There have been parallel and similar developments in the use of FSR in Africa, in Central and South America and in South East Asia.

Nowhere is this increasing commitment more obvious than in the Eastern and Southern African Region where we both currently work. FSR as a tool in technology choice and development is institutionally established in Zambia (1981), Malawi (1984), and Zimbabwe (1984), and regionally deployed teams of farming systems researchers -- each team consisting of a mix of technical and social scientists -- have been structured into the national agricultural research services (NARS). Botswana, Ethiopia, Kenya, Lesotho, Sudan, Swaziland and Tanzania have significant FSR oriented programmes and are actively debating how these should be integrated with technical component research (TCR) and with the extension services. Beyond this Burundi, Mozambique, Rwanda, Somalia and Uganda have, or will shortly have, pilot FSR programmes focussed on technology choice and development.

Although each of us has had the occasional foray into the FSR scene of other continents, the basis of the discussion in this paper is on work in Africa. The paper is dominated by a discussion of issues and problems experienced in applying the concepts and procedures of FSR in this African context. Concepts and procedures are treated briefly as a basis for this discussion.

We use the remainder of this introduction to highlight differences between Australia and Africa in farm characteristics and farmer/sector linkages. Australian farmers are different from small African farmers. Their commercial orientation is a feature of the developed market structure they operate in, and the high levels of resource endowment they enjoy, enhanced by an effective policy and service infrastructure supporting agriculture. Complexity in Australian farming arises from the sophisticated knowledge and large investments needed for specialised farm operations. Small African farmers are different. They often face poorly developed markets or market channels, politically inspired policy distortions and an indifferent, or at the extreme, non-existent, supply and service infrastucture. Their very low resource endowments are not readily enhanced from the fragile and uncertain infrastructure within which they must operate. They need to be self sufficient. Complexity in African small farming is a function of multiple objectives. Farmers need to produce a continuous, reliable and balanced supply of foods, as well as cash for basic needs and recurrent farm expenditure. These are manifest in multiple enterprise farms where resource allocation exploits

enterprise complementarities and demands technical compromise in the interest of the productivity of the whole farm system. Because complexity arises from multiple objectives, and not from the need for high levels of specialised knowledge and investment, grouping small African farmers on the basis of the system they operate is much more practical. It is also much more necessary for cost-effectiveness in R and D. Large scale commercial farms merit and can pay for individual advice. A second difference, important to highlight for later discussion, is of research/farmer linkage. Research is one of the services of an effective infrastructure supporting farming in Australia. Farmers, particularly the strong managers and innovators, always articulate and often aggressive, pressure researchers to produce the right goods (technology). These pressures arise from farmers reading about research, button holing individual researchers and using their own organisations to influence research focus. Small African farmers, often illiterate, have virtually no opportunity to pressure research or research workers. As we shall see one of the interests in FSR in Africa is in its capacity to reflect farmer research needs more effectively. The absence of regular researcher/farmer contact is a major gap in existing research procedure and organisation in Africa.

THE ROLE OF FSR IN TECHNOLOGY CHOICE AND DEVELOPMENT

We must first emphasise the importance of effective technology choice and generation for improving the productivity -- and therefore hopefully the welfare -- of small farmers in Africa. It is the only means to improving physical input/output coefficients and the underlying productivity of farmers' resources. In noting the strong policy and supporting service infrastructure in Australia, we are also recognising that technology is not the be all and end all of development. It is in fact most readily identified and mobilised in a responsive and strong policy and service environment. Nevertheless, this is not a sufficient condition for continuing small farmer development, which needs improved technology.

The fundamental importance of new technology to agricultural development is increasingly realised. Attention has turned to identifying the shortcomings of classical agricultural research with which only limited small farmer adoption of the new techniques and materials has ocurred./2 Attention has focussed on the inadequacy of the reductionist method and the prescriptive style of the blanket recommendations usually made. Looked at in system terms classical agricultural research develops and evaluates a subset of relationships within an ideal technical system. It recommends these for interpolation into differentiated, higher level, real world economic systems where they are evaluated with criteria peculiar to the particular system. The subset may or may not fit. Evidence suggests it seldom does. This weakness in method is compounded by physical isolation. Technical researchers rarely see small farmers, and even more rarely, talk to them as equals. Feedback through the extension service is rarely effective. The lack of any diagnosis from the farmers' perspective results in blindly prescriptive blanket recommendations unrelated to causal factors which are inevitably

peculiar to specific local situations. Classically recommendations tell small farmers to plant all their maize at the onset of the rains and hand weed at two and seven weeks. This is unhelpful if their limited labour resource is locked into alternative work with very high benefits in another part of their farming system. They are obliged to compromise.

FSR is, strictly speaking, a research methodology for understanding the real world economic systems that farmers operate. It can be directed to a variety of objectives. Technology choice and development dominates our experience, ACIAR's interest and thus the paper. Other applications include policy and service assessment from the perspective of the farmer, which to date has been little exploited. We touch on these briefly later in the paper.

In the context of technology choice and development FSR's roles are seen as complementary to technical component research (TCR). It has three such roles:

(a). To look back out of identified farming systems at the stock of materials and techniques accumulated from TCR and to choose technical solutions to priority system problems. On-farm experimentation then adapts chosen solutions to the local situation. This is a mobilising and adapting role, finishing the product for an identified market.

(b). To pass back unsolved technical problems important to the system, and therefore farmer development, to the appropriate TCR team. This is a role in identifying and helping prioritise the agenda for technical research.

(c). To link with farmer clients and extension staff in local farm situations, drawing both farmers and extension workers into the technology generation process.

Many, but not all of the efforts to introduce FSR into the agricultural ministries of the countries of Eastern and Southern Africa (ESA) have had these roles in view. Confusion as to the FSR role, even within its application to technology generation, is one factor which has sometimes called the FSR contribution into question. Recent discussion among eight International Agricultural Research Centres (IARCs) working with FSR in the ESA region revealed four different objectives. These ranged from the understanding of representative or prototype systems, the development of prototype mandated crop technologies, the direct adaptation and dissemination of IARC developed, component technologies, to building up capacity to do FSR in national agricultural research services. These varying objectives had different implications for approach and methods and yet all were being sold to NARS as FSR, though sometimes under differing labels. This is certain source of frustration for research directors, grappling with the "new" concept and its place in their institutions. Adding to the confusion are new roles for FSR being generated by development thinkers. They see FSR as a vehicle for everything from changing the balance of authority between men and women in local communities to bottom-up national policy formulation. While it is

clear FSR can play a number of roles, building the skills and capacity and establishing effective implementation procedures for FSR in national situations is a slow and patient process. It is strictly the art of the possible, which usually means, if one is lucky, two steps forward and only one back.

Few would debate the conceptual logic of FSR. However there are many challenges to overcome before it establishes credibility. The location specificity of FSR work and the fact that work is undertaken with limited numbers of farmers -- hopefully representive of very much larger numbers -- adds to the perception of some of the expensive nature of such research. In arriving at such conclusions sunk costs involved in developing experiment stations and low returns from past research endeavours are likely to be heavily discounted or even ignored. Because of the complementarity of FSR activities and other research approaches there appears to be little value in comparing the benefit cost ratios of different research approaches. However this does not mean that we should not worry about the problem of credibility. The major problem of FSR is that, because of its youthful nature, a conventional methodology is still emerging at a time when donor agencies are pouring millions of dollars into FSR programmes and -- largely as a result -- developing country governments are rushing ahead with plans to establish FSR units. Here lies the dilemma. FSR is perceived by funding agencies -- national and donor -- as a potentially time and cost efficient means of developing technologies and policies relevant to limited resource farming families. FSR teams need quick results in order to obtain credibility and ensure continued funding in the long run. On the other hand credibility with technical scientists and international and national agricultural centres, with national policy makers and extension services and most importantly, with farmers, depends more on the suitability of a recommended practice (technology) and not whether it was developed in one or two seasons. However even the farmer clients of the FSR would lose interest if tangible relevant results are too long forthcoming.

There is a danger that the whole approach may be supplanted before it has a chance to establish its credibility. Obviously a crucial ingredient in the credibility debate is the design of cost and time efficient methodologies. Also linked to the credibility issue are a number of institutionalisation issues. Both methodological and institutionalisation issues will be discussed in some more detail later in the paper.

DEFINITION OF FARMING SYSTEMS RESEARCH

It has already been implied above that the design and dissemination of relevant improved technologies has to be built on an understanding of the farmers' situation. This is a complex task which has been the subject of farm level studies and methodological controversy over the last 20 to 30 years.

At the risk of over simplification a useful starting point for understanding the limited resource farmers' milieu is a look at the determinants of the farming system. The operator of the farming

system is the farmer or more correctly in the African context the farming family -- since the unit of production (the farming system) and the unit of consumption (farming household) are intimately linked and cannot be separated. The farming system adopted by a given farming household results from their decision to allocate the three factors of production (land, labour and capital) to three processes (crops, livestock and off-farm enterprises) to exploit the natural and socio-economic environment in which they operate in a manner which maximises the attainment of their family goals. The farming system is thus determined by the environment in which the farming family operates. The "total" environment in which it develops can be divided into the technical (natural or agro-ecological) and human (socio-economic) elements. /3

The primary objective of FSR is to improve the well-being of individual farming families by increasing the overall productivity of the farming system in the context of both the private and societal goals, given the constraints and potentials imposed by determinants of the existing farming system. Farming systems research (FSR), in the context in which we use it in this paper, /4 consists of two thrusts towards increased productivity:

(a). The development and dissemination of relevant improved technologies and practices.

(b). The implementation of appropriate policy and support systems to create opportunities for improved production systems and to provide conditions conducive to the adoption of technologies already available.

These two thrusts signal a major change in the attitude of research workers. It is increasingly recognised that technologies and policies incompatible with the local natural and socio economic environment has been the root cause of farmers' resistance to proposals for changing their farming practices. Resistance has not been due to small farmer irrationality or managerial incompetence. The emphasis on improved technology and farmer rationality in the farming systems approach is wholly compatible with the ideas put forward by Schultz (1964). Conceptually, at least, the approach recognises the vital interface between relevant technologies and relevant policy support systems. However to date programmes based on FSR have usually been located in agricultural research institutes -- primarily crop orientated -- often with poor linkages to planning or policy agencies. The policy or support system perspective has generally been weak, while livestock also have often not been very prominent in farming systems research.

The term farming systems research (FSR) which usually refers to the development and dissemination of relevant improved technologies through on-farm research by working directly with farmers has often being used loosely. There are programmes called FSR that are not FSR, and there are programmes not called FSR that are indeed FSR. On-farm research <u>per se</u> is not necessarily FSR. To qualify as FSR it has to take into account interactions with the farming system. Shaner <u>et al</u> (1981) have, to our mind, correctly characterised FSR:

(a). The farm as a whole is viewed in a comprehensive manner.

(b). The choice of priorities for research reflects initial study of the whole farm.

(c). Research on a farm subsystem is legitimate FSR provided the connections with other subsystems are recognised and taken into account.

(d). Evaluation of research results explicitly take into account linkages between subsystems.

(e). As long as the concept of the whole farm and its environment is preserved not all the factors determining the farming system need to be considered as variable -- some may be treated as parameters. /5

Therefore even within its role in technology generation, confusion can be caused by a variety of approaches to FSR. These approaches can be summarised as FSR "in the large", "in the small" and "with a pre-determined focus". /6 We need to understand these alternatives and their implications for methodology and institutionalisation.

FSR "in the large" treats all system parameters as potentially variable in a wide ranging search for improvement. It is perhaps analogous to the development of a new farming system which uses the technological "state of the arts" to model what could be done in a particular situation with existing know-how. It is not particularly complex in concept but extremely complex in implementation. We do not consider it further

Both FSR "in the small" and FSR "with a pre-determined focus" recognise that small farmers evolve from their existing situation in steps. The content and scale of these steps must necessarily be compatible with farmer resource endowments, their risk ceilings and their management capabilities. Both seek a focus within the system which identifies potential development steps. Because both recognise the step by step development process in small farming and both seek to identify steps in technology there has been confusion between the two. The difference is that FSR "in the small" arrives at a focus within the system in the course of diagnosis, while FSR "with a pre-determined focus" moves into the system to research an enterprise, or one facet of an enterprise, looking for improvements within that focus, which are compatible with the whole farming system. The two approaches have different implications for the level of leverage obtained in the system and for institutionalisation, which we discuss in subsequent sections of the paper.

Many individuals in the last 10 to 15 years have written extensively clarifying the concepts of FSR. This has led to more acronyms (e.g., FSR and D, FSR/E, FSIP, FSAR and OFR/FSP, etc.) Unfortunately at times this has led to more confusion as different people have given their own perceptions of what is FSR. However there is no question that a certain convergence of ideas is taking place as a review of some of the major papers indicates. /7

We do not intend to discuss semantics but very briefly simply want to summarise what is generally accepted as stages of FSR when used for technology generation. Conceptually there are four distinct stages in the farming systems research process (Figure 1)./8

(a). The descriptive or diagnostic stage in which the actual farming system is examined in the context of the "total" environment to determine the constraints farmers face and to ascertain potential flexibility in the farming system in terms of timing, slack resources, etc. An effort is also made to understand goals and motivation of farmers that may affect their efforts to improve the farming system.

(b). The design or planning stage in which a range of strategies is identified that are thought to be relevant in dealing with the constraints delineated in the descriptive or diagnostic stage. At this stage heavy reliance is placed on obtaining information from the "body of knowledge". This "body of knowledge" is derived from experiment station based research, research managed and implemented type trials (RM-RI) off the experiment station, and knowledge obtained from the farmers themselves. This stage in essence involves <u>ex ante</u> evaluation from the viewpoint of:

(i). Technical feasibility -- whether the physical transferability of technical relationships established elsewhere is valid and thereby contributes to the solution.

(ii). Economic viability -- whether the proposed solution is economically viable in the local situation of the farming family.

(iii). Social acceptability -- whether the proposed solution is likely to be acceptable to the farming family.

(c). The testing stage in which the most promising strategies identified at the design stage are evaluated under local farmer conditions. This stage usually consists of two steps:

(i). Researcher managed but farmer implemented tests (RM-RI) to establish whether transfered technical relationships are altered by farmers' management of non-treatment variables.

(ii). Farmer managed and implemented (FM-FI) type tests when the team are confident that relationships will hold but need to evaluate the proposed technologies under local socio-economic circumstances.

Where transfered technical relationships appear likely to be distorted by differences in local natural conditions researcher managed and implemented (RM-RI) experiments will be a prerequisite to the subsequent RM-FI and FM-FI stages, and may

be undertaken by the FSR team.

(d). The recommendation and dissemination stage in which the strategies identified and screened during the design and testing stages are implemented.

In practice there are no clear boundaries between the various stages. Design activities for example may continue into the testing stages as promising alternatives emerge during trials at the farm level, where farmers and researchers interact directly. Similarly testing by farmers may mark the beginning of the dissemination activities. Also it may not always be necessary to go through all stages. FSR team confidence in transferability during the design/planning stage can mean perhaps going straight to FM-FI work or even to the recommendation/dissemination stage. Thus the process of FSR is recognised as being dynamic and iterative with linkages in both directions between farmers, researchers and funding agencies. The iterative characteristic can improve the efficiency of the research process by providing a means of identifying and tuning improved technologies for a specific locale.

Thus the programme involves putting the farming family as the consumer of the improved technologies in the center of the stage. In summary, the approach involves tapping the "body of knowledge" possessed by farmers, requires the use of an interdisciplinary approach, increases the emphasis on exploiting complementary and supplementary relationships in the farming system, involves a dynamic and iterative approach, and is complementary with experiment station based agricultural research. With reference to this last attribute the FSR contributes in two ways:

(a). By incorporating in adaptive testing at the farm level, technologies developed on experiment stations. Successful testing gives rise to successful dissemination -- all other things being equal -- resulting in the improvement of farming families' welfare.

(b). By responding to failure under adaptive testing at the farm level, resulting in closer specification of requirements for improved technology development that can be fed to experiment station based research programmes. Hopefully this will contribute to the cost efficient development of improved technologies that will improve the welfare of farming families in the future.

Analogous linkages although rarely done to date could be established with planning and development agencies with reference to proposed policy/support programme changes.

There are many challenges facing the practitioner in FSR. We now turn to discussing some of the issues facing practitioners that ultimately directly or indirectly influence the whole credibility issue. Many of the issues that we raise are not new and we do not always give solutions to some of the problems identified /9 The issues are organised under two major headings: methodological and institutional.

METHODOLOGICAL ISSUES

In view of the credibility issue and limited availability of research resources, three important principles have been emphasised in designing cost and time efficient methodologies:

(a). Reducing the time required to move through the four research stages. The methodologies applied, in addition to ensuring fast turnaround, need to be practical, replicable and inexpensive (Byerlee et al, 1981). Complex procedures that require scarce highly qualified individuals to collect and analyse data and to design and test solutions need to be avoided as much as possible (Zandstra, 1979).

(b). Maximising the return from such research by making results more widely applicable. This means defining target groups of farmers (recommendation domains) in terms as broad as possible. The extent to which improved systems can be transferred or extrapolated to other areas directly affects their efficiency.

(c). Using second best or best of readily available solutions. Traditionally research in agriculture has emphasised the concept of developing optimal practices. However when one considers the heterogeneity existing in the "total" environment, cost in terms of finance and time to obtain optimal recommendations for each possible variation would be astronomical. Therefore the emphasis of FSR has been on developing improved technologies that are better than most but not necessarily best for each environment (Winkelmann and Moscardi, 1979).

Some have suggested that FSR is a philosophy rather than a methodology while to some even the methodology constitutes more of an art rather than of a science. Perhaps the easiest way of presenting the various methodological issues is in terms of the four stages of FSR.

1. DESCRIPTIVE/DIAGNOSTIC

The objective of the descriptive/diagnostic stage is to pick target areas, to divide the frame of farming families into target groups or recommendation domains, and to ascertain the major constraints on farming in the area and also the degree of flexibility that exists in terms of modifying the farming systems.

It is desirable if possible to do preliminary target grouping first to help provide a framework for decisions on priorities -- such as where the FSR team should go first. Attempting diagnosis across more than one target group -- unless they are closely interconnected (e.g., draught animal owners and non-owners in the same community) -- is very confounding and mitigates against clear understanding. Obviously more groups emerge as the FSR process proceeds.

Talking to knowledgeable people, examining relevant secondary sources of information, surveys and even technical monitoring are the chief strategies used in fulfilling the objectives of the

descriptive/diagnostic stage. In general, however, the methods used should be based on the criterion of the lowest possible cost commensurate with the degree of understanding that is necessary. Extra accuracy in terms of results comes at a cost in terms of resources and time. Informal surveys (sondeo), single contact surveys and multiple visit surveys are all used.

Informal conversations with farmers without the use of questionnaires or random samples are generally now considered to be useful and necessary for a wide variety of conditions. They do provide a rapid and inexpensive means of obtaining a qualitative understanding of farming systems. They are a useful way for identifying the most important production problems facing farmers and for describing the major characteristics of the natural and socio-economic environment in which farmers make decisions. As an anthropological technique focussed towards the objective of understanding the farming system and household they can also provide a useful input into the planning and execution of later formal surveys in terms of helping guide researchers in hypothesis formation, questionnaire development and choice of sampling technique. However some would argue that there are problems involved in these types of surveys. The two most important ones are the considerable skill involved in undertaking such informal surveys, if good information is to be obtained, and the problem of convincing decision makers not involved in the informal survey process that the information is valid./10 Also of course representativeness is an issue./11

Thus we would feel that it is certainly useful to supplement the informal survey with at least a one shot formal survey to answer issues of credibility, representativeness and quantification. Formal surveys provide means for gaining credibility through the statistical testing of hypothesis set up in the informal survey. Formal surveys are also valuable for assessing proportions of the population falling into different target groups, following different practices, and identifying themselves with different problems. Finally such surveys can help in improving experimental (trial) planning in: bounding treatment levels; verifying evaluation criteria; identifying special locational characteristics to be observed in siting experiments; and assessing current productivity levels to be standards in judging the economics of trials.

These formal surveys do not necessarily preceed, but can also be carried on during the design and testing stages. Currently in Botswana a good deal more time is being spent on formal quantification than perhaps would be necessary in many areas. For example a multiple visit survey is still being undertaken with very small samples of farmers in order to provide valid times series data especially with regard to such variables as labour flow, cash flow and non-cash income, areas that farmers have difficulty in remembering. Also, because of the difficulty of the natural environment for growing crops, time has been spent on technical monitoring to try to ascertain factors that affect stand germination and yields. However, once again it should be emphasised that these in-depth studies are being undertaken concurrently with testing work. In such work a deliberate attempt has been made to minimise measurement errors rather than

sampling errors.

In conclusion, with reference to surveys, we would agree with the collated views of Harrington (1981) who has concluded the following:

(a). An informal survey represents the minimum data collection effort necessary for planning research.

(b). Where time and resources allow it is wise to follow the informal survey with a formal survey. In many cases a small sample single contact formal survey will be sufficient to verify the results of the informal survey.

(c). When data on farmers are not urgently required, when budget and staff and resources allow, and when flow variables must be measured with some precision in the context of a complex farming system, then researchers in addition can consider using a multiple visit type survey.

Two other issues arise with reference to the descriptive/diagnostic stage. They are with respect to the way in which recommendation domains should be defined and whose needs should be addressed.

a. Recommendation Domains

One of the functions of the descriptive/diagnostic stage is to help in classifying farming families into homogeneous groups or recommendation domains. Such groups provide focus for developing relevant strategies to improve their welfare. Effectively delineating such groups depends on being able to isolate the factors influencing variation between groups of farmers and adopting a classification method that effectively weights the influence of the farmers. Dividing farmers into homogeneous groups is a complex process and includes consideration not only of differences in the technical element but also variations in the human element -- which traditionally have often being ignored. As a result of this classification farming families in a particular group will tend to have similar activities and similar social customs, similar access to support systems, comparable marketing opportunities, and similar technology and resource endowment. Farmers within each specific group should have the same problems and development alternatives and should react in the same way to policy changes. In order to reduce the complexity of drawing up recommendation domains it is probably best to ignore some intra-household sources of variation such as the household age cycle. Similarly managerial differencies vary; better managers in target groups are likely to be leaders in innovation who will eventually become new target groups, resulting in increased differentiation. This is not a serious problem in target grouping which is after all a dynamic idea. Target grouping should replace conventional frameworks as a basis for research and developmental planning. Nevertheless major arguments continue on zoning or grouping on the basis of potentials -- especially agro-ecological. However, as we have implied, such an approach only focusses on an opportunity set. Choice within it is dictated by social and economic factors.

We instead argue for selecting target groups or recommendation domains on the basis of existing farming systems broadly reflected by enterprise pattern and calendar, product areas, power sources and methods of land preparation. We would justify this on the grounds that what is going on now:

(a). Reflects farmers' decisions on opportunities weighing both technical (natural) and human (socio-economic) factors.

(b). Is the place from which development has to start.

Once grouping on the basis of the existing systems is done then causes can be sought. Looking for causal factors first can be very confusing.

It is worth emphasising that recommendations arising out of FSR work may -- even if recommendation domains are drawn up carefully -- prove to be better for some farmers within a target group than others, or for one particular part of a farmer's farm. For example, in one part of Zambia, where weeds became a problem after three to four years of cultivation, herbicide application showed a 50% higher return on land that had been cultivated for four years compared with land that had only been cultivated for one year.

In Botswana we ascertained that timeliness of operations was the major problem that had to be addressed in terms of creating an environment for increasing yields. Timeliness is a function not only of managerial capacity but also availability of draught power. In one area we identified six recommendation domains based on whether the farmers hired or owned oxen, donkeys, or tractors. Initially we thought that this was a satisfactory division of farmers. However we have found that farmers often use more than one type of draught power, for example, hiring a tractor and using their own donkeys. Consequently the division between recommendation domains became somewhat blurred. However this is not necessarily critical providing we can come up with strategies to help farmers that fall in each of the groups we are committed to helping. Obviously it will be harder to come up with strategies that help farmers who have to hire donkeys than it will be for farmers who own tractors. The value of the recommendation domain approach is that it forces researchers to disaggregate the farming community, which traditionally has been assumed to be rather homogeneous in composition.

b. <u>Whose Needs To Be Addressed</u>?

What needs or constraints are to receive focus in the research process? Should they be those articulated by farming families (i.e., felt needs), those scientifically ascertained by research workers, or those reflecting the needs of society? As discussed earlier we believe that criteria used in developing improved strategies should reflect the felt needs of farming families providing they are not incompatible with the needs of society (e.g., there is not a decline in soil fertility, nutritional levels, increasingly inequitable income distribution, etc.). A further point deserves emphasis. Farmers may not always be able to articulate their major needs. For example,

farmers in Niger are so used to striga on their sorghum, that they may not always state it is a problem amenable to solution. Thus constraints are not always overtly recognised as problems. In such cases scientists may have to provide leadership. Further informal survey discussions often allow farmers to identify with problems specified by the FSR team, while sometimes it takes comparison in farmer managed verification trials to reveal the problem.

Strategies developed need to ensure convergence between the rather short-term private interests of farmers and those of society in the long-run. Although few would in principle disagree with the above it is in practice a lot more difficult to incorporate societal interests practically into FSR work. The problem of doing this relates to the methodological complexity of the incorporation and the time that would be required in deriving societal impact evaluations. We do not have a good solution to this problem.

However the design or planning stage does allow long-term technical questions (e.g., whether planned intervention is consistent with soil conservation) to be brought to bear in the choice of solutions. Also immediate policy issues -- such as urgent need for food in urban areas, lack of availability of foreign exchange, etc. -- may weight the choice of priority problem and choice of solution.

2. DESIGN

The priorities for research should arise from the descriptive/diagnostic stage in terms of developing improved practices based on the needs of farming families and the constraints they face. This often is a paper exercise depending as it does to a great extent on information derived from experiment station based research and perhaps from practices undertaken by other farmers. However the thinking involved in the design process must be as wide as possible and requires good information flows to provide innovative ideas. For example, a weed problem in maize, caused by labour shortages, prevents a pay-off from being obtained from the application of fertiliser. The classical prescriptive answers would be: the farmer must weed at two and seven weeks after planting, or, more relevant in this case, must apply herbicides. However there may be an appropriate "indirect" solution such as changing the land preparation method to give better weed control, or a "system's" solution. In our example, the farmer is giving priority to weeding cotton and planting groundnuts. Releasing labour from these operations (e.g., by planting a shorter maturing groundnut later) would enable better maize weeding to be undertaken. Widening the intervention possibilities increases the chances of designing an appropriate solution. Information flows giving exposure to ranges of options are really needed. Unfortunately, however, within many national programmes, results from the local station are often not even accessible to FSR teams, let alone from relevant sites in other countries.

Thus design work is often more than simply a paper exercise. This occurs, for example, when there is not much information on the shelf that can be plugged into field situations and when conditions in the practical field situation differ substantially from those on the

experiment station where the improved technologies were developed. These situations have risen with respect to our work in Botswana. There is not a great deal of technology developed that is ready to be applied in practical field situations and one of our major areas of work are located a considerable distance from the experiment station. Also station based scientists increasingly want to enter into collaborative work with our FSR scientists. This needs to be encouraged but it also means that we are spending more time on researcher managed and researcher implemented (RM-RI) work on farmers' farms than perhaps is usually desirable for FSR teams. A lack of technologies on the shelf in essence illustrates another problem of farming systems projects. Donor agencies have on occasion not recognised the complementarity of station based research and FSR work. Consequently FSR projects have been viewed as a substitute for station based research and implemented in areas where station strength does not exist.

The design stage is increasingly recognised as crucial to the success of FSR in technology generation. It is the turning point of the process. On the whole farmers problems are readily identified. In design the FSR team's understanding of the system is brought to bear on the identificaion, and evaluation of apparently appropriate solutions to those problems. The decisions taken can commit several professionals to an experimental programme, often over several years. It is a vital stage in the approach. Figure 2 details one sequence through this stage.

There are four issues in the design work that are a concern to us. They are: the question of leverage in the farming system; the issue of experimental versus non-experimental variables; the issue of breaking constraints or exploiting flexibility; and the issue of single trait technologies versus packages.

a. <u>Leverage</u>

As we indicated above FSR can be undertaken "in the small" or "with a pre-determined focus". We do not view FSR "in the large" as being a viable option. There is, however, still the difficult issue of variables to parameters. Is it wise, for example, to focus research on a predetermined commodity rather than on the whole farming system or on the crop subsystem? When research is undertaken where the predetermined enterprise question is a major absorber of farm resources then that enterprise will usually offer the best leverage on such system problems as deficient income, excessive risk and seasonal variability in the use of farmer owned resources. In fact this small variable to parameter ratio approach is methodologically much easier to undertake than one in which the ratio of variables to parameters is much larger. In fact we would go further and say such FSR work has probably been most successful to date. However in national programmes a different situation often arises. Geographically based FSR teams have responsibility for looking at all crop and livestock enterprises in the system. Obviously most leverage can be obtained with the major crop or livestock enterprise. However this still is a complex situation when viewing the relationships between the various enterprises. Certainly focus on the broader farming system is

advisable when there appears to be little scope for improvement in the farmer's major enterprise.

b. Breaking Constraints Or Exploiting Flexibility

There are two possible ways of dealing with an identified constraint: break the constraint, or, avoid the constraint by exploiting the flexibility in the farming system. A simple technical example would be the possibility of different strategies that deal with a particular disease on sorghum. The constraint may perhaps be broken by applying a seed dressing (requiring an input distribution system), breeding a disease resistent sorghum (a long run strategy requiring an input distribution system) or through exploiting flexibility in the farming system by planting the sorghum at a sub-optimal time (in terms of yield potential) which reduces or eliminates the disease attack. The decision on which approach to use in dealing with constraint will depend on its severity, the flexibility that exists in the existing farming system, and the availability of a potential improved strategies that break the constraints or exploit the flexibility. We have had experiences with both types of approaches. In northern Nigeria it was possible to exploit flexibility in the farming system by planting cotton later than agronomically would have been advisable. However in Botswana where there is a greater inter-annual and intra-annual variation in the distribution of rainfall there is little flexibility in the farming system since a key management factor is the ability of farmers to undertake timely operations for ploughing, planting, weeding, etc., in order to make water more available for germination and plant growth, and to improve the efficiency of water use. Therefore we are faced with a much more difficult situation of trying to break a constraint. In fact if one looks at the success of FSR work to date it is apparent that most of it can be attributed to exploiting flexibility in the farming system rather than breaking constraints. We would submit that breaking a constraint is a much more difficult problem both for researchers and farmers than the strategy of exploiting flexibility. However major long-term increases in productivity have to come through breaking constraints. This must be a step-by-step approach evolving away from the present system towards a new one -- each step being one that is acceptable and absorbable by farmers.

c. Experimental Versus Non-Experimental Variables

The design stage produces apparently appropriate sets of improved practices for testing at the farm level. We would support the following procedure for designing improved pratices:

(a). The experimental variables should consist of practices in which farmers' management is flexible or where *ex ante* evaluation suggests room for increased productivity. Flexibility in management is enhanced when there are under-utilised resources, while increasing productivity of variables is vital to breaking constraints.

(b) The feasible range of treatments for such variables is set by the flexibility that exists. Some flexibility could be

introduced for example by assuming that the institutional support system could change. It could, for example, be assumed that an institutional source of credit could be made available to supplement the cash flow of the farm business. The above remarks suggest that development of improved practices should usually consider the existing or definitely expected infrastructural support system.

(c). Non-experimental variables should be fixed at levels representative of local farm practice, or should be implemented by farmers themselves. Interaction between farmers practices and recommendations is a neglected and crucial reason for poor adoption. This issue leads directly into the question of packages.

d. Single Components Or Packages Of Technologies

Designing improved technologies may involve incremental or single component changes or incorporate packages of practices. The major advantages of packages include the complementary or synergistic effects between the various components. Improved seed for example may respond better than indigenous varieties to the addition of inorganic fertiliser. Disadvantages of packages are the complexities of putting them together and the likelihood of them being inappropriate for farmers in their entirety. Farmers, like researchers, value synergism. Packaging is effective when components are assembled from an understanding of the farming system into which they will be interpolated. This implies researchers should always know the main effects and first order interactions for each component with non-treatment variables held at farmers' level. Where packages contain components heavily dependent on interactions which at the same time compete heavily with resource allocations in the system, an incremental approach is required to the recommendation and extension of the package (Collinson, 1972). FSR teams are in the best place to identify the sequence of innovation leading to the adoption of the complete package. Initial steps will ideally be with components with major main effects which are relatively compatible with farmers existing resource allocations. More complex steps will be possible as farm productivity improves and farmers confidence in absorbing new technology grows. Unfortunately however, this technology ladder cannot always be followed particularly if synergistic effects are very high. In Botswana the first step up the technology ladder is the necessity of having draught power and relevant equipment to pursue timeliness of operations.

3. TESTING

The objective of this stage is to evaluate the improved practices flowing from the design stage to the farm. The evaluation criteria should be those found important to farmers in the descriptive/diagnostic stage. As indicated earlier the testing stage can be viewed as consisting of two parts:

(a). Researcher managed and farmer implemented (RM-FI) type trials

which use farmers' land and maybe labour but with the managerial input still being provided by the research workers.

(b). Farmer managed and farmer implemented (FM-FI) type work with farming families providing their own land, labour, capital and management. In essence at this point an improved technology is being tested for compatibility with the technical and human elements.

Usually the performance of the improved technology drops when it moves from the artificial conditions of the experiment station and drops even further when it moves to the farmer managed and farmer implemented stage, where it is being tested for compatibility with the current farming system and the managerial know-how of the farming family. Five issues of methodological importance arise at the testing stage. These involve selection of the farmers, experimental design, evaluation criteria, precision and extrapolation of results.

a. Selection Of Farmers

The issues of interaction between farmers and research workers, and the representativeness of farmers and farming families are important. Conflict between these two desirable characteristics is conceivable. Some research workers prefer to select the better more responsive and more cooperative farmers to participate in the testing stage. Using a cooperativeness criterion has the advantage of maximising interactions between research workers and farmers. However it brings the potential problem that when improved practices receive a positive evaluation this still may not be truly relevant for the average farmer in the recommendation domain. Technology development may thus be biased towards farmers with with better than average characteristics and jeopardise diffusion through the target group in the long run. Other research workers in FSR advocate selecting farmers representative of target groups under investigation. The possible disadvantage that representative farmers would not maximise interactions between farmers and research workers is seen as being offset by the big advantage of generating improved practices suitable for the average farmer. However the bias that perhaps inevitably results, and to some extent is the case in our Botswana work, is one of including mainly cooperative farmers at the testing stage to ensure maximising interaction between farmers and researchers. Of course the selection of a representative cross section of farmers becomes critically important in farmer managed and implemnted (FM-FI) type work.

b. Experimental Design

At the testing stage compromises have to be made in the experimental design. They usually need to be less complex than those undertaken on experiment stations because of costs, worries about too much land being asked from farmers, and the desirability of interaction between farmers and research workers. Researcher farmer interaction is less likely when experiments become too complex. When one moves from researcher managed to farmer managed type work at the testing stage experimental design becomes even simpler: two plots only -- the proposed improved practice compared with the traditional practice.

We make a fair amount of use in our Botswana work of superimposed treatments on farmers plots. Also we place a lot more emphasis on replication across farmers fields rather than within farmers fields at this stage of testing. The problem of experimental work at this stage is exposure to many additional sources of variation, including differences in the management of non-treatment variables by host farmers, and often inability to explain differences between plots.

We have not really satisfactorily resolved the issue of how long the testing should be done. In Botswana we are in the third year of a drought and each year has been different from the previous one. Therefore it is difficult to get consistent results, although in the case of double ploughing, for example, we have had fairly consistent improvement over the traditional ploughing and broadcasting system each year of the project.

c. Evaluation Of The Improved Technology

The primary issue is to ensure that effective evaluation takes place before technologies are recommended for dissemination by the extension services. Since the 1950's many economists have been pre-occupied with ex post monitoring of farmer adoption of technologies. Their emphasis has been in explaining why there has been high or low adoption. Ex post monitoring is of course too late to prevent wasted investment in extension training, and in support and infrastructural services developed to handle anticipated increases in production. FSR attempts to evaluate the technology as a part of its development. It raises several related issues:

(a). In ex ante evaluation the criteria used should be those which will be used by farmers in the target group. These are often difficult to identify.

(b). Farmer assessment is an important substitute for formal economic analysis.

(c). The balance between evaluation on the criteria used by local farmers and a societal evaluation is a difficult one to strike.

Farmers will use criteria of two types: first whether they are able to adopt. This raises questions about whether the required inputs can be obtained locally, whether the resource levels implied are within the reach of farmers, and whether the changes will be socially acceptable to the community. The second set of criteria used by farmers is whether they are willing to adopt -- broadly speaking whether they will be better able to achieve their goals by using the improved practice. The criteria on which they will decide their willingness to adopt are often obscure. Factors such as the balance between preferred foodstuffs, returns to labour during one particular period of the season, the opportunity cost involving the loss of a non-preferred but risk averting starch staple, are common small farm family criteria. Such factors are particularly difficult for technical scientists to relate to who are "conditioned" to an experimental method which deals basically in weight per unit area of land. Often several such criteria may have to be brought to bear on a

single proposed change. For example staggered planting as a practice may manifest labour or draught power scarcity, risk management and a preference for a prolonged supply of a certain type of fresh food -- all at the same time. There is little chance of weighting these correctly in an economic analysis, particularly where both product and factor markets are rudimentary.

This difficulty in second guessing the balance in farmer evaluation criteria leads us logically to farmer assessment as a practical approach to technology evaluation. The FSR phase of technology development is in their fields, with farmers, on the spot. Yet to date the devices developed and used for farmer assessment are rudimentary. Harrington, (1981) has said that farmer assessment is likely to be useful when:

(a). Farmers have had little previous experience with the component of the new technology and therefore cannot be expected to provide useful information in an ex ante survey.

(b). A knowledge of a recommended technology is needed to focus the questions regarding farmers' experience because there are many solutions to farmers' problems.

(c). The farming system is difficult to stimulate in a formal model.

(d). Ex ante survey work was not well conducted.

We would go further than this; we are convinced this is a vital area for FSR, and would urge a contribution from anthropologists and sociologists in improved methods for routine farmer assessment of technology as part of its development. /12

Sometimes it is a problem to get farmers to interact frankly about technologies, particularly to gain cooperation in types of trials including components they have not seen before. We have found on occassion it takes two or three years before frank views are heard on the utility of unfamiliar technologies.

This emphasis on farmers' criteria for technology evaluation ignores possible impacts on other farming communities interacting with the target group and on broader societal issues. We cannot see any easy way around the question of full social evaluation. We believe that bringing both long term technical and current national policy considerations to bear in technology choice at the design stage is the easiest way forward at present.

d. Precision

A continuing problem for scientists engaged in FSR work is that of precision. Exposing potential solutions to wide sources of variation, representative of what any recommendation will have to survive under, reduces precision. Recognised statistical standards are no longer achieved and coefficients of variation increase. It is becoming commonplace to accept lower confidence levels of 10 to 20%. However, is this just a compromise? FSR scientists don't seem to be able to

pin-point the real answer in a way which satisfies classical researchers and woos them away from 1 to 5% levels. We know farmers work with much lower levels -- as indeed we do -- in taking decisions. The questions we have are:

(a). Should we do our statistical analysis on the economic evaluation criteria?

(b). How should we express the difference between statistical inference and decision theory in a way which removes scientists' doubts?

(c). Do we continue trying to meet lowered statistcal inference standards?

e. Extrapolation Of Results

Costs limit the number of sites that can be included in the testing stage. As indicated earlier efforts are needed to increase the multiplier effect by extrapolating results to other areas. Chances to extrapolate or transfer results to other areas are of course increased if sites for farm trials are picked to represent larger areas. Possibilities for extrapolation are increased by developing technologies that are flexible in timing and other factors. Also at the testing stage, a detailed specification of the proposed improved practices and conditions under which they were tested, is required in order to increase the efficiency of extrapolation to other areas (Zandstra, 1978; Norman and Palmer-Jones, 1977). Unfortunately we are not always very good at specifying exactly the technical or human environment under which the testing was carried out and the criteria for when it will or will not work. There are deficiencies at this level which need to be overcome if the multiplier effect of such work is to be maximised.

Extrapolation of results can also be assessed in terms of a specific location which has a very variable climate, such as Botswana. In such areas it is important for the FSR team to set up hypotheses about the results of experiments for the different "types" of seasons they can expect. It serves to remind them, when the results come in, where they are on the inter-seasonal spectrum. Ideas on how many times such a result can be expected are very important for risk conscious small farmers.

4. RECOMMENDATION AND DISSEMINATION

Development of locally specific recommendations via FSR is causing some problems because of highly centralised "recommendation release" procedures. In a West African country, for example, a two year lag period has been reported between deciding on, and approving recommendations, that had to be passed back to "the centre" for approval. A revision of release procedures, giving more authority to the local level, is important. This should be complemented by a re-gearing of supply agencies and credit banks, to allow initiative and decisions at the local level to alter supply and credit lines. We

recognise however such adjustments will mean that demands on local management capabilities will increase.

INSTITUTIONALISATION ISSUES

Research and extension organisations in developing countries are invariably based in, or under the authority of, Ministries of Agriculture. They are classic bureaucracies and the difficulties of changing these are widely appreciated. The institutional and proceedural requirements for the adoption of FSR as a tool in agricultural research face the inertia, red-tape and vested interests seen as typical of such bureaucracies.

The introduction of FSR has ranged from the addition of a social scientist into existing, multidisciplinary commodity research teams, to the setting up of special teams which include the whole gamut of disciplines, to various positions in between. The process of institutional innovation has several components. Like packages to farmers the introduction of innovational institutional components should be geared to the system within which change is to be made. The strategy followed by CIMMYT in eastern and southern Africa is aimed at driving a narrow wedge into agricultural bureaucracies in the region. "Narrow" in this context covers two ideas:

(a). To limit the selling pitch for FSR to its use in generating more appropriate technology, a need felt by many research administrators, and the focus most consistent with CIMMYT's mandate.

(b). To minimise the number of personalities to be initially convinced of the efficacy of FSR as a useful research tool.

A subsequent strategy is to build up some capacity to apply a systems perspective to agricultural research within the NARS, and then to open out the wedge to make the linkages for effective operation of the capacity. Components of the strategy are listed below:

(a). Identify national research directors in the region who accept the problem of low adoption rates of present research output. They represent targets of opportunity.

(b). Demonstrate, in a local situation of their choosing, the FSR diagnostic techniques to identify an on-farm experimental programme relevant to farmers in that situation. Emphasis in this demonstration is in the importance of local economic circumstances in identifying an appropriate experimental programme, and the role of the agricultural economist.

(c). Promote the need for experimentation under farmers' agro-ecological and management conditions.

(d). Conduct training for local professionals in the use of these techniques and later in the planning, implementation and evaluation of on-farm experiments.

(e). Discuss the FSR team composition and linkages with commodity research teams (CRTs) and extension.

(f). Draw senior extension staff into the discussions, covering FSR/extension links.

(g). Help develop procedures and, when requested, structures to institutionalise these linkages

(h). Discuss the role of linkages back to planners and policy makers to ensure that technologies identified as appropriate to a local situation can be effectively serviced there.

The essence of programme operation is pragmatism in fitting the sequencing of components into local national situations. For example Zambia had a solid institutional structure before strong capacity. To date, the Zimbabwe Research and Specialist Services have no authority to employ Zimbabwean economists, though an FSR Unit has been set up with both crop and livestock scientists. In this respect it is the most advanced of its kind in the region. This wedge strategy has sometimes led to criticisms from academics convinced of the conceptual potential of FSR but ignorant of the hazards of implementation. More down to earth criticisms have been slow progress in drawing livestock and extension considerations into FSR. Bias towards crops has often arisen not only out of the mandates of promoting agencies like CIMMYT, but also because the state of the arts in on-farm experimentation with animals is poor. Most damaging has been that current responsibilities for research into crops and animals are widely divided institutionally. To try to work with personalities in two institutions at the same time would have blunted the wedge. An anecdote illustrates this point. In one national research service the crop department had taken the initiative in a trial of FSR techniques. The report on the diagnosis was being discussed jointly by crop and livestock departments. With the rapidly increasing use of cows for ploughing in the target farming system the report recommended research to examine how the reproductive cycle and supplementary feeding could best be managed to complement the ploughing burden. The reaction from the vets was unanimous and vociferous -- "using cows for ploughing is crazy, it should be banned". In practice the innovation sequence in institutionalising FSR has been very varied, in an attempt to accommodate the peculiarities of particular bureaucracies and the attitudes of the administrators operating them. The time horizon for building capacity and for institutionalisation, once the concept is accepted, is not less than ten years in most national situations. Annex I outlines the FSR history for three countries of the east and southern African region to show the rate of progress in practice.

1. RESEARCH OR EXTENSION; THE PLACE FOR FSR

As outlined above CIMMYT has concentrated its promotional efforts through research which its mandate has brought it into contact with. Whether research or extension is the appropriate location for FSR in technology generation remains a debatable point. Several extension services, such as Kenya and Zimbabwe, have taken their own initiatives towards an on-farm research effort. Two points perhaps dominate the

discussion:

(a). FSR has a local specific area orientation highly compatible with that of the extension services.

(b). If FSR is located with extension, and research/extension remain essentially separate bureaucracies, there is a great danger that component research will remain isolated from its small farmer clientele. FSR is increasingly seen as an effective device for linking research and extension: something which is lacking in most ministry bureaucracies.

The disussion on location is complicated by different approaches to using FSR in a technology generation role. As indicated earlier the two approaches with which we are concerned can be summarised as FSR "in the small" and "with a pre-determined focus". We need to understand these alternatives and their implications for institutionalisation.

a. FSR With A Pre-Determined Focus

With a pre-determined focus FSR is relatively easy to reconcile with existing research institutions organised along commodity lines. The commodity is the focus. Commodity teams are frequently multidisciplinary and adding a social scientist to the team to bring the farmers' perspective to bear in experimental planning and evaluation implies no radical reorganisation. The commodity team is expanded and a modified and extended multi-locational trials programme takes care of a re-emphasis on experimentation under farmers' conditions. The advantages of this approach are easy institutionalisation and an internal CRT/FSR interface, with the commodity team doing both on-station research in the classic mould, and on-farm research. It allows researchers to keep a foot in the camp of their peers, and in the promotional stakes. The career structure for purely farm system researchers remains a grey aea in most national programmes. Kenya is in the process of developing something close to this pattern and the Sudan presently favours this approach. As an ultimate model it has several disadvantages. The major ones arise from poor exploitation of the system's perspective'. Five types of problems are:

(a). The pre-determined focus pre-determines the range of problems identified in the system. Research effort may be focussed on sub-optimal problems and solutions which may not be attractive to farmers whose primary concerns may be elsewhere in the system.

(b). It offers a means for identifying and ranking technical research problems requiring specialist research attention, only within the limited focus. It cannot aid research resource allocation across commodities, a major potential contribution of a full farming systems perspective.

(c). These first two disadvantages contribute to a third, which is the limited cost effectiveness in the application of FSR. There

is great potential for overlap in the workplans of commodity based FSR teams. Reducing the point to an absurdity; farmers operating a five commodity system, a common feature of small farming, might draw the attention of five commodity based FSR teams. Their technologies, identified in isolation, would be competing for the use of farmers' limited resources.

(d). FSR's important linkage role with extension is more difficult to achieve. Little restructuring is required and therefore FSR is likely to be perceived as a creature of research, and its orientation as well as organisation is less compatible with successful extension. Indeed, the coordination and evaluation of several commodity related FSR efforts for any region may create a new research nightmare for extension.

(e). Difficulties have been experienced in trying to build an FSR capacity within existing commodity teams.

Institutionalisation within existing commodity teams has two other disadvantages as a target model:

(a). Specialised researchers tend to be locked into a programme aiming at peer group recognition. Workplans are not easily re-balanced to absorb a systems perspective and content is not readily modified without antagonism.

(b). An early step in building FSR capacity into a commodity team is the addition of a socio-economist. Unless he is very experienced in his profession, and in FSR, it is very difficult for him to make the case for FSR and for social science, and carry the team with him. Young professionals need their own perspective and capacity building before they are ready to hold their own in the arguments which inevitably greet the new emphasis.

b. <u>FSR In The Small</u>

FSR "in the small" lends itself to institutionalisation as regionally oriented teams. Such teams draw from and feed back to specialist researchers of all commodity and disciplinary affiliations as the diagnosis of local circumstances dictates. Teams are usually made up of a general crop agronomist, an agricultural economist and an animal production scientist in areas where animal enterprises are an important part of the farming system. The advantages of this arrangement are virtually the corollaries of the disadvantages of a pre-determined focus:

(a). In seeking a focus to give best leverage to the improvement of the system as a whole, priority problems are identified. Appropriate solutions of these should be readily absorbed by farmers.

(b). Feeding back technical research agenda of unsolved priority problems helps balance specialist research effort according to farmer need.

(c). The above points, plus the use of only one FSR team in any area, contribute to a cost effective research effort.

(d). An area orientation and organisation is wholly compatible with extension. It offers great potential for drawing local extension staff into the various stages of the generation of technologies they will have to sell to their local farmer market. It is a natural research/extension linkage device. Malawi has gone a step further in joint management of FSR teams. Technically the teams will be under the Department of Agricultural Research, and administratively under locally based Agricultural Development Division Managers. These managers will take decisions on priority target groups for FSR programmes in their divisions.

(e). It creates a relatively independent niche for FSR. This niche can be sheltered to an extent from both CRTs and extension while a capacity for FSR is established. This is particularly important where young professionals are involved and morale is easily shattered by apparent antagonism from both traditional establishments.

(f). Finally, and in an apparent contradiction, regionally organised teams allow policy full play in determining the focus in any particular farming system. For example, an overriding policy objective to increase cotton production for import substitution can be implemented by focussing on cotton development in the system through the FSR team.

A more complicated re-organisation of research and extension is needed to fully exploit the advantages of FSR in technology generation. This is undoubtedly a disadvantage and a formal regional structure should probably be seen as a late component in the FSR innovation sequence. Nevertheless in both Zambia and Malawi early institutionalisation of FSR along regional lines has produced a framework of procedures within which FSR teams can operate securely. The other danger in breaking FSR teams out of the traditional research organisation is the danger of isolation from the CRTs. We believe special and careful provision has to be made to avoid this. There are many points in both CRT and FSR processes for interaction between the two sets of teams.

CRTs can contribute in the following ways:

(a). During diagnosis, after focussing on the system, the FSR team may call in relevant specialists, to evaluate technical problems in the field and to identify causes. A weed scientist to identify the weed spectrum and the husbandry practices which promote it would be one example, where a weed problem is identified as a priority focus.

(b). During design the relevant specialists are asked to contribute technical information in specifying possible solutions, and to advise on particular aspects of experimental design related to those solutions.

(c). During on-farm experimentation the relevant specialist may be asked to advise on phenomena arising in the experiments, and to help with biological interpretation.

Once the focus is established it is likely that the same specialists will follow through the full sequence with the team.

On the other side the FSR team contributes to specialist programmes in the following ways:

(a). Feeding back technical problems, identified as important to farmer development, to the appropriate specialists.

(b). Competing for specialist time, which is a help to research administrators, in deciding how to redeploy or expand specialist capacity.

(c). Feeding back local information to specialists to help them structure their experiments. Farmer criteria in evaluating varieties helps in the construction and evaluation of selection blocks and yield trials. Rigidities farmers have to adhere to in their management regimes help to decide which components to combine in packages and how the management of non-treatment variables should be handled in experiments.

Thus there are very significant contributions in both directions. Procedures for interactions should be clear and time set aside in workplans to facilitate them. It must be emphasised that no matter how good such provisions are, effective interaction depends on a mutual appreciation of roles; one side cannot do an effective job without the other. This requires that both sides see an "effective job" in the same terms; the rapid adoption of research results by small farmers. Currently this is not always the case. Historically CRT reward systems were geared to other goals.

There is much current discussion on the interface between CRTs and FSR teams in experimentation. In planning on-farm experiments the FSR team draws possible solutions from the work of relevant CRTs. Transferability has to be evaluated; will the proposed solution hold under the local conditions of the target group of farmers? The FSR team know the local conditions, and CRT specialists are best able to judge the vulnerability of the technical relationships inherent in the proposed solution to local conditions. Relationships may be distorted by agro-ecological differences or by interactions with components of farmer management. Adaptation to farmers' management is clearly within the purview of the FSR team while adaptation to different agro-ecological conditions raises questions of territory. It is already recognised in research services as the role for multi-locational trials of the commodity teams. In Zimbabwe, where research services have both Communal Area Research Teams (CARTs) and FSR teams, it seems to be emerging that researcher managed and implemented trials (RM-RT) -- investigating modified technical relationships -- will be a CART responsibility, and that FSR team responsibilities begin when farmer implementation and management

enters into the experimental effort.

In summary, on the question of institutions, we would stand by regionally deployed FSR teams of a crop agronomist, an agricultural economist and, where appropriate, an animal production scientist. The teams would draw from and feed back to multidisciplinary commodity teams as required by local diagnosis. Strong linkages back to CRTs, and forward to extension, are a vital feature of reorganisation needed to establish such teams. A national FSR coordinator at the headquarter level can be usefully supported by specialists not normally included in commodity teams. Rural sociologists and nutritionists, available to FSR teams on request, are examples of disciplines helping to service FSR in Zambia. Within their regions FSR teams need to work closely with a senior agricultural officer of the ministry. His or her main role is to coordinate the programme of the FSR team with extension workplans, and to take initiatives on the policy and planning implications of recommendations emerging from the FSR work. The decision mechanism to make and service new recommendations at the local level is emerging as a gap in several countries of the ESA region.

This said -- going back to the wedge strategy -- entry may be facilitated by extending commodity teams to include FSR. This will be less of a compromise in institutionalisation when two conditions can be fulfilled:

(a). The FSR efforts of such teams can be focussed on systems where their commodity dominates resource allocation.

(b). When a senior professional, strong in FSR, is available to reinforce the commodity team.

Where professional capacity in FSR is weak, caution is needed. Morale is easily reduced by uncertainity in both concept and role. Again, it emphasises the point that pragmatism and an awareness of the options must dominate the promotion of FSR within national programmes.

2. FACTORS INFLUENCING ATTITUDES TO FSR IN SOME LDC'S

Some confrontation is perhaps inevitable in efforts to change institutions. It can surely be minimised by an all seeing strategy and a Satchi and Satchi style advertising and PR exercise. That confrontations have occurred in the region is partially due to less than perfect diplomacy by would be salesmen. It has other roots in the attitudes dominating bureaucracies, in higher level education, and in donor activity in the region.

Agricultural establishments are heavily dominated by a technical perspective. Agricultural economists have little representation at the higher levels in many agricultural ministries and planning units are often very subordinate to the decisions of the technical professional at the top. Often trained in the west -- or in the east for that matter -- farming to them is big fields, straight rows, monocrops, machines and a commercial outlook. Peasants are peasants and rarely perceived as farmers. Even today university and college

curricula are firmly based in large-scale commercial farming. Lip service is paid to the idea of coming to grips with the small farm sectors but initiatives to base higher agricultural education in a small farm perspective are few and far between. It is seen as a threat rather than a challenge by most agricultural teachers. For example, systems thinking rarely has a place in courses. Indeed some developed country universities have moved further to adjust curricula to the needs of small farming than have many local institutions.

Obviously implementing a successful FSR type project involves having suitable team members both national and at this stage often expatriate. This is not easy because of some rather unique features of FSR type activities involving working on farmers farms, having a farming system focus rather than focussing on one commodity, the necessity of interdisciplinary cooperation, and having an appreciation of the role of other disciplines. Unfortunately until very recently effectiveness in such work has been primarily based on longevity in the field (i.e., relevant experience) rather through formal training programmes. We believe that personality compatibility and a strong grounding in a discipline are important pre-conditions for melding an effective interdisciplinary FS team. However the lack of training geared to such needs contributes to the difficulty of implementing FSR type projects.

Work undertaken by FSR teams involves substantial field work under difficult circumstances, combined with considerable amounts of travelling and involving often living in isolated areas. Such problems not only can preclude the identification and participation of suitable national staff, but also, together with the nature of FSR type work, often make it difficult to recruit suitable expatriate staff. We believe it is important to establish incentives for local staff in terms of salary premiums and satisfactory career paths. In many countries this still has not been recognised as an important issue to be tackled. As a result there is often a lack of continuity in terms of national staff in FSR type work. Such discontinuity can only reduce the productivity of the work and increase the time required to build effective national capacity in FSR.

Civil servants tend to be authoritarian and a teacher/pupil juxtaposition dominates research and extension dealing with small farmers. These attitudes manifest themselves in antagonism to ideas which imply a re-ordering of the existing pecking order. Antagonism is aggravated by the difficulty many countries have in controlling donors who often seem insensitive to national feeling and often seem ruled by fads and fashions. The fact that a single major donor can catalyse a dozen FSR projects in the ESA region over a five year period bears witness to fashionability and brow beating. Money talks. The feeling of being led by the nose brings antagonism against technical assistance in general.

CONCLUSION

We still remain convinced of the value of FSR. However, as we have said for years, we are concerned that it has been oversold too quickly. Donor agencies have moved too rapidly in supporting FSAR

type work before it has had a time to mature. We believe expectations are too high and that results are expected too quickly. Methodologies for resource efficient ways of implementing FSR are still evolving and successful institutionalisation of the approach is only likely to be achieved if it is given a much longer time period to establish its credibility. Donors have used their funds to precipitate the implementation of FSR and are now turning to its evaluation. There is a great danger if evaluation is done from an academic conceptual perspective, without due regard being paid to the slow process of developing national and indeed international capacity, and to the pitfalls of implementation, that the protege baby will be thrown out with the bathwater.

ANNEX I

BRIEF PROFILES OF FSR HISTORY IN THREE COUNTRIES IN EASTERN AND SOUTHERN AFRICA

1. BOTSWANA

Botswana had a donor project with "farming systems" in its title established in early 1976. This project was oriented to the evaluation of improved farming systems and implements -- designed on research stations -- under farmers' conditions. Its orientation modified as exposure to farmers demonstrated their apathy to the innovations on offer. The country has three other FSR projects: the other older one is based in extension; the two newer ones, started since 1980, having a more reognisable, bottom-up FSR orientation. Institutionalisation has been weak perhaps for two reasons: difficulty in establishing credibility and very low numbers of national professionals drawn into FSR.

Poor credibility can be partially attributed to the difficulty of evolving attractive, relevant technology in the harsh unstable climate of much of the country. Station based experimentation has emphasised intensification, and technologies on the shelf have not usually been useful to the highly extensive strategies followed by Batswana farmers. Yields of sorghum, the starch staple, are of the order of 200 - 300 kgs/ha. Again, Batswana farmers rightly place emphasis on cattle in their farming system and only one of the FSR projects have seriously addressed the cattle enterprise. Lack of credibility has limited the support for institutionalisation in the upper echelons of the ministry.

Most nationals involved in FSR have diplomas in agriculture. Expatriates working in the country consider a formal training to the M.Sc. a pre-requisite given the formidable challenge from the environment. Only the latest two FSR projects have had funds for substantial training of nationals. This has often involved upgrading from diploma level, itself a lengthy process. Recently interest in institutionalising the process has increased and currently a proposal is being prepared for the Ministry of Agriculture by the FSR teams.

2. KENYA

Kenya has no donor projects in FSR. Following demonstrations of diagnostic procedures in 1976, a national initiative was taken in 1978 when six graduates, with their final year option being in agricultural economics, were recruited and added to commodity teams on six research stations. Six more were recruited in 1979 to fill six more agricultural economist posts. A senior agricultural economist supported by technical assistance was appointed coordinator and he, with CIMMYT, was charged with the development of their skills and the guidance of their work programmes. Poor consultation with research station directors hindered programme development. A new Director of Research (DOR) appointed in 1981 was unconvinced of the need for FSR and the programme atrophied over the three years to his retirement at

the end of 1983. Under a new DOR in 1984 FSR teams were established at ten research stations. These, together with extension staff from adjacent districts -- in total some 50 professionals -- have embarked on training programmes with CIMMYT assistance.

3. ZAMBIA

The idea of FSR as a means to foster adoption of technology was introduced to the Ministry of Agriculture and Water Development in 1977. Two demonstrations of diagnostic and target grouping procedures were made in 1978 and 1979. Zambian nationals were sought to form FSR teams. Recruitment was difficult with a low turnout from the agricultural faculty and a high demand from the private sector. In 1981 a new DOR institutionalised FSR in the form of regionally based Adaptive Research Planning Teams (ARPTs), and spelled out the relationship with the CRTs. A technical assistance supported national coordinator was appointed and the aim over time was to develop to nine ARPTs, one for each of Zambia's Provinces, and each with a crop agronomist and an agricultural economist. The strategy was to build three ARPTs with six young Zambian professionals and then divide to provide the nucleus for six teams. Donor interest was strong to the point of being forceful at times, and Zambia now has seven ARPTs in seven provinces each supported by technical assistance and funds from a different donor. Rapid expansion has inhibited the development of effective national professionals and low quality in field work has been compounded by inexperienced technical assistance. Nevertheless significant strides have been made in experimental capability and in the development of linkages with both CRTs and extension. The most recent development is the appointment of committees at provincial level to approve recommendation emerging from ARPT work and to coordinate the servicing of locally approved recommendations.

FOOTNOTES

^. Invited for Australian Centre for International Agricultural Research (ACIAR) sponsored "Workshop on Farming Systems Research (FSR)" held at Hawkesbury Agricultural College, Sydney, Australia, 12th - 15th May, 1985.

1. Although it is true that FSR is new in the developing world, some maintain that an earlier version of it was practiced in the 1920s in the US (Johnson, 1982).

2. These approaches, discussed in some detail elsewhere (Norman, Simmons and Hays, 1982), evolved through the somewhat extractive philosophy of colonial times, the wholesale transfer of technology from developed countries largely located in temperate zones, and the use of technology "building blocks" those elements that had made technology development successful in developed countries.

3. The human element determines what a farming system will be as a subset of the potential defined by the technical element. The human element can be divided into two components or groups of factors: exogenous and endogenous. The exogenous factors, the social milieu in which the farming household operates, are largely out of the control of individual farming households, but will influence what its members are able to do. Exogenous factors include: (a) community structures, norms and beliefs, (b) external institutions or support systems, and (c) miscellaneous influences such as location and population density. Endogenous factors -- land, labour, and capital, along with management -- are under the control of individual households and are used by them to derive a farming system consistent with their goals, subject to the boundary conditions laid down by the technical element and exogenous factors.

4. In our own work FSR in the sense it is used in this paper is refered to as "on-farm research with a farming systems perspective" (OFR/FSP) and the the "farming systems approach to research" (FSAR).

5. As well as FSR programmes being differentiated on the basis of the ratio variables to parameters, they can be classified as "upstream" (developmental) and "downstream" (applied). "Upstream" types of FSR programmes having a developmental orientation are mainly experiment station based and really do not render results for immediate adoption by farming families. In contrast "downstream" types of FSR programmes, which are the main concern of this paper, have an applied orientation and aim at developing and introducing strategies that improve the productivity of farming systems for target groups of farming families now and in the short run. It may well be that some of the papers to be presented at this Workshop will have more of an "upstream" connotation.

6. The last two are analogous to the systematic adjustment concept refered to by Dillon and Hardaker (n.d.). The other two possibilities are revision and replacement of the farming system.

Obviously, as they rightly indicate, it becomes much more difficult to convince farmers about the changes as one moves from systematic adjustment to replacement.

7. Byerlee and Collinson (1980), Byerlee et al (1981), Dillon, Plucknett and Vallaeys (1978), Gilbert, Norman and Winch (1980), Harrington (1981), Hildebrand (1976) ISPA (1977), Moreno and Sanders (1976), Norman, Simmons and Hays (1982), Shaner, Phillipp, and Schmel (1981), and Zandstra (1978), and Zandstra et al (1981).

8. There are of course of schema that are largely consistent with this schema. For example, see Byerlee and Collinson (1980) and Zandstra et al (1981).

9. In fact many of the issues have been outlined discussed have in fact been written about by other people present at this workshop, for example, Dillon, Hardaker and Byerlee.

10. This is especially the case for technical researchers and research administrators brought up as technical scientists, who have been taught to rely on statistical inference. However informal surveys do have the strength of relying on observation while the emphasis on hypothesis development rings strong bells.

11. Representativeness criticisms can be overcome to some extent by the use of screening questions to ensure the farmer is part of the target group and by a formal sampling of farmers. However representativeness is not fully formalised since only part of the system is covered. In any one interview, only five or six observations on each part are made and no standard questionnaire is used.

12. Also we would argue farmer assessment is valuable throughout the whole experimentation process. For example, a farmer may compare stand establishment of treatments, even if there are no subsequent yield differences.

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FIGURE 1. FARMING SYSTEMS RESEARCH

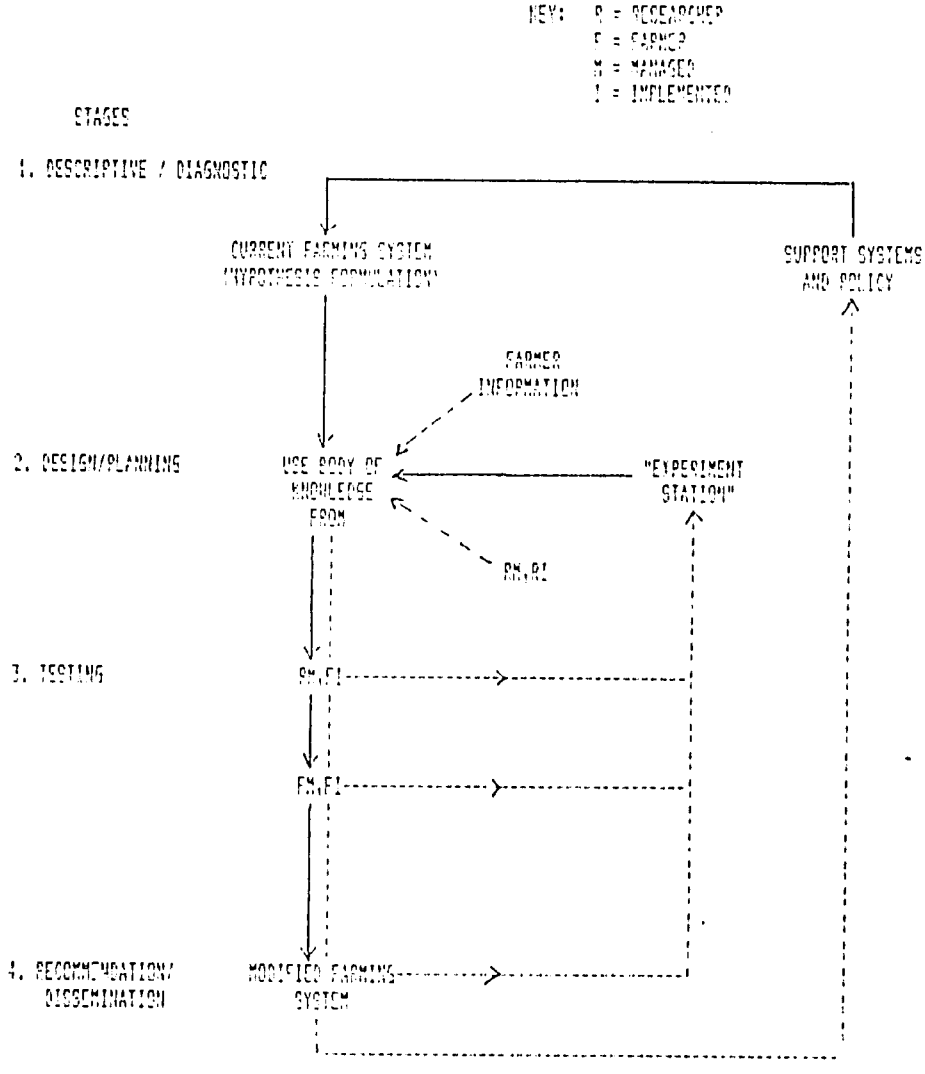
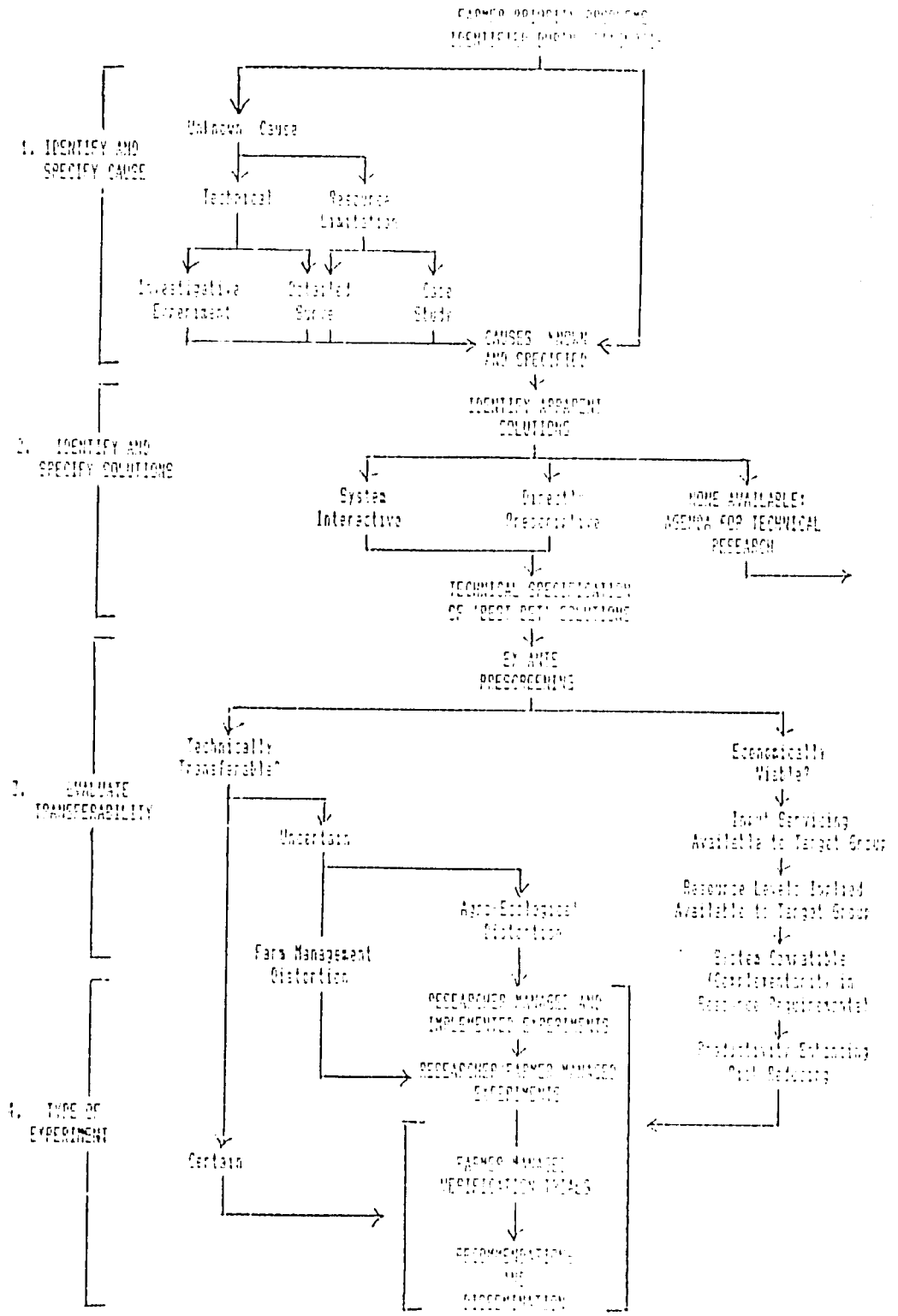
FIGURE 2. THE DESIGN SCHEMES IN FOR FOR TECHNOLOGY GENERATION