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Farming Systems Research & Extension Activities in Botswana

A Results Inventory

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FARMING SYSTEMS RESEARCH AND EXTENSION ACTIVITIES IN BOTSWANA: A RESULTS INVENTORY

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TABLE OF CONTENTS

Executive Summary i

Acknowledgments v

List of Acronyms vi

I. Introduction 1

II. History of Agricultural Research in Botswana 1

III. Description of Farming Systems Projects – FSSR 3
- A. Farming Systems in the Southern Region 6
  - A.1 Objectives 6
  - A.2 Design 7
  - A.3 Implementation 7
  - A.4 Outputs (Evaluation) 8
  - A.5 Constraints 9
- B. The Agricultural Development Ngamiland Project – ADNP 9
  - B.1 Objectives 9
  - B.2 Design 10
  - B.3 Implementation 10
  - B.4 Output (Evaluation) 11
  - B.5 Constraints 11
- C. Molapo Development Project – MDP 12
  - C.1 Objectives 12
  - C.2 Design 13
    - 1. Water Management 13
    - 2. Crop Management 13
    - 3. Socioeconomics 13
    - 4. Service Center 13
  - C.3 Implementation 14
  - C.4 Outputs (Evaluation) 14
  - C.5 Constraints 15
- D. Agricultural Technology Improvement Project – ATIP 16
  - D.1 Objectives 16
  - D.2 Design 16
  - D.3 Implementation 17
  - D.4 Outputs (Evaluation) 17
    - 1. Establishment of a Farming Systems Approach for Testing Technologies 18
    - 2. Institutional Capabilities Developed in the MOA to Execute Farming Systems Work 18
    - 3. Linkages Strengthened 19
    - 4. Information Dissemination and Data Access 20
    - 5. Farming Systems Work Support Activities Strengthened . . . 20
  - D.5 Constraints 20

IV. Summary of Impacts of Farming Systems Projects in Botswana 21

V. Summary of Constraints to Successful Implementation of FSR/E Work in Botswana 22

VI. Lessons Learned 23

VII Conclusions and Recommendations 25
A. Organizational Structure 25
B. Training 26
C. Commonality of Approach 27
D. Process for Technology Assessment 27
E. Linkages 28
F. Information Dissemination 28

Bibliography 29

Appendices 31
A. Persons and Institutions Contacted 33
B. The Farming Systems Approach to Research 35
C. Technologies Developed by the Farm Machinery Development Unit 37

Executive Summary

The purpose of this study was to review, analyze, and document the results of Farming Systems Research and Extension (FSR/E) projects that have been implemented in Botswana. The study forms part of a global synthesis report that analyzes the factors affecting sustainability of FSR/E within national agricultural research and extension systems. The information presented in this study was derived from interviews with government administrators, agricultural scientists, technical assistance teams, USAID personnel consultants, and University of Botswana personnel. Field observations and secondary data were also incorporated. The study focused on all four farming systems projects currently being implemented in Botswana. This included the Farming Systems Southern Region Project (FSSR), the Molapo Development Project (MDP), the Agricultural Development Ngamiland Project (ADNP), and the Agricultural Technology Improvement Project (ATIP). Findings are summarized below.

Summary of Impacts of Farming Systems Projects in Botswana

A. All four projects have made progress in helping to develop and test relevant technologies for limited-resource farmers.

B. Several of the projects have created good linkages with research, extension, and other development institutions. This is especially true of ATIP.

C. FSR/E projects have enhanced farmer confidence in research and extension.

D. Some of the FSR/E projects have helped develop the institutional capabilities of the MOA to execute FSR/E work.

E. All projects have developed the research infrastructure in the regions in which they have been working.

F. Several of the FSR/E projects participated in evaluating the Government of Botswana (GOB) drought-relief programs.

Summary of Constraints to Successful Implementation of FSR/E Work in Botswana

A. The severe drought conditions that plagued Botswana from 1982 to 1987 limited the potential of most of the projects.

B. The target areas where these projects were concentrating their efforts were considered too small.

C. The size of the expatriate staff, the level of their training, and their access to resources made them too visible and competitive with other departments in the National Agricultural Research Organization.

D. All four projects had tremendous difficulty in maintaining or gaining access to trained manpower.

E. The four different farming systems projects are under different administrative umbrellas making it difficult to coordinate research.

F. Pressure to come up with quick results is inconsistent with ongoing research programs conducted on-station.

G. The format taken in the presentation of research results limited impact on policy, research, and extension.

H. On-station researchers do not fully accept farmer assessments of technology as adequate justification for technology recommendations.

I. Attempts to institutionalize farming systems work in the MOA may have been initiated too early.

J. Limited funds are available for institutionalizing a number of development programs.

Lessons Learned

A. All FSR/E projects should be under one administrative umbrella to coordinate research and approaches.

B. FSR/E teams should form the core of decentralized regional research teams working in different ecological zones.

C. FSR/E activities carried out on a project basis have difficulty in undertaking long-term research.

D. FSR/E work can play an important bridging role between extension and research.

E. Best-bet alternatives need to be offered to farmers so that they can participate in technology designs and assessments.

F. FSR/E results should be summarized in a way that ensures their use by extension, research, and policy decision makers.

G. As long as career advancement is contingent on placement in a centralized research organization, it will be difficult to retain trained manpower in the field.

H. A well-prepared plan that outlines the process of technology assessment could help improve the linkages between research, FSR/E teams, and extension.

I. One of the main limitations for the FSR/E projects has been access to good on-shelf technologies for immediate agro-ecological adaptation.

J. A major difference between on-station testing of technology and on-farm testing is the value placed on cause/effect relationships.

K. Consideration should be given to how social science input can be more useful to ongoing research activities.

Recommendations

A. Organizational Structure

1. All FSR/E programs should be under one administrative umbrella.

2. Agricultural research activities in Botswana should be decentralized and conducted in different agroecological zones.

3. A committee should be formed to oversee FSR/E activities.

4. The ongoing agricultural assessment could provide the mandate for the proposed organizational structure.

B. Training

1. Donors should continue to provide long- and short-term training opportunities for individuals in research, extension, and planning.

2. Personnel trained at the B.S.-level could staff farming systems field activities if good guidance can be provided by on-station researchers on problem definition, experimental design, and data analysis.

3. Incentives should be provided to trained personnel to retain their services in the field.

4. To encourage returning researchers to work in regional research positions, a two-year apprenticeship program could be instituted.

5. More in-service training should be provided by FSR/E researchers for extension staff.

6. A regular course should be offered to students at Botswana Agricultural College each year on FSR/E methods.

C. Commonality of Approach

1. Steps should be taken to ensure that all FSR/E teams use the same approach and terminology.

D. Process of Technology Assessment

1. The Technology Evaluation Committee should be reestablished to implement a coherent approach to research planning and setting of priorities.

2. To assist the Technology Evaluation Committee, "research theme" groups could be formed to help sort out priorities and screen technologies and practices.

3. FSR/E teams can work closely with on-station researchers to fine tune

Agrifacts recommendations to take into account locational specificity.

4. Careful consideration should be given to whether existing government policies and the institutional environment are compatible with the proposed recommendations.

5. In–service training for extension staff could help improve the targeting of extension recommendations.

E. Linkages

1. The ATIP project has provided a good model for how linkages can be established with other government departments and organizations.

F. Information Dissemination

1. Information should be packaged appropriately to address policy issues.

2. All FSR/E project reports and publications should become Department of Agricultural Research publications.

3. Better collaboration between commodity researchers and FSR/E researchers can be facilitated through joint authorship of reports and papers.

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List of Acronyms

ADNP	Agricultural Development Ngamiland Project
APRU	Animal Production Research Unit
ARAP	Accelerated Rainfall Arable Production
ATIP	Agricultural Technology Improvement Project
BAC	Botswana Agricultural College
CARO	Chief Arable Research Officer
CFDA	Communal First Development Area
DAR	Department of Agricultural Research
DAFS	Department of Agricultural Field Services
DLFRS	Dryland Farming Research Scheme
DPS	Division of Planning and Statistics
DWA	Department of Water Affairs
EFSAIP	Evaluation of Farming Systems and Agricultural Implements Project
FMDU	Farm Machinery Development Unit
FMU	Farm Management Unit
FSSR	Farming Systems Southern Region
GOB	Government of Botswana
IFPP	Integrated Farming Pilot Program
INTSORMIL	International Sorghum and Millet Program
MOA	Ministry of Agriculture
MDP	Molapo Development Project
ODA	Overseas Development Assistance
RELO	Research Extension Liaison Officer
RAO	Regional Agricultural Officer
RIIC	Rural Industry Innovation Center
SAREC	Swedish Agency for Research Cooperation
USAID	United States Agency for International Development

Farming Systems
Research and Extension Activities in Botswana

A Results Inventory

I. Introduction

The purpose of this study is to review, analyze and document the results of Farming Systems Research and Extension (FSR/E) projects that have been implemented in Botswana. The study forms part of a global synthesis report that analyzes the factors affecting sustainability of FSR/E within national agricultural research and extension systems. It seeks to determine the degree to which externally funded FSR/E projects have assisted in institutionalizing the FSR/E approach into the national agricultural research and extension system in Botswana, and the extent to which the Government of Botswana (GOB) supports these activities. This case study is unique when compared to the Indonesia and Guatemala case studies because the institutionalization of FSR/E by the Botswana Government is currently under review. Key topics addressed in this report within the context of institutional sustainability include: organizational structure; training; content of FSR/E programs; process of technology assessment and development of extension recommendations; linkages with commodity research programs, extension, agricultural support systems, faculties of agriculture, and other government programs; networking and information dissemination.

The information presented in this study was derived from interviews with government administrators, agricultural scientists, technical assistance teams, USAID personnel, consultants, University of Botswana personnel, as well as from field observations and secondary data (see Appendix A). Over 50 interviews were conducted. Field visits were made to project sites in Kanye (Farming Systems Southern Region), Mahalapye (Agricultural Technology Improvement Project (ATIP), Francistown (ATIP), and Maun (Molapo Development Project). Secondary data were also gathered on the Agricultural Development Ngamiland Project (ADNP) based at Gomare.

Although this study focuses on the four farming systems projects currently being implemented in Botswana, the major thrust of the study deals with ATIP. It is recognized that FSR/E type work has been ongoing since 1975. To understand the current situation of FSR/E in Botswana, it is necessary to briefly review the historical context from which it arose.

II. History of Agricultural Research in Botswana

The current status and focus of agricultural research in Botswana represents the culmination of simultaneous developments occurring in arable production research, extension, and agricultural statistics. The more important events are summarized chronologically.

Arable production research was initiated in the Mahalapye area during the 1930s. In 1936, a crops experiment station was established in Mahalapye, and livestock research was conducted at the Morale Pasture Station just outside of Mahalapye at about the same time. In 1947, the first systematic experiments and trials on arable crops began at the

Mahalapye Station (DAR 1969). The experimental work focused on: 1) assessment of new crop varieties; 2) fertilizer trials; 3) row spacing; 4) constraints on the introduction of cash crops such as cotton; and 5) crop rotation (Baker 1987). The general assumption was made that techniques used in South Africa would be adopted by Botswana farmers, so research should focus on developing an appropriate package of modern farming methods for progressive farmers. A package was developed that included winter plowing, row planting after early spring rains, regular weeding, use of quick-maturing varieties, crop rotations, selective use of manure and fertilizer, appropriate spacing, and contour plowing.

As this research was being carried out in the 1950s, extension activities primarily consisted of providing advice to farmers on methods and demonstration plots. Extension had no mandate to offer services to farmers.

In 1962, the Pupil Farmer Scheme was launched as the primary mode of agricultural extension. This scheme relied primarily on a package developed by research. Each extension agent concentrated on improving practices of twenty-four farmers. To qualify, farmers had to own a plow, draft oxen, and have destumped land. Pupil farmers were promoted through progressive and improved stages until they became master farmers (Baker 1987).

During the 1960s, when the Pupil Farmer Scheme was initiated, Botswana was experiencing a severe drought. Under such drought conditions, the good farmers (pupil farmers) with better access to resources appeared to be doing significantly better than the other farmers. This was acknowledged in 1965 in the last development plan before independence which was conducted by the Economic Survey Mission.

By the mid-1960s, several government sections were established in Botswana for agricultural services. These included sections dealing with: 1) research and experiments; 2) seed multiplication; 3) resettlement; 4) farm management; 5) soil and water conservation; 6) agricultural information distribution; 7) farmer training; 8) agriculture agent training; and 9) agriculture extension (Baker 1988). The major focus of research was still at Mahalapye but research activities were being decentralized through eight experimental unit fields distributed throughout the country. In 1966, the Ministry of Agriculture was moved to Gaborone. In 1967, the main research activities also moved to Sebele, 10 kilometers north of Gaborone.

When the rainfall returned in the 1970s, the relative advantages of the Pupil Farmer Scheme were not as apparent (Baker 1987). This was especially borne out by national agricultural statistic surveys conducted by the Agricultural Statistics Unit which was created in 1967. With the help of FAO, statistical surveys in the early 1970s demonstrated how atypical pupil farmers were in comparison to the rest of the farming population. Early in the 1970s, various consultancies commissioned to examine the Pupil Farmer Scheme and the organization of extension recommended abandoning the approach. This recommendation was based on the premise that the technical package did not spread to other farmers due to limited resources and that extension agents were spending 90 percent of their time with the pupil farmers.

At about the same time that concerns grew about the effectiveness of the Pupil Farmer Scheme, research activities were shifting their focus to risk-reducing, soil conservation practices. Research activities conducted at Sebele and substations in Goodhope, Mahalapye, Motopi and Moshu dealt with dryland crop varieties, fertilizers, crop rotation, tillage systems, and horticulture crops. Most of this research was conducted through donor-funded projects such as an FAO fertilizer project (1969-75), a British Bird Pest

Project (ending in 1978), UNDP/FAO research in the Okavongo (ending in 1981), and a U.S. crop-improvement research project (during the 1970s) (Baker 1987).

One of the most important donor-funded projects having a substantial influence on arable production research in Botswana was the British-sponsored Dryland Farming Research Scheme (DLFRS). Carried out between 1971 and 1983, the objectives of DLFRS were to study factors limiting arable production and to investigate means of making crop production more reliable (Baker 1987).

By 1974, a minimum tillage cropping system based on the Makgonatsotlhe two-wheeled tool bar was developed. This system included the following components: 1) crop rotation including fallowing before sorghum planting; 2) maintaining weeds using blade sweeps; 3) subsoil chisel plowing during the autumn; 4) row planting after the first spring rains; 5) inter-row weeding immediately after emergence and whenever necessary afterwards; 6) thinning; 7) top dressing nitrogen in wet years; 8) breaking the surface to improve rainfall infiltration; 9) harvesting early in the season; 10) sweeping crop stubble; and 11) contour plowing (Baker 1987). On-station trials using this system showed a 600-percent increase in yield over the national average.

To test the recommendations developed by DLFRS in farmers' fields, two companion British projects were established in 1975 (Baker 1987). The Evaluation of Farming Systems and Implements Project (EFSAIP) had both on-station and on-farm research activities, and had responsibility for implements development and testing. EFSAIP was the first multidisciplinary project specifically mandated to test agricultural production technologies on farmers' fields (ESAIP 1985). The Integrated Farming Pilot Project (IFPP) was established in the Department of Agricultural Field Services. IFPP worked with technologies developed by DLFRS and screened by EFSAIP and tested these technologies under farmer conditions and farmer management. The activities of these projects represent the earliest beginnings of FSR/E work in Botswana.

In the first two years of trials conducted by EFSAIP and IFPP, it was found that the Makgonatsotlhe system was not that effective when moved off-station. Although the system gave higher yields than the traditional broadcast system, the gross margin per hectare was negative and the amount of grain produced per hour invested was lower than for the traditional plots (Baker 1987). In addition to marginal yield benefits, the equipment was expensive and did not reduce draft requirements. Many of the cropping systems recommendations could not be implemented by farmers because successful crop improvements were contingent on the adoption of the whole system. Subsequently, during the late 1970s, the Makgonatsotlhe system was abandoned.

At the same time that the Makgonatsotlhe system was being developed and tested, consultants were brought in to review the extension program. As stated earlier, the general lack of spread effects that was associated with the Pupil Farmer Scheme led to recommendations for abandoning the program. Recommendations were also made to decentralize the extension system, to initiate both group and individual focused extension efforts, and to apply different approaches for communicating extension messages (e.g., demonstrations, village meetings, and the organization of village groups [Baker 1987]).

In 1974-75--after an exhaustive study of the Ministry structure, functions, and activities, especially extension--the Ministry of Agriculture was reorganized into its current structure (Baker 1988). Four departments were created: Animal Veterinary Services, Agricultural Research (DAR), Agricultural Field Services (DAFS), and Cooperative Development.

DAR was to provide information to help increase the reliability and yield of agricultural production in Botswana. Specifically, DAR was to provide new information and technology to DAFS to achieve the agricultural objectives outlined in the National Development Plans (Baker 1988). The major divisions of DAR include a Division of Arable Research, an Animal Production Unit, an Estate Management Unit, and a Laboratory Services Unit.

Institutional changes were also introduced under DAFS to improve field staff management. These included the introduction of farmer record cards; monthly management meetings involving all agents from each district; and reports on farmers' constraints which were aggregated and synthesized on a district, regional, and national level. Thus, the bottom-up reporting of farmers' constraints was well integrated into the DAFS extension activities. This approach is still followed.

The changes that occurred in the early 1970s with the Botswana research and extension systems were accompanied by improvements in the collection of agricultural production statistics. In 1974, the Agricultural Statistics Unit modified its sample design and increased its sample size to improve the quality of its data. In 1979, the unit expanded the scope of its work with the assistance of a USAID planning project. The annual survey currently covers all traditional farmers and more than 500 large commercial farmers operating on private land (Baker 1987). Enumerators measure planted areas and collect basic information on household characteristics, land tenure, production practices, livestock, areas harvested, and yields. In recent years computer-assisted data analysis has increased the speed at which information is made available.

In addition to the Agricultural Statistics Unit, a Farm Management Unit (FMU) was set up in 1970 to collect farm management data. Originally, four stations were developed in the southeastern part of the country for monitoring 48 nonrandomly selected farms (Baker 1987). This sample was atypical since most of these farmers were pupil farmers. In 1976-77, a new random sample of 90 farmers was selected and the number of data collection stations was expanded from four to six. This sample took gender and access to draft power into account. Computer storage and data analysis were also introduced. In 1981, the number of data collection points was expanded to eleven. Since the same basic format has been used for data collection and analysis since 1977, time series comparisons can be done. Data analysis has focused primarily on production levels, labor inputs, gross margins, and net income for crops and livestock. In 1982, the FMU also was given the responsibility of collecting information on livestock management (Baker 1987).

The primary purpose of the annual surveys conducted by the Agricultural Statistics Unit and the FMU is to generate comprehensive data on agricultural production to document trends in production practices and outcomes. The results of these surveys have shown that there are intra- and inter-regional differences among farm households in Botswana that government planning units should take into account. Recognizing this heterogeneity has important implications for agricultural research and extension programs.

Concurrent with the improvements in agricultural statistics, two important national surveys were conducted during the 1970s that addressed equity issues. In 1975-76, a Rural Income Distribution Survey was carried out. One major finding of this survey was that half of the households in Botswana don't have cattle. Thus any development strategy focusing on only commercial cattle could have negative equity effects (Baker 1988). In 1979, a National Employment Study was conducted. This study found that employment generation was more important than income for the development of Botswana. Agriculture played a vital role in employment generation. Taking the results of these

surveys into account, planners incorporated equity issues and the importance of agriculture in employment generation into the National Development Plan (Baker 1988).

By the late 1970s and early 1980s, an understanding of farmers' practices and constraints had been improved considerably by changes that occurred in the collection of agricultural statistics, the decentralization of DAFS, and the national surveys on rural income and employment. This improved understanding of farmers' circumstances also generated uncertainty about the appropriateness of many of the recommendations promoted by agricultural research and extension. The Makgonatsotlhe system was abandoned in the late 1970s. Disagreements occurred among agricultural researchers over the advantages of row planting versus broadcasting, sole versus intercropping, plant population recommendations, and the profitability of using fertilizer (Baker 1987). The extension service was still recommending many of the practices originally developed for the pupil farmers despite the limited support provided by research for such recommendations (Baker 1987). In spite of these efforts, few farmers were adopting the extension recommendations.

The donor–funded projects that were originally designed to test farmers' reactions to technical packages recommended by research found many of the packages to be unworkable or in need of modification (FSSR Review 1986). This was the case for the IFPP project (FSSR), the Agricultural Development Ngamiland Project (ADNP), and the Molapo Development Project (MDP) (see below). In the process of trying to implement the research recommendations, more information was collected on farmer practices and constraints. This helped modify recommendations and identify appropriate lines of investigation (FSSR Review 1986). These projects evolved into farming–systems–type projects, with emphasis given to investigation and description along with on–farm testing of individual rather than package recommendations (FSSR Review 1986).

In contrast to the other farming systems projects, the Agricultural Technology Improvement Project was specifically designed to improve the capacity of the Department of Agricultural Research to develop technologies appropriate to small farmer needs and to improve the capacity of the extension service to transfer technologies to small farmers (see below). In addition, it was designed to strengthen and institutionalize the linkage between research and extension. On–farm research began in the Central Region in 1982

From 1982 to 1986, severe drought conditions significantly affected agricultural production in Botswana. The government was obliged to concentrate many of its limited resources on drought–relief programs rather than on agricultural development programs. The drought has also had serious repercussions for agricultural research and extension. On–station and on–farm trials did poorly, and it was difficult to extrapolate from field plots any meaningful agronomic or livestock production predictions (Byrnes 1988). Extension personnel were given a number of responsibilities in the administration of programs such as the Accelerated Rainfall Arable Production (ARAP) program and other drought relief programs. Little time was available to conduct actual extension activities such as demonstration plots or to work with the various farming systems projects. The provision of such services is still dominating the work load of extension. The recent return of the rains may give the extension service more flexibility in program implementation, allowing them to work more closely with the FSR/E Projects. Similarly, research results are likely to improve with the return of normal rainfall conditions.

Summary

Prior to the actual appearance of farming systems research/extension activities in Botswana, much of the groundwork necessary for the effective implementation of this approach was already laid. The extension service had become decentralized and was implementing bottom–up approaches for identifying farmer constraints. Improvements in the collection of agricultural statistics shed light on the intra– and inter–regional differences that existed among farm households. National employment and rural income surveys brought equity issues to the attention of planners. On–farm testing of recommended technical packages pointed to the need for more information on farmer practices and constraints as well as individual rather than package recommendations. All of these developments enhanced the Botswana Government's understanding of farmer circumstances, which helped identify areas for future agricultural research. It was within this context that the farming systems research and extension projects were initiated.

In the next section of this report, the four farming systems projects will be briefly summarized. The discussion will address the objectives (concept); design, implementation, outputs (evaluation); and constraints associated with each project. This will be followed by a summary of the impacts on Botswana of all of the projects combined.

III. Description of Farming Systems Projects

A. Farming Systems in the Southern Region – FSSR

The Integrated Farming Pilot Project (IFPP) was a British project (Overseas Development Assistance [ODA]) initiated in 1975, and was based in the Pelotshetlha area in the Southern Region. In the first phase of IFPP, developments from agricultural research were tested on farmers' fields in the target area. The second phase of the project put more emphasis on farm management surveys with the aim of describing farming systems and the socioeconomic aspects of the farms in the target area. The second phase of IFPP finished in 1985 and a new phase titled "Farming Systems in the Southern Region" (FSSR) was established.

A.1 Objectives

The objectives of the FSSR project are: 1) to improve the ability of the Ministry of Agriculture to define farmer problems and seek appropriate solutions; 2) to seek solutions that incorporate the concept of improving existing systems as well as introducing innovations through the process of designing, testing and dissemination; 3) to improve the effectiveness of the national agricultural research program and provide a link between research and extension; 4) to assist the regional planning and development process; and 5) to assist the development and implementation of national policies and programs by reporting on farming systems work (Farming Systems Southern Region Draft Work Program 1986).

Consultations between project staff with research personnel, other farming systems specialists, extension staff in the region, and farmers gave rise to the establishment of these technical priorities and objectives. At the same time, a detailed work program mentioned earlier was produced and was verbally agreed upon by ODA.

A.2 Design

The design of the FSSR project provided for the identification of animal and crop production constraints. This is well detailed in the Draft Work Program of 1986. The animal production officer would be responsible for regional and national programs dealing with development and improvement of livestock production within the sustainable resource capacity of the rural environment. The officer would have to investigate the potential for improvement in the nutritional status of livestock both through range and fodder crops.

The agronomy work program was designed to investigate specific aspects of arable cropping systems in the Southern Region and to evaluate interventions that might improve crop yields or yield stability. Outside agencies were also identified for the necessary collaboration such as the germ plasm exchange program.

The farm management work program under FSSR was proposed to concentrate on the collection of data on specific issues where the need and potential users have been clearly identified. It was envisaged that there would be a move away from large-scale studies with broad objectives such as description of whole farming systems. Data collection was to be limited to an amount that could be analyzed and reported by the existing staff.

The FSSR farm management officer and the technical officer were also required to conduct a two-to-three-month agricultural policy study. This study was to provide feedback to national planners and policymakers in order to facilitate improvement in policy formulation and implementation.

A.3 Implementation

FSSR was placed directly under the Department of Agricultural Field Services (DAFS). The Regional Agricultural Officer (RAO), the Chief Crop Production Officer, and Chief Animal Production Officer also report to DAFS. In the past, the coordinator of FSSR was supposed to report directly to the Director of DAFS. Having FSSR under DAFS meant that its activities would be more extension oriented, resulting in weaker linkages with research. Collaboration with research took place on an ad hoc basis.

Two British technical experts were assigned to this project--one an agronomist and one a farm management specialist. Efforts to get TAs in animal science and agricultural economics were not successful.

Staffing of field positions with Botswana senior counterpart staff did not meet with success. Only when ODA threatened to withdraw support to FSSR was there an attempt to provide three Botswana staff to the project.

The joint GOB/ODA review team noted, "owing to delays in recruiting new professional staff, the transitional phase between IFPP and FSSR lasted a year. The full complement of local staff (nearly 50) employed by IFPP were kept on. Staff numbers were reduced through transfers to other departments. Some posts were upgraded and staff promoted...to improve career prospects and motivation" (FSSR Review 1987).

A strong link between research and extension is necessary for project success. The general observation has been that placing FSSR under DAFS led to poor linkages with research at Sebele where FSSR was to obtain technologies for on-farm testing.

Project implementation, however, was further facilitated by the presence of project enumerators who had to visit project areas where extension staff were working regularly. The FSSR project had a good grasp of farmers' problems through attending all extension meetings.

The GOB/ODA 1987 review team gave tribute to the FSSR team for "...exemplary record of timely reporting. Two annual reports have been produced along with two technical reports on individual programs. There have been submissions to the MOA newsletter Agrifacts."

The project used to have a fleet of vehicles to cover the region. Maintenance of these vehicles is now a major problem.

A.4 Outputs (Evaluation)

The GOB/ODA 1987 evaluation stated that the achievements of the FSSR project by the time of the evaluation could be grouped into administrative, organizational, and technical areas. Administrative and organizational achievements included:

1) establishment of objectives, a work program, and a clear perception of the role of FSSR in DAFS;

2) rationalization of staffing and administration to make them compatible with the objectives and role of FSSR;

3) establishment of the regional Technical Policy and Priorities Committees;

4) participation in national committees and working groups;

5) effective liaison with other agricultural institutions in Botswana;

6) contribution to training and staff development within DAFS; and

7) timely production of results.

In terms of technical achievements, the review team cites two areas where FSSR had made some contribution: the arable program and the livestock and fodder programs. Under arable investigations, they cite definite results in the use of the hill planter for sorghum and weed control interventions. They also identified cowpea varieties resistant to the weed Alectra vogelii.

Livestock and fodder investigations came up with a winter fattening program, supplementary feeding of cows and calves without modification of existing herd management practices, small stock supplementary feeding and management programs to reduce mortality rates, and fodder production and extension by introducing fodder crops such as Lasblab and Babala millet. FSR efforts in the area have led farmers to change their farming practices by adopting row planting and fodder production.

In terms of contributions to national agricultural policy, the FSSR farm management officer collaborated in an assessment of the ARAP and drought relief-policies. These results have just been published.

FSSR staff have also assisted in short-term training of DAFS field assistants. Courses on chemical weed control were provided and the project animal production officer

contributed to the DAFS training of trainers course (FSSR Review 1987).

The RAO in Kanye was very appreciative of the work of FSSR and the way it supported the extension work in the Southern Region (FSSR Review 1987). DAR staff also pointed out that FSSR contributed to their understanding of farmer problems which could be factored into their research priorities.

However, the general feeling of those interviewed in this case study is that during the two years of the FSSR project implementation, the project has not had much impact in the area designated for it outside of the community it worked in. Part of the reason is the fact that the extension officers in the area are overworked due to their involvement in service programs such as providing seed and fertilizer and measuring fields for plowing. Another reason is the fact that on-shelf technology was in short supply for transfer.

A.5 Constraints

Some of the constraints the FSSR project faced included:

1) "FSSR was established without a project document detailing objectives, institutional position, administrative arrangement, GOB and ODA commitments and ongoing expected work program" (GOB/ODA Review 1987).

2) Reporting of ODA staff directly to the DAFS Director and not to the regional agricultural officer did not facilitate good collaboration with the regional extension officers.

3) FSR did not have access to enough trained staff. There is a general shortage of trained manpower to fill in counterpart positions which had a telling impact on the continuity of the project. All along, there was an expression of need to have Botswana staff trained at the M.Sc. level or B.Sc. level in specialized fields and not in a general background. However, very little money was allocated for long-term training of Botswana staff. A major problem has been to get trained Botswana staff to remain in the project area. The placement of the project office in Kanye may help improve the situation.

B. The Agricultural Development Ngamiland Project – ADNP

The Communal First Development Area (CFDA) of Western Ngamiland was the selected target area for the Agricultural Development Ngamiland Project (ADNP) with Gomare as its base station. Initiated in 1978, the ADNP was institutionally placed under the Department of Agricultural Research (DAR). Funding for this project has beem provided by the Swedish Agency for Research Cooperation (SAREC) in cooperation with the Government of Botswana. The activities of ADNP began in 1979.

B.1 Objectives

The ADNP was launched with the broad objective of developing farming systems research in the Ngamiland District. The project was to: 1) "design, develop and promote appropriate technological packages for the different socioeconomic farmer groups, paying particular attention to the resource poor, and 2) provide information and data about farmers within the designated project area to concerned agencies" (Project Memorandum, Phase I 1978).

The ADNP was implemented in different phases. Each phase had its own specific objectives which of necessity addressed issues identified in the preceding phase.

In Phase I, the project was to: 1) describe types of farming and resource endowments of villages included in the survey; 2) describe the market dependence and market orientation among farmers as a contrast to the barter economy; 3) present the farmers' response to innovations tested and provided by DAR and extended by DAFS; and lastly 4) present the farmers' perception of their agricultural problems and their preferences and priorities (Project Memorandum, Phase I 1978).

The Phase II, objectives concentrated on improving the resource endowments of farmers. This was done by: 1) assisting those without draft power to use available GOB services; 2) providing crop improvement and management through the introduction of new varieties of early maturing sorghum, millet, and maize; 3) encouraging proper depth of planting; and 4) implementing proper weed and pest control both in the field and in storage.

Phase II project objectives also included studies of animal husbandry, animal disease and parasite control, and studies of marketing systems in the area.

In Phase III, the project aimed at providing Botswana staff with more training opportunities and adopting a farming systems approach to research and development.

B.2 Design

The project design had the largest professional staffing input within the first three years. It started with five professional staff including an economist, sociologist, agricultural economist, and two agronomists. Staff positioning, however, was less impressive since there was not a single cropping season when all the professional staff were together in the ADNP. This had some effect on the project's output.

Funds were made available for training, procurement and recurrent costs. Houses for senior and junior staff were built, and service structures such as offices, storerooms, and other facilities, were put up. Vehicles were purchased and fuel and maintenance was provided by GOB. Land for research and demonstration purposes was developed and properly fenced.

Priority areas were identified and a detailed work program was described for these areas. Priority areas included extension, livestock, crop production, and off-farm activities. These specific areas called for extensive activities to cover the broad spectrum of project objectives. A time frame for project activities was drawn up as follows: Phase I--project area description and identification (1978-83); Phase II--design and possibly trials and testing (1983-85); and Phase III--primarily testing (1985-88).

B.3 Implementation

The ADNP management structure shows that the project is directly under the Chief Arable Research Officer (CARO) in the Department of Agricultural Research (DAR). Technical officers and assistants as well as field assistants were employed for the implementation of this project and worked with the professional staff. Botswana counterparts available for the project implementation had either certificate or diploma training.

During the 1981-82 season, agronomic and socioeconomic surveys were carried out by project staff in four villages. This resulted in data on crop production activities,

livestock, and the socioeconomic characteristics of these villages.

On-farm trials were set up in the 1982-83 cropping season in which three technological packages had been prioritized. These were: 1) introduction and evaluation of early-maturing varieties of maize, sorghum, and millet; 2) introduction of row planting; and 3) introduction of harrowing to obtain a better seed-bed before row planting using the Sebele single-row planter.

The project was also involved in other agricultural research and development activities directed toward technology design and testing. Chief among these was alternative tillage research work which unfortunately was conducted for only one season.

Needless to say, facilities to do the job were available and the GOB provided the back-stopping services required for the successful implementation of the project. There was little effort on the part of DAR, however, to supervise and control the direction of the project's research work. As a result, the quality and content of the technical reports (when written) suffered.

Furthermore, there were poor linkages between the project administration and other supportive agencies in the area to facilitate smooth implementation of the project objectives.

B.4 Output (Evaluation)

An impressive physical infrastructure was developed by the project in terms of office building accommodations, research plots, irrigation facilities, machinery, and equipment. These facilities and equipment will be made available for future activities of DAR.

A foundation has been laid in the project area regarding chemical weed control and irrigation. Much of the socioeconomic data and agronomic data will also be of use to future research efforts. However, more work is needed in describing the different target populations in the area (i.e., Molapo farmers and refugee settlements on dryland), their farming systems, and their processes of adaptation. Such information will help select representative farmers for on-farm trials.

Although publications have been produced by this project that have contributed to the state of knowledge regarding Ngamiland farming practices, the quality of the publications could be improved. Reporting and monitoring interactions with farmers regarding on-farm trials could also be improved.

Training activities were also initiated; however, they fell short of expectations. Although ample funds were available for training to build up the research capacity of the project, only two Botswana nationals were sent for long-term training for higher degrees in agronomy and animal breeding. Training for a third Botswana researcher in agricultural economics did not come through. On-the-job training for government researchers was provided in the field of agronomy for a short period (less than one year).

B.5 Constraints

The project's objectives, as outlined earlier, may have been overly ambitious given the pattern of staffing at the project site. There was general lack of clarity in how to operationalize the objectives and establish research priorities. This lack of clarity brought into question the relevance of the research conducted by ADNP for farming communities in Ngamiland.

A second constraint that hindered the performance of ADNP was the weak linkages established with other projects and government programs working in the area. There was unnecessary competition with the Accelerated Rainfall Arable Production and Drought Relief Programs which offered ADNP participants opportunities and alternatives for farming activities.

A third constraint facing ADNP has been recruiting and retaining professional staff, particularly expatriates. The Botswana staff recruited in 1982 had mostly left by 1983. The problems with retention are related to the incentive scheme provided, career prospects and the remoteness of the project area.

Other serious constraints to ADNP's functioning have been the lack of well defined reporting and administrative procedures. More input from DAR may have ensured that quality work was done and was relevant to project farmers.

C. Molapo Development Project – MDP

The Molapo Development Project started in September 1983 and was projected to end in September 1989. There are possibilities now that the project might have a six–month extension until March 1990. The project is still in its pilot phase with the immediate objective to develop and test the technical organizational and administrative bases for improved Molapo farming. The project is sponsored by the Government of the Federal Republic of Germany which supports four technical staff in the field. The Government of Botswana provides the necessary local support staff as well as recurrent funds for running costs and support services such as a soil survey, topographic survey, and land use planning.

C.1 Objectives

The overall goal of the Molapo Development Project is to contribute to the food self–sufficiency in the Ngamiland District (MDP 1988). The project aims at improving the farming systems of the Molapo farmers in the project area. There is a dire need to have a secure and sufficient water supply which can be ensured by improved flood control measures. Molapo farming traditionally is based on flood recession cultivation. Molapo farming starts immediately after the water recedes on the higher edges of the floodplain and continues to the bottom of the plain, following the receding water. Molapo is the local word for floodplain (MDP 1988). Molapo farming has an advantage over rainfed agriculture in that the crop benefits from a saturated moisture profile, which, in addition to the rainfall, facilitates potential for higher yields. Occurrence, height, and extent of the floods in the area have been very erratic from year to year, and this has had negative impacts on farming. According to reports, in years of low floods, only a small portion of the area would be flooded and the subsequent crop production would depend mainly on rainfall. However, in years of high and/or late floods water recession would be slow, and cultivation would start very late.

To contribute to food self–sufficiency in the Ngamiland District it was imperative to improve the farming systems of the Molapo farmers through improved water and crop management. A thorough understanding of flood pattern frequencies, conditions, etc., was a prerequisite for developing an appropriate crop management plan.

C.2 Design

The project's design addressed four major areas of importance:

1. Water Management

The measures for improved water management are aimed at "protection of the cultivated area against uncontrolled flooding, control of water intake and recession of floods and the conveyance of water in the Molapo to more distant places" (MDP 1988). To do this, bunds are to be constructed to prevent uncontrolled flooding. This requires labor-intensive methods. Decisions on the location and size of bunds and sluice gates as well as the optimum water levels for flooding are based on topographical data, soil characteristics, and climatological data (MDP 1988). Water management control measures are closely tied to the implementation of the Southern Okavango Integrated Water Development Project in progress with the Department of Water Affairs (MDP 1988).

2. Crop Management

The strategy for improved crop management focuses on increasing food production by increasing yield per area or increasing the cultivated area. Building upon years of research, sound extension packages have been developed for Molapo farming (MDP 1988). The extension recommendations follow a low-cost, low-risk approach. The main components include: a) risk reduction through the spreading of planting times; b) separation of plowing and planting operations; c) harrowing for weed control and seedbed preparation; d) planting with a single row planter; e) inter-row weeding with a light donkey-drawn cultivator; and f) hand weeding and thinning to the desired population within the rows (MDP 1988). Past research indicates that timely planting, proper weeding, and maintaining an optimum plant population will have an important influence on the overall yield.

The project also intends to develop appropriate extension recommendations for female-headed households and other farmers who do not have access to animal draft power.

3. Socioeconomics

The recently established socioeconomic section will attempt to identify the major obstacles to increased agricultural production. This section provides assistance to the agronomy and water management sections in eliciting farmer participation in extension activities, and in the organization and maintenance of the flood control structure (MDP 1988). This section will also monitor and evaluate the impacts of the project on the different categories of farmers.

4. Service Center

Lack of male labor and animal draft power were identified as major constraints to increased agricultural production. A service center was, therefore, proposed and introduced as an additional project component back in 1984. The service center was to provide tractor hire service and possible facilities for the supply of inputs, implements, and spare parts as well as marketing of surplus production.

The long-term economic consideration would seem to suggest that the center should become a more training-oriented, self-sustaining institution. Possibilities of the service center becoming a self-sustaining institution will be investigated.

C.3 Implementation

The Molapo Development Project (MDP) was preceded by the FAO/UNDP program. In its pilot phase, the MDP's immediate objective was to develop and test the technical, organizational, and administrative base for improved Molapo farming.

With a five-year horizon, the project was expected to have achieved these goals. The project worked directly under the DAFS and was linked to agricultural research. However, the linkage with the Regional Agricultural Officer was not very strong. This, unfortunately, reduced the rate of cooperation and collaboration with regional extension programs.

The staff of the technical assistance team often operated the project without sufficiently trained counterparts. In addition, counterpart staffing of the project was not adequate. With its emphasis on training the project should be able to provide the counterparts who do work with MDP staff the hands-on experience much required for project continuity.

The preliminary development plan for the overall project area has been worked out (1988-90). The various project activities include: 1) analyzing the viability of project impacts for the nucleus pilot area; 2) assessing the economic justification of the project for the overall project area; 3) identifying the major obstacles for increasing agricultural production and suggesting possible ways of overcoming them; 4) assisting the agronomic section in matters regarding farmer participation and dissemination of extension messages; 5) assisting the water management section in developing an approach regarding farmers' participation in operation and maintenance of flood-control measures; 6) establishing a monitoring and evaluation system for project impacts on different categories of farmers; 7) establishing an internal project monitoring and evaluation system; 8) identifying promising alternative cropping practices and developing programs for on-farm testing; 9) verifying promising research results under farm conditions; 10) formulating extension packages; 11) assisting farmers in forming extension groups; 12) encouraging farmers to adopt extension recommendations through training courses, block demonstrations, farmer field-days, and on-farm demonstrations; 13) negotiating with DAR regarding appropriate Molapo-oriented research; 14) identifying problems related to animal traction and testing possibilities to improve the efficiency of animal traction; 15) establishing a proper administrative structure for project implementation; and 16) assessing the viability of the Service Center operation and identifying possibilities to assure services to farmers from other sources (MDP 1988)

C.4 Outputs (Evaluation)

A pilot area of 300 ha was selected and is representative of the entire project site. Farmers in the area were formed into groups for project participation. The main criteria for farmer selection was access or possession of draft power (Loos 1986). Access to draft power was considered important because all cultivation practices in the extension package (i.e., plowing, harrowing, and row planting) were those that require animal power for implementation. In the future, farmers without access to draft power will be able to participate due to the introduction of the Master Row Planter (hand-drawn).

Since 1983, field trials have been conducted on plots provided by the farmers. The trials are in the most intensive cropped areas and serve two purposes: 1) to demonstrate improved cultivation methods and secure the farmers' confidence and cooperation; and 2) to determine improved methods and develop recommendations and other areas of investigation (Loos 1986). The trials have focused on: 1) the suitability of different crops/varieties under wet and dry Molapo conditions using improved crop management

methods; 2) assessing the long-term effects of fertilizer application on yield and soil chemical properties; 3) determining the optimum plant population of sorghum under dry and wet Molapo conditions; 4) monitoring soil moisture; 5) assessing the effect of early and late planting on the yield of different crops; 6) investigating the long-term effects of different tillage practices on soil fertility and yields; and 7) assessing the advantages of mechanical weeding versus chemical weeding. Based on this trial experience, recommendations have been developed to overcome the constraints of traditional Molapo farming.

The performance of the project can be measured in terms of its impact on farmers. Currently, the project is working with 150 farmers in the pilot area with two extension officers. An increasing number of farmers are asking for assistance. An interview conducted with one project farmer and three nonproject farmers revealed that all were impressed by the technology advanced by the project. They were particularly impressed by row planting which gave higher yields compared to the traditional broadcast method.

Future agronomic investigations will focus on plant nutrition, chemical weed control, pest control, suitability of high-yielding open-pollinated varieties, optimal plant populations for different crops, long-term effects of different tillage methods, suitability of intercropping, improvement of farm implements, identification of suitable Molapo areas and expansion of extension work, and improvement of post-harvest protection and storage (Loos 1986).

Information on appropriate crop management vis-a-vis optimum water management is still lacking. This is due to the four years of drought experienced in the pilot area. It is important to acknowledge that the project has demonstrated its flexibility in achieving successes despite the absence of floods.

To address the major constraints of farmers in the area such as the shortage of draft power and labor, the project introduced tractor hire services. This was to ensure early plowing and to overcome labor bottlenecks associated with weeding.

To overcome shortages of spare parts for farm implements and the lack of farm inputs and marketing facilities, a service center was established. This service center is only partially operational. A seven-ton truck is available on-site to transport farmers' excess produce to Maun at a current rate of Pl.80 a bag of cereal grain.

Large bunds have been constructed to prevent uncontrolled flooding. Some of these are equipped with sluice gates that can stop water inflow in the area as soon as the desired water level is achieved.

C.5 Constraints

One of the major constraints to project implementation has been the weak links established with the Department of Agricultural Research. The project's emphasis on the production of immediate results in a five-year time horizon was not conducive to establishing long-term linkages to DAR. The proximity of MDP in Maun also did not help establish good communication with Sebele. In addition, placing the MDP under the administrative umbrella of DAFS did not help strengthen linkages with DAR.

A second constraint facing MDP is the weak linkage established with the Department of Water Affairs. This has left uncertainty as to who is going to supervise water intake and maintenance of bunds and sluice gates at the end of the project.

Third, the lack of well-trained counterparts has shed some doubt as to the continuity of the project once the project expires. Attracting counterparts to this remote area has been difficult. The general feeling of many government staff in the field is that they are forgotten by the Central Office when it comes to promotions.

Fourth, linkages between the project administration and the Regional Agricultural Officer have not been strongly established. As a result, communication and collaboration have been minimal.

D. Agricultural Technology Improvement Project – ATIP

The Agricultural Technology Improvement Project (ATIP) was authorized by USAID as a five-year project in September 1981. The technical assistance team began arriving in August 1982, and was fully in place by August 1983. The project was originally scheduled to end in 1987 but was extended to September 1990 to allow for the dissemination of research findings. The project is jointly funded by the Government of Botswana and USAID.

D.1 Objectives

The main purpose of ATIP is "to provide assistance to the Government of Botswana (GOB) Ministry of Agriculture in developing an improved agricultural capability which will be responsive to limited resource farmer needs" (Project Paper Supplement 1987). This focus is consistent with the GOB's strategy presented in the National Development Plan VI to increase agricultural production, farmer income and rural employment, and to enhance equity. The main objectives of the ATIP project are:

1) to institute a system of on-farm research and experimentation to identify constraints and develop solutions for small-farmer production problems;

2) to strengthen the capability of the DAR and its research stations to undertake research on small-farmer crops (cereals and legumes); and

3) to institutionalize linkages between the DAR and the extension service, Department of Agricultural Field Services (DAFS), to ensure that the technologies developed for small farmers are disseminated to the target group (Byrnes 1988).

D.2 Design

The design of ATIP provided for the identification of production constraints as well as trials to test, adapt, and demonstrate technology appropriate for producing basic food crops (Byrnes 1988) (see Appendix B). Two farming systems research teams were to initiate adaptive farming systems work activities by working with limited-resource farmers on their farms. Each team consisted of Botswana and expatriate workers, and was assigned to three villages in a particular region (Mahalapye or Francistown). Technical assistance was provided in agronomy, agricultural economics, and animal husbandry. Two additional expatriate technical specialists were to serve at the national level and in support of field activities. The Chief of Party provided leadership in FSR/E and the extension specialist served as the Research Extension Liaison Officer (Byrnes 1988). Both technical specialists worked closely with DAR in improving its capacity to focus on small-farmer needs, helping strengthen the linkages between the DAFS and the DAR, and attempting to improve communication and cooperation among farming systems projects

operating in the country (Byrnes 1988). In addition, two scientists from the International Sorghum and Millet Program (INTORMIL) were brought in to help the ATIP team address agronomic and soil issues.

The project design identified a number of project outputs that were to be achieved by the end of the project: 1) farming systems approaches would be designed, developed, and fully tested by ATIP in two regions; 2) institutional capabilities and skills would be developed within the Ministry of Agriculture to execute farming systems work in two regions; 3) linkages would be strengthened within the project, between ATIP and on-station research, between DAR and DAFS, between ATIP and other development institutions and organizations, and between ATIP and other farming systems projects; 4) information dissemination and project monitoring would be strengthened; 5) farming systems work support would be strengthened; and 6) data generated by ATIP would be made generally available (Project Paper Supplement 1987).

In addition to technical assistance, the project design also provided for long-term, short-term and on-the-job training. Long-term training was to concentrate on training within a particular discipline while short-term training was to emphasize training in farming systems work. In-service training was to be provided for extension workers to help improve research/extension linkages.

D.3 Implementation

The first five years of ATIP's existence coincided with severe drought conditions. In spite of these constraints, ATIP has made progress. ATIP has been conducting on-farm research in Botswana since 1982 (ATIP 1987). Traditional farming practices have been investigated and modified production practices have been tested in on-farm trials. Two farming systems teams based in different regions have been carrying out this research. One team has been operating in the Central Agricultural Region near Mahalapye and the other team has been working in the Francistown Agricultural Region in the Tumume Agricultural District.

Research activities have primarily focused on crop production technologies. There have been numerous commodity-specific studies, but the main emphasis has been on improved tillage and planting practices (ATIP 1987). Other research topics have included post-establishment practices, postharvest practices, field development, farm equipment, and livestock production practices. ATIP has also focused on household circumstances, local markets, extension procedures, and various farmer assistance programs (ATIP 1987).

Given the harsh production environment and a traditional farming strategy of minimizing agricultural investments, ATIP has focused on modifying production practices that require little or no additional cash investment (ATIP 1987). The project's major contribution has been the investigation of component cereal grain production practices. Work began with assessing the current recommendations of the MOA. ATIP identified farmer constraints and then carried out on-farm trials to adapt the recommendations to farmers' needs and priorities. A number of modified production practices have been identified. ATIP believes these have considerable promise, and proposals are being presented to DAR for possible incorporation into Ministry recommendations.

D.4 Outputs (Evaluation)

The ATIP project has achieved progress in all of the areas outlined in the project paper for anticipated project outputs. These include: establishing a farming systems approach for testing technologies; developing institutional capabilities and skills within the Ministry

of Agriculture; strengthening linkages within ATIP, between ATIP and on-station research; between DAR and DAFS, between DAR and farmers, among FSR projects and among other organizations such as the Arable Lands Development Programme (ALDEP) and the Rural Industry Innovation Center (RIIC); having some influence on policy decisions; and strengthening information dissemination and the availability of data. These outputs are summarized below.

1. Establishment of a Farming Systems Approach for Testing Technologies

Farming systems research has been carried out by two farming systems teams since 1982. In the Mahalapye and Francistown areas, researchers have improved the government's understanding of the human and technical environment and have tested numerous modified production practices (Project Paper Supplement 1987). Progress has been made in the following areas:

a) Localized control of farming systems research activities is being established in the Mahalapye area, but is more limited in the Francistown area.

b) An outline for a methodology handbook for farming systems work in Botswana has been finalized and a draft will be completed by 1990.

c) In spite of severe drought conditions, ATIP has made considerable progress in helping to develop and test relevant technologies for limited-resource farmers. Working closely with the Farm Machinery Development Unit (FMDU), ATIP researchers have influenced technology design for the light weeder for donkeys, the light weeder blade harrow, the jab planter, and the dammer diker. In collaboration with the Rural Industry Innovation Center (RIIC), ATIP has influenced the design of the Masda injection planter, harnesses, modified yokes, and cultivators. A document outlining ATIP's current thinking on a large number of technologies has been produced and has been circulated for comments within the Ministry of Agriculture. Many of these recommendations build upon the work by scientists outside of ATIP while others involve fine tuning recommendations already in existence (ATIP 1988). Some of the modified production practices recommended include double plowing, lightweight cultivators, hand-operated rotary injection planters, improved donkey harnesses, improved cropping systems, groundnut seed treatment, phosphate fertilizer, row planting, short season varieties, sole planting of secondary crops, and supplemental minerals for donkeys.

d) ATIP has generated considerable information about farmer circumstances, local markets, extension procedures, and the farmer assistance programs. Numerous reports have been published by ATIP documenting this information.

2. Institutional Capabilities Developed in the MOA to Execute Farming Systems Work

Training has been a very important component of the ATIP project. Training has been conducted at many levels and has been of many different types, including long-term training, short-term training, and on-the-job and in-service training. Forty person years of long-term training have been funded by USAID (Project Paper Supplement 1987) (see Table 1). In addition, another 15 person years of long-term training are being funded by GOB. Short-term training has emphasized training in FSR/E work. Over 42 individuals have benefited from short-term training. On-the-job training has mainly been provided by expatriate staff working closely with counterparts. ATIP has also offered in-service training courses primarily for extension personnel working for DAFS. Such in-service

training is viewed as important to establishing linkages between research and extension. Two hundred forty-eight professional and technical staff have received in-service training. ATIP provides support to the Botswana Agricultural College (BAC) and the University of Botswana in the form of lectures and some funds. Technical writing courses have also been sponsored by ATIP. ATIP has made a strong effort to provide training opportunities for staff in DAR, DAFS, and the Division of Planning and Statistics (DPS). The project recognizes that improving human resources in all three departments will be necessary to establish an effective FSR/E program.

TABLE 1: NUMBER, ORIGIN AND DEGREES OF THOSE SENT ON LONG-TERM TRAINING, ATIP RELATED FUNDS, 1982-87

	-SENT (USAID)-		----TO BE SENT (GOB)----			TOTAL
	B.S.	M.S.	B.S.	M.S.	Ph.D.	
Origin:						
DAR	3/a	3	--	--	1	7
DPS	4/a	2	1	--	--	7
DAFS	2	1	1	3	--	7
Discipline:						
Ag. Econ.	3	2	--	1	--	6
Agronomy	5	3	1	1	--	10
Animal Sc.	--	1	--	1	1	3
Rural Soc.	1	--	1	--	--	2
Total	9	6	2	3	1	21

a. One of these has also proceeded straight on to take an M.S. degree.

3. Linkages Strengthened

Linkages among the participating parties in the research/extension process help create an effective way of institutionalizing the process of FSR/E work in a low-cost manner (ATIP 1987). ATIP has made progress in strengthening linkages in the following ways:

a) ATIP has improved the linkages among project staff by holding six meetings per year.

b) ATIP has facilitated communication across FSR/E projects by holding two meetings per year, including one on-farm workshop.

c) Linkages between ATIP and farmers has been facilitated by the promotion of farmer groups for testing technologies and holding farmer field days in ATIP villages (Norman et. al. 1988). A recent survey conducted on ATIP farmer participants indicated that project activities have: 1) enhanced farmer confidence in research; 2) stimulated farmer-initiated activities; and 3) influenced farmer demand for technology (Hanson and Molutsi 1988).

d) Collaborative research exists between ATIP and on-station scientists on cowpeas, groundnuts, sorghum, farm equipment, and tillage (ATIP 1988). ATIP has worked closely with DAR scientists in improving livestock research on communal areas and providing farmer feedback on extension recommendations. New opportunities for collaboration are being developed through the creation

of "research theme" groups. On-station and on-farm researchers are working together to determine research priorities on specific themes (e.g., tillage/planting systems).

e) Linkages between research and extension are being promoted at the national level by the Research Extension Liaison Office and at the regional and district level through close collaboration with the RAOs, CPOs, and APOs. This regional collaboration with DAFS staff includes such activities as helping with farmer groups, organizing workshops for farmers, organizing competition in agriculture shows, and collecting baseline data for pilot projects for extension. ATIP has also taken steps to improve its linkages with the Arable Lands Development Program (ALDEP). ATIP helps monitor technology introduced by ALDEP and identifies new technology for ALDEP.

f) ATIP has established good working relationships with other government departments and development organizations as well. ATIP has been working closely with the Farm Machinery Development Unit and the Rural Industry Innovation Center on technology design. Collaborative research has also been undertaken with the Rural Sociology Unit, Division of Planning and Statistics, and the Departments of Rural Sociology and Economics at the University of Botswana.

4. Information Dissemination and Data Access

ATIP produces a series of research reports every year documenting the work it has completed. A computerized mailing list is used to help facilitate the distribution of these papers. ATIP also recently purchased a desktop publishing system for the Agricultural Information Section of DAFS to produce Agrinews, Agrifacts reports and papers in a more timely manner. Agrinews also has a farming systems work page which ATIP publishes in regularly. ATIP staff have also given seminars and lectures on topics related to their activities.

ATIP has made progress in documenting its databases and making them generally available to other researchers.

5. Farming Systems Work Support Activities Strengthened

There is growing support for on-farm research activities within DAR and DAFS. The government is presently considering what should be the appropriate model for institutionalizing FSR/E-type work. Future FSR/E efforts will largely depend on the actions taken by DAR.

D.5 Constraints

A number of constraints have been identified that have hindered ATIP's performance. Many of these constraints apply to the other three FSR/E projects as well, so they will be addressed under Section V which summarizes the constraints across projects. The more specific constraints associated with ATIP include:

1) ATIP has had difficulty gaining access to trained counterparts. This is primarily due to a shortage of qualified GOB personnel in general.

2) ATIP has had difficulty in retaining the services of returning trained

personnel. Such individuals are being placed by the GOB in other posts where they are urgently needed. This makes the localization of Botswana research personnel extremely difficult in project sites.

3) Due to excessive administrative duties, the Chief of Party has not been able to participate fully in field activities. Botswana staff had only limited opportunities to gain from his background as an experienced FSR/E researcher.

4) Two different FSR/E approaches were being implemented in the two agricultural regions in which ATIP was working. This made generalizations and comparisons across sites difficult to make.

5) The Research Extension Liaison Officer (RELO) was placed under the Crop Production Division of DAFS. Because he was loacted in one department, it was difficult for the RELO to promote linkages between research and extension or to coordinate activities.

6) ATIP did not have as big of an impact on policy decisions as it could have partially because of the format the project used to present research results.

7) Sociological input into the project was limited in the early years of project implementation. Recently, the Rural Sociology Unit and the Department of Rural Sociology at the University of Botswana and outside consultants have been used more effectively.

IV. Summary of Impacts of Farming Systems Projects in Botswana

Interviews conducted with government staff indicated that most viewed FSR/E work as important to agricultural development in Botswana. Both DAR and DAFS staff felt that farming systems work was important for testing technologies, obtaining feedback from farmers, and creating linkages between research and extension.

Taken together, the four donor-supported farming systems projects in Botswana have had a number of impacts. The major impacts included the following:

A. All four projects have made progress in helping to develop and test relevant technologies for limited-resource farmers. They have strongly influenced the design of appropriate equipment for limited-resource farmers and have contributed to the content of training courses for rural blacksmiths who will be responsible for the maintenance of this new equipment. In fact, thirteen of the technologies designed by the Farm Machinery Development Unit were initiated or requested by FSR/E projects (see Appendix C). In addition, all four projects have generated considerable information on farmer circumstances, local markets, and extension procedures. This information will be important to future interventions.

B. Several of the projects have created good linkages with research, extension, and other development institutions. This is especially true of ATIP. Several RAOs interviewed were very impressed with ATIP's model for coordinating research and extension. Extension activities have been enhanced by building upon on-farm demonstrations initiated by the FSR/E projects. Researchers have appreciated the farmer feedback on constraints, and such information is being taken into account in establishing research priorities. Communication across FSR/E projects has been facilitated by the two meetings that are held jointly each year. Aside from sharing

research results, such meetings help foster greater commonality of approach in FSR/E work.

C. The FSR/E projects have enhanced farmer confidence in research and extension. Farmer demand for technology has been influenced by on-farm trials such that farmers are now self-motivated to pursue the use of new technologies on their own. FSR/E projects have also improved farmers' understanding of the government programs from which they can benefit.

D. Although the results are mixed, some of the FSR/E projects have helped develop the institutional capabilities in the MOA to execute farming systems work. ATIP has especially been excellent in providing long-term and short-term training opportunities for individuals from research, planning, and extension.

E. All of the projects have developed the research infrastructure in the regions in which they have been working. This infrastructure could form the basis for efforts to de-centralize agricultural research in Botswana.

F. Three of the FSR/E projects participated in evaluating the GOB drought relief programs such as the Accelerated Rainfall Arable Production Program (ATIP 1988). This evaluation will enable policy decision-makers to determine their next course of action regarding these programs.

V. Summary of Constraints to Successful Implementation of FSR/E Work in Botswana

There are a number of constraints that have limited the success of FSR/E projects in Botswana. These include the following:

A. The severe drought conditions that have plagued Botswana from 1982 to 1987 have had a negative impact on research and extension. The government was obliged to concentrate many of its limited resources on drought relief programs rather than agricultural development programs.

B. The target areas where these projects were concentrating their efforts were considered to be too small for the amount of resources being used. For example, the FSSR project did not have much impact on the area outside of the community in which it worked.

C. The size of the expatriate staff, the level of their training, and their access to resources made them too visible in the eyes of national researchers. The donor-funded projects had maintained almost complete independence from the National Agricultural Research System. Competition arose, limiting the potential for collaboration between on-station and on-farm research.

D. All four projects have had tremendous difficulty in maintaining or gaining access to trained manpower. This is due to: 1) a shortage of qualified GOB personnel in general; and 2) the fact that Botswana staff were not that interested in living in rural areas where access to facilities and services were limited and opportunities for career advancement were minimal. National researchers who did work with the projects considered themselves temporarily assigned.

E. The four different farming systems projects are not under the same administrative umbrella. Two are under DAR (ATIP and ADNP) and two are under extension (MDP and FSSR). This poses problems for coordination of activities and commonality of approaches. Departments within the agricultural research system and extension program are organized vertically. Horizontal linkages across projects that follow different lines of authority are more difficult to establish.

F. FSR/E teams under donor sponsorship are under pressure to come up with quick results. Not only is this difficult to do given the harsh unstable climate of Botswana, but this approach is inconsistent with ongoing research programs conducted on-station.

G. The impact on policy, research, and extension has been partially limited by the format taken in the presentation of research results. Executive summaries and bulletins were not used as much as they should have been.

H. On-station researchers do not fully accept farmer assessments of technology as adequate justification for technology recommendations. This is especially true if the cause-and-effect relationships cannot be fully demonstrated. This dilemma can cause substantial delays in getting DAR approval of new recommendations.

I. Attempts to institutionalize farming systems work in the MOA may have been initiated too early. A proposal that was drawn up in 1985 by all the farming systems projects was shelved by the GOB. Many people in the national agricultural research and extension system were not convinced the FSR/E projects had yet proven themselves to be viable development approaches. They wanted to continue supporting farming systems work without making a commitment for full institutionalization at this time. Credibility for FSR/E work was severely hampered by the ongoing drought conditions.

J. Attempts to institutionalize FSR/E programs have been constrained by the limited funding available for multiple development programs. The FSR/E projects are competing with other development initiatives in terms of institutionalization.

VI. Lessons Learned

A number of important lessons have been learned from the Botswana Case Study with regard to FSR/E program institutionalization. These include:

A. All FSR/E projects should be under one administrative umbrella to coordinate research and approaches. In Botswana, FSR/E efforts should be coordinated under the DAR to improve the linkages between on-station and on-farm research. FSR/E teams placed under research divisions have better access to research results and can influence priorities more easily than those placed under extension. Extension linkages will be maintained with FSR/E teams because of their work in the regions. The majority of the MOA staff interviewed felt that this was the appropriate way to administer farming systems work.

B. If research activities in Botswana are to be decentralized, FSR/E teams could form the core of regional research teams working in different ecological zones. The current infrastructure established by the four FSR/E projects could form the basis of a network of regional research stations.

C. FSR/E activities carried out on a project basis independent of on-station research programs are usually unable to undertake long-term research. This leads to a failure to develop credibility among planners, on-station researchers, and extension agents. In addition, the scale of the projects may be the biggest barrier to national sustainability of externally funded development initiatives. Thus, FSR/E activities should not be initiated in a project mode unless they are well integrated with the existing research system.

D. Farming systems work can play an important bridging role between extension and research. All MOA staff interviewed recognized the importance of this role. FSR/E teams can test technologies for on-station researchers and provide feedback from farmers and extension personnel in setting research priorities. Due to farmers' variable access to resources, technologies are not always directly transferable from research to extension.

E. The reluctance of commodity-focused researchers to test and disseminate technologies and practices on farmers' fields until final solutions to production constraints are reached is limiting potential production improvements unnecessarily. There is a real need for best-bet alternatives to be offered to farmers so that they can participate in technology design and assessments.

F. Impact on agricultural policy is one area where FSR/E projects have not fulfilled their potential. The way results are presented is often the key. An honest assessment must be made as to what extension can use, what research can use, and what policy decision makers will read. Executive summaries that highlight major points could have significant impacts, especially if the information is packaged appropriately to address policy issues.

G. It will be difficult to retain trained manpower in the field unless incentives are provided and as long as career advancement is contingent on placement in a centralized research organization. Consequently, there is also little professional reward for interdisciplinary and inter-institutional collaboration. Despite this, human capital development is essential to the success of viable FSR/E programs.

H. A well-prepared plan or strategy that outlines the process of technology assessment could help improve the linkages between commodity-focused researchers, FSR/E teams, and extension. Such a plan would specify disciplinary responsibilities, methodological stages, and feedback channels. This plan could then be used to orient new researchers who come into the research or extension program.

I. One of the main limitations for FSR/E projects has been access to good on-shelf technologies for immediate agro-ecological adaptation. This is especially true for marginal areas under harsh conditions, often where FSR/E teams are assigned to work. Under such conditions research payoffs are often limited in the short run, and may take considerable time to develop. FSR/E programs have always been more successful in more favorable environments. In harsh climates, fewer successful interventions are available and it is often necessary to substantially modify the existing farming system. Thus, it is inappropriate to assume that viable results can be achieved in the same time frame for both types of environments. Such comparisons may have led to the impression that FSR/E approaches have not lived up to expectations (Baker and Norman 1988).

J. A major difference between on-station testing of technology and on-farm testing is

the value placed on cause-and-effect relationships. On-station trials focus on such relationships, whereas on-farm trials are less controlled. Farmer assessments play a key role in such trials, which are not necessarily considered valid to on-station researchers. This can influence the speed at which research recommendations are passed on to extension. In addition, the need of some researchers to determine cause-and-effect relationships in on-farm trials has influenced the emphasis placed on farmer-managed technology validation.

K. Projects that focus on short-term technology generation and/or production objectives may impede the integration of the FSR/E approach into the national agricultural system.

L. Many of the FSR/E projects have not effectively used social science input until recently. Despite the importance of characterization of areas, anticipating sociocultural problems, and the need for baseline studies to be used as comparisons for evaluations, very few social scientists have been used in the FSR projects. This is due both to a shortage of trained personnel as well as to perceptions on the part of technical scientists. Consideration should be given as to how social science input can be more useful to ongoing research activities.

VII. Conclusions and Recommendations

As stated earlier, much of the groundwork necessary for effective implementation of on-farm research was already laid prior to the actual appearance of FSR/E activities in Botswana. The extension service had become decentralized and was implementing bottom-up approaches for identifying farmer constraints. Improvements in the collection of agricultural statistics shed light on the intra- and inter-regional differences that existed among farm households On-farm testing of recommended technical packages pointed to the need for more information on farmer practices and constraints. All of these developments enhanced the GOB's understanding of farmer circumstances, which helped identify areas for future agricultural research. It was within this context that the farming systems research and extension projects were initiated.

This paper has reviewed the four farming systems projects presently being implemented in Botswana, and has summarized a number of the impacts and constraints associated with them. A number of lessons learned were also derived from this review. Building upon this information, a number of recommendations can be proposed that may help contribute to the institutionalization and sustainability of FSR/E work within the Botswana national agricultural research and extension system. These recommendations deal with organizational structure, training, commonality of approach, process of technology assessment, linkages, and information dissemination.

A. Organizational Structure

1. All FSR/E programs should be under one administrative umbrella. Placing them under DAR as a subdivision or unit would be appropriate so that both crop and livestock research could be incorporated. The majority of the staff from both DAR and DAFS that were interviewed felt that FSR/E work should be organized under research. This is primarily because FSR/E teams placed under research divisions have better access to research results and can influence priorities more easily than those placed under extension.

2. Agricultural research activities in Botswana should be decentralized and conducted in different agro-ecological zones. FSR/E teams could form the core of regional research teams working in different ecological zones. The current infrastructure established by the four FSR/E projects could form the basis of a network of regional research stations. Current thinking in DAR seems to be supportive of this idea. Many researchers and extension staff felt that GOB could pick up the recurrent costs except housing and offices. Donor support would still be needed for infrastructural development, training, and technical assistance. The establishment of regional research stations would be gradual, building upon existing substations. The number of regional sites for on-farm testing would be consolidated to use limited staff more effectively.

3. A committee should be formed to oversee FSR/E activities. Committee members would be drawn from DAR, DAFS, and DPS. The coordinator of FSR/E work for DAR would also be present. Meetings could be held quarterly to review accomplishments and problems that should be addressed.

4. The ongoing agricultural sector assessment could provide a mandate for the proposed organizational structure. During the assessment, the GOB must consider the importance of balancing operational support to both research and development to ensure that future FSR/E work has adequate resources.

B. Training

1. Considering that the major constraint to FSR/E institutionalization is the number of trained staff available, donors should continue to provide long-term and short-term training opportunities for individuals in research, planning, and extension. The ATIP model has been excellent in providing this assistance, and should continue to be followed. The Government of Botswana does provide some funding for long-term assistance, but not at the levels that are presently needed

2. Due to the shortage of qualified GOB personnel, it will be difficult to place Ph.D.-level or M.Sc.-level trained professionals in the field. Thus, it is likely that farming systems activities will be staffed by mostly BS-level trained people. Such staffing will be appropriate if good guidance can be provided by on-station researchers on problem definition, experimental design, and data analyses.

3. Incentives should be provided to trained personnel to retain their services in the field. Such incentives might include improved salaries, infrastructural support (e.g., housing, offices, transport), and training opportunities. Researchers should be rewarded for interdisciplinary and inter-institutional collaboration. Unless incentives are provided through a career structure developed by the MOA, it will be difficult to retain trained manpower in the field.

4. One way to encourage returning researchers to work in regional positions is to institute a two-year apprenticeship program. This program could require returning graduates to work two years in a regional station prior to taking a position in the central research organization. The effectiveness of such a program will depend upon how urgently the returning graduates are needed to

fill other GOB posts.

5. More in-service training should be provided by FSR/E researchers for extension staff. This is especially true for subject-matter specialists conducting comparison trials.

6. The training provided to students at BAC in FSR/E methods needs to be improved. A regular course should be offered each year on FSR/E methods. This will ensure that the BAC graduates who are being placed in regional research stations are familiar with FSR/E techniques.

C. Commonality of Approach

1. If FSR/E efforts are to be coordinated under one administrative umbrella, then steps should be taken to ensure that all of the FSR/E teams use the same approach and terminology. Presently an FSR/E handbook is being put together by ATIP. This handbook could provide the mechanism for reaching agreement. Thus, feedback from the other FSR/E teams is essential in developing the handbook. This handbook can incorporate the MDP model for training farmers, the FSSR model for working with extension and ideas on livestock, and the ATIP model for on-farm testing methodologies.

2. To aid in the consolidation of approaches and terminology, an unbiased group from outside could be brought in. This group could look at all of the FSR/E projects and determine what should be the major components to include in the handbook.

D. Process for Technology Assessment

1. There is a need for a coherent approach to research planning and setting priorities. The Technology Evaluation Committee should be reestablished to facilitate this research planning. Membership of the committee should include representatives from DAR, DPS, and DAFS as well as the Permanent Secretary. The committee could discuss policy issues and give technical direction to DAR. The committee would also be assigned the task of giving final approval to technologies or modified production practices that are being considered for extension recommendations. Periodically, the committee could schedule visits to on-station research plots and on-farm trials to monitor research progress and technology development. The committee would meet at least once a year.

2. To assist the Technology Evaluation Committee, research theme groups would be formed to help sort out priorities and screen technologies and practices. Interdisciplinary teams consisting of on-station and on-farm researchers would work together to determine research priorities on specific themes. A good example of one of these working groups is the group working on tillage/planting systems. Other commodity programs could benefit by forming groups on other themes.

3. The on-shelf technologies and production practices currently recommended in Agrifacts do not adequately take into account locational specificity. The farming systems teams can work closely with on-station researchers to fine tune recommendations to take the variability of farmers' resources into account. Such fine tuning would take into account farmer criteria in

assessments of technology and practices. Options should be developed to match differences in resources, and contingency plans should be developed to suit changing circumstances such as erratic rainfall (ATIP 1988).

4. In assessments of extension recommendations, careful consideration should be given to whether the existing government policies and institutional environment are compatible with the proposed recommendation. This process will help determine what changes might be needed at the policy level to enhance farmer adoption.

5. To improve the targeting of extension recommendations, extension staff should continue to receive in-service training. The training will help extension staff obtain skills in communication and improve their knowledge of the technology being recommended (ATIP 1988).

E. Linkages

1. The ATIP project has provided a good model for how linkages can be established with other government departments and organizations. Linkages among the various groups in the research/extension process help institutionalize FSR/E work in a cost-effective manner. To be effective, future FSR/E programs will have to establish good linkages within DAR as well as with DAFS, DPS, ALDEP, RIIC, FMDU, BAC, and the University of Botswana.

F. Information Dissemination

1. There is a need to summarize research results for decision makers, highlighting the important items. An honest assessment must be made as to what extension can use, what research can use, and what policymakers will read. Information should be packaged appropriately to address policy issues.

2. All FSR/E project reports and publications should become DAR publications.

3. Better collaboration between commodity researchers and FSR/E researchers can be facilitated through joint authorship of reports and papers.

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APPENDICES

APPENDIX A

PERSONS AND INSTITUTIONS CONTACTED

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Mr. P. Daly, USAID Mission Agricultural Development Officer
Mr. Gilbert Motsemme, Chief Agricultural Economist
Mr. John Larson, Planning and Statistics
Mr. K. K. Mmopi, Coordinator of ALDEP
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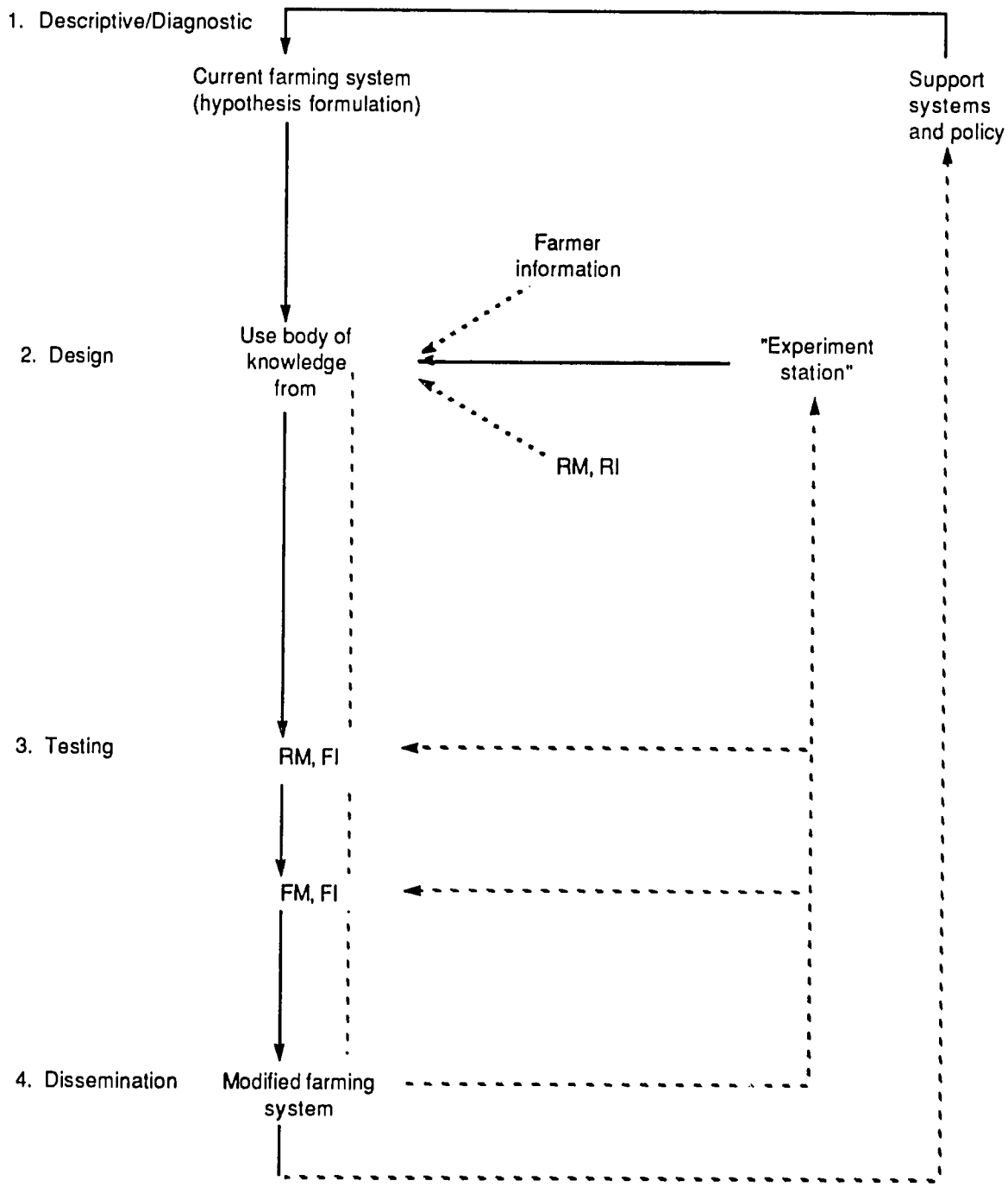
Mr. Levy Modidi, Coordinator, FSSR Project
Mr. Babati Edward Moji, Regional Agricultural Officer, DAFS (Kanye)
Mr. Ernest Makwatje, ATIP
Director of Molapo Development Project

APPENDIX B

THE FARMING SYSTEMS APPROACH TO RESEARCH



Key:
R = Researcher
F = Farmer
I = Implemented
M = Managed

APPENDIX C

Technologies Developed by the Farm Machinery Development Unit

Technology	Initiated or Requested by:
Sebele fertilizer applicator	EFSAIP, tool carrier improvements
Sebele standard planter	EFSAIP, tool carrier improvements
S.S.P. hilldrop attachment	EFSAIP, to improve mz planting performance
S.S.P. row marker	Visiting farmers, NADP (Dr. Loos)
S.S.P. weeder bar	From obs. by BAC lecturer G. Roberts, ARS
S.S.P. cupfeed	To plant groundnuts, A. Meyeux, ARS
S.S.P. incline plate feed	To plant groundnuts, A. Meyeux, ARS
Sebele plough planter	EFSAIP, participating farmers
Tractor plough planter	Agric. contractor, T. Rennie (i.e., APRU)
Larger hopper t. pl. planter	Farmer user, DAO's request
Light weeder for donkeys	ATIP requests G. Henrich
Light weeder/blade harrow	ALDEP and ATIP, G. Henrich
2 furrow plough planters	District extn staff, ALDEP
Automatic tie ridger	EFSAIP/ARS
Hand op. baler	M. Taylor, APRU
Jab planter/local version	ATIP
Chisel plough, animal drawn	Intsomil/ALDEP
Pole plough frame	EFSAIP extn officer & CRSP
Dammer diker	Idea passed on by ATIP
Improved yokes	Dr. Kherteker, consultant
Improved donkey swingletrees	EFSAIP & CRSP
Single yokes	EFSAIP, ARS

EFSAIP	=	Evaluation of Farming Systems & Agricultural Implements Project
NADP	=	Ngamland Agricultural Development Project
BAC	=	Botswana Agricultural College
ARS	=	Agric. Research Station Content Farm Sebele
APCU	=	Animal Production Research Unit
DAO	=	District Agric Officer, Dept. of Agric Field Service
ATIP	=	Agric Technology Improvement Project
ALDEP	=	Arable Lands Development Project
Intsomil	=	Int'l Sorghum & Millet Improvement Project
CRSP	=	Cowpea/bean Seed Improvement Project