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FSSP NETWORK REPORT NO. 1

"ANIMAL TRACTION IN A FARMING SYSTEMS PERSPECTIVE"

A FARMING SYSTEMS SUPPORT PROJECT NETWORKSHOP

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KARA, TOGO

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SECTION I: INTRODUCTION AND NETWORKSHOP OVERVIEW

REPORT LAYOUT

This is a report on the FSSP Networkshop on "Animal Traction in a Farming Systems Perspective", which was held March 4-8, 1985 in Lama Kara, Togo. The report is divided into six sections. The first provides an overview, background and summary of the networkshop and outlines the five major themes of discussion for the five-day program. Section II contains major background presentations including a summary of the systems experience to date related to livestock, an overview of animal traction research and extension in Africa, and a presentation covering the fhighlights of a previous networkshop in Swaziland, sponsored by The International Maize and Wheat Improvement Center (CIMMYT), which also focused on animal traction and forage requirements. Section III reports on the field trip to visit several animal traction projects in the Lama Kara region and the country reports made by the non-Togolese networkshop participants. Section IV summarizes small group discussions on the five major themes. Section V gives the wrap-up and concluding statements by networkshop facilitators and a summary of the participant evaluation. The last part of Section V outlines plans made to continue networking through the rest of the year, culminating in a second networkshop in 1986. The final section contains appendices pertinent to the rest of the report.

WHAT IS A "NETWORKSHOP"?

The term "networkshop" comes from CIMMYT's Eastern and Southern Africa Economics Programme, and is used to describe a workshop where peers with common concerns come together to exchange information and results, and to determine common strategies for solving problems. A "network" of shared results develops from continued support for the same (or nearly the same) group to meet on a regular basis. The Farming Systems Support Project, FSSP, recognizes that both intra- and inter-country peer group interaction will greatly enhance the development of Farming Systems Research and Extension, FSR/E, as a viable agricultural development approach for West Africa. The FSSP is committed to the support of existing FSR/E networks in the West African Region, such as the West African Farming Systems Research Network, WAFSRN, and stands prepared to assist formal networks in developing activities as necessary. However, FSSP also recognizes that networking does and must take place outside of formalized networks and that such activities can often contribute to the growth of formal network structures by creating a "felt need" among researchers and practitioners for peer exchange of problems and results. The Togo Networkshop on "Animal Traction in a Farming Systems Perspective" is an example of such a peer exchange.

RATIONALE FOR THE NETWORKSHOP

The idea for FSSP to organize a regional networkshop on animal traction and FSR/E arose out of a concern expressed by participants in previous FSR/E training activities that too little attention in FSR/E was placed on the animal systems within West African farming systems. In developing a networking activity to address the issue, FSSP organizers felt that "animal systems" in general was too broad of a theme for a single networkshop, and decided instead to focus on a specific intervention technology and use the FSR/E perspective to explore problems and results found to date in its application in West Africa. Animal traction was selected as the networkshop theme for two reasons. First, USAID/Togo offered to host the networkshop, and, since animal traction is a focal issue in Togo's agricultural development plans, the topic seemed especially appropriate for this networkshop site. A second and stronger argument for the topic was the fact that focusing on animal traction technology provided a very useful entry into the exploration of the crop-livestock interaction in the farming systems of the region, and generally into the utility of the FSR/E approach in the research and extension process.

Animal traction is a unique technology in the general agricultural development portfolios of donor organizations in Africa, although worldwide it has a long history of proven utility and adoption. It is a farmer-generated technology many centuries old, found in virtually every ecological zone. Though it spread successfully to most parts of the world without the assistance of extension systems and donor funds, its development and diffusion in West Africa, despite considerable donor funding, has been uneven and problematic. For this reason, it seemed particularly useful to explore the topic in the context of a networkshop where researchers, practitioners and policy makers could have an opportunity to discuss the suitability of animal traction technology for the region, and mechanisms that might promote greater and more successful utilization.

NETWORKSHOP OBJECTIVES

The Networkshop objectives included:

1. Establishing an information exchange among animal traction projects in West Africa;

2. Developing an inventory of animal traction projects and activities in the sub-region;

3. Identifying animal traction research problems and potential solutions;

4. Developing a research agenda for the specific regional problems; and

5. Developing follow-up programs which might involve exchange visits, technical assistance and training activities, and further networkshops.

PROGRAM OVERVIEW

On the first working day, keynote presentations were made relating to FSSP, on-farm research methodology, animal traction in Africa and a conceptual typology of animal traction programs. Background information and observation frameworks were presented for the subsequent field visits.

The second day involved group field visits to four distinct areas and many different farmers, projects and associations. Field trip teams met during the evening to discuss their findings and conclusions.

The third day involved synthesis of the field trip experiences, combined with further information from the projects of the participating countries. Slide presentations were given illustrating the work of the Sierra Leone Work Oxen Project, ILCA/Ethiopia, Senegal, and animal traction activities elsewhere in Africa. A report was presented on the CIMMYT networkshop on feed resources and animal traction held in Swaziland in 1983.

The fourth day involved intensive small working groups, followed by group presentations. Subjects included management of draft animal technology, forage and feeding, preconditions for successful animal traction, methodology for animal traction research, and the monitoring and evaluation of animal traction activities.

The final day involved additional work group sessions, followed by plenary presentations and discussions relating to possible solutions to the problems raised. The networkshop closed following synthesis of the week's experiences and a discussion of follow-up activities. The networkshop schedule in Appendix 10 provides greater detail on the events and presentations made during the week. Following the workshop, (after departure of the participants from outside Togo) the resource group had a day of discussions with representatives of the Togo Animal Traction Project team.

TOPICS OF SMALL WORKING GROUPS

Small working groups focused on five topics which were developed in advance of the networkshop by the facilitators (see participant list, Appendix 1 for the list of facilitators and resource persons). The first three dealt with specific problems in adopting animal traction; the other two considered related topics.

1. Animal feeding.

Dry season maintenance and feeding of livestock is a problem recognized throughout West Africa. Due to the animal traction theme, the main focus for discussion was on cattle and other large ruminants. Maintenance of cattle or other traction animals without recourse to transhumance is perhaps the most important constraint to animal traction and the integration of livestock into crop-oriented farming systems. The effective use of existing forage, the use of crop residues, the possibility of using purchased feeds and supplements, improved forage production and the

elaboration of minimum maintenance rations using locally available feedstuffs were some of the techniques discussed with regard to their contribution toward overcoming this constraint.

2. Management of new techniques/technology.

The introduction of technology has often failed because farmers did not have the technical (management) level necessary to use the technique/technology to advantage. Three-to-five years of accumulated experience may be necessary to manage a new technique well. This delay is exacerbated by the use of technology packages which require a farmer to learn a number of techniques and their interactions at the same time. The group discussed the kinds of information and management requirements a farmer must have when facing animal traction adoption from one of the four (or more) situations described above, and the kinds of information and training needed to facilitate this transition.

3. Preconditions for successful animal traction adoption.

Both exogenous and endogenous preconditions were considered. Exogenous factors are those from the farmer's environment which may influence the success of the farming system or its subsystems. These include the availability of timely input delivery, transportation, marketing services, animal health services and credit. Endogenous factors are those internal to a farming system such as the farmer's resource levels, experience with cattle and other large ruminants, cropping patterns and the level of technical/management skills. Are there certain resources, experiences or technical/management skills which a farmer should have before undertaking the heavy capital investment required by the animal traction technology? Preconditions should be considered not only with regard to repayment, but also with regard to the expectation that animal traction can realistically produce the theorized benefits for the farmers. From a systems perspective, perhaps animal traction should be considered as an intermediate technology in a broader project/development framework. The introduction or improvement of animal traction might be initiated with farmers who meet certain preconditions, but the first phase might be largely devoted to helping other farmers develop the resources and technical/management skills which would allow them to successfully adopt and benefit from animal traction.

4. Methodologies for on-farm experimentation with animals.

Even though there are many years of accumulated experience concerning on-farm agronomic testing, the correct or best methods are still vigorously disputed. The same kind of experience does not seem to exist with regard to on-farm experimentation with animals. Researchers and extension personnel often seem to lack the methods which would allow them to undertake effective animal-related testing. Is it possible to identify procedures or types of on-farm experimentation with animals which have been found to be effective or are likely to be effective?

5. Monitoring and evaluation criteria for animal traction and other projects including livestock.

The lack of generally accepted methodologies for on-farm experimentation with animals contributes to the difficulty in identifying evaluation criteria for livestock-related project components. Adoption rates have often been used, but if animal traction and other livestock components are regarded in a larger systems perspective and/or as an intermediate phase in a multi-phase process, then the placement of animal traction units is not an appropriate evaluation criterion during the early phase(s). If the kinds of preconditions mentioned above can be identified for particular situations then these might indicate better evaluation criteria. But it is likely that these preconditions will differ in different farming systems. This may lead to a system where some evaluation criteria cannot be identified during project design, but must be developed as part of on-going project monitoring and evaluation.

Discussion on these five topics was guided by an overview of Farming Systems Research and Extension (FSR/E) concepts and methods and through the use of a conceptual framework which was developed for the workshop by the facilitators based on the experiences of both FSR/E and animal traction projects in West Africa.

AN OVERVIEW OF FSR/E PHILOSOPHY, CONCEPTS AND PERSPECTIVES

Most of the participants invited to the workshop were drawn from projects with a farming systems orientation. It was assumed, therefore, that it was unnecessary to devote much workshop time to presenting the farming systems approach. A very brief overview was presented to establish a common terminology and as an introduction to observers who did not have a farming systems background. The FSR/E approach was outlined as consisting of five steps (adapted from Shaner et al. 1982):

1. Selection of a target area
2. Diagnostic description and problem identification
3. The design of on-farm experimentation
4. On-farm experimentation, analysis and evaluation
5. Diffusion of technology

In addition FSR/E was characterized as being:

1. Farmer based
2. Problem solving
3. Comprehensive
4. Interdisciplinary
5. Complementary
6. Iterative and dynamic
7. Responsible to society
8. Developmental

A CONCEPTUAL FRAMEWORK FOR THE NETWORKSHOP

Within a farming systems perspective, animal traction, as with any

other technology, must be considered with regard to local conditions such as soils, crops and climate. Two important questions must be addressed: is animal traction appropriate?; and what form of animal traction is appropriate? Animal traction is a "shelf technology", meaning that it is available and relatively well known. It is expected that it can be "pulled off the shelf" and applied fairly rapidly, whereas other technologies might require considerable adaptive research. But in fact animal traction is not a single technology. The appropriate tools and the type of cattle used (Zebu, N'dama, or crosses between them) vary across West Africa for many reasons, including differences in crops, soil, climate, and incidence of tsetse fly. Field operations for one area may not be appropriate in another location. Animal traction components need to be adapted to each local situation. Types of farms or farming systems must be grouped to reflect similar situations. The conceptual framework is a means of grouping similar farming systems so that problems can be specified as relating to a particular situation.

The conceptual framework or typology used in the networkshop consisted of four levels, starting with the most important variable. It did not attempt to be exhaustive, or imply that these are the only elements which could be used, but these four factors seem to be generally applicable across West Africa: agro-climatic zone, livestock traditions, project influence and socio-economic resource level.

1. Agro Climatic Zone.

The agro-climatic zone is the factor which has the strongest influence on differences in animal traction across West Africa. Crop and climatic differences strongly influence field operations and the implements used. For simplicity, the agro-climatic zones identified are limited to the Sahelian zone, the savanna zone and the rain forest zone. These could be sub-divided or divided in different ways, but these are zones that are commonly known and referred to in West Africa.

Many of the other factors to be considered are correlated with the agro-climatic zone. Soils somewhat reflect this zoning with lighter, sandier soils in the Sahel and heavier soils in the savanna. Livestock traditions also generally follow this north-south zoning. In the north most people have a livestock tradition i.e. they are animal producers and herders. In the south, some groups have no tradition of owning and managing livestock. Even project influences are somewhat correlated. Projects in the north have focused on food crops and/or groundnuts. In the savanna area one finds a crossover of cotton and groundnut projects. In the southern region projects are often oriented towards rice production.

2. Livestock Traditions.

Within an agro-climatic zone farmers with different livestock traditions may be found. Farmers with no livestock tradition are in a more difficult position with regard to the adoption of animal traction. They may have little or no knowledge of animal health and nutrition and may even be afraid of the cattle. Four different classifications may be used to classify farmers:

a) Some farmers may have no livestock tradition and no animal traction experience.

b) Another group might have a livestock tradition but no animal traction experience. Half-way between these two might be groups who own cattle, but consign them to Fulani herders and thus have little experience managing or working with cattle.

c) Some farmers may have adopted animal traction, but only partially. Perhaps they plow but do not weed or use other elements of the animal traction packge which is recommended. Such farmers are often labeled as poor managers. But care must be used when considering poor management. The use and application of animal traction in an extensive farming system may give the appearance of poor management. But an economic analysis of their results may show higher revenues and returns than that of some farmers using an intensive farming system where animal traction has been more completely adopted.

d) The final group consists of farmers who use animal traction well and have a high level of technical competence, but may be helped with some advanced techniques and/or animal feeding. Even good animal traction users may not have resolved the problem of dry season feeding for their animals.

3. Project Influence.

The cotton projects have probably been the most successful historically in promoting animal traction. Certainly, projects with a cash crop component have been more successful in promoting animal traction than those with only a food crop orientation. Even if production of a food crop is increased it may be consumed or used for social obligations such as a marriage or funeral. It is not necessarily applied to repaying credit or replacing worn-out equipment.

4. Socio-economic Resource Level.

Many different socio-economic factors may be important in specific situations, but one which is generally applicable is the resource level of farmers. Most villages will contain some farmers with a relatively high resource level and others who are resource-poor. Generally, in an area where animal traction is used farmers with a high resource level have already adopted animal traction while resource poor farmers have not. Resource poor farmers find it much more difficult to adopt animal traction because of its high cost relative to their revenues and economic resources.

The purpose of this broad and very general conceptual framework was to provide participants with a mechanism for comparing their own experiences and the dominant farming systems where they work, with those described by other participants or those observed on the field trips to animal traction projects in the Kara region. Those participants who made the country presentations (Section III) were asked to organize their information within the conceptual framework, and most were able to do so. The framework also provided organization to the small group sessions in terms of the discussion as well as the presentations.

SECTION II: KEYNOTE PRESENTATIONS

SYSTEMS EXPERIENCE RELATED TO LIVESTOCK

HUBERT G. ZANDSTRA
IDRC CANADA

(The prepared text of the paper given by Hubert Zandstra can be found in Appendix 11. Following is a transcription of his delivery and the discussion which followed it).

INTRODUCTION

First, I wish to thank the co-sponsors of this meeting for giving me the opportunity to discuss some aspects of agricultural research about which I have been concerned for some time. This certainly is the kind of audience I prefer to speak to. You are all involved in various aspects of agricultural research that directly relate to farmers. Second, I am not a specialist on animal traction, so you will have to deal with me in the way you deal with farmers. We have to combine our experiences to make what I say useful. I also want you to think about questions you wish to ask me at the end of my talk. These questions should focus on the problems you see in applying some of the design and testing methods about which I will be talking.

I am going to depart from the text of my paper prepared for this workshop and deal with the same information in a slightly different way. Feel free to refer to the tables and text as I proceed. In farming systems research, there are the steps of area selection, diagnostic analysis, design, testing, pilot introduction of recommendations and production programmes. As I alluded to earlier, I will focus on the design and testing phases. Design is one of the least-stressed and -practiced aspects of farming systems research. It is also the more difficult one in terms of concepts. Testing is by far the most demanding in terms of time and money, and in the case of livestock, testing can be extremely difficult. Operationally, on-farm testing with bovines is exceedingly difficult and we need to gain more experience and exchange existing experiences.

Farming systems research is designed primarily to improve resource productivity on the farm. The workshop coordinator has already described farming systems research and extension (FSR/E) and I would like to approach it from the negative side for a moment. I want to stress that it shouldn't be limited to a commodity, for that brings with it the danger of ignoring possibilities for interventions or evaluating the impact of interventions on the rest of the farm enterprise. Neither should FSR/E be implement-driven. That is, many of us have been fascinated by an analytic technique or by a certain implement. For example, I am in an unenviable position to review projects which are constructed around amino acid analyzers or some such things. That is an extreme example, but in the case of farming

systems research and technology development for farms, we should not allow our thinking to be driven by a commodity, factor or implement. So much for the negative side. There are many positive things that can be stressed.

In this talk I will focus on research. I realize that you are an audience which is strongly dedicated to introducing animal traction in a given system. That is good and by focusing on research, I am not implying that one should not continue to dedicate oneself to the introduction of research results or of animal traction specifically.

THE DESIGN OF ALTERNATIVE PRODUCTION SYSTEMS

(Refer to Fig. 2 at the end of Appendix 11).

The design process is characterized by being a synthetic activity of recombining information. In so doing some conceptual and operational difficulties may be encountered. The purpose of the activity is to bring to bear on a selected production system information about that system and about alternative management techniques and/or land use that might improve the system. This requires an interdisciplinary approach by a group of people who contribute their knowledge about the specific production system and about agricultural technology in general.

Refering to Figure 2, there are nine steps which were identified by a group of livestock production systems researchers in Latin America. The group has interacted as a group for three years and references are provided in the full paper. Their experiences are offered here as one approach to the design of improved technologies for systems in which livestock is involved.

ELEMENTS OF THE DESIGN PHASE

1. Understanding the existing system and what has lead to its evolution.

This is an important element of the analysis for animal traction.

2. Consideration of the development objectives of the nation and/or the region.

Certain conditions may be imposed on land use that may compete with the alternatives being considered and help explain what is evident in the present production system.

3. Focusing on selected systems or sub-systems which one may wish to modify.

The analysis starts with exogenous factors such as incidence of disease or the potential supply of animals for draft purposes. Then the analysis considers such structural elements as herd size and composition, pasture availability, equipment and cropland. Finally, the analysis considers how the farm functions. This analysis can be greatly helped by finding what

the most important limiting factors of production are. One should also be able to explain why certain apparently desirable developments did not take place (why did animal traction not become adopted earlier? why is there no history of planted forages? etc). One may refer to the diagnostic phase and note an inconsistency or oddity before proceeding. There is no stronger analytical tool in farming systems research than identifying anomalies or inconsistencies between what we think about the production system and what we see in fieldwork.

4. Understanding the farm type.

Previous analysis leads to a level of knowledge and understanding of the farm type. Subsequently, the technologies that can be applied to the general region are identified, extrapolating what can be used in future research activity and specifying what is referred to as the adaptive domain. This can be a contiguous or non-contiguous area of land with certain characteristics. It can also be a condition and thus one should feel free about specifying the adaptive domain. Should a cultural factor differentiate farm types, it should be used as a stratifier in defining the adaptive domain. Another example might be bush fallow and the number of years following fallow which may influence the type of production system one would generate for a specific crop.

5. Identifying technical interventions useful to develop alternative production systems.

These are listed in terms of merit and interactions within the system. This leads to an analysis of what the design team feels are promising alternatives. The focus can be on the total farm system or limited to one enterprise such as a crop or a single factor such as animal traction. However, modification of one component may affect others or the total system.

6. Understanding of technical coefficients of each intervention to be applied.

This is referred to as an ex ante analysis. If technical parameters are not known, then a best estimate must be developed by the team. Ex ante analysis uses the costs in terms of cash, time and the benefits of animal traction. In other words, one estimates how the proposed intervention will behave. At the simplest level such an analysis will allow the application of partial budgeting techniques to predict the economic viability of each alternative. Theoretically this may not be enough, because one should take into account foreseen interactions with other parts of the farming system.

7. Evaluating an alternative production system.

This step implies a needed comparison which can be accomplished by comparing an alternative with the one that is being replaced. It is also the best way to evaluate results in the testing phase which is discussed in the next section. Where there are no viable enterprises (such as in some resettlement areas), one will have to use common measures of economic performance of enterprises in the region, such as what might be the return for a day's labor or what expectation might there be for return on money,

or rental rates for land.

8. Listing of assumptions arising from the design process.

Important assumptions concerning such things as rainfall, crop duration, input responses, operation time and imputed costs, infrastructural support and presence of credit or markets should be listed. We often make these assumptions without considering the possibility of a less favorable environment or input response. Also the team should show the requirements being placed on infrastructure in terms of inputs required at the farm level.

9. Identifying research priorities.

Finally, the team will determine what research is needed and arrive at a set of research priorities. Also an assessment of further information needs, such as market or climatic information (which can be descriptive), may be made. It is important to do this right after the design of alternatives, since information gaps and their relative importance will become apparent during the design process. Note that research needs are not only experimental work, but may refer to further diagnosis or survey work.

ELEMENTS OF THE TESTING PHASE

Testing of livestock and related activities refers to experiments used to evaluate the performance of technological alternatives (see Appendix 11 for greater detail).

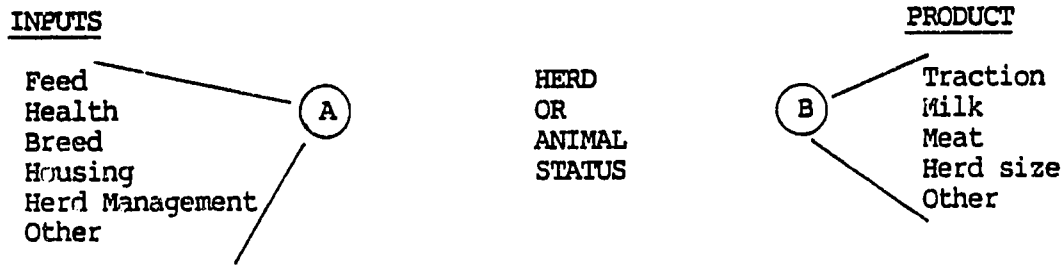
1. Testing objectives.

For this presentation, these are designed to measure on-farm, not on-station, performance of alternatives. Often there are large differences between the two, with on-station yields being 35 to 50 percent greater than on-farm yields. Another objective is to be able to compare the formulated alternative with the existing production methods. Additional resource requirements need to be identified. For example, the number of hours an animal works compared to what was projected at the design stage will need to be recorded. Finally, resource conflicts need to be identified at the farm or community level. We know that livestock on mixed farms can create resource conflicts related to land use, labor for tending animals and, at times, cash for feed. Trade-offs between meat and milk production or between milk production and traction can occur.

2. Testing Interventions.

Measurements commonly used in livestock systems that relate directly to or are a function of interventions include feed availability, carrying capacity, reproductive efficiency, health, herd composition, breed or type and product mix. Measurement possibilities for testing may be illustrated as follows:

POSSIBLE POINTS OF MEASUREMENT



The decision as to where one locates the measurement is important and depends on the questions asked. For example, if planting of a browse species leads to an increase in feed availability to the farm animals, the measurement can be done at POINT A. If the question is whether the additional feed led to some increase in output, such as the ability for the animal to supply power or produce milk, then one would need to measure at POINT B. I wish to stress that we know much about what happens in the animal and in the herd and about the effect of some of these interventions on the performance of the herd. With that kind of knowledge our measurements at POINT A are much more manageable than having to measure the effect of an intervention at POINT B. This is a trait of working with livestock that one should exploit. Variation, for example, in pasture yield responses to changes in pasture or stocking rates are great betweeen locations and years; therefore the responses are difficult to measure. But once one has a certain quantity of pasture available to the animals, one knows pretty well what it will contribute to the status of the herd or individual animals.

For on-farm research, several stratifications are possible. Experiments can be designed on an animal basis where individual, pairs of animals or a sample of animals are studied. Split herd techniques can be used for measuring supplemental feeding regimes or disease controls. In other cases, one may want to look at herd composition. This will require studying the whole herd or flock over time. Other variables can be studied on a field basis, like pasture establishment or fertilizing a crop to increase by-products for animal feeding or comparing times of operations for implements. The point is not to refrain from doing on-farm research with animals because of the reputed design or execution difficulties, but rather to break the task into elements to be researched or interventions to test, and then think about the difficulties. Usually one will find that 80 per cent of the tests are not that difficult, that they have been done elsewhere and they can be done by using available on-farm research techniques.

As to replications, this can be quite a problem with large, animal-based interventions. The questions are do we need to replicate and what do we replicate for. One must look at the objectives of the research. For example, if one is to test the use of crude rock salt compared to a balanced mineral mix, then one deals with a treatment-to-treatment comparison. That can be done on a farm or one may want to do it elsewhere.

If you wish to sample a farm type, then replication at each location is less important. More important is securing a decent sample of that farm type. For herd-based or field-based interventions one should select a number of farms which are representative of the adaptive domain.

Typically, the experience in farming systems research projects has been using six individuals in a system or sub-system. Thus, monitoring 12 farms will allow comparisons of the existing system to one alternative on those farms. Some researchers prefer to start with few replications and then expand to more as time progresses. For example, one may look at six systems (and existing alternatives) on 12 farms the first year, then at three the second year and maybe two the third. This narrowing down of alternatives will give a reasonable number of observations and will have eliminated a number of alternatives that initially appeared useful.

Another tool is the survey technique, used to solve some of the testing problems by capitalizing on situations that exist in regions in which one is working. This is most effective where some farmers are experimenting with alternative systems or where there is a wide range of performance of a system. This technique is often used by farm management specialists and social scientists, but can just as well be used to improve our agronomic or bilogical insights into a system.

TESTING ANIMAL TRACTION ON FARMS

In on-farm testing of animal traction a number of questions may be the object of research. These need addressing before the research is started and the experimental technique is identified. For example, to answer the question of whether a farm can "carry" two or more animals or whether animal traction is a good idea for a given farm type, one will have to use methods that require more time and a more sophisticated research design. On the contrary, if one is looking at health care or housing alternatives or an implement type, then the design is more straightforward. Thus it is important to start by breaking down livestock-based research into specific questions to be addressed and then move to the matter of how to do the experimentation.

Though I will approach the next topic from a research point of view, I would like to discuss the non-research side of the introduction of animal traction. The question of whether or not animal traction is right for an area will have to be answered through on-farm testing. This will require much time for training farm families to care and use animals properly, particularly where there is no livestock tradition. This may require a couple of years to stabilize valid testing before it can start. To evaluate animal traction, other topics to be addressed include: implement use and monitoring; evaluation of feed provided; the health and nutrition status of the animal; the costs involved in the purchase and maintenance of animals and equipment; labor requirements for the maintenance of animals (realizing animals save labor but also require labor); the frequency of animal work; the number of hours of work and the seasonality of the work cycle; the type of implements and their application to animal traction in that farm unit; and the benefits from animal traction in terms of labor savings, area planted and yields or sale of animal produce.

In summary these abbreviated points seem most important in conducting on-farm tests of multifactor interventions:

1. Farmer participation; the farmer's motivation; the personal relationship between farmer and researcher.

2. Measuring the right thing; focus on measures that directly indicate performance of interventions and allow one to compare with the existing system.

3. Effects on the system; evidence of conflicts and trade-offs within and between enterprises or at the family or community level.

4. Always compare to the system being replaced if it exists.

5. Economic analyses; costing out alternatives as measured by farmers; comparing with existing systems; using indexes of the productivity of major constraints.

6. Evaluation; using sensitivity analysis. Contemplate what conditions will change upon substantial adoptions. Will labor constraints become apparent, will markets or veterinary support become limiting? Is there an equipment maintenance capability in the community?

QUESTIONS DIRECTED TO DR. SANDSTRA FROM PARTICIPANTS

Q. How useful are models and linear programming relative to sensitivity analysis?

A. I was thinking of less sophisticated approaches. The same thing applies to the whole farm impact of limited interventions. Sensitivity analysis can be done at the partial budget level. For economic analysis of on-farm research partial budgeting is still the most useful tool. Modeling does not always return the cost in time and effort used in the design or evaluation alternatives.

Q. What is the best way to use animal pairs?

A. Unless one can relate to a farmer who completely understands the testing, agrees with it and is not fearful of any damaging effects from the treatments, one doesn't have much hope of effective comparisons between paired animals. In such cases it is better to use different farms, some for testing an intervention and others as the control. Using pairs on the same farm is a great tool and a most effective means of reducing variation but a lot of farmer preparation is needed to establish the required confidence and trust.

Q. Do you recommend using certain models like linear programming?

A. Yes, if you are using whole farm enterprises and dealing with entirely new production systems in a region it is a good research tool, but not for the "run-of-the-mill" application of on-farm research.

Q. From this workshop, do you have suggestions for a common theme or activity that can be presented for practioners?

A. I cannot answer this now, as I think it is an objective for this workshop. Because projects and conditions vary so much, even with animals used for traction, it is dangerous to extrapolate to all projects. There is one thing that we all can work on and that is to find ways to improve our ability to get answers from farmers so that farmers can become effective participants in on-farm research.

Q. Is there a predominate factor on which research can be focused?

A. The identification of such a factor can become the result of on-farm production systems research, but should not be the starting point. If after a good diagnostic analysis a certain factor related to animal traction appears to be one that can make a major contribution, then I would channel research efforts in that direction. But it would be wrong to say that we must study animal traction without going through the process of careful diagnosis which asks if indeed traction power is a key constraint and animal traction is the most appropriate solution. There may be other ways to supply or reduce traction requirements. There may also be more valid reasons for introducing animals into the system. These should be considered. This is what I meant when I said that interventions should not be factor-driven or implement-driven. If in the design stage it appears that the introduction of the plow and traction animals will make a contribution that cannot be easier or better achieved by another alternative, then the intervention should be incorporated in the on-farm research.

ANIMAL TRACTION RESEARCH AND EXTENSION IN AFRICA - AN OVERVIEW

PAUL STARKEY
SIERRA LEONE WORK OXEN PROJECT

INTRODUCTION

In attempting to provide an overview of animal traction in Africa one is faced with many problems. There is a shortage of reliable information; very few statistics are available on the extent to which draft animals are used in the various African countries. There is no single source of information, and research data relating to animal traction are often in the form of reports, circulated only within the country of origin. When data are published internationally, they can be in any one of a wide range of journals, covering many disciplines. Thus, while the information given here is based on computer database searches, literature reviews and visits to a large number of African countries, it is far from comprehensive. The limitation of the information presented here is therefore acknowledged from the outset.

The great diversity of Africa geographically, ecologically, socially, economically and politically makes meaningful generalization very difficult. Yet in taking an overview, one must inevitably generalize. It is accepted from the outset that this presentation will be full of over-simplifications, which can be justified only to the extent to which they help provide a general picture of animal traction in Africa. Further, in order to stimulate ideas, reactions and debate, this presentation will involve certain exaggerations and the questioning of priorities. The justification for these will simply be the discussions catalysed by such overstatements.

It is estimated that there are up to 400 million draft animals in the world, directly or indirectly serving two billion people. Around 250 million draft cattle representing 20 per cent of the cattle population of the world are employed for work, the vast majority (approximately 220 million) in Asia. In China alone there are 92 million draft animals, and in India between 72 and 110 million draft animals are employed. Animal traction is used to cultivate about half the total area cropped in the developing world, and on the order of 25 million carts are pulled by draft animals throughout the world. Thus, by world standards, the total number of draft animals in Africa (approximately 15 million) is very small; the great majority of the land farmed on the continent is cultivated with human labor. Nevertheless, many million farming families in Africa do depend directly on animal traction, and the use of draft animals is growing in almost all countries of the continent.

To put animal traction research into context, the present use of draft animals in Africa will be considered first from a historical, and then from a geographical perspective. Some generalizations will be presented on the present status of animal traction research before questions are posed

concerning the future needs and direction of draft animal research and extension.

A HISTORICAL PERSPECTIVE

In Egypt and North Africa, the use of animal traction for crop cultivation and transport goes back several millennia. The use of war-elephants by Hannibal in 218 B.C. was a particularly dramatic use of animal energy. In Sub-Saharan Africa, Ethiopia is notable for widespread use of oxen for farming, a tradition that dates back many centuries. However, elsewhere in Africa, the use of animals for crop cultivation is relatively recent.

Pack animals have been traditionally used in several African cultures, and draft animals were introduced for transport in many towns on the African Coast, particularly during the nineteenth century. For example, horses were used for commercial and military transport, and for recreation in Dakar and Freetown in the nineteenth century. In Southern Africa, early white settlers used animal power on their overland treks, and also for their farming operations.

The major introduction of animal traction for crop cultivation occurred between 1905 and 1935. In most cases, emphasis was placed on the production of export crops. In many parts of Francophone West Africa, including Senegal, Guinea, Ivory Coast, Mali, Burkina Faso and Cameroon, independent companies provided all the training, extension, credit and equipment necessary to allow some rapid adoption of draft animals for cotton and groundnut production. In other countries, including Sierra Leone and Botswana, colonial administrators encouraged animal traction to increase local food crop production, and public funds were used to provide various services including equipment importation, extension services and, in some cases, credit.

By 1940, the time of the Second World War, animal traction had become very well established in Botswana, and was widely used in many specific and geographically limited areas within most of the African subregions, notably in parts of Senegal, Mali and Burkina Faso in West Africa, and areas of Kenya and Tanzania in East Africa. However, at this time, most of Africa was under European administration, and it is important to understand what was happening to European agriculture at this time. For centuries, draft animals had been the major source of farm power in Europe, but after the Second World War the numbers of draft animals in Europe fell dramatically as tractors became widely adopted. Thus, in Great Britain, around 11 million draft horses were used in 1910. As tractor power developed, this fell to 650,000 in 1940 and 370,00 in 1965. In France, in 1940 there were around two million draft cattle and 1.8 million work horses, but by 1965 this had dropped to 100,000 draft cattle and 730,000 horses. From the point of view of European agriculture, it seemed clear that animal traction was an old-fashioned technology that was being rapidly superceded. In universities and agricultural colleges, emphasis was placed on the new forms of mechanization.

During the 1950s and 1960s, there were many attempts to introduce

mechanical cultivation on the African continent, often with disastrous economic and ecological consequences. At the time of independence, the decision makers in most countries had been educated in Europe, had been educated by European expatriates, or had been educated by other Africans who themselves had received European training. Thus a whole generation of African decision makers and African educators had been trained in an environment in which it was generally assumed that animal traction was old fashioned, and of purely historical interest. This gave rise to many rejections of the whole concept of animal traction, which was perceived, to quote a West African, as "a U-turn back to the Stone Age".

By the early 1970s, most countries had recorded failures of over-ambitious tractorization schemes. Fuel crises were followed by chronic foreign exchange problems. Agricultural planners became fully aware that despite tractorization schemes the vast majority of the farming population was actually still using hand labor. Thus almost everywhere in Africa there was a new interest in the possibility of developing animal traction. Multilateral and bilateral aid projects proliferated, particularly in the Sahel, where drought conditions attracted extra aid resources. Thus, by 1985, in almost all countries in Africa the use of animal traction was being actively promoted by government departments, parastatal organizations, major aid projects and by smaller non-governmental aid agencies. In a smaller number of countries, draft animals were also being actively encouraged by private manufacturing or commodity trading companies.

A GEOGRAPHICAL PERSPECTIVE

Of the 15 million draft animals used in Africa, a very high proportion are found in one country, Ethiopia, where more than six million draft cattle are used to plow with the traditional ard (plow). In the highlands of Ethiopia more than 90 percent of farmers make use of animal power. Elsewhere in Africa the use of animal traction is very uneven, with the average figure of about ten percent of farmers using animal power; in some areas it is used by less than one percent of the farming population.

In West Africa there are three broad ecological zones in which animal traction is used. In the Sahel zone of northern Senegal, northern Mali and northern Burkina Faso, horses and donkeys, and to a much lesser extent camels, are the preferred draft animals. To the south of this zone is a belt where Zebu breeds of cattle are mainly used for draft purposes. Further south, in the tsetse zone, to the south of a line running from The Gambia, through southern Mali and southern Burkina Faso to central Nigeria, the small trypanotolerant taurine breeds of cattle are employed in animal traction.

To give an idea of the order of magnitude of draft animal usage in West Africa, about 20 percent of the farmers in Senegal make use of 500,000 draft animals, including horses, donkeys, Zebus and Taurines. Senegal is exceptional in Africa in that the use of seeders for planting is common. In The Gambia, about 33 percent of farmers use animal traction, mainly donkeys and N'Dama taurines. About 100,000 N'Dama oxen are used in Guinea, mainly for plowing. In southern Mali, around 170,000 draft oxen are used,

and inter-row cultivation of cotton and maize is reltively common. In Ivory Coast about 30,000 draft cattle are used, often for weeding of cotton as well as plowing, and in northern Ghana about 20,000 draft taurines are employed. Much smaller numbers of draft cattle, mainly taurines, are used in Sierra Leone, Togo and Benin. In central African countries, cattle populations are small, and while animal traction is slowly expanding, absolute numbers of draft animals are still low.

In East Africa, around 700,000 draft cattle are used in Kenya, and the overall usage by 12 percent of farming families includes certain areas where 80 percent of farmers use oxen for plowing. In Tanzania, about 300,000 draft oxen are used, and in Zambia, Malawi and Zimbabwe about 15 percent of farmers use draft cattle. In Southern Africa, Botswana is exceptional in that virtually no primary cultivation is carried out with hand tools. In Botswana, 80 percent of the farmers use animal traction, employing 360,000 cattle and a few thousand donkeys. In West and East Africa, animals are almost always used in yoked pairs. However in Southern Africa large teams comprising two to six pairs are common. In Madagascar around 330,000 draft cattle are employed.

A RESEARCH PERSPECTIVE

While animal traction is generally a neglected area of research, in most African countries one or more research center, agricultural project or NGO development program is actively involved in some aspect of draft animal research and development. While noting that there are huge variations between different countries—some of which have excellent, well-coordinated, farming systems-orientated animal traction research programs—some broad generalizations can also be made.

Frequently, within countries there is very little liaison and information exchange between the different organizations working on animal traction. This may be because different institutions and projects fall under different ministries. For example, there may be separate ministries responsible for agriculture, livestock, higher education and research. However, even when a single administration is responsible for all aspects of rural development, there may not be liaison between its different projects in different parts of the country. For example, recently in one West African country there were two projects developing animal traction, both financed by the same multi-lateral aid donor, and both with expatriate animal traction "experts", but they worked in complete isolation and the "experts" had never met each other. In a Central African country, there were five projects funded by different donor agencies developing animal traction in different parts of the country, and each of them believed they were the only animal traction project in that country. Each project was starting from the beginning in trying to identify suitable equipment, techniques and cropping systems, and, unaware of each other's existence, there was no possibility to build on each other's experience. Recently in one East African country, there was almost no liaison between the implement designers and producers on the one hand, and the extension workers and farmers on the other. As a result equipment was being developed and produced at considerable expense, and not adapted to the needs of the farmers. In this same country there was similar lack of liaison between

the research stations and the agricultural development projects. In one Southern African country a development worker spent four years designing and adapting a system of donkey carts and harnesses, and he eventually made the effort to contact a research worker from West Africa to discuss his problems and seek further information. However, it transpired that he had never considered looking to see whether there were more appropriate sources of information expertise within the country in which he was working.

While information exchange within countries is seldom ideal, communication and liaison between countries is extremely rare. Draft animal research workers in one country are generally completely unaware of similar research in neighboring countries. When technical problems occur, the historical and communications links with Europe, combined with language barriers and the organizational structures of bilateral and multilateral aid donors, mean that it is generally easier to seek advice from outside Africa than from colleagues who may be just a few kilometers away, across a political frontier. While there are some encouraging signs that more intra-Africa "network" contacts are being developed, in general there is still a tremendous duplication of research effort. In particular there is the failure to learn from other people's experience, simply because there is not the liaison that would allow profitable information exchange.

The vast majority of animal traction research, development and extension projects are supported by one or more multilateral, bilateral or NGO aid agencies. However there is very little technical liaison relating to animal traction either within or between these donor agencies. Most aid agencies are organized with departments administratively responsible for specific countries, or sub-regions, and funds are allocated to individual national programs in agreement with the government concerned. There is seldom an administrative structure that allows problems to be viewed and funds allocated on a regional basis with liaison benefits for more than one country. While it may be administratively possible to write intra-Africa liaison into the budgets of aid projects this is seldom done, although the practice of budgeting for consultants from outside the region is extremely common. There are very few donor agencies that have internal mechanisms whereby experience from a supported project in one part of Africa can benefit another project elsewhere on the continent. Thus one sees the very same mistakes being repeated in different projects supported by the same donor agencies, but in different countries. Frequently there is lack of liaison between different aid donor departments. For example, those specializing in crop production, animal production, agricultural engineering, rural transport, implement production and rural sociology may separately be involved in animal traction activities. Overall progress could be much faster if the aid agencies made more use of their own expertise and experience gained from many parts of Africa. Not only is there insufficient information dissemination within the donor agencies, there are very few channels of communication between the different donors, so that there is great duplication of effort and failure to learn from each other's experience. There are, however, a few examples of specific liaison between different donors. In one East African country, a forum has been established with government departments, non-government organizations and the major donor agencies which aims to help coordinate activities and share experience on specific development issues, such as animal traction.

A great deal of the research relating to animal traction is carried out in research stations, in conditions very different from those of the surrounding villages. On-station research can be important, particularly as a way to assess the technical feasibility of highly innovative ideas before risking introducing them to farmers. However, to be relevant, on-station research must be carried out in conjunction with on-farm studies involving the farmers themselves. Sadly, on-station research studies are often carried out in complete isolation, using systems of management totally different from those attainable by the small farmer. For example, in one research station in East Africa, animal traction research involves purebred Friesian animals, while throughout the country farmers actually use East African Zebu cattle about half the size of the Friesians. In another research station in East Africa, an attempt has been made to create model farms to simulate, on the station, the management conditions of the small farmers. However, the danger of such research became evident when research operations fell behind schedule and a tractor was used to plow the "ox-cultivated" farm. In several African countries pronouncements have been made about the suitability of exotic cattle, or even water buffalo, as a result of on-station research where management conditions, including the availability of feed and veterinary services, were totally different from the realities of the nearby villages. Similarly, many on-station feed trials have involved complex mixtures of feed supplements, which even if technically ideal would simply be unavailable or unaffordable in the surrounding villages.

A related and in many ways more serious problem is that most animal traction research concentrates on just one component of a complex system. Thus engineers concentrate on perfecting equipment designs; animal scientists emphasize the importance of the genotype; and nutritionists concentrate on problems of forage conservation and utilization. Such studies may be valid where discussions with farmers have indicated that some area of research is a limiting factor, and where the studies are carried out in close cooperation with the farmers. However, many cases could be cited where the "problems" are mainly in the minds of the researchers, and where technically excellent studies that are largely irrelevant have been performed in specific disciplines, as the object of the research was not a limiting factor. For example, in many countries research has been carried out on crossbred cattle in the mistaken assumption that animal size was the crucial factor. In many cases, what the farmers needed were highly adapted animals, that were easily bought and sold, that could survive on limited forage and that individually did not represent too much capital risk. In such circumstances, the adapted indigenous cattle were almost ideal, and any attempt to increase draft power through increases in size would have had deleterious consequences for these other critical charactersistics. A similar example of component-oriented research comes from Southern Africa, where researchers looking at the problem of feed supply found that an annual legume could provide highly nutritious feed resources. However, only when they looked at the whole farming system was it apparent that the crucial limiting factor was available draft power for food crop production at the beginning of the rains. As the cultivation of the proposed legumes also required plowing at the start of the rains, the suggested solution, though technically very sound, actually exacerbated the situation at the most critical time. Throughout Africa there are examples of technically excellent implements

designed by agricultural engineers (and perhaps for agricultural engineers), that most farmers would immediately realize were inappropriate, being too weak, too heavy, too complex, insufficiently maneuverable, or far too expensive for the task involved. The engineers would not have made such costly errors had they been working closely with farmers and discussed how the implements would fit into the total farming systems.

In some countries animal traction research is being carried out by multi-disciplinary teams of agriculturalists in conjunction with farmers. However, even in such ideal circumstances, there is a danger that the research will be limited to the animal traction aspects of a complex social and economic environment. It must be recognized that animal traction is just one sub-component of the total farming system and draft animal research should not ignore other social or economic factors that can indirectly influence the technical success of animal traction. For example, in an East African country, local religious festivals severely restrict the number of days in which draft animals can be used. In one West African country it was found that farmers kept their animals enclosed for dangerously long periods because palm-wine tapping took priority, being economically more important for these farmers than crop production. More seriously, research may ignore the importance of women and children in the farming systems where animal traction is employed.

A further generalization relating to animal traction research in Africa is that results are insufficiently publicized. The few excellent case histories that have been produced show just how useful such studies can be in enabling research and extension workers to learn from the mistakes of others. However, few people are prepared to publicize what may be seen as failures, and few governments or donors wish evaluations of disappointing projects to be made public. There is also a danger that misinformation may be published. For example, there are reports in the literature of apparently highly successful experiences with wheeled toolbars in Southern and Western Africa. Such reports become quoted by others and so enter the mythology of animal traction research. The fact that not long after the initial euphoric reports the toolbars proved costly failures was not reported by the original authors, and the project evaluations have had limited circulation. There are many other examples of animal traction workers in many different disciplines, rushing into print after early success, and seldom has it been stressed that their work has yet to stand the test of sustained farmer adoption.

Finally, there is the problem that animal traction research workers are often unaware of valuable publications in their field, and they often do not know how to obtain the information that is available. While works on animal traction are limited, there are some excellent research reports and case studies which are often obtainable free-of-charge. Nevertheless a large number of research workers in Africa have never come across some of the most useful references. While the situation is improving with the production of animal traction bibliographies and information bulletins, there is urgent need for much greater information dissemination by those individuals and organizations who write or publish work relating to draft animal power.

EPILOGUE - SOME UNANSWERED QUESTIONS

The foregoing has included some very broad generalizions based on observations and reports from many countries. However, in view of the enormous diversity of agricultural, ecological, social, economic and political systems, and very different research and extension structures, one must question whether such generalizations are actually valid.

A further question concerns whether the farmer or the research and extension workers really know what is best for the farmer. At one extreme there are research and extension workers who regard farmers as uninformed, simple and reluctant to change. At the other extreme there are those who argue that the farmer is constantly assessing innovations, but seldom adopts them since the traditional farming system has evolved to become almost perfectly adapted to the prevailing conditions. There are many documented cases where it has been clear that the research and extension workers did not know best. In the examples cited of the research/extension workers who tried to impose wheeled tool carriers on farmers in Southern and Western Africa, the farmers quickly returned to their more conventional implements, and the research workers started asking questions rather than giving answers. However many questions are still to be answered.

In Southern Africa, farmers habitually used large teams of 6 to 12 oxen, and have done so for decades. Elsewhere in Africa oxen are generally used in pairs, so certain research workers feel that in Southern Africa it also would be more efficient to use fewer animals and smaller implements. This would imply the time-honored system is relatively inefficient and illogical but it has yet to be proven whether the research worker or the farmer knows best in this case. In one highly publicized research study, a genuine farmer quotation was used to the effect that the farmer's ancestors could not have believed it possible to plow with a single ox. If this is the case, and if the single ox technology is proved by the farmer adoption, it would seem a classic example of how a simple research program can in just two years, come up with an innovation that could revolutionize a farming system. However, it could also be that generations of farmers have preferred to use two oxen, rather than one, for some very good and logical reasons. Only time and sustained farmer adoption will demonstrate whether the innovation is fully adaped to the farming system.

A further example of the dilemma of research workers comes from a West African country where cattle are taken to a crop field specifically to allow their dung to be collected. However, prior to plowing the dung is burned on the field and only the ashes are plowed in. The first reaction of an agricultural research worker might be that this is highly irrational behavior (and this indeed might be the case) but it might be that there is some undefined and very logical reason for burning the dung. Finally the same questioning approach must be applied to farmers not using animal traction. Do they not use it because they are unaware of its potential, or is it because they have actually made an informed and logical judgement? Despite the well-meaning aspirations of animal traction projects, have these farmers decided that animal traction is not appropriate to their social, economic and farming system?

Perhaps the most important question is why do only about 10 percent of

the farmers in Africa use animal traction? Is it lack of knowledge, lack of extension, lack of money, lack of equipment or lack of feed resources? Is it related to problems of health, husbandry or social traditions? Is it related to the intensity of population and farming, or is it simply that using animal traction is seldom profitable? Given that historically animal traction spread through Asia, North Africa, Europe and the Americas without the "benefit" of agricultural development projects or significant government intervention, is the current emphasis on public sector promotion really necessary or desirable?

Is lack of technical knowledge and understanding a constraint? If research is not a limiting factor, is further research really justified? Presumably some research workers will argue that studies need to be undertaken simply to identify whether or not research is indeed a limiting factor.

Finally, if it is decided that further animal traction research is necessary and desirable and that it should be carried out on a farming systems basis with local farmers, there are still some important questions. What impact is the research really likely to have by, say, the year 2000 on both the total level of utilization of animal traction in Africa and on the efficiency of draft animal usage within individual farming systems? Are the potential benefits sufficient to justify the research, and if so what can be done to maximize the impact of the research findings?

This presentation has included some broad historical and geographical generalizations and then questioned whether such generalizations are appropriate. It has included some overstatements concerning the present status of draft animal research and questioned whether such research is necessary or desirable. One could go on to question whether such background perspectives and questions have themselves been justified; the answer to this will depend on the extent to which they have served to provoke further discussion of the issues raised.

REPORT ON CIMMYT NETWORKSHOP ON DRAUGHT POWER AND ANIMAL FEEDING IN EASTERN AND SOUTHERN AFRICA, EZULWINI, SWAZIILAND OCTOBER 4-6, 1983

SANDRA RUSSO
MIXED FARMING PROJECT, THE GAMBIA

INTRODUCTION

The first networkshop on draft power in East and Southern Africa was held in Swaziland in October 1983 by CIMMYT. It was felt that a report on the networkshop proceedings, methodology and results would be useful for the participants in this West African networkshop.

NEED FOR NETWORKING

Formal and informal networks exist worldwide as a response to peoples' needs to communicate and exchange ideas. In a field such as on-farm research, the need for networking is great because:

1. Researchers are few and scattered;

2. Formal links do not exist; and

3. Development of sound methodologies requires much trial-and-error which may be repeated time and again by researchers unknown to each other, especially across a region but also even within a country.

NETWORKING MODES

Once agreed that networking is important, the question arises as to what is the best mode to facilitate networking. Newsletters are an obvious way of communicating. CIMMYT, FSSP and ILCA, to name a few, publish newsletters on a routine basis. However, newsletters are a passive means of communication in that everyone likes to receive them but few contribute.

A second mode of networking suggested by Michael Collinson, CIMMYT, Nairobi, Kenya, is the identification of a specific area of concern in a region and inventorying two aspects of that area of concern. The first aspect would be to describe the characteristics of local specific systems, see how the problem manifests itself under different agroclimatic, economic and social conditions, and inventory the ways in which farmers manage the problem under different conditions. The second aspect would be to list past and ongoing research and to generate a directory of researchers.

The CIMMYT networkshop therefore dealt with the first inventorying task—descriptions of systems where access to draft power had been diagnosed as important—and reports on experimental work that addressed the problem through animal feeding or reduction in draft requirements. The second inventorying task—reports on research in an area—started with a report entitled "Draught Power Problems and Related Research in Botswana, Lesotho and Swaziland" is available on request from the CIMMYT office in Swaziland (c/o Allen Low, CIMMYT, P.O. Box 1473, Mbabane, Swaziland).

INVENTORY OF CROSS-COUNTRY EXPERIENCES

East and Southern Africa have a history of domestic animals and use of animals for draft. This does not mean that the problems are lessened, only that in some cases they are different from draft animal problems in West Africa. For example, animals in these regions are often available but too weak to use, whereas in West Africa animals may not be available and farmers may have no history of animal ownership.

Networkshop participants were asked to prepare a paper in advance about their work and send it to Swaziland so that all papers could be copied and ready when the networkshop started. It became obvious early on that the systems were very different, yet some similarities existed across countries. Systems calendars were devised as a means to discuss these similarities. Participants broke into groups by country to prepare systems calendars which were to include a graph by year of rainfall, feed availability, and timing of agricultural labor and problem points (land preparation, planting, weeding, harvesting, marketing, labor bottlenecks and feed scarcity). Some country participants (e.g., Kenya) had to prepare more than one systems calendar because of wide agroclimatic variability. These calendars were hung around the room and provided an excellent backdrop to discussions of experimental programs.

Discussions of experimental programs included interventions thought to be appropriate in the local farming systems described by the participants. Interventions fell into two broad categories:

1. Interventions aimed at improving the capacity of animals to generate more draft power, e.g. feeding management (forage crops, crop residues, selective feeding) and animal management; and

2. Interventions aimed at reducing the demand for draft, e.g. minimum tillage, farmer training.

Further discussions occurred as participants commented on work from other countries and the appropriateness to their own particular areas. Examples included:

1. Work in Kenya on crop residues was thought to be relevant to Western Sudan;

2. Selective feeding of animals in Kenya and Lesotho was of interest to Malawi, where animals given to farmers died from poor feed management; and

3. Minimum tillage and herbicide work in Zimbabwe was thought to be relevant in Botswana but not in Kenya, where mixed cropping of cereals and legumes precludes such activities.

NETWORKSHOP ASSESSMENT

An overall consensus was that papers and systems calendars should have been prepared well in advance. Given the mail system, this proved difficult even for preliminary communications. Alternatively, the workshop

could have been longer. As it was, participants worked every night on their presentations and saw little, if anything, of Swaziland.

Interestingly enough, participants felt that either too much or too little time was spent on presentations and that presentations were too limited or too general to obtain useful information from them. The prescribed formats were felt to be good but could have been organized in a different fashion.

SECTION III. ANIMAL TRACTION PROJECT EXPERIENCE

Several country presentations were made during the networkshop in order to become more familiar with the animal traction experiences of the country representatives visiting Togo, in terms of research agendas, development, improvements and methods of introduction. These were not prepared in advance, but were informal presentations which used the conceptual framework as an organizational guideline for information presented. Summaries of the presentations on Sierra Leone, The Gambia, Burkina Faso and Senegal are presented in this section.

For Togo, several means were used to elicit an understanding of animal traction experiences. A brief overview of animal traction project work in the Savannes region and the area around Kara itself was given on the first day using the conceptual framework. On the second day, the entire networkshop group was divided into four small groups. Each one went to visit a different animal traction project site in the Kara area. That evening, reports were prepared which were given in the plenary session on the third day. These reports were summarized by the resource persons in order to draw out the common issues and problems identified by the four field trip groups. These summaries are also included. As there are some 30 projects in Togo which have animal traction components, a listing and summary of these projects is also provided.

In addition to the above information on animal traction experiences, each participant completed a project inventory questionnaire. These have been summarized and are listed in Appendix 6. Further inventorying will be needed in order to complete the record of results and experiences in the region.

ANIMAL TRACTION IN SIERRA LEONE

PAUL STARKEY and BAI KANU
SIERRA LEONE WORK OXEN PROJECT

AGRO-CLIMATIC TYPOLOGY AND LIVESTOCK RESOURCES

Sierra Leone is a small country (73,000 km^2) with Guinea savannah ecology in the north, where annual rainfall is 1800 mm, and rain forest in the south, where rainfall exceeds 2500 mm annually. The staple food of rice is the dominant species in the rain-fed intercropping of the traditional bush/fallow agricultural system. Swamp rice is also grown in numerous inland valleys.

The whole country is considered to be of medium trypanosomiasis risk, and the national herd of 333,000 cattle are all of the N'Dama trypano- tolerant taurine type. In the north of the country, where 75 percent of the cattle are found, natural pasture is available for most of the year, with dry-season regrowth being stimulated by fire. Cattle ownership is concentrated in five percent of the farming population, notably within the Fula and Madingo ethnic groups. Cattle obtain all their feed from grazing natural pasture, but a traditional mineral supplement of leaves, salt and termite hill soil is provided two or three times a year.

PREVIOUS PROJECT INFLUENCES

Animal traction was introduced on a small scale in 1927. In 1950 a government-sponsored scheme to expand draft animal usage was inititated in one part of the country, but it was not followed up and was forgotten by the agricultural department after a few years. However, the farmers in the area continued to use work oxen, and the technology was transferred to subsequent generations. In 1985, three-quarters of the plows bought in 1950 were still in use, indicating that animal traction was perceived as economically viable by the farmers, and could be sustainable without significant government intervention. The farmers use their draft animals for plowing and harrowing, mainly for swamp rice production, but with some cultivation of rain-fed rice and groundnuts. Several subsidized tractor cultivation schemes have been attempted, but have all proved impossible to maintain. However, they have raised unattainable aspirations in many sections of society, somewhat reducing national interest in the potential for animal traction.

SOCIO-ECONOMIC FACTORS AFFECTING ANIMAL TRACTION

Agricultural investment is affected by land-tenure systems which do not guarantee continued usage of specific areas of land to individual farmers. In general, farmers' income is low and arable cropping is seldom profitable if conventional economic criteria are used to assess farming costs and benefits. A labor constraint exists, particularly for land preparation. Ownership of draft oxen is associated with the more affluent farmers cultivating above-average areas. Smaller farmers can have access to draft power through traditional systems of hiring; in one area 274 farming families make use of 52 pairs of work oxen. Some women farmers have been among those

hiring oxen from others, and recently some womens' groups have started using animal traction. Through the influence of donor agencies, some village associations have been formed for communal ownership of work oxen.

PRESENT PROJECT ACTIVITIES AND METHODOLOGY

The present Sierra Leone Work Oxen Project is a national project charged with promoting animal traction through adaptive research, extension and training. It is primarily catalytic, providing technical advice and training services to other agricultural development programs, which then develop animal traction components. The project started from a university-based pilot study, which included the review of past records and published experience from other countries, on-station trials and on-farm socio-economic studies. The socio-economic surveys were stratified to allow comparisons of ox users and non ox-users in villages where draft animals were used, and ox hirers and non ox-hirers in villages where there were no work oxen. Studies identified availability of equipment as a limiting factor. Implements from several countries were tested, first on research stations and then by farmers in various villages. The preferred design of a multipurpose implement was appropriately modified and its local manufacture was started. The toolbar is now available with both six- and nine-inch plow bodies to suit different ecosystems and different sizes (ages) of animals. A triangular harrow is also available and other cultivation implements and carts are being evaluated by farmers in several locations. All innovations, such as the use of nose rings to improve animal control and the use of inter-row weeding, are first tested on-station and then by selected farmers in different villages. If proved acceptable, techniques are recommended for widespread adoption and are then followed through with monitoring and evaluation studies.

The project comprises a multidisciplinary team of Sierra Leone, British and French research workers who must all participate in general extension and promotional activities in addition to their specific research areas. All staff, both senior and junior, commence their project experience by training a pair of work oxen themselves. French language training has been given to the Anglophone senior staff to allow liaison with neighboring Francophone countries. Present research interest covers equipment evaluation, animal health, traditional animal husbandry techniques and medicines, row-cropping systems, socio-economic studies and the formation of farmers' associations, including womens' groups. Monthly multidisciplinary technical meetings of staff ensures a farming systems approach is maintained. Overall project policy is determined by a national liaison committee, comprising representatives of the Ministry of Agriculture, agricultural development projects, the university and several aid donors.

The project has great placed emphasis on publicity, with the development of symbolic logos, participation in agricultural shows, wide circulation of project reports and the organization of an annual national ox-plowing competition. The project has also emphasized external liaison, and has initiated several exchange visits and workshops, notably with neighboring Guinea and Liberia.

ANIMAL TRACTION EXPERIENCES IN THE GAMBIA

SOLOMON OWENS
MIXED FARMING PROJECT, THE GAMBIA

AGRO-CLIMATIC ZONE

The Gambia is located in the Sahelian region of West Africa. Historically, rainfall averaged 1100mm per year, falling from June to October. Recently, however, rainfall has been 68 percent of the norm or 600-700 mm with a small drought occuring in August.

Commercial agricultural crops are groundnuts and cotton, the latter less important in terms of foreign exchange. The government sets the price of the cash crop. Food crops are rice, millet, sorghum and maize. Rice is grown primarily in the swamplands and is entirely the responsibility of women. Traditionally, maize had been grown as a backyard crop and picked "green" (fresh) and eaten roasted. In 1981 about 4,000 ha were planted to maize. The Mixed Farming Project (USAID-CID-GOTG) has promoted maize production and in 1984 more than 16,000 ha of maize were planted.

LIVESTOCK TRADITION

Horses (and presumably donkeys) were introduced into the Senegambian area by the Portuguese in the 15th century. These animals continue to play a crucial role in transport throughout the region. Gambians have kept livestock for centuries, both small ruminants and cattle. Before the 1970s there were approximately 300 to 400 work oxen in the country. In eastern Gambia, horses and donkeys are the important draft animals; in western Gambia, work oxen are more important. Farmers are interested in animal traction and the availability of animals is not a problem. Women can own livestock but their draft animals will be used by men. Most Gambian livestock owners have contractural agreements with Fula herders for cattle management from June to December. These agreements do not include small ruminants.

PROJECT INFLUENCE

During 1962 to 1963, the first draft projects started with an imported plow, an ox cart and implements. Ox-plowing schools were set up around the country at 25 mixed farming centers. The trainers were extension agents who had undergone one year of training. This training included animal health care and the agronomy of cultivated crops. Plows were given out and loans made for equipment. This project continued for a long time until funding ended. Training was transferred from the centers to the villages, but unfortunately the quality of the training being done now is much poorer.

The imported plow is still used in eastern Gambia. SISCOMA (SISMAR) developed a seeder and weeder which some farmers have. The cooperative unions have taken over the responsibility of distribution but costs for equipment are prohibitive.

The Mixed Farming Project (MFP) is a livestock-oriented project (supported by USAID through a bilateral agreement with the Gambian Department of Agriculture/Consortium for International Development/Colorado State University) that initially focused on producing feed for animals (maize and forage). Maize proved so popular a food crop that the project turned to that use. The limiting factor in maize production is labor. MFP developed a two-row cultivator with discs, which was first tested in 1984. It used the basic SISMAR design. Testing will be better organized this year, since the training aspect has undergone improvement. Unfortunately, the price for this plow, even if it proves effective, may turn out to be too high for farmers to purchase.

SOCIO-ECONOMIC FACTORS

Farmers are very interested in animal traction. Animals and trainers are available. The major constraint is cost of equipment and the farmers' willingness to take on those costs.

ANIMAL TRACTION EXPERIENCE IN BURKINA FASO

VINCENT BARRETT, EASTERN BURKINA FASO PROJECT (1977 TO 1980)

The project area covered 50,000 km^2 with a total population of 440,000. This compares with Togo in terms of area but with an average of only 2.9 people per square kilometer, the area is sparsely settled and has a poor infrastructure. Rainfall ranges from 900 mm in the south to 500 mm in the north. Over 80 percent of crop area is in millet and sorghum with some cash crops such as rice, soybean, peanuts and cotton of limited importance. Only 8 to 15 percent of total crop production is sold. Few farmers have animal experience and equipment used is much the same as in Togo.

There were six previous attempts to introduce animal traction. All more or less failed because they relied on imported equipment that was poorly adapted. They took the "model farmer" approach, which failed to provide the support needed to maintain animal traction. Also the short duration of the projects (three to five years) mitigated against success.

OBJECTIVES OF PROJECT

1. Improve institutional capacity of the regional development organization.

2. Increase agricultural production and rural income through the introduction of animal traction.

3. Provide technical assistance and conduct farm production and regional marketing surveys.

STRATEGY

1. Working small well-defined areas using Peace Corps Volunteers and local extension staff, although a government decision to make the program country-wide disallowed P.C.V.s.

2. Increased the number of extension agents six-fold during the life of the project to over 400; many were young and inexperienced.

OUTPUT

1974 - 180 animal traction units plus owners

1980 - 1,800 animal traction units plus owners (of which over 1,000 were using donkey traction).

RESULTS OF THE FARM LEVEL SURVEY

The survey was intended to provide baseline data as well as comparisons between animal traction and manual farmers. There were 480 households using animal traction, either oxen or donkeys. Fifty-eight percent of the farmers using oxen had less than three years experience, thus showing that the technology had been adopted only recently.

Over half of the farmers used their animal traction unit less than 12 days per year. This has serious economic implications since the animals have to be fed throughout the entire year. Rental income was minimal, 530 CFA for oxen and 63 CFA per donkey. Oxen carting was insignificant (four percent of animal use) and even donkey carting was not widespread. Plowing was by far the most important use of animals. Donkey farmers plowed 85 percent of their cultivated area while oxen farmers plowed 50 percent of their cultivated area. Very little weeding was done. Farmers using animal traction for weeding averaged 11 years of animal traction experience.

Animal traction households on the average, cultivated six ha while manual households cultivated only four ha. Animal traction households were wealthier and larger than manual households with averages of 11.5 people and 4.8 active workers versus 7.7 people and 3.6 active workers. The difference in area per worker between animal traction and manual households was less than ten percent. Thus the area expansion effect of animal traction was very small. Ox farmers using animal traction weeding did cultivate an area 22 percent larger per active worker than ox farmers who did not weed. Therefore, weeding did have a substantial effect on the area cultivated per worker. The crop mix changed very little between manual and animal traction farmers except for a slight increase in cash crop production. Yield effects were negligible. Yields in the area are low and dominated by agro-climatic conditions. On-farm trials did show a positive effect from plowing. Animal traction did reduce labor inputs per hectare by 174 hours or approximately 25 percent. Even with animal care considered, there was an 11 percent decrease in labor inputs per hectare.

Animal traction increased variable input costs by 50 percent over those of manual farmers. Fixed costs were more than 125 percent higher. Donkey traction was significantly less expensive than oxen traction and appealed to resource-poor farmers. The higher costs of oxen, however, were more than covered by appreciation in the price of the animals. The price of donkeys did not appreciate. The cash costs of animal traction were so high and farm cash revenues so low that farmers needed non-farm cash revenues to support the cost of animal traction.

Survey data was used to generate projections of farm income over a ten year period. A ten year period was used because it is usually agreed that farmers require five years to learn to use animal traction effectively. For farmers using oxen only for plowing with no area or yield effects, the projected internal rate of return was only two percent. Most of the income generated came from the increase in the price of oxen. Net income actually decreased seven out of ten years, from what it was prior to animal traction adoption.

Projections for farmers who use their oxen for weeding and obtain some area and yield effects, showed an internal rate of return of 24 percent. This increased to 28 percent if the weeder was not included in the original equipment package but purchased later when the farmer was capable of using it. Donkey traction projections showed less income but higher rates of return.

CONCLUSIONS

1. The number of animal traction units placed is not a good criteria for evaluating an animal traction project.

2. Farmers are likely to experience a decrease in net income initially when adopting animal traction.

3. Weeding is a key component of the animal traction package in terms of making it profitable.

4. Animal traction allows a substantial reduction in labor inputs per hectare, even when the time needed to care for the animals is included.

5. Good extension support to farmers is vital to the success of the project.

6. The introduction of animal traction is a long-term process and the evolution of that process should be constantly evaluated.

PROJECT EXPERIENCES IN SENEGAL

ADAMA FAYE
ISRA, KAOLACK, SENEGAL

INTRODUCTION

Senegalese agro-climatic zones vary from Sahelian in the north to Savanna in the south. Rainfall varies from 300 mm to 1,200 mm. Northern soils are sandy while in the south soils very from lowland clays to upland lateritic soils.

Several important historical factors have affected agricultural production in Senegal. One is a 1964 law which permitted the redistribution of land not being cultivated. The effect has been to push farmers to produce on all their land, leaving none in fallow. Marketing in Senegal was organized only for groundnuts. Production inputs like seed and fertilizer could be paid in kind using groundnuts. Credit was made available as part of the groundnut extension package and inputs were subsidized.

JUSTIFICATION

Use of animal traction was a response to the need for additional sources of power. Experiments with tractors had failed and labor bottlenecks existed, especially for planting and weeding. There was also a need to harvest groundnuts quickly before the soil became so dry and hard that it was difficult to remove them. The objective of introducing animal traction was to replace some manual labor using equipment that would allow the operation(s) to be more timely, completed more quickly and possibly increase (groundnut) yields through better efficiency.

Donkeys and horses were available in quantity but did not have sufficient draft force for some operations. Mules were socially unacceptable because of their sterility. Oxen were available but neither the Zebu or the N'Dama had the size, conformation and disease resistance thought necessary. Many years were spent trying to develop a new cattle breed by crossing Zebu and N'Damas. But the process was too complicated for farmers and the research organization was never able to produce enough of the improved breed to have any impact.

METHODOLOGY

Studies on the work capacity of different types of animals were carried out for the various operations and soil types found throughout the country. Considerable effort was devoted to developing animal traction tools. Stables were developed in part as a means of collecting manure to be used in maintaining soil fertility. The effects of manure, timing of operations, and the field operations themselves were studied in terms of their impact on soil structure and soil fertility. Production systems were studied looking at different rotations and the effects of long-term animal

traction use. These were evaluated both for physical and economic results.

Farmers typically had livestock traditions and were capable of caring for their animals with the help of government vaccine programs. Pre-extension activities were carried out at a number of centers throughout the country (PAPEMs). These served as sites for multilocational trials as well. The Experimental Units served as a pilot project where research problems could be tested on farms and extension problems and procedures could be tested as well.

Extension activities were carried out by parastatal development organizations. These activities included:

1. Supplying oxen and equipment;

2. Training oxen at centers;

3. Training farmers in tillage techniques;

4. Supplying credit under easy terms; and

5. Supplying other inputs at subsidized prices.

RESULTS

Animal traction by itself has not had a yield effect in Senegal. It has increased the area under cultivation by increasing the speed and reducing the difficulty of work. Perhaps the lack of yield effects is due to the fact that certain techniques, such as plowing under organic matter at the end of the rainy season, have never been adopted by farmers. Comparisons of profitability can be very hazardous due to the lack of homogeneity of conditions between the point of departure and an existing situation.

With regard to animal health, the government veterinary service lacks the means to meet the demand for its services. In spite of all this, animal traction is well-integrated into the farming systems of Senegal. The diffusion of animal traction has proceeded rapidly using horses in the north and oxen in the south (Senegal has the largest number of animal traction units in West Africa, over 200,000). Over time the use of donkeys has decreased and horses have increasingly been used for transportation as well as field work.

Statistics for the Sine-Saloum region show the following results:

	1970	1980
Area Under Cultivation (ha)	770,000	935,000
Pairs of Oxen	2,100	26,600
No. Ha/Pair of Oxen	39	9.7

Additional problems remain in the areas of preventing soil erosion, maintaining soil fertility and with several aspects of the availability of animals. The availability of animals for hire is limited by their use in a number of activities and by the importance of timeliness and climatic conditions. Some farmers also find it difficult to replace aging animals. At the national level there is a need for animal traction to help increase agricultural production. However, as both animal and human populations grow in numbers, there is increasing competition between the two for land and other resources.

Plowing at the beginning of the rainy season is no longer advised. Plowing has been demonstrated to increase yields but delayed planting reduces yields so much that the advantages of plowing are not worth the risk of planting being delayed.

Senegal has recently adopted a new research approach, placing farming systems research teams in each region of the country. These teams are identifying problems specific to each region and will work to test and develop locally adapted solutions. This effort is only now beginning to produce preliminary results.

DRAFT ANIMALS IN TOGO

KOSSIVI APETOFIA AND ARTHUR WESTNEAT
PROPTA, ATAKPAME, TOGO

HISTORICAL DEVELOPMENT OF ANIMAL TRACTION

The use of draft animals is a practice that dates from antiquity. In Togo, it seems that the use of work oxen dates back to May 1900 when the German Colonial Economic Committee invited a team of black American experts from Tuskeegee (Alabama) Normal and Industrial Institute to help introduce the use of oxen to local cotton farmers. Oxen appeared in the vicinity of Kpalime in 1901 and were introduced to Sansanne Mango by 1908. Efforts to expand the use of draft animals did not succeed because the average Togolese farmer was not used to handling cattle. The promotion of draft animals thus ended and this activity lay dormant until around 1960 when the BDPA (Office for the Development of Agricultural Production) and the SORADs (Rural Improvement and Development Company) initiated work oxen programs in the Savanes Region. Their initiatives ended in a second failure, this time due to inadequate health and technical follow-up.

From 1967 to 1970 the religious order of Dzogbegan, followed by the Breme missionaries in Apeyeme, tried using draft animals on the Danyi Plateau. These efforts were likewise failures.

In 1971, a few Peace Corps Volunteers based in Agbassa (Doufelgou Prefecture) undertook to introduce work oxen to local farmers. This center at Agbassa eventually became the DRDR-Kara training center administered by the Draft Animals Project Kara-Savanes (PCA Kara-Savanes).

Around 1973, the Centre d'Animation Rurale (Rural Animation Center) of Ayengré (CAR-Ayengré) made work oxen demonstrations a part of its program.

Several similar attempts to introduce work oxen were also sponsored by SOTOCO starting in 1969 in the Bassar Prefecture but, here too, the oxen teams disappeared before 1976 due to an inadequate infrastructure.

In 1976, PRODEBO (Project for the Development of Cattle Raising) was created with, among other things, the task of promoting the use of work oxen.

A further impetus came with the failure of a motorized agruculture project launched in 1977. It was found to have created problems for small farmers without producing the anticipated results. The Togolese government subsequently asked that a draft animal component, whenever possible, be included in all agricultural development projects so as to give its food self-sufficiency policy a better chance of success.

CURRENT PROJECTS AND ACTIVITIES

Today about 30 projects and organizations, both governmental and non-governmental pursue animal power activities in the rural sector of Togo.

As examples, we cite:

1. Agricultural Intensification Project of the Savanes Region (FED-Savanes).

2. Project for the Exploitation of the Kara Valley (FED-Kara).

3. Draft Animals Project Kara-Savanes (PCA-USAID).

4. Staple Food Crops Project Atchangbade-Sirka (PVAS-USAID).

5. Agricultural Development Project of the Central Region (DRDR-GTZ).

6. Regional Rural Development Administrations (DRDR).

7. Togo Cotton Company (SOTOCO).

8. Tami Center for Community Organization (Dapaong Diocese).

9. Ayengré Center for Community Organization (MISEREOR).

10. "Maisons Familiales" for Rural Training.

11. Wli Center for Training and Rural Promotion.

Always mindful of the need to give draft animal programs a better chance of success, the Togolese government created the Project for the Promotion of Animal Power (PROPTA) in Decree No 10/MDR of September 3, 1982. This project succeeded PRODEBO.

Today there are at least 4,195 work oxen pairs across Togo. Their distribuion among the five economic regions in indicated by the table below.

OXEN TEAMS IN TOGO

Economic region	Number of teams	Percentage
Savanes	3,214	76.2
Kara	637	15.18
Central	257	6.13
Plateaux	55	1.31
Maritime	32	0.76

The fundamental key to the success of draft animal projects in Togo is the political will shown by the 4th and 5th national councils of t[illegible] RPT in adopting animal power as the dynamic factor in Togolese agriculture.

This political will found concrete expression in the establishment of the necessary administrative structures:

1. UPROMA: The Agricultural Equipment Production Center
The creation of UPROMA permits:

a. The timely acquisition of agricultural equipment for draft animals.

b. The standardization of equipment design.

c. The improvement of agricultural equipment by adapting it to local soils and animal types.

d. The acquisition of spare parts.

2. PROPTA: Project for the Promotion of Animal Traction.
As the monitoring and support organization, PROPTA's purpose is to strengthen and invigorate efforts to promote the use of animal power in the rural sector. It is principally responsible for:

a. Gathering and distribution of technical information concerning the use of animal power and associated technologies.

b. Supply of draft animals as needed (farmers and projects may also supply their own needs).

c. Coordination of health follow-up for draft animals in collaboration with the responsible government animal health and veterinary services.

d. Processing of purchase orders for draft animal equipment for which it has a monopoly.

e. Evolution and improvement of draft animal equipment in continuous consultation with its users.

f. Encouragement of extension service staff training in draft animal technologies.

3. THE RANCHES: Adele, Namiele and Avetonou.
The government-sponsored ranches reinforce PROPTA's work oxen supply activities.

EXTENSION PROGRAMS

Numerous extension programs across the country, some of which are mentioned above, share the primary responsibility for introducing draft animals into Togolese agriculture.

FARMER AWARENESS

The growing awareness of Togolese farmers of the potential of draft animal power is an equally important key to the success of draft animal programs.

CONCLUSION

With numerous projects and development organization in the rural sector, animal power in Togo is experiencing a strong take-off.

From 1,040 oxen teams in 1978 to 4,195 teams in 1984, the use of work oxen has increased an average of 525 teams per year for an average annual increase of about 50 percent. Admittedly, the technical level of most of the farmers using oxen teams can be improved; it is here in the area of training that PROPTA can play a determinant role.

SUMMARY REPORTS ON FIELDS TRIPS TO ANIMAL TRACTION PROJECTS IN THE KARA REGION, TOGO

GROUP 1: KANTE

SITE DESCRIPTION

60 kilometers north of Kara
increasingly arid region of poor sandy and rocky soils

PROJECTS VISITED

Projet Kanté Ferme (Kanté Farm Project), Projet Nord/Togo (North Togo Project), and Animal Traction Project/Kara/Savanes.

The above projects are all working on various extension efforts in this region, focusing particularly on animal raising and draft animal farming. At Adjaite there is a center of demonstration, training and animal raising (small as well as large ruminants). A neighboring village of Souté is the site of cooperative animal production efforts (bovine) done by a collective of male farmers in the area who in turn practice animal traction individually. Female farmers are associated in small ruminant production efforts.

Group 1 made their first stop at the village of Kanté about 50 km north of Kara. The agro-climatic zone is not quite savanna with natural vegetation still appearing green late into the dry season. Farmers in the area had been cattle owners, but had always given their herds to Fulani (Peul) to manage in the past. This was apparently an uneasy arrangement and with the introduction of the animal traction project the farmers took over management of the herd. There are several animal traction projects in this area and we received conflicting and confusing stories about project goals, monitoring and inputs. One of a pair of oxen had died with no attempt to replace it by either the farmer or any project. The physical facilities were excellent (paddocks, manure pits and barrages). The farmers could recite project goals and objectives but did not seem to have adopted the entire "package". The animals looked to be in good health. The women had formed a cooperative and were raising sheep. They had received 12 ewes and a ram, had purchased 24 additional ewes, and had a current herd of 63. The ram was extremely overworked and exhibited signs of a pulmonary-respiratory ailment.

Group 1 then visited the animal traction training center at Adjaite. Again, we were impressed with the physical facilities but as there were no farmers or oxen currently in training we only spoke about the training program with the personnel there.

The last visit of Group 1 was to UPROMA, the implement factory outside Kara. The factory's responsiveness, willingness and ability to respond to requests for equipment manufacture and changes will greatly assist in the supply of equipment for future of animal traction projects in Togo.

GROUP 2: BROUKOU

SITE DESCRIPTION

Located 50 kilometers northwest of Kara in the Kara River Valley.

PROJECTS VISITED

Savanes Agriculture Intensification Project, FED (EEC)

This area of more fertile sandy soils is inhabited by displaced mountain peoples under the direction of Project FED Kara. All infrastructures are provided including draft animals and equipment. Visits included animal and farmer training programs as well as with farmers practicing various improved techniques such as improved pasture, one-person draft work and traction by cattle.

The group visited an area 50 km northwest of Kara where farmers from the hills were being resettled through Projet FED Kara, on reasonably flat and fertile land, recently made free of river-blindness. Farmers have been allocated approximately six ha of land, provided a small house, and allocated pairs of draft animals and equipment, including plows, triangular cultivators and ox carts. Repayment schedules were established with nominal interest rates. To date, about 300 pairs of draft animals have been installed. The main crops in the farming systems are sorghum, maize, cotton and groundnuts.

The first farmer visited was thoroughly convinced of the value of animal traction, and he and his wife demonstrated the use of a cultivator to break old ridges. They had recently bought a second pair of animals; both pairs had their rough grazing supplemented with groundnut hay, and seemed in good condition. Being among the more innovative farmers, they had been provided with Stylosanthes seeds and had a good 1/2 ha stand to graze animals on immediately prior to the plowing season. They used a plow, ridger, harrow, triangular cultivator, seeder and cart. They were enthusiastic about all items of equipment, including the seeder, although they only used it for half a day a year, for sowing 1/2 ha of rainfed rice. On the day of the visit an important bolt had broken on his cultivator, but he was confident of obtaining repairs and spare parts with the help of the project.

The second farmer used cows for plowing. His animals were very small and seemed to be in dangerously poor condition. Subsequent veterinary investigations failed to demonstrate the presence of blood or gastro-intestinal parasites. Thus, the poor condition was probably attributable to malnutrition. However, the 13- to 15-month calves of these cows were in excellent condition, although apparently maintained under the same management system. Draft oxen on neighboring farms were also in good condition, although they too were only grazing rough natural pasture and crop residues. Despite their apparently poor condition, the farmer intended to use his cows for plowing in the near future. He appeared convinced of the benefits of animal traction, and his successful raising of

calves from his draft cows may have been his most profitable farm enterprise.

A farmer training center was visited, where farmers train their animals and learn the techniques for using various implements during a three-to-four week training session at the start of their participation in the program. Detailed discussions were held with project extension workers, who were enthusiastic about the benefits of animal traction in the area. However, they were concerned about the continuation of farmer services when the present phase of FED funding ends.

GROUP 3: LANDA KYZENDA

SITE DESCRIPTION

20 kilometers southeast of Kara
1,100 to 1,400 mm/year rainfall

PROJECT VISITED

Projet Nord-Togo (North Togo Project)

The zone of Landa is interesting for its integrated efforts at farming, animal raising, and draft animal extension work. To date they have worked with pure Zebu oxen and have had to develop an efficient health system in order to ensure the health of the less trypanoresistant variety. Within the health program is a system for extension of cotton seed and salt blocks for the draft animals. On this visit the zone was having its annual cotton sale, which exemplifies the effects of cash cropping in a traditional farming system.

The group visited five farmers, one a Fulani, another a second-year farmer and three "model" farmers who were trained as animal traction extension workers. Their farms were a few kilometers southeast of Lama Kara in the Togo Animal Traction Project area. The farms were relatively flat, soils reasonably fertile and land seemed to be no constraint, with much of it personally owned. Rainfall averaged 1,100 mm over a six month period. Crops consisted of sorghum, millet, yams, groundnuts and cowpeas. Families were small and labor had to be hired. Farm sizes ranged from 6 to 13 ha.

Examining the pre-conditions for project success, we found the exogenous factors to include available mechanized equipment for farm clearing; suitable soil texture and fertility; suitable conditions for animal traction (except oxen were imported under the project and did not seem as suitable as locally available cattle); a well-organized extension service, using "model" farmers who after two years as extension workers became full-time farmers and relied on project resources for their operations. Access to roads and markets seemed good, custom hiring of ox carts was practiced and a good potential existed for cash crops. Credit was available for inputs, land preparation and equipment but not as one package. Veterinary services were developed and suitable equipment and spare parts were available at project headquarters. The animal traction packages consisted of a moldboard plow, tine harrow, weeder and ox cart. The rural development center provided some maintenance and there was a blacksmith in the area. Water and pastures did not appear to be major constraints. The high cost of the animal traction package, largely due to the price of imported cattle, was identified as a problem. Of 20 farmers identified as interested in animal traction only three entered the program because of the initial cost. The three "model" farmers shared their labor. The farmers seemed motivated and animals were culturally accepted in the area. Of the five farmers participating in the project, four relied mostly on the project for their resources.

Feed resources seemed adequate, except the supply of groundnut hay was exhausted. We did not see the oxen to confirm the question of adequate feed but from the obvious crop residues, grass and weeds, feed was not likely a problem this year. Cotton seed and mineral mix were available and one farmer was growing Stylosanthes but had a disease problem. Others wanted to develop an improved forage program.

With respect to management of technology, we saw that animal health care was extremely important and was provided by the extension agents but paid for by the farmer. The farms were well kept and the animal holding facilities adequate and in good repair.

It appeared that the technology was being adopted slowly but not fully. For example, two of the farmers were not using oxen for weeding. We questioned whether training had been sufficient to enable farmers to adopt the whole package or whether the whole package itself was limiting wider use. There appeared to be opportunities to increase use of oxen for transport to increase the crop mix, to perhaps intercrop and to make better use of manure.

GROUP 4: ATCHANGBADE

SITE DESCRIPTION

12 kilometers southwest of Kara
Moderate rainfall of 1,100 to 1,400 mm/year
Hilly, rocky region southwest of Kara covers 60,000 ha
Crops: yams, cotton, sorghum, corn and groundnuts
Arable land in short supply because of terrain

PROJECT VISITED

Projet Vivrier (Home Food Consumption Project)

The extension work in this area of soils with diminishing fertility has been organized by Projet Vivrier through the use of Councils of Development (CDs) which are farmer organizations formed to put development decisions and initiatives in the hands of the people. The visit included a meeting with one of these Councils followed by visits to members farms, some of which are practicing integrated techniques of animal feeding and farm waste recuperation. The training and demonstration center was also visited, where model field waste, crop residue storage and pigeon pea experiments are taking place.

ANIMAL TRADITIONS

Previous attempts to introduce animal traction failed. There are no livestock traditions. Farmers are often afraid of the oxen.

PROJECT INFLUENCE

A focus on food crops and community development has the objective of providing a catalyst for self-development. From 1980 to 1985, 82 animal traction units were placed. The project provides credit at 2.56 percent, animal health care, farmer and oxen training and blacksmith training.

SOCIO-ECONOMIC FACTORS

Resource levels vary. Land is a serious constraint. Access to land is very important.

UPROMA

UPROMA is a recently established factory producing animal traction and other appropriate technology equipment. Until it was established, projects imported animal traction equipment from various sources. Orders were small, expensive, often delayed and stocking spare parts was a problem since they often were not interchangeable. Producing equipment locally allowed equipment to be standardized, to be available on a timely basis and made spare parts and repairs easier to provide. UPROMA-manufactured equipment included: plow and multipurpose tool bar (triangular), two types

of harrows, carts of three different sizes, a hand push seeder, a manual cornsheller and a handpump. The factory's main problem at present is an inadequate sales and distribution system.

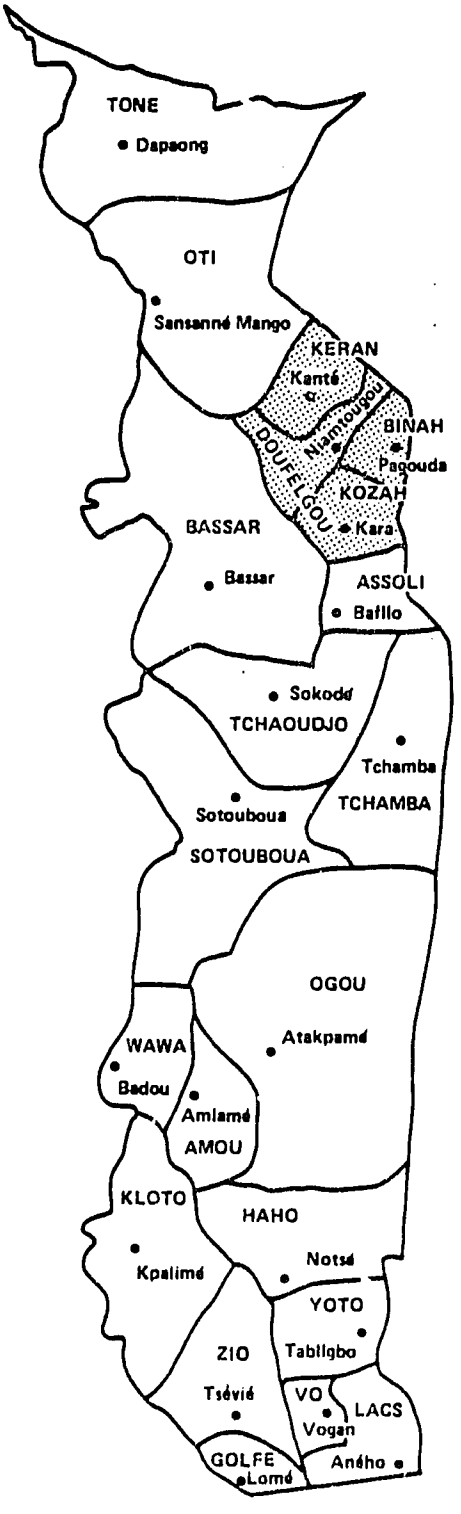
FARM VISITS

Farmers were not available to talk with the group until mid-afternoon because of a communal fishing activity. The project director made a general presentation on the project, followed by a visit to the oxen training center and the blacksmith training center. Problems raised by project staff included: farmers' fear of cattle, availability of animal health services, a change in the credit system requiring a substantial down payment and the availability of land.

The first farmer encountered was a partial adoptor, who wanted a cart and seeder but found them very expensive. He had problems feeding his animals in the dry season and paid a cattle merchant to immunize and help care for his animals since the government-provided veterinary services were not regularly available. The second farmer would only be getting an animal traction unit this Spring, but expected the down payment and animal feeding to be major problems. The third farmer was a very good animal traction user even though he had adopted only four years ago. His major problem was the availability of land. He plants two or three successive crops on each field during the rainy season.

We also met part of the village Development Council which makes decisions about and coordinates village development activities, including requests for credit.

Figure 1. Map of Togo



Administrative Divisions in Togo, including the Project Zone

Figure 2. Map showing routes of four field visits.

ROUTES

1. Kanté
2. Broukou
3. Atchangbadé
4. Landa-Pozenda

SUMMARY OF FIELD TRIP REPORTS

Although each field trip site differed from the others in a number of ways, it is possible to identify 11 common points or problems which were raised in all four reports.

1. Adaptation of equipment.

Generally, equipment is found to be fairly well-adaped to farmer needs. There is a need, however, for appropriate peanut lifting equipment.

2. Supply of spare parts.

This does not appear to be a significant problem. UPROMA is doing a good job of producing spare parts and local blacksmiths are also engaged in the repair business for local animal traction farmers.

3. Cost of animal traction package.

Most reports noted the high cost of the unsubsidized animal traction package. There is a need to know whether the cost of the package has now gone beyond the means of the average farmer. There is a high initial cost to the equipment; currently one-sixth of the total price or 240,000 CFA. To afford the initial payment, farmers must have an animal traction cash crop. In this region, cereal prices fluctuate too much to be a dependable cash crop.

4. Animal supply and availability.

Most reports noted that animals are normally imported (Burkina Faso) and therefore have both a high price and considerable health problems. Future emphasis should be placed on using local animals.

5. Collective ownership.

This was not mentioned in all reports but was brought up as a potential introduction strategy. Collective ownership may bring certain benefits, but these may be overshadowed due to management problems collective ownership brings.

6. Animal health.

In all cases the status of animal health is directly related to project intervention rather than to any coordinated national effort. In the Brokou report, it was noted that cows were thin and likely having health problems, but elsewhere, animal health was generally good. The topic raises an important question: should animal health continue to be so related to project presence, or could the national animal health service be improved?

7. Animal feeding.

This topic generated a lot of attention and a number of ideas and problems were raised. Two stand out, however. First, peanut haulms offer a good potential source of feed, particularly beneficial due to its protein quality. However, problems in successful storage and conservation of haulms by farmers were underlined. Second, it was generally agreed that an adapted leguminous cover crop could be a potentially beneficial introduction into local rotation patterns. However, serious problems were raised as to the real potential of such an introduction (such as Stylosanthes sp.) given the difficulty in collecting or obtaining seed for planting. It should be pointed out that to the visitors from more Sahelian environments, the field trip areas seemed to have abundant feed resources by comparison.

8. Animal care.

Lack of a livestock tradition among most of the farmers in the field trip site areas suggests a generally poor understanding of animal care due to inexperience. This points to the need for intensive training in animal care and management as a basic component for any successful project.

9. Soil management/fertility.

While land availability was not noted as a major constraint in the project areas visited, maintaining soil fertility is a continuing problem and has not been adequately resolved. Manure is generally poorly utilized. It should be kept in mind that animal traction without attention to soil fertility maintenance may increase soil degradation.

10. Use of tillage techniques.

Generally, it was found that everyone plows but very few people weed. Yet, weeding technology is where gains to the farmer have greatest potential benefit. The introduction of animal traction is a long, slow process. A project has to have a long time-frame (many estimate ten years before benefits to farmers are seen), and must be able to deal with farmers on at last three different levels at the same time: beginners, partial adopters and advanced adopters.

11. Multiplicity of projects.

It is apparent that Togo in general, and the northern region in particular, has numerous projects dealing with animal traction. The multiplicity of projects and services seems to create confusion for farmers, underscoring both the necessity of the Project for the Promotion of Animal Power (PROPTA), and the difficulty this organization will face as it develops its coordinating role.

PROJECTS INVOLVED IN ANIMAL TRACTION IN TOGO

There are 32 activities in Togo which include animal traction as a major input to increasing agricultural productivity. These activities, the primary sponsors and the specific area of concentration are summarized briefly as follows (the USAID Culture Attelée Project (AIP) is not included):

1. Regional Rural Development Administration (DRDR) Savanes Region. Goverment agency responsible for integrated rural development in the Savanes region. It oversees the activities of the Draft Animals Project (Projet Culture Attelée) and the FED-Savanes Project as well as providing extension services to the work oxen farmers who participated in the former Agricultural Development Office (BDPA) Project.

2. Togolese Cotton Company (SOTOCO)-Second Rural Development Project in Cotton Areas (IDA). Set up to promote cotton nationwide, SOTOCO promotes the use of draft animals throughout its operations.

3. Savanes Agricultural Intensification Project (FED-Savanes). Farmer training in improved methods of cultivation and adapted inputs is promoted through an outreach program that aims at ameliorating soil fertility to sustain future agricultural production.

4. Draft Animals Project (PCA-USAID). Project set up to put into effect a training program for work oxen, farmers, and technicians and for the provision of oxen teams and equipment to farmers. It is a project that operates in both Kara and Savanes.

5. Namiele Plain Production (UNIFOCO). Originally this project was a private, agro-industrial project to develop the hydrological and rangeland resources of a broad plain for cattle production, primarily for meat. The project, in its third phase, is being integrated into the larger Ministry of Rural Development Program and, in collaboration with PROPTA, will produce oxen, improve village herds, and address environmental issues.

6. Social Affairs Service-Savanes. A multidisciplinary social service agency; draft animals are part of a program to improve Togolese family farming in the Savanes region.

7. "Maisons Familiales" Association. A French social assistance agency; village-to-village, family-level improvement of living standards with an accent on increasing staple food crop production. The use of draft animals (oxen and donkeys) is a major emphasis. Five centers are located in the Savanes region, several more are located in the Central region and one in the Plateau region. Maisons Familiales in Akpare promotes the use of oxen by women.

8. Rural Training Center at Tami. The Center trains young married couples in all aspects of agricultural and rural economy, including animal traction. The program was originated and is supported by the Diocese of Dapaong.

9. Community Organizing Center at Tabimong-Ogaro. Recently opened, this initiative by the Diocese of Dapaong follows a similar program to that of the Rural Training Center at Tami.

10. Catholic Community Organizing for Youth (JARC). Working with young farmers in the seven districts of the Diocese of Dapaong, JARC has been promoting the use of draft animals since 1968.

11. Regional Rural Development Administration (DRDR) Kara Region. Government agency responsible for integrated rural development in the Kara region. This DRDR was one of the innovators of oxen use in Togo and currently oversees the activities of the Draft Animals Project, the FED Kara Project and the North Togo Project.

12. FED Kara Project. A resettlement project initially, the program is being integrated into the Togolese Government Development structure. Animal traction has been a major component of this project from the outset.

13. North Togo Improvement Program (UNDP). Now integrated into the Togolese Development structure, the North Togo Program is a large, integrated rural development project in the Kara region. The use of work oxen is an important element of this program.

14. The Staple Food Crops Project of Atchangbade-Sirka (Entente Fund, USAID, FAC). This is a rural community development project in the Kara region. Village councils are organized to address the felt needs of the village. Assistance is of the self-help form. The use of oxen is part of the technological improvements encouraged by the project to lead to a gradual, sustainable increase in the production of staple crops.

15. The Missionary Brothers of the Countryside at Massedena. A religious order dedicated to helping the community with small projects, one of which is the introduction of animal traction. Farmer Development Councils are encouraged to determine choice of activities to be implemented on a self-help basis.

16. Regional Rural Development Administration (DRDR) Central Region (GTZ). Government agency responsible for the integrated rural development of the Central region. The rural development program, sponsored by the West German government, has a major draft animal emphasis. Farm families receive intensive training (as much as two years) in agricultural and rural technologies at a training center. This program is currently in a two-year evaluation phase.

17. Community Organizing Center (CAR)-Adjengré. Sponsored by the Diocese of Sokode, the project promotes food self-sufficiency and encourages young adults to engage in modern farming and the use of oxen.

18. Regional Rural Development Administration (DRDR) Plateau Region. Government agency responsible for the integrated rural development of the Plateau region. Its work oxen program is small and limited to its centers at Nyamasilla and Notse.

19. Notse Rural Development (IFAD). This project is designed to help develop the region east of Notse through a better infrasructure, improved staple crop production, and through the production of cotton.

20. Community Organizing Center (CAR) at Danyi. Working with 15 villages in the Danyi Plateau, the CAR-Danyi has long promoted the use of oxen in agriculture.

21. The Staple Food Crops Project of Notse-Dayes (FVND);(Entente Fund, USAID, FAC). This project emphasizes the development of corn production on old or marginal coffee and cocoa plantations. The use of tractors and oxen are part of the program. This project inherited the extension service component of PRODEBO, now PROPTA.

22. Rural Youth Center at Kpele-Govie. Sponsored by the Youth and Sports Ministry, this project provides oxen training and technical support to a group of young farmers.

23. Regional Rural Development Administration (DRDR) Maritime Region. Government agency, formerly PRODERMA, responsible for the integrated rural development of the Maritime region. Its technical service oversees the limited draft animal program at the Todome Center.

24. French Association of Voluneers. The French Volunteer program, in collaboration with the DRDR Maritime region, runs an animal traction center at Todome (Badja). The center serves village groups in a ten km zone.

25. Catholic Mission at Togoville. The Catholic Mission in Togoville has been active in promoting the use of oxen in agriculture since 1978. From a cooperative format, the emphasis has shifted to that of an animal traction school for selected farmers.

26. Rural Training Center at Wli. Sponsored by the Catholic Church, this project has broad interests in promoting agricultural and agro-artisanal industries in the region. The use of oxen and the manufacture of oxen-drawn implements are features of the program.

27. The Observation and Rehabilitation Center at Cacaveli. This center for the rehabilitation of juvenile delinquents employs oxen as part of its agricultural training and familiarization program.

28. The Community Development Center at Togodo. Sponsored by the Togolese National Political Party, the project is aimed at young adults who are interested in a career in modern agriculture. The use of oxen in this program has been highlighted on national television.

29. The Future Center at Kamina. A center for training young delinquents in vocational skills; its section on modern agriculture promotes the use of oxen.

30. The Livestock Research Center at Avetonou (CREAT). A German-funded cattle breeding and research center dedicated to improving animals adapted to the southern Togo environment. In addition to the oxen employed at the center for on-farm transportation, CREAT has inroduced a research and

production program to help provide improved oxen to the farmers of Togo's southern economic regions.

31. National Agricultural Training Institute at Tove. The agricultural training college provides technical education to Togo's young rural development professionals and modern farmers. Training in work oxen technology is playing an increasingly important role in this program.

32. The Opportunities Industrialization Center Togo (OIC-TOGO). This American-sponsored initiative provides training in a broad spectrum of agricultural and non-agricultural topics, one of which is draft animal technology.

SECTION IV: SUMMARIES OF SMALL GROUP DISCUSSIONS

GROUP ONE: PRECONDITIONS FOR SUCCESSFUL ANIMAL TRACTION ADOPTION

REPORTED BY: PAUL STARKEY

Group discussions aimed to identify conditions that could be considered prerequisites for success in animal traction. Such preconditions were broadly defined as exogenous, resulting from the environment in the broadest sense (agro-climatic, social, economic and infrastructural environments) or endogenous, being characteristics of the farm or farming family. Questions were posed as to whether certain endogenous resources, technical skills or management abilities were essential to the successful adoption of animal traction. By defining such preconditions, it was envisaged that some practical guidelines relating to successful adoption criteria could be presented, through a farming systems perspective.

The success of any animal traction program will depend on a unique combination of exogenous and endogenous factors specific to the area of introduction. The principle factors affecting the adoption of draft animal power differ not only between the different West African countries represented, but even within countries, and within relatively small areas, such as those of the various Togolese projects visited. While the broad categorization into exogenous and endogenous factors can be useful, the complex interaction of the two categories makes precise definitions difficult. Recognizing the great diversity of conditions and the dangers of generalization, some very broad observations can be made. These may be considered under the broad headings of the profitability of draft animal use, socio-cultural factors, knowledge, financial resources and the availability of appropriate services. It is emphasized that these headings are neither comprehensive nor discrete categories, and in any situation there is a complex interaction of the various factors.

PROFITABILITY OF DRAFT ANIMAL USE

For animal traction to be viable, the use of the draft animals must be either economically profitable or have distinct social benefits. In cases where work animals are used solely for transportation, forestry operations or for powering pumps or machinery, profitability will depend largely on the availability of animals, labor and feed resources and the relationship between operating costs and the income or benefits obtained. Farm profitability depends on numerous complex and interacting criteria, but when animals are used for crop cultivation the following prerequisites may be defined.

1. Land.

Farmers must have reliable access to land of appropriate quality and quantity. The minimum area of land will vary with cropping intensity and

the value of the crops produced, and so will be highly area-specific. Farmers with land areas below the critical minimum may still use animal traction through systems of hiring or communal ownership.

2. Agro-climatic factors, soil conditions and availability of natural pasture.

Environmental conditions will determine if cultivation with draft animals is feasible, and also whether or not it is profitable. Certain exogenous characteristics such as steep slopes, insufficient rain or soil and low fertility militate against animal traction. Availability of natural pasture will depend on the climate and farming system. While animals can be fed from specially grown forages or purchased feeds, the introduction of draft animal technology is likely to be more successful in areas of adequate natural pasture.

3. Labor.

Availability of labor is a critical endogenous factor affecting draft animal use. Use of draft animals requires labor for cultivation operations or transport, besides the care and maintenance of animals throughout the year. The labor required may involve several members of a farming household, or labor may be hired. The use of draft animals for plowing large areas can create labor bottlenecks at other times, for example, at weeding or harvesting. If there is gender partition of farming operations, which is common, the use of draft animals may decrease the labor of one sex while inceasing that of the other. The profitability of animal traction will increase as more labor-saving operations are used. Efficient management of operations and thorough training of cattle can save labor, for example by having one person control a pair of oxen; but such labor use is rare in West Africa. An important criterion is that the labor required for care and maintenance should not distract from other important farm operations.

4. Adapted animals.

For animal traction to be successful, adapted animals (those that are disease-resistant or disease-tolerant) must be readily available. It is stressed that, in village situations, adaptation is much more critical than size. Thus the small trypanotolerant taurines of West Africa are particularly appropriate as draft animals in areas of trypanosomiasis risk. Not only must animals be adapted, they must be readily available, and ease of purchase and resale is particularly important. The combination of adaptation and availability will generally mean that indigenous animals are used, and the use of exotic breeds or novel species is seldom likely to be appropriate. Crossbreeding schemes are unlikely to make a significant contribution to the success of draft animal programs, as they are generally expensive and complicated to manage. There is a complex inter-relationship between the importance of animal adaptation, the availability of animal health services and systems of animal husbandry and nutrition.

5. Existence of adapted cultivation systems.

Successful animal traction requires proven systems of crop cultivation,

adapted to local agro-climatic and soil conditions. Before animal traction is promoted, appropriate cropping systems should have been tested and proven. In a few cases traditional cropping systems may be suited to animal traction. More frequently, changes in fallow length and stumping of land that are associated with draft animal use necessitate new crop rotations or associations to maintain soil fertility.

6. Market for produce.

For animal traction to be successful, farmers must be able to sell produce to pay for implements and other inputs. The use of the word "cash crop" in this instance may be misleading, as farmers may be able to sell the staple food crop to obtain sufficient income. Nevertheless, an assured market for a high-income crop is particularly advantageous to draft animal adoptors. The success of draft animal programs associated with cotton and groundnut marketing operations is of particular note.

The price of the inputs—notably for animals, implements and services required to maintain these—must be proportionate to the benefits gained. In particular the value of the crops produced must be commensurate with the overall costs of animal traction. Several case histories discussed in the workshop illustrated the problems farmers face when offered expensive equipment packages while the value of their production is low.

SOCIO-CULTURAL FACTORS

The social environment must be supportive of farmers adopting animal traction. Previous knowledge of animal husbandry is not a prerequisite and animal husbandry skills are not limited to certain ethnic groups. Nevertheless, familiarity with animal husbandry is clearly advantageous. The local population must be prepared to accept the principles of animal traction so that individuals can learn the necessary skills. The importance of status should not be underestimated, for animal traction may be adopted even when apparently unprofitable if it confers enhanced social status. The natural tendency of farmers to diminish their risks may be significant, and the decision to adopt or not adopt animal traction may be based on whether it is perceived as basically spreading risks, or whether it makes the farmer more vulnerable to exogenous variables over which the farmer has little or no control. The division of farming roles between men, women and children in a farming society may influence the adoption of animal traction. Investment in animal traction is more likely if the investing heads of households have their own labor diminished, through the use of the draft animals. It must be stressed that such socio-cultural factors are not fixed, and can change with time. In addition to the exogenous socio-cultural environment, the endogenous motivation of individual farmers is a prerequisite for successful adoption.

KNOWLEDGE

Before farmers can adopt draft animal power, they must be aware of its possibilities. This is an endogenous precondition. However, knowledge comes through contact with external sources, by seeing other farmers using animal traction, by hearing descriptions of draft animal use or from specific publicity activities such as agricultural shows or demonstrations.

FINANCIAL RESOURCES

Adoption of animal traction involves considerable capital investment in animals and equipment. Farmers must either have sufficient resources to allow this investment or they must have access to a form of credit, which could be provided through traditional, modern, commercial, governmental, or NGO credit arrangements. Farmers already owning suitable animals require much less capital or credit to enable them to employ draft animals. While not a precondition, appropriate animal ownership is a marked advantage in favor of successful animal traction adoption.

SERVICES

Successful adoption of animal traction requires the provision of certain external services to support the farmer. These services may be provided by other farmers and traditional expertise, by modern commericial agencies or by governmental or NGO development agencies. It should be stressed that governmental provision of these services is not a precondition. Historically, the development of draft animal use in Europe, North and South America, Asia, and North Africa did not involve significant government intervention or formal development projects. In these cases, the diffusion of knowledge and the provision of training services, health services, equipment and research and development activities have involved traditional artisans, entrepreneurs and local initiatives. There is ample evidence from the rest of the world, and even West Africa, that draft animals can be introduced and sustained through private services, whether traditional or modern. Animal traction technology frequently diffuses over international boundaries, where it may be sustained without any direct government-sponsored interventions. Farmers can provide their own research and development, adapting their cultivation systems and equipment to find ways of improving the technology. Nevertheless, throughout Africa animal traction is being promoted by agricultural development projects and government services. Short-term projects may speed the rate of adoption, but in the long-term such activities are unlikely to maintain animal traction if other preconditions, notably socio-economic profitability, are not met.

1. Equipment, spare parts and repair services.

Farmers require access to appropriate equipment and maintenance services. In many African countries appropriate animal traction equipment is not readily available, and its provision may be a precondition to successful introduction. The mere sale of such equipment is not sufficient, however, for farmers must be able to readily obtain spare parts and repair services when equipment fails. Village blacksmiths frequently provide such services, and may be vital to the success of animal traction programs, but they are frequently constrained by difficulties in obtaining raw materials. Such a secondary factor can indirectly constrain draft animal adoption through the restriction of a vital service.

2. Health, husbandry and nutrition services.

The degree to which farmers require animal health and nutrition services, including husbandry and management advice, depends largely on the

ecological zone and the previous animal husbandry experience of the farmers. In places of long term draft animal use, traditional skills and resources have been used to provide management and health care. However, many projects introducing animal traction have experienced high mortality rates, often associated with the movement of animals, the use of unadapted breeds or species and insufficient attention to nutrition factors. In such cases, the provision of appropriate animal health services is a prerequisite. In particular, prophylaxis or treatment for trypanosomiasis may be critical in much of West Africa. For the long-term viability of animal traction, husbandry practices must be well adapted to the environment, and, in general, greater attention should be given to traditional systems of maintaining animal health.

3. Extension and training services.

In areas where animal traction is clearly beneficial, farmers will obtain information and advice from other farmers, and may obtain assistance in training through hiring the services of others with appropriate skills. Thus the provision of government extension workers need not be a precondition for successful animal traction adoption. However, in areas where there is little experience of draft animal use, extension and training services can speed rates of adoption, or can improve management techniques, provided an adapted cultivation system has evolved or has been developed. Inappropriate extension can actually retard farmer adoption, as other farmers see the problems encountered by early adoptors taking unsuitable advice.

4. Research and development services.

Preconditions for the success of animal traction include the existence of appropriate cultivation systems, adapted equipment and suitable systems for maintaining the health and nutritional status of animals. Such systems come from adaptive research. Throughout the world, innovative farmers have carried out their own research, and consequently, over time, have developed highly adapted systems of draft animal utilization. Historically, in most parts of the world, innovations in animal traction have been developed and spread by progressive farmers, and not by government research bodies. However, in many parts of Africa, proven systems of animal traction use have yet to be developed, and in such cases the provision of appropriate research and development services would be a precondition to any animal traction program. Such research should start with the farmer, and should be carried out on a multi-disciplinary systems basis. Studies focusing only on one factor, such as equipment, nutrition, health, crop-rotations or socio-economic factors are unlikely to meet the necessary preconditions for an appropriate, adapted system of draft animal utilization.

PRACTICAL IMPLICATIONS OF THE DEFINED PRECONDITIONS

In any region, country or area there will be a unique combination of endogenous and exogenous factors that will determine whether or not animal traction is appropriate. Prior to any animal traction research or development activity, a farming systems-based socio-economic study should be performed to ascertain the various economic and social costs and benefits of using draft animal power. Such a study need not be a

comprehensive baseline survey with statistical analyses; more subjective, broad-based assessments can usually identify the major limiting factors.

Following such a study, it should be possible to decide whether or not animal traction is socially and/or economically profitable. A note of caution is required here, for experience from numerous West African animal traction programs suggests that in many project appraisal documents, animal traction has been said to be profitable, while subsequent evaluation documents have highlighted the problems of unprofitability.

If the initial study indicates that animal traction is socially and economically beneficial, then factors that are limiting the rate of adoption or the efficiency of utilization can be defined. These factors include land, agroclimate, labor, adapted animals, adapted cropping systems, marketing opportunities, price equilibria, socio-cultural factors, knowledge and financial resources or the provision of appropriate services (see Fig. 3). One choice that can be made by the national government, agricultural project or development agency is to allow the technology to develop without intervention (which should be possible given its social and economic profitability). The alternative decision is to intervene to speed up the rate of adoption, or increase the efficiency of utilization. Such intervention will inevitably involve costs, so emphasis should be placed on the most cost-effective methods of intervention. This will almost certainly mean concentrating resources on those factors which are seen to be limiting. For example, if capital is limiting, then credit may be required; if knowledge is limiting, then extension services may be desirable; if animal health is limiting, prophylaxis may be indicated. It may also be prudent to initiate farming systems research to identify methods of further improving profitability and efficiency of utilization. The result of such interventions should be increased rates of adoption and/or improved efficiency of draft animal utilization. This is illustrated schematically on the left-hand side of Figure 4.

If an initial study indicates that animal traction is not economically or socially profitable given prevailing conditions, then a policy decision is required by the national government, agricultural project or development agency that will determine whether or not to intervene to change the cost/benefit equilibrium of animal traction. If the decision is for non-intervention, then animal traction is unlikely to be adopted, as farmers will reject the technology due to its social or economic unprofitability.

If a policy of intervention is chosen, it will involve costs to the government, project or development agency, and so resources should be directed at the key limiting factors. For example, direct or indirect subsidies can decrease farmer costs, farmer income can be increased by changing pricing or marketing policies, or subsidized services may be provided. Such interventions may then make animal traction profitable for individual farmers, which can be confirmed by a reassessment of the socio-economic study. If this is the case one re-enters the schematic diagram (Fig. 4) at the point of profitability. Many examples of such interventions exist in West Africa, where decisions taken at national or project levels provide resources that alter existing cost/benefit equilibria to make animal traction adoption possible. Such decisions may

be taken for social reasons, or more often in the belief that animal traction will become profitable and self-sustaining once a certain level of adoption is reached.

An alternative strategy, which may not be mutually exclusive, is to initiate farming systems research with the aim of identifying improved systems of utilization that can make animal traction socially and economically profitable. Such research would be multidisciplinary, but would concentrate on identifying limiting preconditions. For example, if natural pasture was found to be limiting, research could concentrate on systems of improving animal nutrition; if equipment costs were seen to be critical, emphasis could be placed on developing less expensive equipment or developing systems to improve the efficiency of equipment. Such interdisciplinary research may result in more intrinsically profitable systems of animal traction being identified, in which case, following re-assessment, one re-enters the schematic model at the point of profitability, as illustrated in Figure 4.

CONCLUSIONS

The diversity and complexity of farming systems makes it impossible to provide a definitive list of preconditions for successful animal traction. Nevertheless, some generalizations have been presented, and these fall into five broad interacting categories: socio-economic profitability, socio-cultural factors, knowledge, financial resources and the availability of services. It is of particular note that several commonly held perceptions of prerequisites are not considered as essential preconditions. For example, previous animal husbandry experience, animal size, and the provision of project or governmental services are not essential to the long-term success of animal traction, although they may be important factors in determining the speed of adoption. Using the principle of limiting factors, a schematic model has been presented. The model is necessarily simplified, for it represents extremely complex combinations of interacting social, economic and environmental criteria, which are not constant, but which evolve with time. However, it is intended that such an approach may allow a farming systems research perspective to assist in decision-making at the national, project or development agency level.

FIGURE 3.

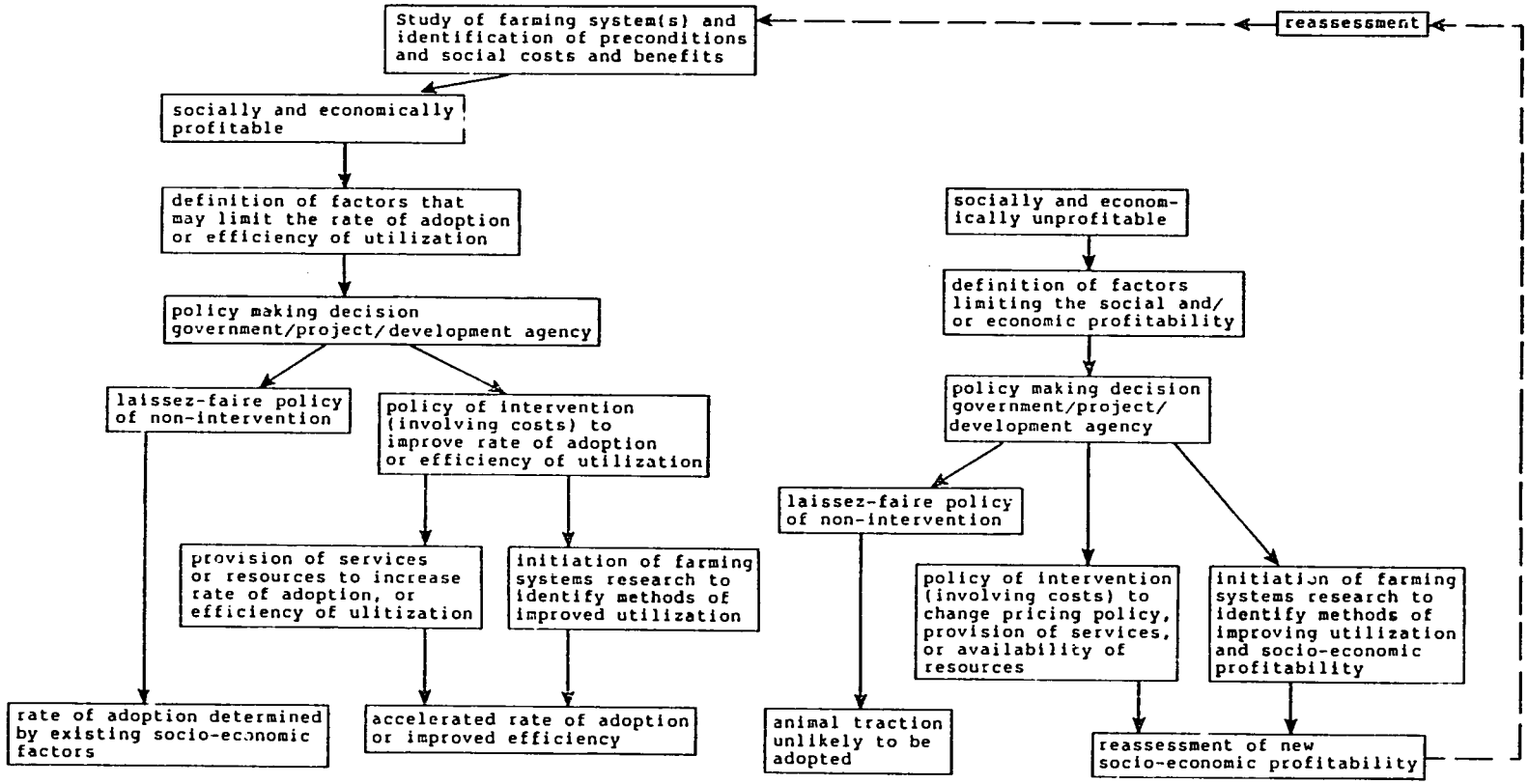
SUMMARY OF PRECONDITIONS FOR SUCCESSFUL ANIMAL TRACTION

EXOGENOUS FACTORS	ENDOGENOUS FACTORS
1. FARM PROFITABILITY	
a) agroclimate, soil types,	land availability
b) availability of natural pasture	
availability of natural pasture	
c)	labor availability
d) availability of adapted animals	
e) existence of adapted cultivation system	
f) market for produce	
g) price of inputs relative to sale price of produce (equilibrium of costs and benefits)	
2. SOCIO-CULTURAL FACTORS	
social acceptance	farmer motivation
3. KNOWLEDGE	
information or examples	knowledge
4. FINANCIAL RESOURCES	
credit	capital

5. SERVICES (traditional, governmental or commercial)

a) equipment/spare parts/repairs
b) extension and training
c) animal health and nutrition
d) research and development

Figure 4. MODEL OF IMPLICATIONS OF IDENTIFYING PRECONDITIONS FOR ANIMAL TRACTION ADOPTIONS



Best Available Document

GROUP TWO: FEED RESOURCES AND ANIMAL FEEDING

REPORTED BY: SANDRA RUSSO

A major problem facing livestock in West Africa is feeding and maintenance of animals, especially during the dry season and into the start of the rainy season. Our charge was to discuss the major problems facing livestock owners (particularly draft animal owners) and to come up with viable short and long term solutions to the problems of animal feeding.

PROBLEMS

Four basic problem areas relating to draft animal feeding in West Africa were identified :

1. Use of animals part time or full time;

2. Feeding programs ranging from no selective feeding through some attention paid to feeding all year;

3. Tradition of livestock ownership and rearing; and

4. Feed availability, climate, land pressure, cultural biases, and water availability.

USE OF ANIMALS

Farmers having draft animals do not necessarily utilize them continually or at the same level of work during the year. Some animals may only be used for plowing, others for additional agricultural operations (ridging, cultivating, harvesting, groundnut lifting, etc.) or for transport and some animals are used for both agricultural work and transport. While it appears obvious that the different work loads to which animals are subjected would require different levels of feeding, it may or may not be obvious to the animal owners. In a situation, for example, where animals get no supplemental feed and are expected to obtain their nutrient requirements from bush grazing: at the beginning of the planting season a hard working animal may not have enough time in the day to graze or may be too far from the bush to get to the grazing that is available. As another example, a pair of oxen used for both agricultural work in the rainy season and for transport in the dry season have different ration needs at the different levels of work, and may require no more than a minimum maintenance ration for the latter.

FEEDING PROGRAM

The range of feeding practices for draft animals goes from zero selective feeding to some selective feeding year-round. In the more humid areas of West Africa (e.g., Sierra Leone), biomass production on the natural grasslands is more than adequate to meet nutritional needs of livestock, including draft animals. In northern Togo, farmers practice

some selective feeding of their animals. Depending on resources available, they may use cottonseeds or groundnut hay as additions to the natural grasslands during the dry season. Farmers in semi-arid areas (e.g., The Gambia, northern Senegal) use their draft animals almost all year, primarily for transport. The animals are very important in the farming system (i.e., valuable) and consequently are rarely left alone to graze. They are fed either near the owner's compound or in the immediate vicinity of the village. Owners must therefore provide for some sort of year-round animal feeding.

TRADITION OF LIVESTOCK OWNERSHIP AND REARING

Farmers now using animal traction in West Africa can be divided into two broad categories:

1. Those farmers with only cropping experience who have never owned large livestock and

2. Those farmers with livestock experience as owners or herders. In this category are also:

   a. Farmers who have managed animals for transport (donkeys, horses, camels) but not for agricultural work; and

   b. Farmers who have managed agricultural work animals (usually oxen) but not transport animals.

Without going into even more categorical detail, the problems of animal feeding would be seen from a different perspective by each category of farmers. Crop farmers are presumed to have the least knowledge of animal nutrition while those farmers who have owned only non-ruminants (donkeys, horses, pigs, poultry) have a view of animal nutrition that would require some modification.

FEED AVAILABILITY

Factors affecting feed availability for draft animals include:

1. Climate

2. Land pressure

3. Cultural biases

4. Water availability

This listing should not be interpreted as all-inclusive. Many other factors also affect feed availability.

In semi-arid zones, a greater need exists for a fodder program. Long dry seasons and usually sparse vegetation (less biomass) predicates a supplemental feeding program. In semi-arid areas, there are more animals per area despite the limited biomass resource, implying a relationship with disease factors (less incidence of disease). In humid areas, with greater

biomass production and increased incidence of disease, less attention is paid to feeding programs and supplemental feed.

Land pressure in West Africa manifests itself in several ways vis a vis animal feeding. In a few countries urban and suburban areas have a large population of transport animals with almost no access to grazing. These animals rely entirely on purchased feeds of various natures.

Land pressure around village areas means that there may be little, if any, land available in fallow or permanent natural grassland. No room exists for pasture crops or the pasture areas are located far from the village and work areas. Usually in West Africa there is no land ownership by individuals. A farmer therefore has no incentive to improve the land, to plant pasture or forage crops, or to make a dam or a well, when there is no assurance that land will remain under his or her control in the next season. Where usufruct rights (rights to use) to land exist for at least a few years either by tradition or authorities, inability to control migrating herds may still make land improvements uneconomical.

Areas which have no history of animal use may impose actual physical barriers to feed availability in that access to grazing and watering areas may not exist and the necessity for such passage may not be recognized or honored. There may be a tradition of resentment or fear of livestock and their owners, particularly seen in clashes between crop farmers and transhumant peoples, that could also affect feed availability for other animals.

SOLUTIONS

While the problems were broken down into four areas specifically related to feed availability and management, the solutions were more systems-oriented and seen as vertical. Solutions were listed as:

1. The need for farmers to recognize the nutritional needs of their livestock;

2. The need for on-station and on-farm research on developing better/more feed resources;

3. The need for information transfer to farmers via various channels;

4. The need to increase feed supply; and

5. The need to assess water and passage problems.

RECOGNITION OF NUTRIENT REQUIREMENTS

Farmers with no tradition of livestock rearing must have nutrition information included when they are introduced to animal traction. Those farmers already using animals and/or animal traction probably need more detailed information on variation in nutrient requirements depending on work load, season, availability of feed, etc.

ON-STATION AND ON-FARM RESEARCH

Both on-station and on-farm research should continue to be supported by national programs and donor agencies. The history of forage research and techniques of crop residue management is very short in West Africa. While researchers can certainly learn and apply results from the rest of the world, it cannot be assumed that results will always be applicable to West Africa. Research on testing of forage legumes, for example, has only begun recently in many parts of Africa and in most cases the quantity of seed available is too small to be used for other than experimental purposes. Mechanisms for seed multiplication have to be established so that promising varieties can be tested on farmers' fields.

On-station research must be kept closely tied to the real world of the farmer. Experiments on silage-making or treating low-quality feeds with chemicals to improve the digestibility are often of no more than academic interest as the farmer is unlikely to be able to afford the resources (forage chopper, alkali, etc.) to produce such feeds. Even research on management of crop residues (stocking, stacking, storing) may seem low-cost if the labor required to cut, stack, and transport is not taken into consideration.

Agronomic research on forages and feeds is a long-term prospect and the questions to be answered may seem infinite. Caution must be taken to avoid trying to answer all quesions in one experiment in the rush to get information to the farmer. The urgency exists but it should be tempered with sound scientific reasoning.

INFORMATION TRANSFER TO FARMERS

Farmers can receive information on animal feeding and nutrition through several channels:

1. Extension and research staff;

2. Mass media;

3. Farmer organizations; and

4. Other farmers.

The research and extension staff may need training themselves in animal nutrition especially in areas where draft animals have recently been introduced. In FSR/E, links are presumed to exist between research and extension staff but not all projects have an FSR/E focus and not all projects have such linkages. These linkages should be encouraged at the national level in order for extension agents to pass information on to farmers and for farmers to be able to tell researchers (via the extension agents) their reactions to the new research.

In West Africa, radio can be a powerful tool for extending information to farmers. Newspapers are less likely due to their urban focus, distribution pattern, and the illiteracy of the rural population, especially among women.

Farmers clubs, committees, and organizations are other useful means of

communicating information. In areas where extension programs are non-functional due to lack of mobility, a surprising amount of information still manages to get around. Ideally, of course, regular meetings of extension and research staff should be held with farmers' groups not only to pass along information but to answer questions and clear up possible misunderstandings.

INCREASING FEED SUPPLY

Mechanisms for increasing the feed supply are many. They may be location specific, but often are not, and can be used not only for draft animals but for other ruminant livestock as well.

1. Encourage the farmers toward better storage and management of crop residues already produced. In most instances, after harvest residues are left in the field for animals to eat but a high percentage of the residues are wasted because of trampling and scattering. Not all residues could or should be stored because in the typical low-resource farming system, residues and manure provide the only organic matter/fertilizer for maintaining soil fertility. Some of the residues could be stored and saved; the rest left scattered in the field. The former is a key issue as farmers generally let their animals graze the croplands right after harvest when the natural grasslands are still highly productive. Saving some of the crop residues would extend the feed supply longer into the dry season.

2. Since the use of animal traction allows the farmer to increase crop acreage, there should be more crop residues produced and, hence, more feed available.

3. With increased acreage due to animal traction, the farmer could produce more of certain crops with dual purposes, e.g. groundnuts as a cash crop and groundnut hay.

4. In humid regions, cut-and-carry supplemental feeding of locally adapted grasses (e.g. Napier) could be a cost-effective means of feeding draft animals.

5. Another location specific source of feed is the cutting of grass to make hay (e.g., Andropogon in The Gambia) or making silage in small pits or containers (e.g. northern Ghana).

6. A sensitive issue is the improvement of fallow and grazing lands. Technically, it can be done but the questions of land tenure and resource availability (including farmer knowledge and willingness, seed, fertilizer, herbicides, etc.) make this problem a very difficult one for which to provide generalized solutions.

7. Nigeria, notably, has been experimenting with alley cropping, fodder banks and living fences. This research is in the pre-extension stage and seems to be applicable to the more humid regions of West Africa.

8. After the first or second weeding of a cereal crop (maize, sorghum, millet), a legume intercrop could be seeded to provide either a legume hay or grazing for the next dry season. Seed would have to be readily available (e.g., cowpeas) and inexpensive so the farmer would have some motivation for doing the extra work. Preliminary results with relaying Stylosanthes in The Gambia (seed is not commercially available) indicate that the legume can provide grazing midway through the dry season and that the re-seeding and presence of the legume could be beneficial to the next season's cereal crop.

9. The feed needs of urban transport animals has already been discussed. In northern Senegal, for example, entrepreneurs travel as far south as The Gambia or Casamance to purchase groundnut hay, primarily for horses. Production of groundnuts as two cash crops (nuts and hay) could become economically very interesting to rural farmers.

10. Most of the cash crops produced in West Africa (cotton, goundnuts) produce by-products. If these are not also exported, the agro-industrial by-products could be an important source of feed for draft animals. In Togo, for example, trucks travel throughout the country collecting cotton. Generally empty trucks leave the factories en route to cotton sellers. The trucks could carry cottonseed to the farmers rather than traveling empty. A problem with this very practice occurred in Southern Mali where farmers routinely purchased cottonseed for livestock feed and were left with a major gap in their feed supply when suppliers began to export the cottonseed.

ASSESSING WATER AND PASSAGE RIGHTS

Access and availability of water is a political-ecological issue. More boreholes means more livestock, especially in semi-arid zones where existing vegetation cannot support current herd levels. Water issues were not discussed except as related to passage rights. When farmers begin to see the benefits of animal traction, especially access to transport of crops to market, water and passage rights may be increased to allow draft animals to get to grazing areas and watering holes and to allow for road-widening so that carts can pass.

GROUP THREE: METHODOLOGIES FOR ON-FARM EXPERIMENTATION WITH ANIMALS

REPORTED BY: JAMES OXLEY

LACK OF PRECEDENTS

A major concern expressed by the group was the paucity of examples of and experiences with on-farm trials involving animals. The FSSP Livestock Task Force identified this as an area of need and as a result the FSSP, in cooperation with the International Livestock Center for Africa (ILCA), has been encouraged to co-sponsor a workshop in Africa on this specific subject June 23-28, 1985. A few cases of on-farm research in which animals are involved can be cited but most research with farm livestock has been done on research stations without being tested on farms. Some research is underway on draft animals in West Africa where feed, equipment, types of animals and other interventions are being tested but the results are preliminary and the methodologies involving livestock illustrates to some degree the difficulties and problems encountered in conducting integrated animal-crop research, particularly from the farming systems perspective. While the interdisciplinary approach is basic to FSR/E, the tendency has been to exclude the animal component because it complicates the analysis or seems complicated by its very nature.

COMPLEXITY OF PROBLEMS

The animal itself is a complex biological system which involves such parameters as health, nutrition, genetics, reproduction and behavior, ny one or combination of which lend themselves to possible interventions. Also the multiple uses to which animals are put complicates the issue. For example, some bovines are used primarily for draft purposes but ultimately also for meat. Others are kept for only meat and/or milk. Despite all these factors which can make for a complex situation when one looks at the animal within the farming systems context, the group agreed that it should direct its efforts toward the principles of on-farm experimentation, leaving the details of design and statistical snalysis to the researchers who will have to develop these for any given intervention.

ON-FARM TRIALS

Dr. Zandstra's remarks in his keynote address provided the background for the group's discussion. He pointed out that good farming systems research methodology is applicable to livestock in mixed farming systems. As characteristic of all farming systems research, each trial must respond to the farmer's needs, which have been identified by the researchers during the diagnostic phase. For example, the objective might be to identify a way of providing more fodder (through introduction of a forage crop) for a pair of oxen at the end of the dry season in order to improve their condition for the oncoming plowing season. At the same time the technique of conducting forage trials on a nearby research station or extension farm may be necessary where different forages or forage systems (crop rotation) are being explored and the variables measured. On-station oxen trials, paralleling those on farms, can provide supporting information. From the

on-station information the most promising intervention can be tested on farms. Feedback from the farm trials will help the researcher in his or her station experimentation. Also, it is important for extension personnel to be informed and involved in both the on-station experimentation and the on-farm trials.

The important concepts of on-farm trials may be outlined as follows. The participation of different disciplines is of great importance. In the example above, the need exists for an animal scientist, agronomist and agricultural economist working together from the planning through the completion stages. Starting with a clear definition of the objectives, the trial must include the variables to be studied (time of planting, time of feeding, amount of feed consumed duration of feeding, etc.). Then the measurement methods need to be determined (weight or estimated volume of forage grown; body weight or body measurements and/or body condition scores of oxen; endurance recovery periods of oxen measured over time). Regardless of what measurements are used, it is important to limit them to only key measures and keep them as simple as possible. Though subjective, much information can be gained from recorded observations of changes in animal feeding, working and behavioral patterns.

The sample and design phase of on-farm trials requires the designation of the experimental unit (perhaps a 1/2 ha field for forage production, or a pair of oxen for the animal unit). The number of replications for the suggested trial should be a minimum of six farms, each with a pair of oxen and a similar area of forage production; and another six farms identified as the control or check farms which represent the traditional system.

A schedule of measures plotted over a given period of time will enable the researcher to plan and to secure data in a timely manner. Forage supplementation would likely occur during the last one or two months of the dry season and for the first month of the rainy season (with the schedule determined by on-station trials or the best judgement of the researchers). A minimum of one year duration, completing a normal yearly cycle, is recommended for a forage oxen trial as described here. Second and even third year trials should be considered as a means of confirming the intervention and measuring year-to-year effects.

Careful selections of cooperators must be stressed, as they are the key to successful on-farm testing. Researchers will have to rely on the judgement of extension agents, other farmers or area leaders plus information gained from interviewing farmers and from the diagnostic survey.

In the execution and monitoring of on-farm trials, the researcher/extension worker will need to develop a good relationship and understanding with farmers. This is done by getting their confidence through visiting farms at frequent intervals; keeping farmers informed of progress and results on their farm and on others' farms; holding key field days; and in general by conveying an attitude of caring, concern and helpfulness. It is important for the person in charge of on-farm testing to make sure the exact treatments are implemented, and, particularly with livestock, that careful monitoring is done on the feeding, working schedule, and general health and condition of the oxen.

The farmer must be protected against undue risks as a result of participating in the trials. In cases where animals can be adversely affected by a treatment, the farmer must be assured against personal loss. Project resources are often used to make up any losses accruing from experimentation.

Insofar as data collection and analysis are concerned, the person in charge of on-farm trials will need to develop field and animal plans and appropriate forms on which to record data and other observations. With some animal feeding and management trials, high costs and operational complexities dictate that careful and exhaustive analyses be done. In addition to establishment of treatment differences, the analyses should stimulate the impact of the partial results on the whole production system (for example, the effect of improved oxen nutrition on the farm production system). For the first level of analysis, generally simple analytical methods are used. It is important that as many non-treatment effects as possible be removed by statistical analysis.

Finally, economic analyses are conducted by using a partial budgeting procedure to compare treatments. In the case of a forage oxen trial it will be necessary to assess the costs and benefits of this intervention on the whole farm. In the process, conflicts between resources (labor, other crops) will be identified and qualified in economic terms that can be related to the farmer.

GROUP FOUR: MANAGEMENT OF TECHNOLOGY

REPORTED BY: JOHN LICHTE

What management (technical) capabilities does a farmer need to use a technology like animal traction to advantage? What information or training should be provided to help facilitate adoption?

This group focused very strongly on problems at the farm/farmer level. Initially there was a tendency to assume that the technology and project recommendations were all adapted and appropriate and that farmers who did not use the technology as recommended were poor managers. This created a lot of discussion, which caused the group to refocus their presentation and look at the responsibility of projects to adapt a technology so that it responds to the needs and constraints of local farmers. Information must be readily available or training provided in order for farmers to learn to use a technology quickly and well.

Some of the potential solutions to resolve problems of management of technology at the farm level are given below.

ORGANIZATION AND MANAGEMENT OF THE FARM

The group decided that adaptive research and extension at the farm level using the FSR/E approach would be helpful in developing systems which satisfy farmers needs. Farmers need a mix of food and cash crops appropriate to their conditions, both technical and socio-economic as well as agro-climatic. New adopters require several years to learn to use a new technique effectively, whether it be plowing, weeding or using fertilizer. Effective management of a number of techniques combined in a package requires even longer. Farmers who do not have the high technical level necessary to profitably produce a crop like cotton need an alternative cash crop until they obtain the necessary technical skills. The crop mix may also need adjustments to include the production of some forage for dry season feeding. Crop diversification makes it easier for farmers to find the means to meet their own needs.

Certainly the integration of livestock into the farming system can make an important contribution to helping farmers maintain soil fertility. Including crop residues in manure or compost and returning them to the field can have an important impact on soil structure and fertility and reduce the need for purchased fertilizer. In most cases, the use of fertilizer or manure should be considered for a whole rotation, rather than on a per crop basis. A rotation which includes an element which could be plowed under as green manure would be good, but it is difficult technically and socially in West Africa. Cropping patterns may also require adaptation before some animal traction techniques can be used. Monocultures have traditionally been recommended to facilitate the use of animal traction weeding, ridging, etc. Planting intercrops between plants in the row (rather than between rows) will also allow animal traction weeding, without greatly disturbing a useful crop association. Relay cropping can also improve land productivity without impeding the use of animal drawn

equipment. Flexibility is important. Not every crop or field on a given farm has to be weeded and ridged using animal traction in order to reduce a labor bottleneck. Certain crop associations may be worth keeping even if they interfere with animal traction field activities.

The final point raised under general farm management is the need for farmers to replace aging oxen and perhaps equipment. Farmers should be trained to recognize the need to replace animals and equipment, and encouraged to set aside money over time so they have the means to do so.

ANIMAL MANAGEMENT

Farmers need to accept limits on the amount of time oxen work so that the oxen's health is not compromised unnecessarily. A reasonable rule of thumb might be four to five hours a day. This also applies to farmers' groups. One group contacted on the field visits had worked 22 ha over a short period with one pair of oxen. One of the oxen died while working. Projects must look carefully at the relationship between needs and means and be aware of the information needs of farmers with no cattle raising traditions, i.e. potential causes of animal abuse.

On the other hand, many farmers also need to use their oxen more during the non-cropping season. Partial adopters who only plow may use their oxen only two or three weeks a year. Weeding with oxen will extend their use to several months. Carting activities are particularly interesting because they continue all year long. Unless oxen are used regularly throughout the year, they will have to be retrained each rainy seson as field activities commence. Carting may improve the farming system if used to haul crop residues off the fields and manure or compost back to the fields. It can also help reduce the transportation constraint at harvest. Carting will help with other family needs like hauling wood and water. If carts are not numerous in a village or region, carting for others may provide some cash income. In some areas, oxen are be used for activities like irrigating, pumping water or powering grinding mills.

ANIMAL MAINTENANCE

In many areas farmers do not have experience herding and caring for cattle themselves. These farmers in particular need in-depth training on animal health, care and feeding. This should probably be a precondition to adoption. The extent of such training must be related to farmers' experience with livestock. Knowledgeable farmers may also contribute to such training.

FEED MANAGEMENT

Animal feed resources may be available in surplus over much of the year but feed shortages may occur, particularly during the dry season, for three to five months. One method of trying to balance feed availability over the year is to save crop residues for dry season feeding. Usually animals have more than adequate grazing at harvest time so they do not need the crop residues. If left lying in the field much of the crop residues will be trampled and wasted, if not completely consumed by termites, etc. Collecting these crop residues will be difficult unless carts are

available.

Many farmers do not keep crop residues such as cowpeas and groundnut hay until the dry season because of difficulties in preserving them. Often it is still raining when these crops are harvested, so without drying and some form of preservation they will mold unless used quickly. Drying is usually possible even during the rainy season, but simple means of preservation need to be found. In some areas they are piled on top of shelters, but the quality often suffers. Storage in empty huts is effective and requires no investment if one is available. Thatch shelters or shelters covered with grain stalks would offer protection for hay or legume residues. Drying tripods have also been used successfully in some areas. Farmers generally have not adopted pit silos because of storage problems encountered unless the grass is cut quite fine. The high labor requirements of cutting grass preclude adoption of the technology.

Relay planting of legumes for harvest after the rains can also help resolve the problem of preservation.

EQUIPMENT MANAGEMENT

Farmers should have the opportunity to observe the use of different tools. Whenever possible this should be done by observing other farmers in the area who use the different tools well. Potential adopters can then talk with farmers who use the tool effectively to learn more about how it might be useful to them. In this manner they can make up their own mind about what equipment to purchase and use. Equipment which is not used does nothing to improve the farmers productivity and is a useless investment. Projects should focus their efforts on helping farmers decide what equipment to use rather than insisting that they buy a full set of equipment and assuming it will be used.

Project personnel should make sure that farmers know how to use and adjust equipment correctly, once purchased. Any tool needed to adjust equipment must be readily available. Training on the proper use and adjustment should accompany the sale. Extension agents must themselves know how to use and adjust equipment to be of any help to farmers.

MAINTENANCE AND CARE OF EQUIPMENT

Farmers also need to be trained in the proper maintenance and care of equipment. Equipment should be sheltered, particularly during the rainy season, to protect it from rust. Proper cleaning and oiling of equipment should be demonstrated. Farmers should also be trained to recognize when parts need to be replaced, particularly plow and cultivator points. It is much cheaper to replace points on time than have to replace other parts because there were no points to protect them.

GROUP FIVE: MONITORING AND EVALUATION

REPORTED BY: JOHN LICHTE

The charge for group five was to identify evaluation criteria that would be more appropriate than the number of animal traction units placed, and to consider the principle of identifying evaluation criteria as part of on-going project monitoring rather than a priori as part of project design.

VARYING LEVELS OF EVALUATION

This group had great difficulty finding a common starting point acceptable to all members. The group included individuals who are involved in evaluation at three different levels, each wanting to focus on the level appropriate to their work. One was interested in the type of monitoring which would allow the identification of aspects of an ongoing animal traction program which were not functioning effectively so that the program could be re-directed to be more successful. A second was involved in overall project monitoring and evaluation, where animal traction is one of a number of components. This person wanted to start with project objectives, establish evaluation criteria based on those objectives, and develop a monitoring program which would collect the data necessary to use these evaluation criteria. A third person was involved in evaluating 20 different animal traction projects in a country with the objective of determining what each project is doing concerning animal traction and trying to coordinate and harmonize credit, provisioning of animals and equipment etc. across projects.

The group found it very difficult to agree on a starting point because of the varying needs of these three different levels of evaluation. Finally, it was agreed that the group would begin with the lowest level of analysis, i.e., that which was most directly focused on animal traction programs and the type of monitoring useful to project managers to redirect those programs over time so they would be more effective. The group would then try to build upward toward project evaluation and evaluations across different projects.

SETTING OBJECTIVES

A general objective or purpose for the use of animal traction also had to be agreed on before additional progress could be made. The objective agreed on by the group was: to increase production in a manner that permits repayment of any credits related to the purchase and use of animal traction technology without any decrease in the farm family's standard of living. It was felt that this combined the social objective of increasing production while considering the minimum short-run objectives of the farm family.

BASIS FOR EVALUATION

Turning back to evaluation, it was agreed that the basis of an evaluation must be a comparison with the situation which existed prior to

the introduction of the project or program. This led to a discussion of how to get information on a situation prior to project influence. A number of persons in the group mentioned that no such information had been collected in their project, making evaluation very difficult. It was quickly agreed that traditional baseline studies requiring one or two years of detailed surveys are not an effective means of getting the necessary information. However group participants did not have easy answers to define the alternatives. It was specified that those activities or factors recognized as preconditions for the adoption of animal traction should be monitored. Some of the information group participants agreed it was necessary to know the situation prior to project influence, and which should also be monitored over time included:

1. The availability of family labor
2. The effectiveness of animal health services
3. The availability of arable land and the manner in which it is used
4. The availability of water and feed resources for livestock
5. Technical level, use of: weeding, fertilizer, carting, etc.
6. Marketing of produce
7. Access to production inputs: credit, equipment, spare parts, fertilizer, etc.
8. The effect of animal traction on the environment: physical; social (women, children, intra-household effects)
9. Evaluation of extension service available to farmers and the content of any training provided
10. Regular surveys of production statistics

MONITORING VS. EVALUATION

This combination of factors to be used in both monitoring and evaluation led to some confusion of the two. It was decided that evaluation could be defined as an analysis of the situation or project results at a given moment in time. Monitoring was defined as follow-up on the application of a program or strategy. A precondition for monitoring is establishing a well-defined program or strategy and taking account of the activities necessary for its execution. Monitoring should consist of the systematic collection of data over time, as well as brief studies of a specific program. Such information may be applied either to redirecting a program to make it more effective or to an evaluation of the results from a specific program and its contribution to the project. Information which would be collected on a systematic basis includes:

1. Area cultivated

2. Crops and crop association

3. Yields (recognizing that these are difficult obtain)

4. Revenue and expenditures (recognizing that these are unlikely to be complete and are affected by consumption)

5. Use of production inputs: fertilizer, manure, improved seeds, etc.

This is the type of information that is objectively verifiable in principle. It should be collected by farm type or by farming system, noting the specific need to compare manual farms with farms using animal traction and with motorized farms using tractors. Most members of the group agreed that an evaluation should be based on objectively verifiable results, i.e., analysis of production related statistics and how they have changed over time. It was agreed that in most cases these statistics would have to be collected by the projects, although there was discussion as to whether or not this could be added to the extension agents existing tasks.

Short-term, specific studies are a necessary complement of systematic monitoring. Examples might include a status report on soil structure or interviewing participants in a training program to learn if the training has been effective. The evaluation of animal traction requires both systematic monitoring and short-term specific studies. Evaluation of the adoption of a technology such as animal traction should be done over the long term, i.e. 10 to 15 years.

FSR/E RESERVATIONS

Only one person in the group had participated in a farming systems orientation. The principle of developing evaluation criteria following the identification of problems during the diagnostic phase of FSR/E was presented. The group generally agreed with this principle. In practice, however, most of the group was interested in developing a system of monitoring which would provide the data for evaluations specified *a priori* during the design of their project.

The use of rapid reconnaissance techniques complemented by very specific and restricted formal surveys was also discussed. Most of the group, having no farming systems research experience, found it difficult to understand how these techniques could be used as the basis for an evaluation. They found it difficult to imagine how such procedures could provide the objectively verifiable data they believed necessary for an evaluation.

On-farm systems research was also discussed briefly. Participants from projects were very skeptical of the utility of research on farms until they became convinced that it would be similar to extension with an experimentation component (*recherche d'accompagnement*).

SECTION V: THE WRAP-UP

COMMENTS ON THE NETWORKSHOP BY THE RESOURCE PERSONS

HUBERT ZANDSTRA

There appears to exist quite an exciting potential to increase production in the region as the result of good, problem-oriented on-farm research. There are a number of possibilities and potentials for alternative technologies to increase yields and productivity.

Secondly, much of animal traction research can be conducted with farmers even though there are problems of design. Researchers should not be dismayed by the problems, but should initiate modest activities with farmer-cooperators in on-farm trials. A learning process is started by practicing on-farm research.

The rate at which animal traction research will develop in West Africa will depend on how effectively you can share your experiences with each other. There is no need for everyone to go through the same trial and error process. Share your experiences in the future. This will help you as a group to develop the required methodologies for effective on-farm research in animal traction and livestock production areas. There is a lot of value in continuing to have this kind of networkshop in the future. What the workshop should be like is a personal opinion. The workshop should be very specific and stick to two or three narrowly defined topics. One might be on-farm field techniques for the comparison of alternative equipment. Other possible topics include: How can we measure feed availability accurately over the year in a manner which is low cost and uses minimal staff? How do we evaluate alternative animal health protection measures? There are costs associated with animal health and there may be cheaper, alternative ways of ensuring that animals remain healthy. What methods can be used to monitor animal traction farmers as part and parcel of an ongoing research program, which will allow an analysis of the problems and responses of the farmers. This kind of analysis should continually address some of the assumptions that researchers and designers of development projects have made. These assumptions can be evaluated as one develops a better data base.

The objectives we should stress are learning together and developing the methodologies that are needed. Much of the effort will have to come from you, the West African scientists involved in this area of animal traction related research. Many of these techniques depend on the availability of staff and the structure within which an individual works. On-farm work must be adjusted to those conditions. Often there are techniques that are transferable despite differences in personnel structure and financial capabilities.

I certainly owe a particular word of thanks to the organizers of this

project, Susan Poats and John Lichte, who labored beyond the call of duty to make my stay here highly productive.

SUSAN POATS

On Monday morning we presented an overview of the week's activities. This overview was like a map showing where we wanted to go during the week. We hoped that we would be able to follow directions and stay on track. In some respects we have gotten to our destination. In other respects we may have decided some destinations were not appropriate. But I think, in general, we progressed through what we set out to do. I would like to talk about where we came from in the perspective of someone participating, but also watching others.

On the first day we came together, many of us not knowing each other. We were a long ways apart. We represented several countries, both African and non-African. We had a lot of different opinions, some of which were also far apart. But one of our objectives was to at least lay them all out on the table through presentations and exchanges.

The second day was the field trip. It served to bring the group closer together. Participants were placed in small groups to talk to people. You probably did more talking within the group than with others, but still the procedure brings the understanding of individuals closer together (and the parts in our puzzle of information begin to line up).

The third day began with the field trip reports. Part of that reporting experience began the day before, working in small groups to prepare the reports. Again, it served to bring us closer together in terms of concepts and terminology so we could communicate, even if opinions still differed.

On day four, we spent most of the day in different small groups. People from field trip groups were reorganized into five different groups. But we continued the process of exchange and relaying information. Our objectives became clearer as we were forced to identify problems, lay them out on paper and explain them to each other. The focusing continued.

On Friday we narrowed the gap still more. We reached more agreement about where we had been and where we were going. Taken all together, this process could be seen as resembling a "funnel", wide apart in the beginning and slowly narrowing our collective vision to focus on the task at hand and the subject of concern to all of us. The process has served as a tool, much as a microscope serves a scientist. It has helped us in defining our own objectives more precisely, and in developing and coming to a consensus on some methodologies which might be useful. But the process does not end there. Now the task at hand is to use the vision and clarity achieved at this point to take another look at where we might go and what we might achieve in the future. It is not possible to resolve all of the problems in five days. It is probably accurate to say that there are still many questions, and certainly things still hanging, unresolved. And there should be. We should not be able to solve everything here. We hope that our conceptual framework and methodology will help you to deal with these

remaining unresolved issues. The lists of problems and the solutions or strategies generated this week provide a focus for the future tasks we will have before us.

As one of the coordinators of the networkshop, I feel quite content with what happened during the week. It has been very intriguing because when you set up something like this you can't tell where it will go in the end. You hope you will arrive where you wanted to be and work every day to make sure you keep it on track. I want to thank each of you for the work you did during the week in order to maintain this track and reach our goals.

JOHN LICHTE

I would like to come back to what we did this morning. One of the things I think we want to take away from this workshop is that many of the topics or problems discussed here are closely interrelated. I think we found that we could not talk about on-farm feeding without also looking at on-farm management, and management of some of the various technologies we were talking about. I think we also found that preconditions, monitoring and evaluation should be looked at together. The preconditions determine some of the aspects of monitoring, and some of the elements from monitoring and evaluation are necessary to determine if the preconditions exist. The interaction between these various problems indicates that we cannot isolate animal traction problems and deal with them independently. We must consider these interactions to deal with the problem effectively, and this underlines the need for a systems approach.

SANDRA RUSSO

I found it heartening that the participants, who were from widely different backgrounds despite a common interest in animal traction, were able to come together and use a systems perspective to discuss specific problems.

VINCENT BARRETT

We have seen that the adoption of animal traction is a long-term process, often requiring 10 to 15 years. Animal traction programs need to be based on this type of long-term perspective. The full effects of animal traction can only be observed after a similar time period. We need this long-term perspective in considering animal traction, and particularly in the evaluation and design of animal traction projects.

We have also seen the importance of exchanging ideas and experiences during this workshop. The type of networking which we have begun here can make an important contribution to the effective development of animal traction by allowing projects to take advantage of the experience of others.

PAUL STARKEY

I came to the workshop already believing in the great importance of information exchange and intra-country and inter-country networks to improve communications and research progress in the field of animal traction. This workshop has thoroughly reinforced these beliefs, and provided ample evidence of the value and benefits that can come from networking with professional colleagues.

I also came to the workshop aware that systems of utilizing animal traction are very diverse and complex, with numerous interactions of a multitude of ecological, agricultural, social and economic factors. This networkshop has further reinforced the difficultues imposed on research and extension staff in working on animal traction in such diverse and complex systems. A particularly vivid example of this was seen on one of the field visits, where working cows (as opposed to oxen) were seen to be in dangerously poor physical condition. According to the farmer, his system of feeding and management was no different from that given to his other young animals, which were very healthy. Animal health problems were therefore suspected as a cause for the unthrifty appearance, but detailed veterinary investigations produced no evidence of pathological agents. Thus here was a classic example of a farmer with a serious problem, yet despite the considerable expertise and experience of the project, the visiting group and the extension workers, no obvious answers could be given to help that farmer. This reinforced very clearly both the complexity of animal traction, and the need to maintain a broad, open-minded, questioning, multidisciplinary, farming systems approach to apparent technical problems in particular, and to research and extension in general.

I have personally learned much from valuable in-depth discussions with colleagues from other countries during our field visits and in the detailed consideration of the preconditions for successful animal traction adoption. In addition I have benefitted from the presentations of others. The great stress placed by many participants on the need for appropriate monitoring and evaluation of any animal traction program seems to have been particularly appropriate.

I am very encouraged at various suggestions and proposals relating to future networking activities, and I see this networkshop as having been instrumental in initiating what I hope will be some very useful, and ongoing, information exchanges between individuals and projects.

JIM OXLEY

Through this structured workshop which was designed in part to acquaint us with Farming Systems Research and Extension (FSR/E), we have experienced the process of networking as well. Through the course of the week we have shared field and project experiences, each from our own point of view. We have had an excellent interaction between practitioners and conceptualizers of the farming systems approach. We were able to become better acquainted with each other and to meet people whose names are familiar in the literature. We shared published and unpublished information and thereby

increased the size of our libraries on the subjects of animal traction and FSR/E. The field trips gave us an opportunity to see farms, meet farmers and experience the production systems in this area of Togo. There is nothing like seeing first hand the farmers' problems and perspectives.

Not being a researcher or practitioner in animal traction, the workshop was an exciting and challenging learning experience for me. Draft power is an extremely important and unique use of animals, and the subject relates well to a farming systems perspective. We cannot introduce animal traction or evaluate it without considering the whole system in which it is used.

One of my interests is in research related to draft animals on farms. I am interested in what research is under way, the methods used and the types of research that should receive priority attention. We need to keep pooling our research knowledge and experience gained with animals on farms and on research stations. The sharing of research designs, data analyses, results and conclusions will be of assistance to other researchers, extension workers, farmers and governments. One of my roles with the FSSP is to develop some guidelines for research methodology related to on-farm and on-station trials that will be useful within the context of farming systems research and extension. One of the challenges as we leave this meeting is to continue to work on suitable measures, viable experimental designs and techniques related to on-farm research with animals. Another challenge for us and for those who could not attend the workshop is to maintain this kind of networking activity by keeping in contact with each other; by contacting those who are active in the field of animal traction; holding information exchanging sessions, or a workshop within your area, region or country; by helping develop the formal networks just established in West Africa; and by visiting one another's projects.

WORKSHOP EVALUATION

WORKSHOP OBJECTIVES

Participants generally agreed that the objectives were fairly well met. Several people would have liked more, particularly about on-farm experimentation related to animal traction and livestock.

SPECIFIC PART OF THE WORKSHOP

a. The workshop overview was well received and Susan Poats and John Lichte were complimented for their presentations.

b. Hubert Zandstra's presentation was considered good but too theoretical and not specific enough to animal traction. He was complimented for his strong contribution throughout the rest of the week.

c. Participants liked both the style and the content of Paul Starkey's presentation. It received rave reviews.

d. The conceptual typology was considered good and useful. Some people thought that it should be more detailed. Others found it too theoretical.

e. Preparation for the field trip was considered good, considering the situation (changed from Wednesday to Tuesday with little notice).

f. Reactions to the field visits were generally very positive, but there were a couple individuals who did not have a good experience. Several also complained that there were too many Togolese.

g. Variation in the quality of field trip reports was recognized. Some French speakers thought these reports should have been critiqued by the group organizers.

h. Reactions to the overview of both the methodology and the monitoring and evaluation topics were mixed. There were more positive comments than negative but some people found it confusing or were disturbed by the enumeration of many points with little structure.

i. The country presentations were generally well-received. Several people commented that they should have been prepared in advance and written up for distribution.

j. Paul Starkey's slide presentation went well. As one person said, "Paul's always interesting".

k. Only three or four people saw Adama Faye's slides, but they found them interesting.

l. The small group discussions and presentations on problems were much appreciated, especially by Francophones. Anglophones were also generally positive but commented more on the problems of using small groups and

experiential learning, i.e. slow getting started, results somewhat disorganized because of the lack of structure, the difficulty of guiding or managing the groups to a predictable outcome. (Many of the Anglophones were group leaders and in many cases this was the first time they had participated in an experiential workshop. They had a predetermined notion of what the outcome should be, but found it difficult to guide the group to that result). People commented that the methodology group was both confused and confusing.

m. The ILCA slide module was considered interesting, but vague and not well organized, too diverse, or not relevant.

n. The small group discussions and final presentations on potential solutions/strategies were considered good and useful. However, many people were disappointed that the results tended to be general strategies rather that detailed specific solutions. The quality of group results were considered somewhat irregular, and again people were particularly disappointed with the results of the methodology group.

o. Most participants did not comment on the discussion of the follow-up networkshop. Those who did (Anglophones) commented that it seemed disjointed, low energy, force-fed, and that people did not seem interested. This was likely a misinterpretation of what was happening. People believed that finding a host was the critical factor, and that topic, timing and location would depend greatly on who would volunteer to host the workshop. Since nothing had been negotiated with potential hosts, little could be decided at this time.

STRENGTHS OF THE WORKSHOP

Informal interaction, good flexible resource people and organization, exchange of ideas, small group experiences, field visits and good interaction and exchange of information.

WEAKNESSES OF THE WORKSHOP

The fact that some countries did not send representatives even though this may have been due to scheduling conflicts and the mail service; not enough Africans; abrupt schedule changes caused some confusion; certain presentations and discussions remained too oriented towards theoretical research; topics were too broad; too much emphasis on oxen and not enough on other draft animals; little emphasis on equipment; and too many Togolese who did not participate.

RECOMMENDATIONS FOR IMPROVING THE WORKSHOP

More emphasis on problem solving; focus on two or three topics; better balance between presentations and group activities; invite people with field experience relating to specific topic, focus on adaptive research, not theoretical research; focus slide presentations on topics of discussion; have a specialist intervene on each topic; prepare and distribute more materials in advance; and more emphasis on equipment.

(ENGLISH) TO WHAT EXTENT DO YOU FEEL YOU ARE NOW KNOWLEDGEABLE ABOUT FSR/E?

The workshop was a good introduction; big improvement; still learning; moderately knowledgeable; gained a huge knowledge about FSR/E but have difficulty defining it; "What is FSR/E?"

(FRENCH) WHAT PERSONAL BENEFIT DID YOU GAIN FROM THE WORKSHOP?

Making the acquaintance of c[illegible] people working on animal traction; an exchange of experiences and idea[illegible] a better knowledge of animal traction problems; appreciation of the need for adaptive research; reflection on methodology; better knowledge of the literature; and the results of the small group discussions.

WHAT FOLLOW-UP ACTIVITIES WOULD YOU LIKE TO SEE?

Maintain the contacts established during this workshop, continue exchanges of information and ideas; additional workshops and a committee to organize them; exchange visits; and long-term initiatives in FSR/E and livestock.

FINAL COMMENTS, PARTICULARLY ON THE ORGANIZATIONAL/LOGISTICAL ASPECTS OF THE NETWORKSHOP?

The organizers and resource people were flexible and did a good job under changing circumstances; translation from English to French was good; English to French was less good; glare on the flip charts made them difficult to see; the overhead was useful.

USEFULNESS OF THE DOCUMENTATION CENTER

Fifteen people had used the center, five had not, and four did not answer the question.

Time available allowed only a brief use of the documentation center. People had to choose between looking over the large number of documents available and trying to read one or two documents.

FUTURE NETWORKING ACTIVITIES

POTENTIAL ACTIVITIES FOR FSSP SUPPORT

Networking activities on livestock in West African farming systems which could be supported by FSSP in the future are: additional networkshops; support of West African livestock researchers for study and networking visits to other countries; and reports on various topics relating to livestock research and extension.

THE 1986 NETWORKSHOP

Consensus of this networkshop's participants was that yearly networkshops should be held. To ensure network continuity, the theme of animal traction in Farming Systems Research and Extension should be continued at least for the 1986 networkshop.

For the 1986 networkshop, more specific topics relating to animal traction will be discussed in detail. Topics that networkshop participants expressed an interest in included: a more thorough discussion on animal feeding research on-station and on-farm; methodologies for training farmers including the possibility of developing a training manual; training for trainers (especially extension staff); on-farm livestock research and monitoring in general; implement design and production; and traditional animal health and husbandry.

A coordinating committee composed of representatives from six West African countries was selected to initiate the organization of the 1986 Networkshop. Sierra Leone is the proposed location. Information on West African and African farming systems (e.g. animal feeding, on-farm livestock trials) will be solicited.

COORDINATING COMMITTEE

Chair: Paul Starkey, Sierra Leone

Secretariat: Sandra Russo, The Gambia
Solomon Owens, The Gambia

Members: Bai Kanu, Sierra Leone
K. Apetofia, Togo
Adama Faye, Senegal
Yesso Philidor, Ivory Coast
Abou Berthe, Mali

SITE OF THE 1986 NETWORKSHOP

Networkshop participants were impressed by the enthusiasm of the Sierra Leone Work Oxen Projects representatives for their research and extension work with farmers. An almost unanimous decision was made to hold the networkshop in Sierra Leone sometime between March and May 1986, pending

official government approval for such activity.

SUPPORT OF WEST AFRICAN RESEARCHERS

All of the following are proposals which must be approved by USAID, FSSP and the governments or other organizations named.

1. A visit by Togolese researchers to the Sierra Leone Work Oxen Project's plowing competition in May, to be followed by a Sierra Leonean researcher's visit to Togo on a work/study visit of Togolese Animal Traction Projects.

2. Support for at least one West African livestock researcher to attend the ILCA conference on methodologies for on-farm research with livestock in June and to present a paper on his or her research.

3. The opportunity for a West African group (one Anglophone, one Francophone, one facilitator) to join the Asian Cropping Systems Network's livestock monitoring tour in August.

4. A meeting of the coordinating committee for the 1986 Networkshop on animal traction, together with at least one FSSP representative, to be held in The Gambia in November 1985, to finalize plans and agenda for the networkshop. A tour of animal traction programs in Senegal and The Gambia will be included.

REPORTS

In addition to these proceedings, a bibliography of documents specifically related to animal traction should be produced as part of FSSP's documentation effort. Reports on topics of interest relating to livestock in FSR/E should be commissioned over the coming year to serve as background papers at the 1986 networkshop.

APPENDIX 1

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APPENDIX 2

ABBREVIATIONS AND ACRONYMS

AID	Agency for International Development
AIP	Accelerated Impact Program
ANTRAC	Animal Traction
CFA	West and Central African Franc
CAR	Community Organizing Center
CDs	Councils of Development
CECA	Comite d'Etude et d'Orientation du Programme de Culture Attelee
CREAT	Livestock Research Center at Avetonou
DRDR	Direction Regionale de Developpement Rural
DVSA	Direction des Services Veterinaires et de la Sante Animale
ENA	Ecole Nationale d'Agriculture
EORD	Eastern - Organization Rurale de Developpement
FAC	Fonds d'Aide et de Cooperation
FAO	Food and Agriculture Organization
FED	Fonds Europeen de Developpement (European Development Fund)
FSR/E	Farming Systems Research and Extension
FSSP	Farming Systems Support Project
GOT	Government of Togo
GTZ	German (Federal Republic of) Development Asssistance Program
ICRISAT	International Crop Research in Semi-arid Tropics
IDA	Second Rural Development Project in Cotton Areas
ILCA	International Livestock Center for Africa
JARC	Catholic Community Organizing for Youth
OAR/Lome	Office of the AID Representative, Lome, Togo
OAU	Organisation Africaine d'Unite
OIC	Opportunities Industrialization Center
PC	Peace Corps
PCA	Projet Culture Attelee
PCV	Peace Corps Volunteer
PRODEBO	Promotion et Developpement d'Elevage Bouvine
PROPTA	Projet de Promotion de la Traction Animale
PVND	Staple Food Crops Project
SAFGRAD	Semi-Arid Food Grain Research and Development
SOTOCO	Societe Togolaise du Cotton
TAT	Togo Animal Traction
UNDP	North Togo Improvement Program
UNIFOCO	Namiele Plain Project
UPROMA	Unite de Production de Materiel Agricole

APPENDIX 3

CLOSING SPEECH

Delivered by Monsieur Assih S. Passinim, Adjoint Préfet de la KOZAH (Adjunct Magistrate of KOZAH).

Durant une semaine, la Préfecture de la KOZAH en général et la ville de Kara en particulier, ont eu le privilège et l'agréable honneur d'accueillir en son sein des experts et des techniciens venus d'horizons divers, pour échanges d'expériences in matière de culture attelée.

A cet effect, le Commissaire Régional du RPT, Préfet de la KOZAH que je représente et la militante population de la Kozah, par mon canal, remercient du fond du coeur les promoteurs de cette rencontre du donner et du recevoir dans notre ville, et plus particulièrement l'USAID qui a mis tous les moyens logistiques à la disposition des participants, leur permettant ainsi de travailler aisément dans ce cadre idéal de l'Hôtel Kara.

Mmes et MM., notre fierté est aussi grande, parce que ce séminaire-atelier qui tire à sa fin ce soir aura, non seulement apporté un complément d'information, de formation et de sensibilisation aux vaillants techiciens de la culture attelée de nos pays respectifs, mais aussi vient appuyer avec force la politique, d'auto-suffisance alimentaire prônée par notre chef d'Etat, President-Fondateur du RPT, Le Général Gnassingbe EYADEMA au lendemain de son accession au pouvoir: les centres de dressage de boeufs pour la culture attelée d'Agbassa, dans la Région de la Kara, le Centre de formation de Kamina, dans la Région Centrale, le Projet National de Promotion de la Traction Animal, et d'autres multiples projets à caractère cultural à travers tout le pays en disent long. En effet, pour le PRESIDENT-FONDATEUR du RPT, la santé et la dignité humaines, la paix, sont, entre autres, des maillons solides et indispensables à la stabilité politique dont jouit heureusement son peuple depuis 18 ans. Grâce à cette politique d'auto-suffisance alimentaire, fruits de la culture attelée, les greniers des paysans regroupés ou non ça et là en coopérative, ceux des fonctionnaires regorgent de vivres de toute nature. Bref, grâce à la culture attelée pratiquée par les couches valides togolaises, les vivres abondent sur les places de nos marchés.

Les Togolais doivent leur reconnaissance à cette pratique moderne qu'est la culture attelée initiée par leur Président-Fondateur; aujourd'hui, les Togolais n'ont plus rien à envier aux autres peuples nationaux ou extérieurs. C'est dans le souci d'améliorer davantage la vie de son peuple bien-aimé que l'homme du 13 Janvier, l'ayant exhorté à pratiquer cette méthode culturale peu coûteuse, a fait de nos jours des gens heureux robustes, fiers et n'envient non plus le fonctionnaire du coin. En d'autres termes, le paysan agriculteur pratiquant la culture attelée se suffit largement à tout point de vue.

Mmes et MM., en votre qualité de techniciens en la matière, votre dévouement, à l'issue de ce séminaire-atelier, se manifestera plus tranchant pour encadrer davantage nos laborieux paysans agriculteurs

modernes qui tendent aujourd'hui à se débarrasser entièrement des méthodes ancestrales culturales, pénibles et peu rentables. C'est par cette assistance, c'est par la vulgarisation des expériences acquises dans ces locaux de l'Hôtel Kara, que vous aiderez nos Chefs d'Etat respectifs à soulager l'Afrique de la sous-alimentation, de la malnutrition de la disette, bref de la misère avilissante. Comme vous l'avez constaté, les heureux lauréats nationaux entourés de soins à Yamoussoukro, en R.C.I., par les Chefs d'Etat membres du Conseil de l'Entente, doivent leur chance à la pratique de la culture attelée. Je suis persuadé que de votre dynamisme renouvelé, de votre sensibilisation, de vos multiples efforts à, tous les niveaux, sortiront les années à venir d'autres lauréats pourvu que le ciel manifeste sa clemence par la régularité de la pluviométrie.

Je ne saurais terminer sans dire aux divers assistants américains, combien l'Afrique en général et nos pays respectifs en particulier, leur sont reconnaissants pour les lourds sacrifices humains et financiers qu'ils ne cessent de consentir pour nos peuples, surtout dans le domaine cultural moderne: à travers eux, nous remercions très sincèrement le Président des Etats-Unis d'Amérique, Son Excellence Ronald Reagan, dont les visées claires rejoignent celles de nos Présidents respectifs pour lesquels, apprendre au peuple à exploiter judicieusement la terre vaut mieux que lui donner des denrées alimentaires importés.

*Au nom du Commissaire Régional du RPT, Préfet de la Kozah, je souhaite à vous tous un excellent retour dans vos pays respectifs.

*Longue Vie au Président Reagan,
*Longue Vie aux Chefs d'Etats Africains,
*Vivent l'USAID et tous les autres contribuables,
*Vive la Culture Attelée.

APPENDIX 4

CABLE FROM USAID/TOGO TO OTHER AFRICAN MISSIONS AND AID WASHINGTON CONCERNING RESULTS OF NETWORKSHOP

1. A Farming Systems Support Project (FSSP) networkshop on "Animal Traction in a Farming Systems Perspective" was held in Kara, Togo, March 3-8, 1985. The thirty participants included representatives from Togo, Ghana, Ivory Coast, Senegal, Gambia, Sierra Leone and Burkina Faso (SAFGRAD/FSU) as well as representatives from USAID, GTZ, ODA, IDRC, Peace Corp, FAC, and ILO.

2. The major conclusion drawn from networkshop presentation discussions in small and plenary groups, field trips and general exchanges between participants was the importance of localized conditions and the constant need to adopt animal traction technology to these conditions, and thereby underlining the need for continuous adaptive research.

3. Small groups worked to identify strategies to deal with five critical areas of concern in animal traction programs: management of technology, preconditions necessary for adoption, animal feed resources, methodologies of adaptive research, and monitoring and evaluation.

4. Highlighted throughout the week was the need for continued exchange of ideas on problem areas and potential solutions through on-going networking activities. Emphasis was placed on the need for networking within countries in order to identify and improve existing information sources and to encourage more internal exchanges of project results. Equal emphasis was placed on the need for more exchanges between countries. Both levels of exchange will help to decrease research overlap and speed up the process of adaptive research for local and regional conditions.

5. Plans for future networking activities under FSSP sponsorship were also formulated during the networkshop:

a. Two more annual networkshops on the general theme of animal systems in farming systems will be sponsored by FSSP and held in West Africa.

b. Togo networkshop participants' concensus was to focus the 1986 networkshop on four specific themes: 1) animal feeding research for on-station and on-farm; 2) training of trainers in animal traction; 3) design and manufacture of implements; and 4) traditional animal health and husbandry.

c. A coordinating committee was selected to plan the next networkshop:

Bai Kanu, Sierra Leone
Paul Starkey, United Kingdom
Solomon Owens, Gambia
Sandra Russo, Gambia
Kossivi Apetofia, Togo
Yesso Philidor, Ivory Coast
Adama Faye, Senegal

Abou Berthe, Mali (nominated but not present at networkshop)

d. Tentative site selection and date for 1986 networkshop were made and will be announced following host country approval.

e. Several exchanges between teams from different country projects have been proposed for 1985-86, at least under partial FSSP sponsorship, and will be announced upon approval.

f. The coordinating committee will meet in The Gambia, November 1985, to plan the agenda for the 1986 networkshop, pending country approval. In addition to proposed FSSP sponsored exchanges, tentative arrangements were made for exchanges between technicians and administrators from neighboring countries, for example: Togo - Ghana, Togo-Burkina Faso and Gambia-Senegal.

6. The precipitating impetus for holding the networkshop in northern Togo is the Kara-based AID-funded Togo Animal Traction Development Project (693-0218). The project has been designed around the networkshop principles of a) drawing on lessons learned by AID, Peace Corps and other donors in the course of previous and current animal traction projects in Togo and elsewhere in West Africa; b) adaptive field testing of extension themes to be tested by farmers according to farming systems procedures.

7. USAID/TOGO would like to bring this particular networkshop to USAID Science and Technology Bureau's attention as an example of promoting the common theme network. FSSP has served as an excellent device for linking and backstopping the issue of animal systems within a farming systems perspective. This is especially important with regard to the Agency's policy emphasis on technology generation and transfer on the one hand, and the scientific/technical capacity-building process within West African countries on the other hand.

APPENDIX 5

VOICE OF AMERICA NEWS CABLE CONCERNING NETWORKSHOP

LE CULTURE ATTELEE AU CENTRE DES DEBATS D'UN SEMINAIRE INTERNATIONAL

1. Un séminaire atelier portant sur la culture attelée dans un système d'exploitation agricole s'est tenu du 4 au 8 mars à Kara (deuxieme ville du Togo). Il a eté organisé par le Farming Systems Support Project (FSSP) de l'Université de Floride (Etats-Unis) que représentait Dr. Susan Poats, Directrice Adjointe du Projet et Coordinatrice du séminaire. Les Travaux ont permis à une trentaine de chercheurs travaillant dans des projets de culture attelée au Burkina-Faso, en Côté d'Ivoire, en Gambie, au Ghana, au Sierra Leone, au Sénégal et au Togo, d'échanger les expériences respectives dans le domaine de la culture attelée.

2. Il s'agit, pendant cinq jours de travaux, de mobiliser autour de la question les avis et résultats obtenus dans les pays ou est experimentée cette forme de culture dans des conditions souvent différentes d'un pays à l'autre de la sous-région Ouest Africaine. En effet, la traction animale se présente à l'heure actuelle comme l'une des formes de mécanisation à la portée des agriculteurs des pays en développement essentiellement pour ce qui concerne le coût de sa gestion. Mais comme l'indique M. John Lichte, second coordinateur de l'atelier et spécialiste de la traction animale, les participants ont surtout mis en relief les problèmes rencontrés sur le terrain, notamment l'adaptation des techniques aux conditions des différents pays, le problème de l'alimentation des animaux souvent perturbée par les effets de la sécheresse, ainsi que la gestion de la technologie. Autant des problèmes autour desquels se sont déroulés les travaux, avec l'apport des expériences de trois autres Américains, un Britannique et un Canadien, chacun spécialiste dans une des branches du développement rural, mais ayant tous opéré dans des projets de développement agricole en Afrique.

3. Le séminaire, la première d'une série de trois prévus pour cette année, mettra ses conclusions à la disposition des projets initiés dans la sous-région, par le canal entre autres du Réseau de Recherche sur l'Exploitation Agricole en Afrique de l'Ouest (WAFSRN), crée en 1982 au Nigéria.

4. Le FSSP, financé par l'Agence Américaine pour le Développement International (USAID) a été créé dans le but de fournir l'appui technique aux projets de développement, à travers l'assistance technique, la formation à court terme, et l'organisation de rencontres pour faciliter la communication entres les hommes de terrain.

APPENDIX 6

ANIMAL TRACTION PROJECT INVENTORIES

PROJECT NAME: Work Oxen Project

COUNTRY/REGION: Sierra Leone, Northern region initially, expanding to other provinces

TIME FRAME: Open ended; being institutionalized

FUNDING SOURCES: Sierra Leone Government 50%
British Technical Aid 25%
French Technical Assistance 25%

PROJECT ACTIVITES:
Equipment production and testing
Training and supervision of extension workers
Training of farmers and university students
Animal traction research programs
Socio-economic and animal health research
Develop animal traction through village associations
Participate in agricultural shows
Monitor and evaluate credit

ANIMAL SPECIES USED AS POWER SOURCE : Cattle

PROBLEMS:
Promotion of techniques in non-cattle rearing areas
Lack of knowledge of the technology
Unavailability of health services
Unavailability of implements
High initial cost and unavailability of subsidies

SUCCESSES:
Acceptability of the technology by farmers, government officials
High farmer participation and increase in draft animals
Equipment production
Publicity of the technology
Creation of ox units in the various agricultural projects and institutions
Creation of village associations for owning oxen and equipment

PROJECT NAME: Farming Systems Unit/SAFGRAD

COUNTRY/REGION: Burkina Faso

TIME FRAME: 1979-1985

FUNDING SOURCES: USAID

PROJECT ACTIVITIES:

Identify socio-economic environmental and technological constraints which limit farm productivity in semi-arid West Africa (Burkina Faso)

ANIMAL SPECIES USED AS POWER SOURCES:

donkeys 75%
cattle 25%
horses < 2%

PROBLEMS:

Availability of animal traction
Condition of animals at beginning of season
Having proper equipment to effectively utilize animal traction

SUCCESSES:

Cereal yields of animal traction farmers are greater than yeilds of manual cultivating farmers
Weeding is effected on a more timely basis
Tied ridges are constructed better by animal traction farmers
Fertilizer is more thoroughly incorporated with animal traction

PROJECT NAME: Eastern ORD Integrated Rural Development Package

COUNTRY/REGION: Burkina Faso, Eastern region

TIME FRAME: 1974 - 1980

FUNDING SOURCES: USAID and Government of Burkina Faso

PROJECT ACTIVITIES:

Administrative support and staff training for credit program
Credit revolving fund for animal traction
Training extension agents
Technical assistance for oxen feeding and care
Socio-economic surveys and monitoring activities
Regional planning surveys
Marketing surveys

ANIMAL SPECIES USED AS POWER SOURCES:

donkeys:	about 1000	attelages
oxen:	about 800	attelages
horses:	about 2	attelages

PROBLEMS:

Size of area
Inexperience of farmers and extension staff
Project focus on distribution of package without sufficient emphasis on proper use of equipment
Low use rates
Lack of suitable cashcrop to make repayments
Animals are returned to Fula herders for their training

SUCCESSES:

Well run credit system
Animal training at village level using master trainers (bouviers)

PROJECT NAME: Ghanaian - German Agricultural Development Project (GGADP)

COUNTRY/REGION: Ghana, Northern region

TIME FRAME: 1970 - 1985, handing over planned for 1985.

FUNDING SOURCES: Governments of Ghana and Federal Republic of Germany (through GTZ)

PROJECT ACTIVITIES:

Agricultural extension in northern region
Animal traction program
Support to Ministry of Agriculture in transport, communications and information
Rural dug outs

ANIMAL SPECIES USED AS POWER SOURCE:

Project trained 2100 pairs of bullocks from 1975-1985. Total number of trained pairs in Northern Ghana 10,000 donkeys - about 1000 used for transport.

PROBLEMS:

Increased incidence of CBPP, heartwater and penumonia - animal health problems
Lack of capital due to increase in prices of inputs as well as after effects of 1983 drought
Lack of initiative by extension agents due to lack of renumeration, discipline and supervision

SUCCESSES:

Training of 2100 farmers and bullock pairs
Providing 5000 farmers with bullock plows/ridgers
Self-sustained training of bullocks by farmers in four project areas

PROJECT NAME: Mixed Farming Project (MFP/University of Colorado/CID/USAID)

COUNTRY/REGION: The Gambia, entire country

TIME FRAME: 1981 - 1986

FUNDING SOURCES: USAID and Government of The Gambia

PROJECT ACTIVITIES:

Maize agronomy
Forage agronomy
Range improvement and inventory
Socio-economic surveys
Farming systems research in crop/livestock systems

ANIMAL SPECIES USED AS POWER SOURCE:

Oxen for cultivation and transport
Donkeys for transport and some cultivation
Horses for transport

PROBLEMS:

Infrastructure and materials needed to manufacture equipment locally
Training program needs to be improved in several areas especially in use of equipment, training of oxen, training of trainers
Oxen lose their training skills over dry season

SUCCESSES:

Village level feeding program has been expanded in 1985 in response to farmer requests.

PROJECT NAME: Farming Systems and Rural Technology Transfer

COUNTRY: Senegal

TIME FRAME: 1983 -1986

FUNDING SOURCES: World Bank, Government of Senegal, FAC

PROJECT ACTIVITIES:

Research in Farming Systems
a) zonage
b) farming systems research
c) technology transfer

ANIMAL SPECIES USED AS POWER SOURCE:

Bovine - NDama, Cross breed	500,000
Equine - horses, donkeys	60,000

PROBLEMS: Not applicable - animal traction existed in the region before the creation of this project

SUCCESSES: Not applicable.

PROJECT NAME: Togo Animal Traction Project

COUNTRY/REGION: Togo, Kara and Savannes regions

TIME FRAME: 1983 - 1986

FUNDING SOURCES: USAID, Government of Togo

PROJECT ACTIVITIES:

Animal Traction:
a) training
b) demonstration
c) extension
Agricultural credit: small farmer prefinancing
Evaluation and documentationof draft animal farming
Supply of draft animals

ANIMAL SPECIES USED AS POWER SOURCE:

Taurine, Zebu, Crossbreeds

PROBLEMS: All problems to date relate to the Kara Region:
a) lack of animals
b) price of animals is prohibitive
c) low production increases
d) lack of available usable land

SUCCESSES: Farmer and extension agent training
Training of rural development agency extension agents
Training of farmers

PROJECT NAME: Project for the Promotion of Animal Traction (PROPTA)

COUNTRY/REGION: Togo, whole country

TIME FRAME: 1986 - 1987

FUNDING SOURCES: FED, USAID, Government of Togo

PROJECT ACTIVITIES:

Coordination of animal traction activities in the country emphasizing

a) supply of equipment and animals
b) coordination of a national animal health program
c) training of extension workers

ANIMAL SPECIES USED AS POWER SOURCE:

Bovine - taurine zebu crossbreed

PROBLEMS: Coordination between animal traction projects especially for credit and animal health

SUCCESSES: Unification of agricultural material
Harmonizing training efforts.

PROJECT NAME: Project Vivrier

COUNTRY/REGION: Togo, Kara region

TIME FRAME: 1980 - 1984

FUNDING SOURCES: Entente Fund and USAID

PROJECT ACTIVITIES:

Organizing and training of peasants with the goal of their achieving self development knowledge and capabilities

Promotion of food crop development

ANIMAL SPECIES USED AS POWER SOURCE:

Bovine

PROBLEMS:

Availability of adapted species of oxen Health Program implementation

Land availability

SUCCESSES:

Extension of animal traction

Replacement of associated farming to monoculture farming

PROJECT NAME: Agricultural Development Project of the Central Region.

COUNTRY/REGION: Togo

TIME FRAME: 1979-1986

FUNDING: GTZ

PROJECT ACTIVITIES:
Introduction of an agro-forestry production system adaptable for animal traction

ANIMAL SPECIES USED AS POWER SOURCE:
Taurins, Zebus, Crossbreeds

PROBLEMS:
Low market prices are prohibitive to animal traction adoption and restrict repayment of loans
Poor technical knowledge of maximal animal traction operations.
Poor soil fertility restricts intensive agriculture
Lack of techniques and technology to improve soil fertility.

SUCCESSES:
The creation and implementation of a system for introducing animal traction in areas where it and animal raising were heretofore unknown.

PROJECT NAME: Southern Mali Farming System Research

COUNTRY/REGION: Mali, southern region, but expect activity will expand to other regions. New project is under consideration.

TIME FRAME: 1977 to present (Dutch AID)
1979 to present (IDRC)

FUNDING SOURCES: Dutch Aid/Royal Dutch Institute
IDRC/USAID/Ford Foundation
Malian Government/Rural Economic Institute

PROJECT ACTIVITIES:

Farming systems research and pre-extension activities in cooperation with CMDT extension service
Focus on integration of livestock into farming systems
Livestock studies and testing
Socio-economic studies and testing

ANIMAL SPECIES USED AS POWER SOURCE:

Primarily cattle, donkeys for carting

PROBLEMS:

The technical level of new adopters is not usually sufficient to grow cotton profitably. Farmers who haven't adopted can't get into the system.
Dry season feeding of oxen and family herds: on-farm maintenance as alternative to transhumance
Alternative crops and revenue sources - diversification
Maintenance of soil fertility and erosion control
Access of resource poor to technology and means of production

SUCCESSES:

Increased forage production using cowpeas as intercrop or relay crop
Crop and revenue diversification: rapid expansion of upland rice and maize production in research villages
Erosion control program adapted by CMDT
Maize program for resource poor farmers extended to pilot project in cooperation with CMDT

APPENDIX 7

INFORMATION SOURCES ON ANIMAL TRACTION

Prepared by Paul H. Starkey

Several organizations have produced valuable reports relating to animal traction. A summary of some of them is given below in alphabetical order. All these institutions are happy to receive letters in either French or English, although in many cases the replies willbe in the official language of the country or the organization. In many cases both english (E) and, French (F) editions of the reports are available. While some organizations charge for their reports, many are prepared to send single copies to research workers, projects or institutions free of charge.

CDR Centre for Development Research
9 NY Kongensgade, DK-1472, Copenhagen K, Denmark.

Publishes mainly socio-economic studies relating to Africa including "Kjaerby, F. 1983, Problems and Contradictions in the Development of Ox-Cultivation in Tanzania" (E).

CEEMAT Centre d'Etudes et d'Experimentation du Machinisme Agricole Tropical, Parc de Tourvoie, 92160, Anthony,France

Government sponsored research centre for agricultural engineering, with information and consultancy services available. Publication include "Aide memoire du moniteur de culture attelee" (F).

CTVM Centre for Tropical Veterinary Medicine
Easter Bush, Roslin, Midlothian EH 259RG, Scotland, U.K.

University research centre with an animal traction activities including measurement of nutritional and work requirements for animal traction. Publications include "Draught Animal News" (E,F), "The work Output and Nutritional Requirements of Draught Animals" (E).

FAO Food and Agriculture Organization
Via delle Terme di Caracalla, 00100 Rome, Italy.

United Nations aid agency with FAO/UNDP representatives inall African countries through which publications and information can be obtained. Numerous publications including:
"Employment of draught animals in Agriculture" (E/F)
"Animal Energy in Agriculture in Agrica and Asia" (E/F)
"Report of FAO Expert Consultation on Appropriate Use of Animal Energy in Agriculture in Africa and Asia" (E/F)
"Animal traction in Upper Volta" (E/F) (with filmstrip)
"AGRIS" - a computer database search service. (E/F).

GRET Groupe de Recherche et d'Echanges technologiques.

34 rue Dumont d'Urville, 75016 Paris, France.

Government sponsored information service with many contacts with official and NGO development agencies in the francophone world. Publishes many technical information sheets (F), for example animal powered water pumps, and newsletter "Recherche Developpement" (F).

GTZ Deutsche Gesellschaft fur Technische Zusammenarbeit
Dag-Hammarskjold Weg 1, D-6236 Eschborn, Federal Repuglic of Germany.

Official bilateral aid agency, with advisory and consultancy services. Derivative organization GATE (German appropriate Technology Exchange) includes expertise on animal powered gears and pumps. Publications include "Munzinger P, 1982, Animal Traction in Africa" (E/F).

ILCA International Livestock Centre for Africa
P.O. Box 5689, Addis Ababa, Ethiopia.

International Research Centre on African Livestock, with research programs in Ethiopia, Kenya, Mali and Nigeria. Specific research interests include animal traction. Comprehensive information search and dissemination service using computer database (E/F). Publications include "Goe, M., and Hailu, M., 1983, Animal Traction a selected bibliography" (E/F), "ILCA Bulletin 14 1981, Animal Traction in Sub-Saharan Africa", "Gryseels, G. et al ., 1984, The use of single oxen for crop cultivation in Ethiopia". (E/F).

ITDG Intermediate Technology Development Group
9 King Street, London WC 1 E 8HN, U.K.

NGO appropriate technology organization with a publications section which sells many useful booklets on animal traction, including some case histories from different countries. Its own publications include a series of technical drawings of animal traction carts and implements, (E) and "Barwell, I., and Ayre M., 1982, The harnessing of draught animals" (E).

MSU Michigan State University, Department of Agricultural Economics, East Lansing, Michigan 48824, USA.

University department which carried out some valuable evaluations of animal traction in Africa. Publications include "Sargent, M.W., ie Lichte,, J.A. et al ., 1981, An assessment of animal traction in francophone West Africa" (E/F)

NIAE National Institute of Agricultural Engineering,
Wrest Park, Silsoe, Bedford MK45 4HS, U.K.

A government sponsored research centre which has been associated with the development of animal traction in various parts of the

world. Publications include "Matthews M., and Pullen D.,1975, Cultivation trials with ox-drawn implements in The Gambia" (E).

ODA Overseas Development Administration
Eland House, Stag Place, London SW1 E 5DH, U.K.

Official bilateral aid agency with advisory services. Publications include "Mettrick, h., 1978, Oxenization in The Gambia" (E).

PC-ICE Peace Corps ICE
Official bilateral volunteer program. Publications include "Watson, P.E., 1981, Animal Traction" (E).

TSFP Tillers Small Farm Program
Nature Centre, 7000 N Westnedge Ave, Kalamazoo, MI 49007, USA.

NGO appropriate technology centre interested in animal traction. Publication "Tillers Report". (E).

UEA University of East Anglia,
School of Development Studies, Norwich, NR4 7TJ, U.K.

University department with interest in animal traction. Publications include "Bartlett J., and Gibbon D., 1984, Animal Draught Technology, An Annotated Bibliography" (E).

VITA Volunteers in Technical Assistnce
3706 Rhode Island Avenue, Mt. Rainier, Maryland 20822, USA.

Information dissemination service providing photocopies of numerous animal traction documents (E/F).

IBRD World Bank,
1818H Street NW, Washington, D.C. 20433, USA.

Official multilateral aid agency. Agricultural research department has published documents relating to animal traction including "Binswanger H., 1984, Agricultural Mechanization, a comparative historical perspective" (e/F) "Binswanger H., and Pingali P., 1984, The evolution of farming systems and agricultural technology in sub-Saharan Africa" (E/F).

WN World Neighbors
5116 North Portland Avenue, Oklahoma City, Okla 73112, USA.

NGO aid agency. Publications include "In action : Animal Power" with filmstrip (E/F).

APPENDIX 8

DOCUMENTATION CENTER

One necessary component to any networking activity is the review and exchange of written documents. To encourage such an exchange and to provide an opportunity for networkshop participants to review the literature available on animal traction and general livestock production, the FSSP brought a portable documentation center to the networkshop. The documents included books, reports, reprints of published articles and copies of unpublished manuscripts. Most of these documents were collected prior to the networkshop by means of bibliographic searches and requests to specific documentation centers such as: ILCA, CEEMAT, FAO, USAID, Michigan State University Sahelian Center, Purdue University, ICRISAT, IDRC and national research or extension programs and projects dealing with animal traction or related topics.

An additional set of documents relating specifically to farming systems research and extension were also included. Networkshop participants and resource persons brought other documents to add to the collection. Following the workshop, other relevent documents suggested by participants were added to the list. The completed bibliography is found in Appendix 9.

During the course of the networkshop, the documentation center was housed in a bungalow near the conference room of the Kara Hotel. It was open at lunch and during evenings. Documents were catalogued and could be loaned out over night. It was not poss ible to make individual copying requests, but most documents are available free of charge if requested in writing. For most users, the center provided an overview of the range of documents available. There was not enough time to allow thorough reading and most used the collection to gather references for future requests. It is quite likely that a smaller sample of documents would be sufficient for future networkshop activities on this subject.

Following the networkshop, those documents with duplicate copies at the University of Florida were left behind to be incorporated into the PROPTA Documentation center at Atakpame. As a follow up to the networkshop, FSSP is assisting PROPTA in obtaining a large number of the documents from the bibliography to add to the PROPTA documentation center in Atakpame.

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APPENDIX 10

PROGRAM
ANIMAL TRACTION IN A FARMING SYSTEMS PERSPECTIVE
FSSP NETWORKSHOP
MARCH 4 - 8, 1985
LAMA-KARA, TOGO

Sunday

9:00	Left Lome for Lama-Kara via bus
12:00	Lunch at hotel in Atakpame
4:30	Arrived at Hotel Kara, Lama-Kara
5-6:00	Arranged meeting room
6:30	Words of Welcome Introduction of participants Cocktail

Monday

8:00	Opening - Mr. Komi Gbeblewoo, Directeur de Statistique Agricole, Ministere de Developpement Rural
8:15	Overview: Housekeeping, procedures, workshop background, What is FSSP? - Susan Poats, FSSP What is FSR/E?, workshop objectives, topics of discussion, workshop schedule, day's objectives - John Lichte, FSSP
10-10:30	BREAK
10:30-12	Keynote address - Hubert Zandstra, IDRC
12-2:00	Lunch
2:00	Overview of animal traction in Africa -Paul Starkey, Work oxen Project, Sierra Leone
3:00	Conceptual framework - John Lichte 1. Agro-climatic zone 2. Livestock traditions 3. Project influences 4. Socio-economic factors
4-4:30	Break
4:30	Placing country experiences in conceptual framework, examples: 1. Sierra Leone 2. Gambia 3. Togo
5:30	Free Period
6:30	Field trip preparations - description of sites,

logistics, topical focus
1. Management of Technology
2. Animal Feeding
3. Preconditions for Adoption

Tuesday

8:00	Departure of 4 small groups on separate field trips (picnic lunch prepared by hotel and sent with each group)
3-5:00	Groups returned from field trips
5-6:00 or 6-7:00	Groups prepared field trip reports

Wednesday

8:00	Day's objectives Housekeeping
8:10	Field trip reports Atchangbade - Jacques Delobre Kante - Solomon owens Brokou - Bai Kanu Landa Pozenda- Adama Faye
9:50	Summary of field trip experiences - Vince Barrett
10:10-10:40	Break
10:40	Remainder of the other topics of discussion 4. Methodology 5. Monitoring & evaluation
11:05	Field trip experiences related to methodology and monitoring & evaluation
12-2:00	Lunch
2:15	Problems in animal traction programs outside Togo 1. Sierra Leone - Bai Kanu
3-3:30	2. Eastern ORD, Burkina Faso - Vince Barrett
3:30-4:00	Break
4:00	Problems in animal traction programs outside Togo (cont.) 3. Senegal - Adama Faye
4:30	Report on CIMMYT Swaziland workshop - Sandra Russo
5-6:30	Free period
6:30-7:30	Slide presentations 1. Paul Starkey, animal traction

2. ILCA slide module, FSSP
3. Adama Faye, Senegal

Thursday

8:00	Day's objectives Identification of small discussion groups
8:20	Small group discussion to list and prioritize problems related to group's topic 1. Management of technology 2. Animal feeding 3. Preconditions for adoption 4. Methodology 5. Monitoring and evaluation
10-10:30	Break
10:30	Small group presentations, problems related to topics 1-3
12-2:00	Lunch
2:30	Small group presentation, problems related to topics 4 & 5
3:30-4:00	Break
4-6:00	Small group discussions to propose solutions and strategies related to group's topic
6-6:30	Free period

Friday

8:25	Day's objectives
8:30	Small group presentations, solutions and strategies topics 1-3
10-10:30	Break
10:30-11:50	Small group presentations, solutions and stratgies topics 4&5
11:50	Parting comments - Hubert Zandstra
12:05-2:30	Lunch
2:30	Workshop wrap-up - comments by resource people and K. Apetofia, Togo
3:00-3:30	Verbal and written evaluations
4:00-4:50	Discussion of follow-on workshop: topics, location and

timing
Nomination of coordinating committee

Sandra Russo	Solomon Owens
Paul Starkey	Bai Kanu
Kossivi Apetofia	Adama Faye
Yessoh Philidor	Abou Berthe (not present)

5-6:00	Break
6:00	Official closing
6:30	Closing cocktail

Saturday

Meeting of workshop resource people with personnel involved in the Togo Animal Traction Project:

Kossivi Apetofia	Vince Barrett
Pakoubatcho Lekezime	Sandra Russo
Adjevi Mensah	Susan Poats
Kossi Loho	John Lichte
Koffi Tebou	Jim Oxley
M. Yassim	Paul Starkey
Joe Howell	
Tom Remington	
Art Westneat	
George Brunei	
Jim Lewis	
Craig Kramer	
Sid Bliss	

8-8:30	Overview of TAT project
8:30-10:00	Discussion of policy related problems
10:30-12:00	Discussion of technical problems in small working groups

APPENDIX 11

THE DESIGN AND TESTING OF IMPROVED LIVESTOCK TECHNOLOGY FOR MIXED FARMS [1]

HUBERT G. ZANDSTRA[2]

INTRODUCTION

Farming Systems research was formulated to make available modern production techniques to the complex, poorly endowed mixed farms so predominant in the developing world. First and foremost, Farming Systems Research should have as its objective to generate improved technology that is acceptable to farmers of a defined region, farm type or well-defined production environment. The technologies as such should not be confined to a pre-conceived input, e.g. irrigation, and should consider the balance between farm enterprises (crop, animal, fish pond, etc.) and, therefore, land use as a variable (Zandstra, 1982). This interpretation of FSR sets it apart from a systems approach to research (Norman, 1982), which in itself is highly commendable, and can be applied to by-product use for livestock feed (Berhane et al, 1983) or crop improvement or any other component or sub-system of the farm.

This discussion will emphasize the livestock component of the farm and stress large ruminants. The focus will be on the design and testing of livestock production alternatives, and an attempt will be made to make available experiences from Latin American and Asian researchers. The methodological discussions and examples will refer primarily to a sedentary farm type in which livestock are kept for all or most of the year within farm boundaries. It is hoped that the research approaches discussed will also apply, or can be readily modified to suit farm types in which livestock depends on seasonal access to grazing lands away from the farm unit or in which contractual arrangements exist for livestock management away from the farm for part of the year.

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The opinions expressed are those of the author, and do not necessarily represent those of the International Development Research Centre.

FRAMEWORK FOR FARMING SYSTEMS RESEARCH

There are numerous presentations of the overall farming systems research framework. All of these recognize the following steps: selection of target area, a diagnostic phase, a design phase, and a technology evaluation phase (Fig. 1). For most of these steps, specific research methodologies and instruments have been developed for the cropping system, in such a way that the type of research conducted at a site is a result of the farm environment that prevails (Zandstra et al, 1981; Shaner et al, 1981). A brief summary of the specific activities, for each of the research phases, is provided in Appendix 1.

For the livestock component, the diagnostic tools developed for more or less rapid appraisal (Cobos and Gongora, 1977; Hildebrand, 1978; Collinson, 1982) can generally be applied to crop-livestock production systems. The simple graphic representations of the mixed farm and the contribution of the sub-enterprises to each other developted by Hart (McDowell & Hildebrandt, 1980; Hart et al 1982) provide an excellent insight into the interaction and limits that operate on the farm.

INTERACTIONS BETWEEN CROP AND LIVESTOCK ENTERPRISES

There is no need to stress to this audience the important contribution made by animals to the farm enterprise and the extent to which the benefits derived from crop production can depend on livestock. The productivity of labour, considered to be one of the main constraints to the development of African agriculture, can be more than doubled by the introduction of animal traction (see for example Brossier and Jager, 1984). The important contribution of manure is unfortunately best demonstrated by what happens when generations of farms have been forced to use manure as fuel, as is the case in many highly depleted highland areas of Ethiopia (Tinker, 1985).

At times livestock is the only means by which farmers can efficiently benefit from a communal good, such as grazing lands or forests. Livestock also provides an alternative market possibility for crops through the utilization of low quality roughages and poor quality grains. In addition, livestock ownership provides a viable investment that stores reasonably well and produces returns through birth and weight gains. This flexibility for marketing and saving adds to the stability of the farm enterprise and provides protection against natural calamities.

However, the livestock enterprise also competes with food crops for time on the land. Forage crops may occupy land or may be intercropped with food crops, planted in hedgerows, or confined to land types that are difficult to manage. Livestock of course competes for farm labour used in feeding and care of livestock and processing of livestock products (Banta and Frio, 1974).

MAJOR INTERVENTIONS IN THE LIVESTOCK SYSTEM

The interactions between crop and animal enterprises show that changes in the livestock system of the farm or the introduction of livestock into farms will require substantial modifications in the crop enterprises. The possible

interventions in the animal enterprise are modifications to:

Feed availability
Carrying capacity
Reproductive efficiency
Animal health
Animal mix, herd composition
Animl breed, or type
Product mix -- traction, milk, meat, hides, wool.

By far the most important constraint to increased livestock production is year-round feed availability; therefore, the feeding system receives the most attention in the design of alternative livestock production methods. The low quality of feed available from low input tropical pastures and crop residues leads to limits on digestibility and animal intake. For this reason, it has often been easier to increase the carrying capacity than to increase individual animal performance.

The importance of animal health should not be understated, but the extent to which farming systems research will address animal health beyond the application of existing control techniques is limited. The selection of animal type is generally dictated by the livestock resistance to disease and by climatic and market conditions prevailing in the area. Unless energy intake exceeds maintenance requirements by 180% or more, a strong emphasis on exotic breeds can only be justified on the basis of resistance to disease (De Boer, 1983).

The importance of animal mix and product mix in the consideration of improved livestock technology is often secondary to that of feed availability. It is, however, important for researchers to consider the various expansion paths of the livestock production system and relate this to their understanding of farmers' objectives. Where, for example, animal traction is the initial impetus for the introduction of livestock, an increase in the number of animals may lead to a greater concern for offtake as milk, such as is generally the case in South Asia, or as meat, such as is the case in Batangas, Philippines, e.g. the cattle raisers described by Moog (1980) and in Bali, Indonesia, e.g. the beef enterprise described by Nitis (1983).

INTERVENTIONS IN THE CROPPING SYSTEM TO SUPPORT LIVESTOCK

The most common means for increasing feed availability is by the intensification of forage production. Based on Plucknett (1978), the following means can be used to increase feed:

1. Collecting a catch crop after the main crop.
2. Intercropping a minor crop for forage, or to provide additional crop by-products or residues (thinning high density plantings).
3. Use of Cut-and-carry cultivated forages.
4. Use of multiple purposes hedges, fencerows, and fodder trees.
5. Supplementation by tethering or grazing on non-arable land.

6. Modifying the existing cropping systems by
   a) improvement of amount or feeding value of straw
   b) treatment of residues and by-products
   c) protein supplementation to improve digestibility of low quality feed sources.
   d) increasing yields of the cropping system to produce more forage.

Other crop-based interventions are: to reduce animal traction requirements by minimum or zero tillage (Van der Veen, 1983); to increase post-harveset plowing so that the main animal traction demands take place when livestock is at its peak condition; and to introduce fuelwood plantations at the homestead and in hedgerows and thus replace manure as a source of fuel, and increase fertilization of fields. There are undoubtedly many more interventions in the cropping system that could be listed.

THE DESIGN OF ALTERNATIVE PRODUCTION SYSTEMS

The design phase has two distinct but closely related activities: the design of improved production systems, be they farming systems, livestock or cropping systems; and the formulation of the overall research program to be conducted in a certain year. The design of the research program can conveniently be broken down into the experimental design and techniques to be used in the evaluation of alternative production systems, and the research to be conducted on key technological components of these systems. The experimental aspects will be discussed in the testing section.

The design of alternative production systems is a synthetic activity which uses the physical and socio-economic characteristics of the target farms obtained at the diagnostic stage, and combines this with knowledge about the performance of component technology (such as alternative plow designs, supplementation with urea, an improved sorghum variety) to identify improved production systems that are well adapted to the conditions of the target farmers (Fig. 2). Normally, the design of production systems is conducted by an interdisciplinary group thoroughly familiar with the diagnostic information and with experience in the target area. The mix of disciplines will depend on the enterprise or enterprises being considered and on the predominant biological or social constraints which prevail in the existing production systems.

The third workshop of the Latin American Animal Production Systems Research Network is entirely dedicated to an analysis of the techniques used for the design of alternative production systems. Participants also applied the methodology to three well-documented Latin American Livestock production systems (Ruiz and Li Pun, 1983). Most of the following discussion of the design process is based on the results of this workshop.

According to figure 1, the design phase follows neatly after the diagnostic phase, and precedes the testing phase. In reality, the design of alternative production systems overlaps with the diagnostic phase and with the testing activities, and depends substantially on feedback from these activities. For this reason, the design of alternative production systems can

take place simultaneously with diagnostic and testing activities at the farm level.

1. Analysis of the Region and the Target Production Systems

Assuming that the target area has already been selected, the design methodology starts with an analysis of historic events, trade pressures from outside and inside the country or region, migratory flows, customs of ethnic groups and consideration of population growth rates and medium and long term development trends. Particular attention is to be paid to the way these factors might interact or conflict with the way existing and evolving production systems may use land.

This analysis is important to arrive at an understanding of the factors that might stimulate or impede future activities required for the improvement of production systems. Understanding the causes and trends which have created certain limitations typical of the region, such as non-availability of credit, lack of roads, undeveloped markets, and a poor level of education, will help identify which of these limiting factors can be readily eliminated by intervention, or will gradually be removed through general development processes. This knowledge of the direction in which the overall system is prone to evolve is particularly important in new settlement areas or regions in which conditions are under rapid change. In such regions, the production systems are unstable and are prone to a series of modifications before an equilibrium is obtained.

2. Definition of Development Objectives in the Region

One of the first questions is how important is the production system under study in this region e.g. how important is a sorghum-millet-cowpea food crop system complemented with cotton and groundnut cash crop, with or without animal traction, in this region? This importance can be based on the product value which the system contributes, the frequency of the system and the size of the rural population associated with it, the percentage land use or other indices.

A more in-depth consideration of the system is obtained by an examination of the extent to which the interdisciplinary research team understands the reasons behind the particular form the production system has taken. Too often a diagnostic phase provides only information about the systems' form, land use, prices, percentage produce marketed, number of animals, their use, etc. It often provides very little insight into the reasons for this particular constitution of a production system and its functioning. Certain questions should be posed, such as: "Why has the acreage of groundnuts not expanded beyond what it is, given the tremendous utility farmers obtain from grain and haulms?" or "Why are farmers not using a particular input or approach, even though they are aware of it?" This ensures that the interpretation of the farming system given by the team, on the basis of the diagnostic studies, is internally consistent.

In this descriptive analysis of the system, it is important to take into account the human component, and the objectives, plans and attitudes of the

farm family and the institutional structure within which they operate. The design of alternative production systems begins to take form once the development objectives of the study region are understood. These objectives exist at three levels: objectives of the government and of the national research institution; objectives of the group of researchers responsible for the design and transfer of alternative production systems; and most importantly, the objectives and goals of the producer.

3. Analysis of the Production System or Sub-system to be Modified

The analysis of this system starts with the consideration of exogenous factors which have conditioned the system. This often explains certain intrinsic characteristics of the system, such as disease occurence, genetic potential of livestock, mortality, etc.

The second level of analysis is structural, and refers to an inventory of land uses, structures and equipment. At this level, the areas of crop land, type and size of pasture land, number of animals and structure of the herd, stalls, sheds, and other constructions, equipment and machinery are analyzed.

The third analysis focuses on the way the system functions, and therefore addresses the management of the components of the production system (e.g. sorghum production, pasture production, herd management, veterinary controls, feeding systems, purchase and sales, etc), and interactions between the production system under consideration and other ways in which land, labour and capital are used on the farm. In many cases, the evaluation of the dynamics of the production system will have to be of a qualitative nature. In other cases, sufficient production data and resource allocation information is available to allow effective reconstruction of the actual production system. This is an important capability, as it will also allow a more precise ex ante analysis of alternatives.

4. Definition of Adaptation Domains

The objective here is to capture with a minimum of stratifications the greatest percent of the potential target population for the research activity in the region. An important starting point is to take into account ecological factors such as climate and land. Where the variability between regions is smaller than the variability within the region, for example from year to year, there may not be sufficient reason to stratify the adaptation domain. Other factors may be farm size or tenure, distance to markets, or others which will be generally expressed in substantial (structural) changes of the production systems used by farmers. An important method to evaluate if a splitting of adaptation domains is justified is to evaluate if the stratification will mean a difference between the domains in the structure of the production system in terms of crop types or enterprise types (Ruiz, 1983). This consideration is parallel to the differentiation made between readily modifiable and not readily modifiable factors (determinants) which condition cropping systems (Zandstra, 1976). Only the latter were considered acceptable as criteria for stratifying adaptation domains. In effect, the stratification of an adaptation domain means that the research team is convinced that the final recommendation and the research leading up to it for these regions will

be sufficiently different to justify the added research cost and effort.

5. Identification of Technical Interventions

At this point, the research team should be able to identify a number of practices or technologies which can produce an increase in farm productivity. The list of possible solutions should be closely related to the production constraints identified previously. The solutions can be compared in terms of their advantages and disadvantages and can be ranked as to the extent of their impact on the performance parameters of the productions system.

At this point, it will become obvious that the research team involved in the design of alternatives is in effect working with a preliminary model, and it may be to great advantage to attempt to formalize this model as much as possible in graphic descriptive form (see for example Van der Veen, 1983; or Ruiz and Li Pun 1983, for several examples). An example of the existing, alternative production system for livestock producers in Sona, Panama is presented in Table 1.

6. Ex-ante Analysis of Potential Alternatives

The designed alternatives can be specified as a series of proposed changes in components of the existing production systems, such as a change in cropping patterns, supplementation of low quality roughages with high quality leguminous browse, treatment of low quality roughages, improved storage of crop residues or changed plowing time or methods. The ex-ante analysis seeks to evaluate the expected biological and economic impact of these changes. Although the use of ex-ante analysis in cropping systems research has been strongly advocated, the difficulty and risk associated with testing alternative livestock production systems gives greater importance to this methodological step. This analysis will require that the research team be aware of the resource requirements and their costs for the new techniques to be introduced. This will allow the application of partial budgeting techniques to predict the economic viability of each alternative. In addition to this analysis, which is limited to the changes introduced in the sub-system considered (for example the livestock system or only the feeding system), the ex-ante analysis should take into account interactions foreseen with other parts of the farming system. Careful consideration should be given to the demand of proposed alternatives on farm labour, cash inputs or specialized equipment. Other factors to be evaluated should include the returns to labour, net family income, and the production of a minimum amount of subsistance food crops. This type of analysis is greatly facilitated by simple input-output models of the production system under consideration.

The extent to which the ex-ante analysis can be formalized as simple simulation models or linear programming models can reflect in an important way on the type of testing procedures the research team decides on. Where a strong data base exists and ex-ante evaluation allows sensitivity analysis against assumptions on labour and cash input availabilities or assumptions about the biological response of interventions, the ex-ante analysis can be

used in future comparisons with the measured performance of alternatives to further refine the understanding of production constraints and possible solutions.

7. Evaluation of an Alternative Production System

The indices calculated in the ex-ante analysis should be compared to similar indices of production systems predominant in the adaptation domain. Where several alternatives are considered, their performance criteria should be compared. In general, the diagnostic phase will allow researchers to become familiar with the acceptable range of production criteria and with the desireability of the direction of change. For example, in systems in which land is not the primary limiting factor, it may be more important to increase productivity of labour, as indicated by returns to family income. Where severe limits on credit exist, reduced input levels and very high returns to cash inputs will be desireable.

The ex-ante analysis should also evaluate the impact of additional changes in the levels of inputs, the management components in the proposed alternatives, the cost and price structure that was used in the analysis. This sensitivity analysis is of great utility to estimate the sensitivity of important performance criteria to selected changes in the designed production system. Great sensitivity to changes in price structures, or to expected productivity changes (for example, of pasture or sorghum straw availability) may be indicative of an unstable production system which carries considerable risk.

8. Listing of Assumptions and Requirements for the Alternative Production System

Once a certain system has been selected for field evaluation, it must be described in detail. The demands of the system in terms of input availability and the assumptions made should be listed. These assumptions include the level of institutional support expected. Other assumptions related to the production environment, such as drought or flooding probabilities, are referred to the biological co-efficients used to calculate the performance (impact of fertilization, benefits of reducing calving intervals, relation between weight gain and TDN).

9. Identification of Research Priorities

At various points during the design process, the research team will have encountered difficulty in specifying biological relationships, in predicting the performance of alternative management practices, or in agreeing on the interpretation of farmers' behaviour. These information gaps should be listed to arrive at a set of research priorities on component technology or systems description which should be included in the activities of the research team.

TESTING OF CROP-LIVESTOCK SYSTEMS

The testing phase of farming systems research is the most demanding phase in terms of staff and operational requirements. In this phase, experiments

are used to evaluate the performance of technological alternatives. These alternatives may be single management components -- component technology research -- or a combination of changes which may be a package of crop or animal production techniques or may introduce a completely different production system or land use (better farm resource use).

1. Objectives of the Testing Phase

1. To measure the performance of alternative technologies in the farm environment.

2. To compare alternative component technologies and production systems with those presently in use by farmers in terms of biological productivity, farm resource use efficiencies, and farmers' preference.

3. To identify labour, cash, and agricultural input requirements of the alternative technology.

4. To identify resource conflicts at the farm or community level that may be caused by the alternative technology.

2. Testing Component Technologies

Adherence to the design. At the design phase, researchers carefully consider the appropriate factor and input level (treatment) to be tested. The management used for other factors should also be specified, and should either adhere to the farmers' management or to that of a designed alternative production system. If, for example, only the effect of dietary supplementation with molasses and urea is to be evaluated, the herd management and the remainder of the feeding system should not be changed from that practiced by the farmer. If, however, this supplementation is to be evaluated as part of a new production system that includes changing animal grazing to a staff-fed system, and that also changes the weaning time of calves, then the nutrition sub-system must be evaluated together with the newly designed animal management methods.

Experimental designs. On-farm testing of component technology for animal production is complicated by the following factors:

a) The number of animals per farm is small;
b) animals vary in age, sex, breed, and physiological stage (lactation, pregnancy);
c) animals move and forage in different areas;
d) the effects of treatments on animal productivity may take place at a later stage in the animal's life cycle; and
e) animals may change ownership before the results are in.

These factors make the choice of experimental design very important. In addition to the selection of animals and the allocation of treatments to similar animals across different farms, experimental designs must be chosen such that as many non-treatment effects as possible can be removed by statistical analyses.

Farmers participation. Testing should actively involve farmers, and the farm community. A range of farmer participation can be recognized:

a) as observer, when the researcher designs and executes a trial on the farmer's land or with his animals, often through a rental agreement;
b) as executor of a test designed by the researcher, but realized by the farmer, who conducts all operations. The farmer uses his resources and animals, often augmented by production inputs or implements and supervision from the researcher;
c) as participant in design of the trial and its execution as under b);
d) as originator of the test, through partial or complete adoption of a recommendation, using his own means to obtain additional inputs that may be required, from a production infra-structure specifically designed for the introduction of the new technology (pilot production program).
e) as originator of the test without access to special institutional arrangements.

It should be emphasized that only the test situations in d) and e) can provide realistic estimates of the performance of the new technology. Tests b) and c) will reflect the farmers' execution, but results are often strongly influenced by continuous contact with researchers. For research not directly involving animals, such as that on forage crops or forage handling and storage techniques, the experiences obtained in cropping systems research can be directly applied. For treatments to large animals, considerably more care should be taken to avoid risks to the farmers. This is further complicated by the a large number of farmers that will be involved in such trials. The comparison of only 4 diets for buffalo will often involve as many at 30 farmers.

Interpretation of results. Because of the high cost and operational complexities associated with some animal nutrition and management trials, careful and exhaustive analyses are warranted. In addition to establishment of treatment differences, the analyses should simulate the impact of the different treatments on the whole production system. This can be done by tracing the effect of the treatment through the system. Economic analyses are also required. These can be confined to a partial budget analysis strictly comparing treatments, but ideally the costs and benefits should be identified after a careful study (or simulation) of the treatment's impact on the whole production system. For example, the effect of straw treatment will lead to digestibility increases. This is associated with higher consumption and may lead to a need for purchasing straw. It will also lead to increased labour costs for storage and handling. It may even change the rice production methods chosen by the farmer toward rice varieties with lower grain/straw ratios.

TESTING DESIGNED ALTERNATIVE CROP-LIVESTOCK SYSTEMS

These systems introduce a number of changes in the farmers' production methods. Changes may be radical, involving alternative crops or animal breeds, but to avoid unnecessary risks, it is best to start with minor

modifications. Table 2 provides an example of the existing and alternative systems from a research project for a dairy/beef production system and the result of a preliminary test of these systems.

The testing of such alternatives involves changes in the crop and livestock components of the farm, and therefore will often require one farm per treatment. To avoid excessive variation and treatment bias, the selection of farms must be made with great care. This selection should be based on a classification of farm types and on a careful selection of those farm types to which the research is directed. There can also be advantages to using pairs of similar farms within the selected farm types to remove variations associated with, for example, farm or herd size, from the treatment effects. Because at least 6 replications are needed, and because data collection requirements are substantial -- covering both crop and animal enterprise and certain whole-farm parameters -- the testing of alternative crop-livestock systems can be very demanding of staff and finances. An example of the whole-farm approach to testing alternative livestock systems is the program of the Panamanian Institute for Agricultural Research (IDIAP), which evaluates one livestock system alternative in each of three regions in which specialized livestock production is dominant (Ruiz and Li Pun, 1983).

Evaluation Criteria. These are similar to those used in cropping systems research and include technical feasibility, economic viability, and social acceptability (Table 3).

Problems Unique to Testing Crop-Livestock Systems

Because of the small number of animals on each farm, their higher cost, and the close emotional ties between the farm family and its animals, on-farm experimentation is much more difficult in animal production than in crop production research. Treatment failure leading to a drop in milk production (even in animals adjusting to new feed sources), or loss of weight, listlessness, and diseases will have more serious repercussions for researchers than a reduced grain yield in one of the farm fields. For this reason, the emphasis on ex-ante analysis of the biological and economic feasibility of new production methods should be greater in animal production research than in cropping systems research.

Data requirements for testing by means of simulation techniques depend on whether a biological model or an economic model is used; these two models have very different uses and data requirements. Most of the biological models require detailed information on herd composition, feed supply, etc. Economic models require data on prices, quantity of inputs, etc., which are more readily available. In most cases, partial budgeting techniques suffice for the comparison of alternative systems to those used by farmers.

In the case of modifications to the animal production system, multiple products, and a complex use by the farmer of a difficult-to-cost range of crop by-products, labour, and agricultural inputs, can make for a complex analysis. In mixed farm types, the simultaneous modification of the crop and animal production sub-systems (e.g. introduction of a pre-monsoon forage crop that delays the rice by 20 days and thus reduces its yield by 15%) can lead to

such complexities that ex-ante evaluation of designed technology requires simple whole farm models. These models should be used for sensitivity analysis to determine responsiveness to changes in crop and animal management methods.

There have been suggestions that for large ruminant production systems, researchers should depend primarily on models derived from the descriptive phase of FSR, combined with on-station and on-farm tests of component technology. This would be followed by a thorough ex-ante analysis of alternatives to identify a single alternative that would be validated in a pilot production setting involving a small number of farmers. The validation will allow a comparison between farms with and without the alternative technology and between the predicted and obtained results. This validation process can also employ successive changes in the alternative that is evaluated. In rare cases, it may employ alternatives that use a scheduled introduction of new techniques (e.g. incremental changes in improved pasture to be followed by a change in animal breed).

An alternative approach is to carry the model through to a physical reality, as was done in the modules of CATIE (Avila et al, 1980) for dual purpose milk/beef production and for specialized milk production. A similar module approach is used by the Instituto Veterinario de Investigaciones Tropicales y de Altura (IVITA) in its Amazonian Production Systems program in Peru (Riesgo et al, 1982). These modules have the disadvantage that they are researcher managed, but they do allow tuning and validation of the whole farm models on which they are based. An example of the results obtained in CATIE by comparing monitored farms to a production module is given in Table 4.

The use of unit farms, where a particularly suitable farmer is selected to "allow" his farm to be modified at the researcher's cost, appears more attractive. It keeps the test within the farm environment, and depending on the researcher's willingness to listen, this approach allows continuous input from the farmer or from a farmers' group.

There is a danger in removing the tests from the management constraints that exist on the farm. Researchers would also continuously have to remind themselves that their performance estimate is based on a highly simplified model, and that the "best" alternative mixed production system would still have to be tested on a number of farms to allow a comparison with the system used by the farmer.

Differential Transferability of Technological Components. There is much to be said for the research approach that evaluates individual parts of the mixed system in on-farm testing, and that uses a modelling technique to interpret the performance of the whole system. The effects of changes in animal nutrition or several other animal management components on the animal's performance are much more predictable and transferable than are the effects of changes in the forage or feed production phase. Exploiting this transferability could make the testing phase operationally simpler and would make less demands on experimental designs and data collection protocols.

CONCLUSION

The testing of crop-livestock systems presents the greatest methodological challenges to farming systems researchers. The small number of animals per farm, their long lifecycles, and differences in age and physiological state introduce a lot of variation. Farmers also are more concerned about something unfortunate happening to their animals than to their crops (you talk to animals, seldom to sorghum).

There will have to be a greater emphasis on ex ante analyses at the design phase that employ simple biological models to conduct sensitivity analyses and that serve as a tool to combine experimental results from several technological components into a measure of their performance in the whole farming system. Such analytical techniques may need to replace part of the research process which, in cropping systems research, is realized by cropping pattern trials.

Experience in on-farm animal production experiments is increasing rapidly, and close communication among scientist in a network context can provide an important stimulus to further methodology development.

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APPENDIX I:

FARMING SYSTEMS RESEARCH FOR IMPROVED SMALL FARM PRODUCTION SYSTEMS

The following is essentially the production systems research framework used by the International Rice Research Institute (IRRI) and the Tropical Agricultural Research and Training Centre (CATIE). It consists of seven research phases, which form a conceptual sequence. In practice however, several research phases may take place at the same time.

1. Selection of the target areas. One or more geographical areas representative of a large homogenous production zone are selected. The area should be a priority area for development by the national government. In this way, when the potential for increased production has been demonstrated, support for production programs will be given.

2. Site description. The first activity of the research is to describe the existing farming systems, the physical environment, the socio-economic environment and constraints to production. The chracteristics of the farm environment will decide research priorities at the on-farm research site and at supporting research stations. At this time, the area is also divided in different land types, each of which may require a different production recommendation.

3. Selection of land types or farming systems. The stratification of the target area into land types is based on important environmental traits that are generally reflected in the type of food or forage crops grown and the type of animal feeding system or animal species that predominate. Land types are usually differentiated on the basis of pedological, irrigation, market, climatological or social factors. They should be general enough in occurrence to warrant research expenditures. Because of the staff and funding limitations and to reduce complexity, the research is generally confined to one or two land types and the predominant farm types associated with them. For the selected land types, the predominant farm types are studied in depth over time. This occurs while other research is ongoing and continues through the testing phase. This analysis concentrates on the biological and economic performance of the existing systems and its components. In mixing farming systems, particular attention has to be paid to the competition for farm resources -- cash, labour, land, at certian times of the year --, and to input transfers between subsystems -- crops as feed, manure as fertilizer, animal power, etc. The particular roles that livestock play in the farm enterprise have to be clearly defined.

4. Design of alternative systems. This includes the design of alternative cropping patterns, feeding systems, animal housing and management methods that are well adapted to the area. The design of alternative production methods takes into consideration the physical and socio-economic site characteristics, the performance of the existing production methods and the available component technology for the crops and animals in the farming

system. There are numerous practices which must be specified at the design stage. Many can be specified on the basis of existing knowledge and local methods. Others warrant separate experiments to establish optimal input levels or time and method of application. This component technology research may be conducted in national, regional, and local experiment stations or where possible on the farming systems research sites.

5. Testing of alternative systems. This involves the testing of the designed systems or selected management components in their respective environments on the farm. Farmers participate in the testing by managing the crops and animals according to the designed methods, with frequent advice and constant monitoring of the research staff. Based on the biological and economic performance of designed systems, problems that limit intensification of production can be identified and fed back to discipline or commodity oriented researchers. This scheme helps orientate such research to solve relevant problems of the target farmers. The evaluation of alternative systems involves careful analyses of the performance of each component management change in terms of its contribution to farm productivity. Where possible, a whole-farm analysis has to be used to evaluate the performance of a number of changes in management components that constitute the alternative system under evaluation. Farmers' observations and their tendency to adopt changes in the study area are important means for the evaluation of alternatives.

6. Extrapolation areas. When acceptable production alternatives have been identified, greater benefits from these research results can be achieved by their extrapolation to a wider area. Identification of similar land types and confirmation of the suitability of the new production methods to those environmental homologues is a necessary step prior to extension activities.

7.. Pilot production program. The on-farm testing and the identification of extrapolation areas for the recommendation have at this stage provided substantial information about the performance of the new production methods. A pilot production program is often advisable before embarking on a large scale extension activity. Such a program generally starts off in the original testing area and has the objective of identifying the institutional support and intervention required to assure the successful introduction of the recommendation. If successful, this experience will provide the information needed for the design of a full-fledged production program.

TABLE I

PERFORMANCE OF MILK/BEEF SYSTEMS IN SONA, PANAMA

Criteria	Farmers [a]	Experimental [a]
U.A/ha/yr	1.3	1.7
Milk l/ha/yr	538	735
Beef kg/ha/yr	49	123
Value of Prod/ha	$228	$315
Returns - Var.cost	206	253
Net Family income/ha	$122	$182

a) N=3

IDIAP, Panama, 1982

TABLE II

FARMERS AND EXPERIMENTAL PRACTICES EVALUATED
FOR DUAL PURPOSE CATTLE

Component	Farmers	Experimental
Pasture	H. rufa	H. rufa
U.A/ha/yr	1.1	1.8
Weed control	2, manual	2, chemical
Minerals	Crude salt	Balanced
Internal Parasites	2/year	3-4/year
External parasites	As needed	each 21 days
Grazing:		
- Milking	15-45 days	7-35 days
- dry cows	21-21 days	21-21 days
- calves	continuous	rotational, impr. grass
King Grass	absent	1 ha with 150-55-0/year
Dry season supplement	absent	King Grass Molasses-urea

IDIAP, Panama 1982, average for 3 locations

TABLE III

Types of evlauation criteria for on-farm Experimentation.

Type of evaluation	Criteria
1. Technical feasibility	a) Ecological balance b) Bio-physical compatibility with existing systems. c) Yield d) Sustainability of crop yields e) Efficiency in use of inputs
2. Economic viability	a) Profitability b) Stability of returns c) Release of resources d) Compatibility with resource base e) Compatibility with existing support services.
3. Social acceptability	a) Farmers' assessment or reactions b) Adoption rate c) Social benefits d) Compatibility with short and long term societal goals e) National priorities

Source: Ngambeki, D.S., and G.F. Wilson. 1982. On-farm Experimentation in Farming Systems Research, IITA, Ibadan, Nigeria.

TABLE IV

COMPARISON
FARMER'S DUAL PURPOSE PRODUCTION SYSTEM
TO THE IMPROVED SYSTEM

Criteria	Farmers (N=17)	Module
Use of concentrates, kg/cow.day	0.45 (47)*	0
Use of molasses, kg/cow.day	0.44 (59)	1.5
Carrying capacity, cow units/ha	1.8	4.0
Birth rate, %	52	57
Death rate, %	10	4
Milk production, l/cow.year	431	1,150
Total cost [1]	$ 387	999
Variable cost	$ 189	600
Labour (days)	$ 167	345
Investment in:		
constructions	$ 211	535
machinery, equipment, tools	$ 20	60
Milk Production, l/ha pastures	652	3,068
Meat Production kg/ha pastures	192	307
Product value	$270	1,241
Net returns	$ -117	242
Family income (FI)	$ 155	617
FI/labour days [2]	$ 6.17	10.88

1. All monetary values are in Costa Rican currency

2. Minimum wage was $5.45/day.

(FROM: AVILA ET AL , 1980).

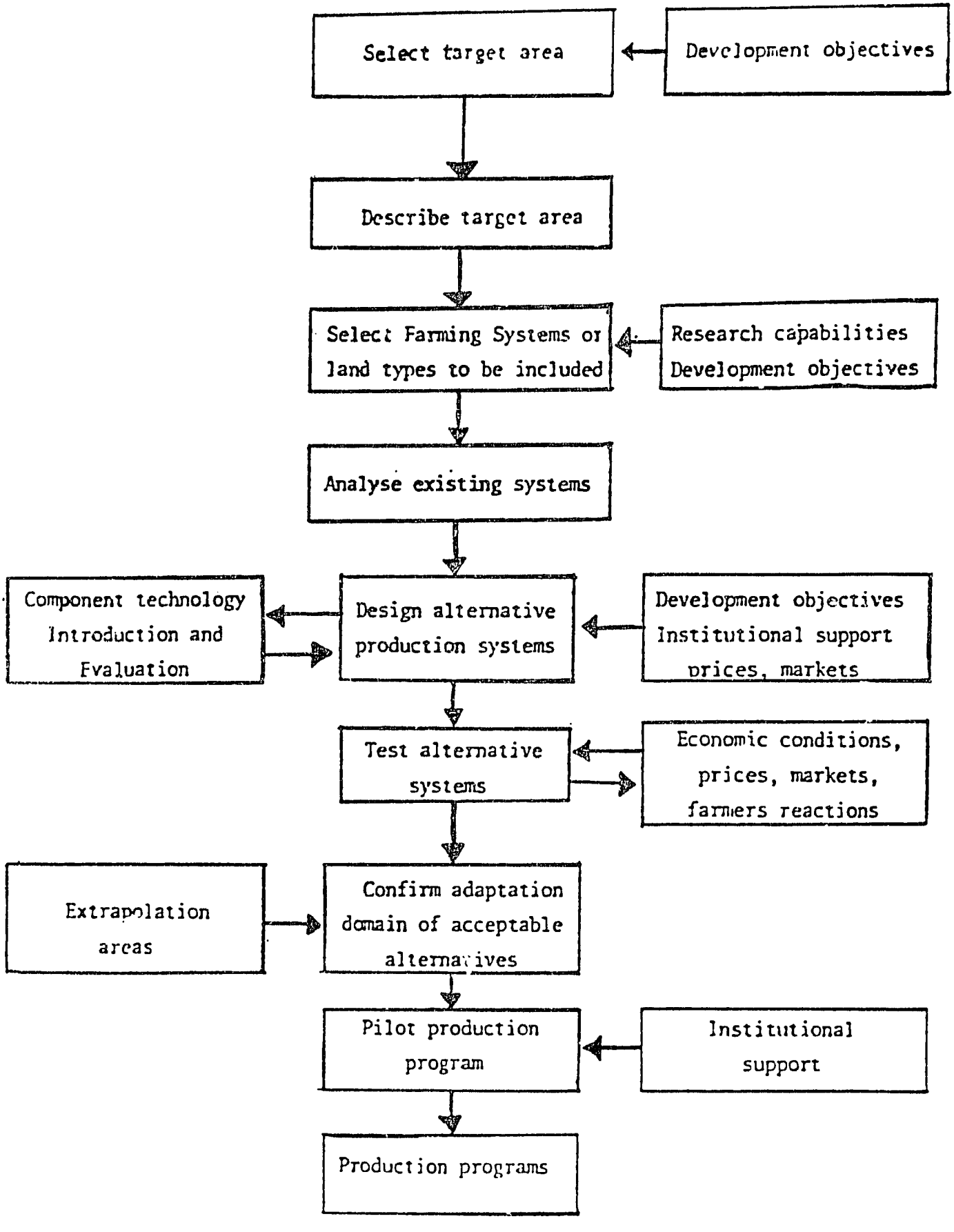

Fig. 1. Conceptual flow of activities in research and development of mixed farming systems.

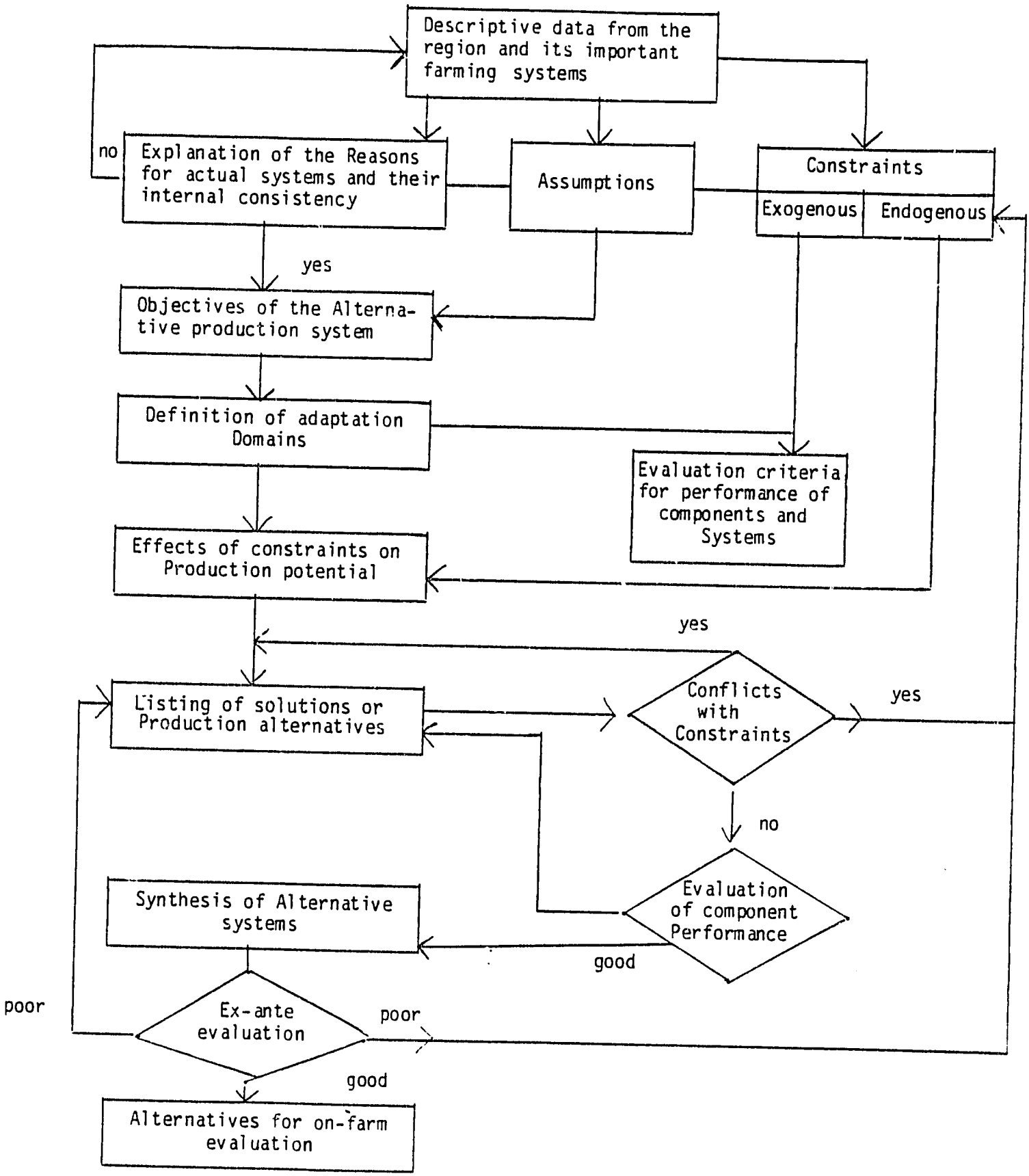

Fig. 2. The design process for alternative production Systems.

Source: Ruiz and Li Pun (1983)