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THE FARMING SYSTEMS RESEARCH MODEL IN ZIMBABWE

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The objectives of this presentation are to provide an overview of the evolvement and organizational structure of the Farming Systems Research Unit and its research focus and to highlight selected methodological issues of crop/livestock systems research.

1. Background

In Zimbabwe, agricultural production is carried out under five agroecological regions characterized by varying amounts of rainfall and consequently agricultural potential. There are two major and distinctly different agricultural production sectors viz. the large-scale commercial (comprised of less than 20,000 white farmers) and the communal (African farms numbering more than 800,000 farmers) sectors. The former, which is roughly proportionately distributed among the 5 agroecological regions, has achieved crop and livestock productivity levels comparable to the European and North American farmers, mainly because of favorable agricultural policies which has provided for sound infrastructure, easy access to credit and substantial investments in relevant research. The communal sector, on the other hand, lags far behind, but in the past few years it has gradually increased yields, particularly in maize and cotton crops despite having more than 70 percent of its land area in the 2 lowest potential regions (Table 1).

Agricultural research in Zimbabwe is conducted by public, parastatal and private organizations. The Department of Research and Specialist Services (DR and SS), a public organization, is by far the most predominant in the country. DR and SS is structured into three divisions (Crop Research, Livestock and Pasture Research and Research Services) which in turn are subdivided into disciplinary institutes and experiment stations. Although DR and SS has made a substantial impact on the large-scale sector, its contribution to the communal sector has been rather negligible. Some of the factors that have hindered the development of the communal sector are the lack of appropriate technologies, lacks of agricultural inputs and credit, poor marketing facilities, low and erratic rainfall (less than 600 mm

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per annum in most areas) and low soil fertility (mostly sandy soils with very low organic content).

Table 1. Percent distribution of land area and Yearly Rainfall by agroecological region.

Sector	Agroecological Region I	II	III	IV	V	Total
Communal farms	0.2	3.1	7.0	18.1	12.8	42.7
Large-scale farms	1.2	9.8	5.6	9.7	5.7	32.1
Small-scale farms	-	0.6	0.7	1.5	0.5	3.5
Resettled farms	0.1	0.4	2.4	0.5	1.1	4.5
Total	1.8	14.8	17.8	36.3	26.1	100.0
Rainfall, mm	1100	875	725	550	500	-

Because of the obvious need to focus attention on the communal sector, DR and SS has expanded its programs into these areas. Now it is generally acknowledged that the low adoption rate of available technologies, developed for and used on large-scale farms, by communal farmers was due to the fact that thei particular socio-economic and physical circumstances, household goals and complexities of their totally integrated farming systems, were not taken into account in the design of past research. It was a top-down approach. Therefore, in order to effectively tackle communal production constraints, DR and SS has strengthened its research thrust by adapting the approach of on-farm research with a farming systems perspective. This is a bottoms-up approach.

2. Overview of FSR Unit

2.1 The Farming Systems Research (FSR) Unit was first started 1980 within the Agronomy Institute in the Crop Research Division and thus focused entirely on improving crop productivity with no attention to livestock production constraints.

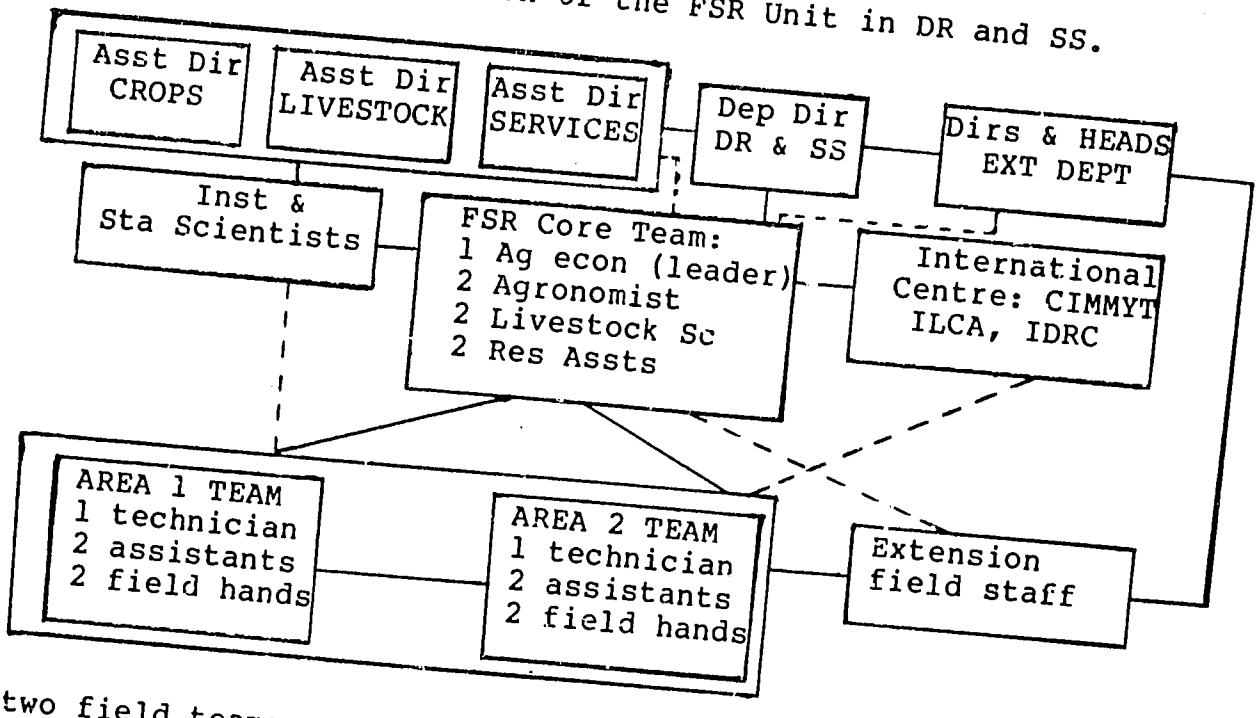
A separate project on Animal Production Systems Research was designed in 1982 and a request was made to obtain financial assistance from the International Development Research Centre (IDRC) and technical support from the International Livestock Centre for Africa (ILCA). IDRC approved the project in 1983 which provides for support to DR and SS and ILCA for its implementation.

In February 1984, the Directorate of DR and SS resolved that FSR (Crops) be amalgamated with Animal Production Systems because a) research to improve the current farming systems must invariably focus on the strong interactions and

interdependencies between crop and livestock production sub-systems, and b) team interaction, given a minimum critical mass of researchers, was considered essential to achieving program objectives, in particular the development and implementation of FSR methodologies. Strong emphasis was placed on coordination and collaboration among FSR and other DR and SS component research institutes. It was envisaged that they should be complementary, viz: results of component research should be useful to FSR and the findings of FSR should assist in designing component research priorities and trials.

The schematic position of FSR in DR and SS is presented in Figure 1. The FSR Unit is comprised of; a core team stationed in Harane which includes one agricultural economist, two agronomists and two livestock scientists; and

Fig. 1. The organization of the FSR Unit in DR and SS.



two field teams permanently assigned to each area. The FSR unit is under the overall coordination of the Deputy Director of DR and SS who formally relates it to and obtains support from the divisions within the Department and from the extension organization at the directorate level. There are formal linkages between the FSR Unit and DR and SS institute and station scientists and the international research centres, both on the design and implementation of on-farm research.

2.2 Objectives of the FSR Unit

The specific objectives of the FSR unit, as defined by the Directorate in its proposal to IDRC, are as follows:

- To study mixed crop and livestock production systems in two representative sites in the communal areas in order to identify opportunities for and major constraints to improved crop and livestock production,
- To adapt, develop and test on farms improved crop and livestock production technologies and systems;
- To develop and test a model for FSR acceptable to DR and SS suitable for wide-scale application in Zimbabwe;
- To train the FSR Unit in appropriate research approaches and methodologies; and
- To provide information for the formulation of agricultural development policies for communal areas.

2.3 Content of the Research Programme

The FSR Unit has identified the following as the major constraints to farming system development in the study areas: shortage of land and land tenure, low quality of land, shortage of draught power, shortage of labour, shortage of cash, shortage of marketing facilities and shortage of technical information and dissemination. To evaluate potential interventions to solve these constraints, on-farm trials have been conducted during the 1984/85 season:

- 48 trials on maize production, testing reduce tillage, fertilizer management, variety x planting date x population x fertilization, manure x fertilization, lime x fertilization, and moisture conservation treatment. Twenty-four of these were farmer-managed trials.

- 13 researcher-managed trials on sorghum production, testing variety x fertilization and moisture conservation treatments.

- 39 researcher-managed trials on sunflower, soyabean, groundnut, fingermillet and pearlmillet.

- 14 researcher-managed trials on herbaceous (Stylosanthes and Siratro) and tree (Leucaena) legume introduction.

- 1 researcher and farmer-managed trial on the improved management (storage) and use (protein lick) of crop residues for strategic feeding of draught oxen.

Three systems studies are being carried out presently. The first is a cattle/goat/donkey/sheep productivity study in which the life histories of females have been compiled,

ages have been estimated by dentition and all animals are being weighed bi-monthly. Productive and reproductive performance and herd dynamics will be assessed. The second study concerns household decision-making and is aimed at defining their basic objectives and priorities, sex/age decisions, decisions and responsibilities for making and implementing decisions, decision criteria being employed and sources of information, rights to and distribution of outputs, and the advantages and disadvantages of group membership. The third study concerns the economics of the farming systems with particular emphasis on the value of livestock contribution and crop/livestock interactions.

For the future the strategy is to intensify research, both on station and on farm, on the following problem areas:

- irrigation: this is considered necessary due to the recurrent drought and the increasing number of irrigation schemes being established in the low potential areas;
- moisture and soil conservation: this has been identified as a priority by several research programmes in DR and SS;
- sorghum and millets: the absence of improved small grain varieties and management for low rainfall areas has been an obvious constraint to the FSR programme;
- fertilizer and manure combination: this should be done for different crops and rainfall regimes on the basis of available quantities and quality of cattle manure;
- intercropping and crop rotations: monocropping is the recommended mode of production and intercropping is discouraged. There is a need to evaluate the possibility of intercropping patterns and crop rotations over time to cater to human and animal nutritional needs and the soil fertility problem; and
- screening of improved annual and perennial fodder plants and varieties: leguminous and non-leguminous species should be tested for cultivation on fallow land within cropping areas, small fenced areas within grazing schemes, non-productive land within grazing areas, or for reinforcement of the grazing area.

3. Methodological Aspects

3.1 Key Aspects in Crop/Livestock Systems Research

There is a need to look more carefully at concepts such as structure and function to understand the interactions within a system. Structure refers to spatial and

chronological arrangements of the various elements: soil, plants, animals, buildings, equipment, etc. It is what is present physically at a particular period in time. Function, on the other hand, refers to a process which takes place in time, e.g. feeding, breeding, cropping and producing milk. There exist functional interactions within a systems when an output of a subsystem becomes an input of another. Such type of interaction could be direct or indirect, administrative or technical. These concepts are important in systems research because they can assist in classifying and analyzing the farmers' systems and in selecting particular types of interventions. For example one could classify systems on the basis of presence and dimensions of particular enterprises (structure), on the basis of the type and dimension of particular interactions (functions), or on the basis of performance indicators (function/structure relationships).

Team composition and interaction is a crucial area. A team of one agronomist, one livestock scientist and one economist work rather well because of mutual respect for their competence in their specialized fields when they possess similar academic credentials (the best trained member, when there is a difference, usually dominates). However, when there are more than one member of the same specific or broad discipline, there usually seems to be more conflicts/differences of research focus. Often the problem is personalities but sometimes differences in professional and personal aspirations play an important part. In this context, the role of the coordinator or leader is to ensure and facilitate the work of the team (help members develop experience in team work) in order to define jointly work objectives, priorities and measurement criteria. The definition of responsibilities and rights to future authorship also needs to be addressed in the very early phases of team work.

In comparison to cropping or livestock systems research, more thought and effort has to be given to the design phase in crop/livestock systems research. The objectives of farmers, policy makers and even researchers (assessing system trends and needs in the next 5 to 10 years when research results will be available) have to be carefully defined. Understanding the hierarchy of systems (e.g. soil, insect and pests, crops, livestock, whole-farm, village or community) permits networking cause and effect relationships within and across different hierarchical levels and sets the stage for identifying opportunities to intervene in the systems and their effect on farmers' objectives. Fitting technological changes within crop/livestock system entails assessing their advantages (benefits to farmers) and disadvantages (conflicts with conditions at the farm and community levels). Thus, how much the proposed improved system varies from the target farmers' system depends

entirely on the definition of the design objectives and the assumption made with respect to the endogenous versus exogenous condition, the manipulable is non-manipulable variables for the farmers, and possibilities for short term vs long-term improvements.

Experimentation on-farm with animals is difficult, costly and risky. The statistical evaluation of specific treatments usually leads to ambiguous results because of the inability of researchers to control non-treatment variables. System experimentation (livestock or whole-farm) may be more suitable for on-farm research but logical analysis and farmer assessment are more relevant evaluation methods. Modelling in this respect is recommended as a helpful tool but it must be practically oriented to reflect how the farmers manage the system. Usually, in livestock system experimentation, it is the cost, both investment and operational, which limit the type of interventions. This is a blessing in disguise since it is also a very important criteria from the farmers perspective.

3.2 Selected Aspects of the FSR Approach in Zimbabwe

Team interaction has been emphasized and utilized to design the FSR approach methodologies and research directions. The team has made a review of methodologies and experiences in cropping systems research (IRRI, CIMMYT, CATIE, etc.), livestock systems research (CATIE, ILCA, WINROCK, etc) and agroforestry (ICRAF). Various methods of data collection (literature review, key informants, informal survey, single and multiple visit surveys, case studies, etc) were assessed for suitability in terms of research hypotheses/objectives, type/reliability of data needed and cost/resource availability. Secondary information was collated to bear on system description and constraints to system development. The screening of interventions was a time-consuming process which resulted in a concise definition of target farmers (for each intervention), hypotheses for the on-farm experimentation, and the need for additional system studies and supportive on-station research.

The role of the field teams is not simply that of data collection but also of serving as an effective feedback link between farmers and the core team. Their continuous liaising with farmers should contribute substantially to the design and analytical phases of research. Therefore their training is a priority in the programme.

On-station scientists were involved from the initial phases. They have provided, upon request, reviews of past research on key topics or problem areas, have assisted in assessing farmer situation and identifying research opportunities *in situ*, have participated in designing on-farm research trials, and are planning to establish on-station

trials which have been identified as priorities for component technology development. The close interaction between the FSR staff and station scientists has resulted in a better understanding of FSR philosophy and methodologies and in a mutually beneficial working relationship.

Another feature of the model is the active participation of the extension staff and organized communal farmer groups in the research process. To cover a large number of households while saving on travelling time and costs, trial sites in each of the two research areas are clustered on the basis of extension workers and farmer groups, given particular soil, climatic and farmer characteristics. Extension staff participate in an area-specific, one-week workshop to discuss farmer problems, research successes and results of the previous season and to plan strategies for the following season. Subsequently, extension workers are selected and each accepts responsibility for one cluster of a farmer group with up to 7 farmers in the managed trials. Discussions with and preplanting demonstrations for farmers in the clusters are then conducted by research and extension staff before the start of the cropping season.

System studies (livestock monitoring and household economics and decision making) have been designed to support technology design and assessment needs. The overriding strategy is to generate less data (than similar FSR projects), do more analysis of collected data and consequently obtain more useful information. Since specific interventions have been identified and analyzed ex ante, it is very clear to the team what additional information is required to test them and assess their adoptability among the specific target farmers.

The evaluation of on-farm research trials include statistical methods using technical considerations, economic methods (looking very carefully at labour efficiency and returns), and farmer assessment (relevance and acceptance of treatments, management and social considerations, etc). However, the emphasis placed on each of these evaluation techniques depends on the type of trial being analyzed which is largely a function of the trial objectives. Since researcher-managed trials are aimed at assessing biological performance of interventions, statistical analysis is most important. Economic analysis is done to identify rough indications relevant for determining future directions. Farmer assessment in this type of trials is of minor importance, but some effort is spent on analyzing with farmers their opinions of trial treatments. In researcher-farmer managed trials, statistical analysis is also very important. However, technical components are evaluated for economic viability and compared to farmers' practice. Empirical evidence from such trials coupled with farmer and extension worker assessment lead to the selection of "best bets" which

can be advanced into farmer-managed trials. With these trials emphasis is on across-site analysis based primarily on economic evaluation and farmer assessment. Statistical analysis is of minor importance at this stage because of the high variation attributed to large plot sizes, management and environmental differences between farms. In the case of Zimbabwe, the above evaluation strategy has been successfully applied to crop trials but has not been entirely done on livestock production trials since the on-farm research process on the latter component is in its early phase of implementation.

Another important aspect of the FSR programme that has been dealt with to some extent is the clear definition of its clients (farmers, extension workers, station researchers, policy makers, development professionals, etc.) and the strategies that should be utilized to effectively transmit the corresponding messages. The reason for this concern is that the present model of research and extension has had an impressive record on the large-scale commercial sector in the country. FSR, fairly or unfairly, will be judged on how well it measures up to its promises and commitments vis-a-vis the success of the previous approach.

3.3 Concluding comment

Finally, the particular model of FSR in Zimbabwe was negotiated and defined according to the peculiar circumstances prevailing in Zimbabwe, namely: the strength and tradition of the agricultural research organization, the commitment of the Department of Research and Specialist Services, the objectives and support of the international centers (CIMMYT, ILCA and IDRC) and the present socio-economic and organizational conditions in the communal areas. This model has been assessed after one year of operation by departmental directors and FSR staff, with the assistance of foreign FSR experts, and it was decided not to make any modification for the time being.

DISCUSSION

Q: (Pandang)

How far are FSR findings extrapolated to other areas with very different conditions?

A: This is an area we should explore. I think a good start would be to look carefully at the key determinants of technological intervention management and performance and assess other areas in terms of these determinants. Some testing in new areas, I think, would be necessary. The other aspects is to count on the design capability of the FSR team to quicken the pace of assessing the appropriateness of innovations in other areas than the ones in which they were developed.

Comment:

It would be interesting to share the experiences of others about the composition of the teams. Economists look through the data, they don't use their eyes. Plant and animal scientists use their eyes mostly.

A: Farming system economists are looking carefully at the system, interaction with farmers and of course with technical scientists to make sure their analysis is useful.

Q: (Oli)

The system explained in this presentation is excellent. Any excellent system can fail, if there is no incentive for the farmer. What approach or methodology do you suggest on this e.g. subsidies like in developed world?

A: Absolutely I agree with you. The farmer must be given incentives. It has been said that attractive prices (of commodities) is the best extension method.

Q: Our approach is always to work with the relatively well off farmers. Do you have some idea wherein the system is tried to approach the weaker sector of society and if this will have some value?

A: Better farmers, in my opinion are usually selected because FSR tries to work through the extension organization which usually deals with above average families. These farmers are more interested in collaborating and more likely to have some resources to assist in technology testing (quicker testing). However, FSR should be developed to focus attention on the lower farm strata, and thus this issue needs to be addressed.

Q: (Patanothai)
You have reviewed several methods for different objectives, what methods have you used, and what have you found useful and practical in your situation?

A: We have used: extensive review of secondary information; informal interactive surveys with experienced scientists interviewing/discussing with range of farmers representative of various types of systems; single visit surveys with very narrow focus, consultation with site specific professionals (extension, schools, district council, etc.) and monitoring. However, emphasize that methods should basically be matched with specific research objectives and resources availability.