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FARMING SYSTEMS RESEARCH:

THEORY AND PRACTICE IN MALAWI

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BACKGROUND

The purpose of this paper is to describe the farming systems approach and how it is being developed within Malawi. The farming systems research program is based within the Department of Agricultural Research of the Ministry of Agriculture as an important component of the total research effort, but the program also links the Department with other departments within the Ministry, particularly the Department of Agricultural Development and the Division of Planning and Evaluation, and with the research faculty at Bunda College.

Professional and technical staff within the Department of Agricultural Research need to know more about the farming systems research program because it is part of the restructuring toward more adaptive research. The restructuring means some significant changes in the allocation of Departmental resources and in the work orientation of research staff. In addition to this introductory paper, a series of in-service courses in farming systems research will be given for Departmental staff and other interested Ministry and Bunda College staff. During the courses the theory, methods and issues will be covered in more detail. This paper is more of a brief comprehensive overview.

The farming systems program is part of the United States Agency for International Development (USAID) funded project to strengthen the Department of Agricultural Research. This project is supervised by the University of Florida. The purpose of the five year project (1979-1984) is clearly stated in the agreement signed by the two governments.

> "The purpose of the Project is to strengthen the capability of the Department of Agricultural Research (D.A.R.) to provide socially acceptable and economically sound research recommendations to the extension service for smallholder crop and livestock production... Emphasis will be placed on assistance to improve and strengthen the systems for research coordination in the selection, implementation, and management of research projects of optimum value to small-

holders. Special attention will be given to the needs for continuous liaison between research and extension functions to achieve transfers of research results to smallholders."

The main points of this project are, therefore, to help the Department provide research recommendations that will help the extension service address small farmer priorities. The recommendations must be relevant and appropriate to small farmer conditions and must be acceptable to the small farmers. This is the reason for the training and scholarships for Departmental research staff, for the presence of University of Florida technical assistance staff, and for the vehicles, housing, and laboratory equipment purchased by USAID.

Farming systems research is designed specifically to help the Department realize these goals of smallholder recommendations. The farming systems approach helps identify high priority problems of small farmers, understand the critical constraints and opportunities in the existing farming patterns, and develop farm-tested recommendations that are appropriate and acceptable.

CONCEPTS

Farming systems research is primarily carried out on smallholder farms. The focus of research and the central concept of this approach is the "farming system." This concept has been defined in different ways by various people, but the definition I prefer is the following (from Hansen, et.al. 1981).

A farming system is not simply a collection of crops and/or animals to which one can apply an input and expect immediate results. A farming system is a complicated interwoven mesh of resources and factors (agronomic, economic, social, cultural, physical, etc.) which are managed to a greater or lesser extent by a farmer. Utilizing the technology known to the farmer, this person or family unit attempts to increase or maximize the farmer's or farm household's utility within a given context of accepted preferences, aspirations, and socioeconomic conditions. The farmer's unique understanding and interpretation of the immediate environment, both natural and socioeconomic, is instrumental in creating the farming system. The term "utility" in this definition refers to a broad range of satisfactions. In the case of Malawi's small farmers, utility definitely includes the provision of foodstuffs, both for nsima (the staple dish) and ndiwo (the accompanying side dishes), as well as the provision of some cash from the sale of crops and/or animals.

Each farmer interprets the opportunities and constraints of the ecological (climate and soils, crops and animals, pests and plagues) and social (prices and markets, political policies, cultural values, and uses for labor)

environment in which he or she lives, and each farmer then utilizes some of the resources that are available to produce a certain mix of crops and/or animals. The farming system that results is the interaction of environment and resource allocation, integrated by the farmer's management decisions and work. Environmental variables (rainfall, pests, input availability, etc.) may determine each year whether the farming system successfully satisfies the farmer's desires, but the form of the system itself is determined by the farmer's attempts to cope with the anticipated environment. A drought one year will affect crop yield, but where droughts are common farmers anticipate them by including sorghum, millet and cassava into their farming systems or by early or dry planting.

At one level each farm may be considered a unique farming system. At a more general or abstract level, there are a number of similarities among individual farms and farmers, and individual systems may be grouped into fairly homogeneous categories. The farming systems research program in Malawi (and other programs in other countries) works with categories rather than individual farms because there are not enough research resources for individual work. The program must first identify the important categories in various areas and learn how farms in each category operate (learn the resources, constraints, goals, and relationships) and then devise and test alternative technological possibilities that will permit farmers to improve their productivity and utility.

The central concept in this work, the farming system, has a complex definition that includes many variables. This is because the management decisions that Malawi's smallholders are actually making are complex decisions, and the resulting systems are complex. Almost every decision the farmer makes involves satisfying some goals at the expense of others. Almost every action involves costs and benefits since the resources used could be used in several ways, and applying resources today to one activity means they cannot be applied to another. Another way to understand this is to see most farming decisions as compromises. The farmer continues to balance everything he or she wishes to accomplish against available resources and available time. Generally the farmer must cut back on the optimum production practices for each specific crop or animal enterprise (in terms of optimizing yield) in order to keep a number of enterprises going to satisfy a number of goals.

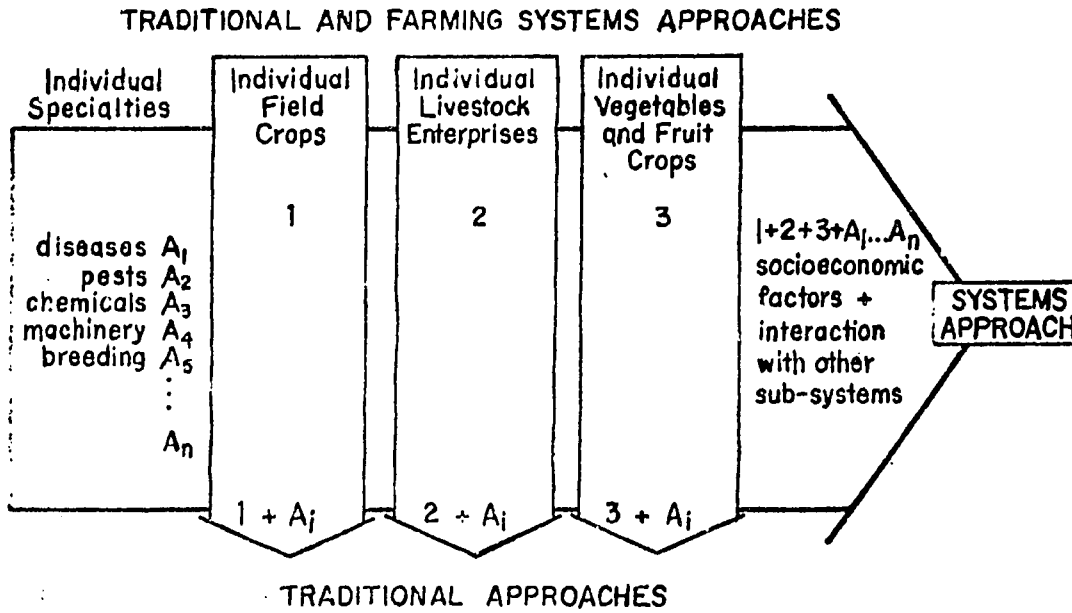
The complexity and inclusiveness of the farming systems concept force research and extension staff to consider the same complexity of interdependent costs and benefits that confronts the farmer. This helps the staff understand why farmers make certain decisions, so that the staff may devise recommendations

advocated by research and extension staff may be explained by the differences between the "real world" environment of the smallholder with its complex interdependencies and the controlled research plot environment where many variables are held constant and many others assumed to be irrelevant. Research recommendations are made with the assumptions that farmers want to maximize yield per unit of land and that farmers will devote as many resources as are needed for that specific enterprise. Sometimes those assumptions are true in fact, and the recommendations permit the farmer to obtain very high yields. Often, however, smallholders are attempting to maximize several goals, such as a secure food supply with several ingredients (nsima and ndiwo crops, plus animals or animal products for ndiwo) plus a cash income, and must compromise on their allocation of resources to each specific enterprise. Because they grow many crops which demand attention during the single growing season, the smallholders must either hire additional labor or compromise on performing some cultivation tasks which demand simultaneous applications of labor.

The farming systems approach considers a wider range of factors and relationships than more traditional research and extension approaches which commonly focus on single crops, animals, or other elements (pests, soils, machinery, etc.). This does not mean that a farming systems program replaces the single-factor programs. Both approaches are needed to complement each other. The more narrowly focused programs pursue in depth specific technical relationships, while the broader, more comprehensive farming systems program examines the extent to which existing recommendations are appropriate for smallholders, identifies high priority research projects for other research programs, and helps establish procedures to test the adaptability of recommendations to smallholder conditions and goals. The farming systems research program is, therefore, a component of the total research effort that specifically addresses smallholder needs and constraints.

The relationship between the different types of research programs is clearly illustrated in the diagram at the top of the next page. This diagram, adapted by van Blokland from the Tropical Agricultural Center for Research and Teaching (CATIE) in Costa Rica (see Hansen, et.al. 1981), shows how the farming systems approach (the broad arrow cutting horizontally across the page) and the traditional single-commodity or single-discipline approaches (running vertically) fit together.

Another way to conceptualize the difference between the two approaches is to see the commodity-specific or discipline-specific approaches as being more idealistic. They construct ideal or optimum biological solutions to the problem of increasing one characteristic, yield. The farming systems approach



is more practical. It emphasizes adaptive research to discover which alternative solutions are more suitable to actual small farmer conditions, resources, and constraints. This is adaptive research in a complex sense because it includes adaptation to natural and socioeconomic circumstances as well as to the interplay of enterprises on a farm.

METHODOLOGY

There are four general steps in any farming systems research program: diagnosis and description, design of alternative technologies, testing of the alternatives, and extension (Gilbert, et.al. 1980). After describing this general method, I will detail how the research is being developed in Malawi.

The first step is descriptive and diagnostic. There are several goals:

1. Identify and understand the existing local farming systems.
2. Identify recommendation domains, i.e., categories of farms and farmers that are homogeneous enough so that one set of recommendations will fit.
3. Identify relationships within the systems where resources are not used as efficiently as possible. These would include compromises on technically optimum production technologies.

This first step involves reviewing secondary data (information collected by someone else) as well as conducting on-farm interviews and observations. Secondary information gives the research team background information about soil and rainfall patterns, population distribution, economic flows (crop and livestock sales, purchases of inputs, location of markets, availability of inputs), and existing research and extension recommendations and activities. Extension staff are usually able to provide valuable information about local cropping patterns and, since they are in close contact with smallholders, information about smallholder complaints and the ways in which smallholder practices differ from recommendations.

On-farm interviews and observations are an essential activity. These visits to smallholder farms and talks with smallholders permit the research team to appreciate the multiple objectives of smallholder farming and the resultant complexity. Interviewing farmers about their cropping patterns and decisions while actually standing in their fields allows the team to check verbal information with actual observations. The interaction of research staff and smallholders is a consistent feature of farming systems research. Smallholder farmers are at the same time the ultimate clients of this research and actual participants and partners in the research process. Research staff have one type of expertise, and smallholders have another. They have a great deal of experience with local conditions. They know what they are trying to accomplish with their multiple enterprises, although they may not be able to clearly explain their goals verbally. The research team must actively encourage and support smallholder participation in describing, analyzing, prescribing, testing, and evaluating technologies and systems.

The incorporation of farmers and extension staff into the research is part of the general method employed in farming systems research. Another part of the method is the use of multidisciplinary research teams. Since the unit that is being investigated (the farming system) is complex and includes a wide variety of factors, the research team includes production and socioeconomic staff from various disciplines.

The initial descriptive and diagnostic stage ends with the identification of some high priority targets for adaptive research. Farming systems work is action-oriented. The team must constantly remind itself that the goal is rapid development of appropriate technology that smallholders can and will use. The single most important criterion for evaluating the success of the farming systems approach is the extent to which smallholders adopt technologies developed by the approach. Innovative technologies that are not adopted are failures. Non-adoption of the innovation probably means it is inappropriate for smallholders.

Extension is an essential step in the farming systems research process since adoption of the proposed alternative technologies is the single most important criterion by which the program will be evaluated. This is sometimes signified by adding extension to the program description and calling it farming systems research/extension. The best way to evaluate the success of the program is to resurvey the locality two or three years after starting the extension step to test how many smallholders are adopting the alternatives and to analyze any reasons for delays in adoption.

THE MALAWI PROGRAM

Although the University of Florida/USAID agricultural research project with its farming systems research component was planned and accepted in 1979, the first actual demonstration of the farming systems approach in Malawi was carried out by Dr. Mike Collinson of the Eastern African office of the International Maize and Wheat Improvement Center (CIMMYT). Dr. Collinson conducted a diagnostic survey (the first step) of Ntcheu in February 1980. This involvement reflects the interest in farming systems reseach expressed in the various international agricultural research centers (see Technical Advisory Committee 1978; Cilbert, et.al. 1980; Collinson 1980). Another expression of the widespread interest in this approach is the fact that farming systems research programs are already in various stages of development in the countries neighboring Malawi (Zambia, Zimbabwe, Tanzania, Kenya, etc.) as well as in Malawi.

The program in Malawi started effectively with my arrival earlier this year. My responsibilities as farming systems analyst with the Department of Agricultural Research include developing such a research program for Malawi, collecting and analyzing data on actual farming systems in various regions and areas, and helping train Malawian research (and other Ministry) staff in the methods and intent of farming systems research so that they will continue the program after my departure.

As has been noted earlier, this is a multidisciplinary program. It focuses the attention of numerous scientific disciplines on ways to effectively improve existing systems of smallholder farming. Many of these disciplines are already present within the Department. Instead of isolating a few scientists in a separate farming systems unit, the procedure that will be followed in Malawi is that this sort of adaptive technology research will be considered an important aspect of almost everyone's research. All of the different specialists within research will be involved at one time or another in surveying or in planning or testing alternative technologies. Agronomists will be most involved,

and eight agronomists from the Chitedze, Bvumbwe, Makoka and Baka Research Stations have already participated to varying degrees this year. Other specialists in plant breeding, pathology, soil science, etc., have also been involved, primarily in planning trials.

Only two new disciplines are being added to the Department in order to complete the multidisciplinary coverage needed for more effective smallholder research. These two are agricultural economics and applied anthropology which are being added to the Department as sections of production economics and farming systems analysis, respectively. The latter is called the farming systems analysis section because I am spearheading the introduction of the program from that section, while simultaneously selecting and training staff in my own discipline of applied anthropology. In actuality, the farming systems program will be part of almost everyone's research, not the specialty of any one section.

The farming systems analysis program has been initiated this year in three areas of Malawi: the Lilongwe plain of Lilongwe Agricultural Development Division (ADD), the Phalombe area of Blantyre ADD, and the Bulambia plain of Chitipa District of Karonga ADD. These areas were chosen in consultation with Ministry of Agriculture staff. Diagnostic surveys have been planned and carried out in each place; problems and constraints have been identified; and adaptive research trials have been planned in two of the areas.

In each place the process began with planning meetings with the ADD program manager and with other management and technical staff (primarily evaluation and extension) and agricultural research staff. From these planning meetings and a review of secondary materials, a relatively homogeneous area (in terms of rainfall, soils, and cropping patterns) was chosen in each ADD to be surveyed. Since the purpose of the survey was to rapidly identify systemic characteristics, problems and constraints, survey team members were chosen from the professional and higher and more experienced technical levels. This survey work cannot be left to less skilled or experienced staff.

Each survey team included approximately eight people who were drawn from research (agronomists and myself), evaluation, extension, and other ADD sections. Each person received a copy of an interview guide prepared by CIMMYT that outlined the variety of topics to be covered during the survey. The purpose and methodology of the survey was explained, and it was emphasized that the team was going to learn from the smallholders, not lecture to them.

The actual on-farm surveying lasted three days in each area, with the team members being split each day into three or four interviewing groups (two

to four people in each group). After the first half day of interviewing, most people felt reasonably comfortable in their new role of listening and observing. At the end of each day the groups met together to exchange information and to synthesize as a research team their impressions and beliefs about local farming systems and constraints. At the end of the three days of surveying the teams spent from half a day to two days discussing what they had discovered about the locality and what recommendations they had for further research or for extension.

In each area the three day survey was sufficient time for the team to identify the basic characteristics of the local farming systems and to identify a number of ways in which local farmers were compromising the yield potentials of specific crops. The teams were also able to identify some of the reasons why smallholders were unable or unwilling to follow research recommendations. These surveys were action-oriented; they were intended as rapid ways for skilled staff to assimilate the outlines of the local systems, constraints and opportunities. The surveys were successful in that each did identify what they set out to identify. Each survey resulted in new insights into the local situations and good ideas about targets for adaptive trials.

Farming systems programs in different countries have evolved different ways of verifying the truth of what is discovered in the exploratory or rapid surveys. Some country programs in fact have elected to spend one or more years in exhaustive background surveying before even attempting to identify targets for adaptive research and extension. In Malawi the program is more action-oriented. Instead of waiting until the local systems are fully understood (a process that could take years of complex study), we will set up adaptive trials on the basis of the rapid survey as supported by existing data from evaluation, agro-economic surveys, extension, and ADMARC. My original intent was to conduct formal verification surveys of selected random samples of local smallholders to validate the information and impressions from the first surveys. As it has turned out, all of the areas are project areas with evaluation sections, and all of the areas have a lot of available data on farming outputs. Because of the available data, and because up to now studies of the available data tend to confirm the results of the rapid surveys, we shall continue to set up trials without carrying out formal verification studies.

It is important to note here that the farming systems method is iterative. That means that there is a continual cycling back of information into planning. As trials are conducted, they are monitored for smallholder reactions and to gain more data on the costs and benefits (yields, labor, capital inputs, cash and food outputs). This new information is fed back into the planning process

to modify our understanding of local systems and to modify our recommendations. This feedback process is especially important when we are dealing with such a complex unit as a farming system. Thus, instead of delaying any trial research until all information on local systems is collected and analyzed, we will move rapidly into on-farm trials and intensive monitoring to discover more about the systems as they respond to our proposed innovations.

Another basic feature of the approach in Malawi has been the continual interaction among research, ADD management and staff. After each survey there has been a meeting in which the assembled ADD staff had an opportunity to hear the results of the survey and discuss its significance. In both Blantyre and Karonga ADDs the meeting combined the presentation of survey and evaluation data, and these joint presentations were especially effective in permitting ADD management and staff to put together this overlapping data and interpretation of data. Joint meetings of agricultural research and ADD staff are essential to achieve a successful turnover of research recommendations (the fourth step in the general method). ADD staff usually know a great deal about local conditions and farming patterns, and this needs to be included in planning adaptive trials. Extension staff, in particular, need to be involved in setting up and monitoring on-farm trials so that they appreciate the results and are able to correctly interpret them to local smallholders.

This is the present status of the farming systems research program in Malawi. We have surveyed three areas; joint meetings of research and ADD staff have evaluated the survey findings; adaptive trials have been planned in two of the areas; and trials will commence with the rains of 1981 (for the 1981-82 cropping season). It is too early to point to recommendations that have emerged from the surveys and been tested on farms. At this stage we have generated hypotheses about systems and recommendations but not yet tested them. Although it is too early to evaluate the results of trials, let me present some of the issues that have been raised and the hypotheses generated, so that you gain more understanding of the sorts of results and the orientation of the program.

ISSUES AND EXAMPLES

I will start by presenting an example of one of the areas surveyed - Phalombe - since it is from the study of actual conditions and systems that issues and hypotheses arise. Phalombe is a drought-prone area bounded on the north by Lake Chilwa, on the east by the Malawi/Mozambique border, on the south by Mount Mulanje, and on the west by the Phalombe River and Traditional Authority (chiefly) boundaries. The area lies between 1900 and 2400 feet above

sea level; rainfall is unreliable, the average rainy season lasting three to four months but frequently being too short for a good maize yield; and the distribution of rainfall across the area varies from being highest near Mount Mulanje and to the east of the mountain and being lowest near Lake Chilwa, where it averages below 30 inches a year.

There is intense population pressure on arable land, and the average amount of cultivated land per household is slightly more than one hectare (1.02 ha.). The pressure on land and the resultant small landholdings were noted in the survey and corroborated in evaluation and agro-economic surveys for the 1978/79 and 1979/80 cropping years. More than 60% of all households cultivate less than one hectare, and approximately one quarter of the households actually cultivate less than half a hectare apiece.

People have responded to the dual constraints of short and unreliable rainfall and the shortage of arable land with two obvious strategies: intense intercropping and off-farm employment. Every farmer interviewed during the May survey mixes cowpea and maize seed before planting so that the two seeds are planted together. Fields were frequently observed where three, four and even five crops were mixed. Maize, sorghum or cassava are present in almost every upland (munda) field, since only the minority of farmers have enough land to devote a field to a non-nsima crop. In the areas of higher rainfall, smallholders with very little land even intercrop sorghum and maize, sorghum serving as an insurance nsima crop in years of drought, although smallholders with slightly more land prefer to separate sorghum and maize. In the drier areas, cassava replaces sorghum as the major insurance nsima crop. In addition to the crops already mentioned, sunflower, pigeon peas, groundnuts, various varieties of beans, chickpeas, and grams are also intercropped in various combinations, primarily with maize. Rice is grown as an alternative nsima crop, but usually where there is dambo land available.

The majority of smallholders interviewed mentioned a consistent shortage of nsima during the December through March period, and some started running out of nsima even earlier. Most of them respond by working (ganyu) on local farms or migrating farther away to work on estates. Few attempt to increase their maize yields through applying manure because only a minority own cattle (approximately 10% of households). Some of the smaller farmers had applied fertilizer to their food (local) maize in the past but encountered two problems: when the rains fail they lose their investment, and they need their available money to buy food for this year, so instead of buying fertilizer in December they buy maize to eat. The first priority for most smallholders appeared to be ensuring a stable production of enough nsima for their household.

Even though enough nsima was the highest priority for many, that in itself is not enough. All households have a need for some money income, and some households that did not produce enough maize for themselves still sold some of that maize after harvest in order to have some money. Others utilized off-farm labor (ganyu) or businesses or the sale of crops such as sunflower, grams, chickpeas (all of which are grown primarily as cash crops) or the surplus of ndiwo crops. Only those households with enough land to devote some to non-food production were growing and selling the cotton and tobacco.

The survey focused on crop production since the major livestock were more of a minority concern: 10% of households owning cattle and 25% goats, although we did recommend that the project supply Newcastle disease vaccine for chickens. In terms of crops we focused on nsima production in an intercropping context of scarce land and capital. The intercropping would have to include ndiwo crops (since all farmers are trying to supply the basic diet of nsima and ndiwo from their farms), although the ndiwo did not appear to be a major problem, at least not in comparison to the nsima problem. Another goal with the intercropping research would be the increased production of money-generating crops, as long as this did not interfere with the primary goal of ensuring a stable and increased production of nsima.

What immediately becomes clear from this example is how the farming systems approach to research starts from the existing systems and constraints and attempts to deal with the highest priority problems that are identified for the majority of local smallholders. In this instance, the approach means that research should look at intercropped maize, small-scale farming, and increasing production and stability with little money or land. How does this obviously differ from the traditional research approaches? Monocropping, single commodity, single discipline, and focusing on yield optimization with a full package of inputs - these are basic features of the existing national research programs.

But the two approaches are best seen as complementary. In this case, farming systems research identifies existing problems and priorities for research trials. Then specialists from the various other research programs (in maize breeding and agronomy, minor legumes, grain legumes, sunflower, and soil science in this instance) cooperate with the socioeconomic research staff to plan, conduct, monitor, and evaluate research trials. These specialists know a lot about pieces of the smallholder puzzle, and the farming systems work helps focus that knowledge. The extent to which these two approaches assist each other will determine the success of the Department in providing sound and acceptable research recommendations for smallholders to extension.

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The publications noted above as well as others concerning farming systems research and smallholder farming systems are available for loan from my office at Chitedze Agricultural Research Station.