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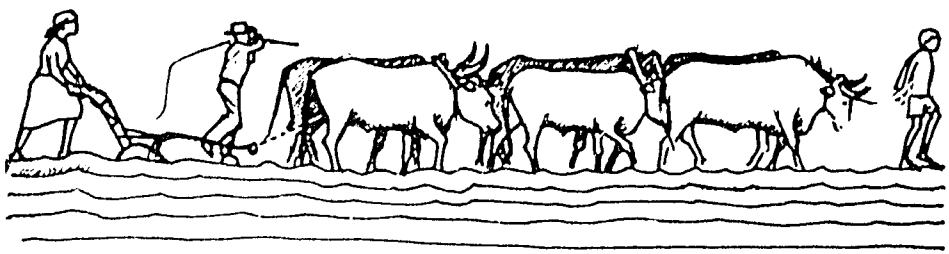
AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT (ATIP)

ANNUAL REPORT NUMBER 6



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AGRICULTURAL TECHNOLOGY IMPROVEMENT PROJECT

(ATIP)

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FOREWORD

This report is divided into four parts as follows:

I: Executive Summary
II: Summary of Activities, September 1986 - August 1987
III: Work Plan, September 1987 - August 1988
IV: Financial Plan, September 1987 - August 1988

In addition there is an appendix which contains a list of all the papers written by ATIP staff since the inception of the project.
An attempt has been made to continue the format adopted in the last two years of reducing the amount of empirical material reported on the survey and trial work. This material is available in papers listed in the appendix.

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GLOSSARY

AD	Agricultural Demonstrator
ADNP	Agricultural Development Ngamiland Project
AED	Academy for Economic Development
APD	Animal Production Division
APRU	Animal Production Research Unit
ARAP	Arable Rainfed Accelerated Project
ATIP	Agricultural Technology Improvement Project
BAC	Botswana Agricultural College
BAMB	Botswana Agricultural Marketing Board
CARO	Chief Arable Research Officer
CBP	Contour Bed Plowing
CIMMYT	International Maize and Wheat Center
CPO	Crop Production Officer
CRSP	Collaborative Research Support Program
CTO	Central Transport Organisation
DAO	District Agricultural Officer
DAR	Director of Agricultural Research
DAFS	Director of Agricultural Field Services
DLFRS	Dryland Farming Research Scheme
DPS	Division of Planning and Statistics
EEC	European Economic Community
EFSAIP	Evaluation of Farming Systems and Agricultural Implements Project
FAB	Forestry Association of Botswana
FMFI	Farmer Managed and Implemented
FMU	Farm Management Unit
FSRLA	Farming Systems Research Liaison Agronomist
FSSR	Farming Systems Southern Region
FSW	Farming Systems Work
GOB	Government of Botswana
HPS	High Potential Site
IITA	International Institute for Tropical Agriculture
IFPP	Integrated Farming Pilot Program
INTSORMIL	International Sorghum and Millet CRSP
ISNAR	International Service for National Agricultural Research
KSU	Kansas State University
LAC	Livestock Advisory Center
LBDR	Labor Based Drought Relief
LOP	Life of Project
LUO	Land Utilisation Officer
LWMRP	Land and Water Management Research Project

MOA	Ministry of Agriculture
MDP	Molapo Development Project
MIAC	Mid-American International Agricultural Consortium
PPS	Project Paper Supplement
RELO	Research Extension Liaison Officer
RAO	Regional Agricultural Officer
RECU	Research Extension Coordinating Unit
RIIC	Rural Industry Innovation Center
RMFI	Researcher Managed and Farmer Implemented
RMRI	Researcher managed and Implemented
RSU	Rural Sociology Unit
RTC	Rural Training Centre
SACCAR	Southern African Center for Cooperation in Agricultural Research
SADCC	Southern African Development Coordination Conference
SLOCA	Services to Livestock Owners in Communal Areas
SMU	Seed Multiplication Unit
SMS	Subject Matter Specialist
SCS	Soil Conservation Section
UNDP	United Nation Development Program
USAID	United States Agency for International Development
USAID/B	United States Agency for International Development in Botswana

PART I: EXECUTIVE SUMMARY

CHAPTER 1: EXECUTIVE SUMMARY

1.1 PREAMBLE

The major purpose of ATIP is to develop and extend farming systems recommendations, relevant to the needs of the small (limited resource) farmer. Essential to this effort are the Mahalapye and Francistown farming systems teams, and the liaison activities between research and extension. The actual steps and attributes of farming systems work (FSW) can be found in previous Annual Reports.

During the existence of ATIP there have been two External Mid-Term Reviews. These have generally been favorable, although it has been noted that there is room for improvement, especially in terms of linkages between FSW and extension and on-station research. It has also been emphasized that there is a need to analyze issues that inhibit or facilitate the adoption of technologies. There was a recognition in the external evaluation reports of the complementarity of relevant technologies and relevant policies for improving the productivity and, therefore, hopefully the welfare of farming families.

The current contract with MIAC was due to expire on December 1st, 1987. Due to representations on the part of the Government of Botswana (GOB) and USAID/B the contract with MIAC was extended to September 28th, 1990. This has been made possible due to the availability of unspent funds. No new funding is being placed in the project.

There are a number of changes in the extension of the project which involve greater emphasis on the linkage functions together with continuing major efforts on the technology and training fronts.

This last year, the decision was made to state results and the new work plan in terms of themes. Therefore to facilitate comparisons with the work plan drawn up and outlined in the last Annual Report No. 5 (Chapters 9 to 13), the section numbers used in the work plan have been given after the relevant heading in this report. In terms of chapter headings direct comparison is possible as shown in Table 1.1.

TABLE 1.1: CROSS REFERENCES BETWEEN ANNUAL REPORT NO. 5 AND THE CURRENT ANNUAL REPORT

	Chapter in Report	
Topic	Current Report	Annual Number 5
Personnel and Equipment	3	9
Training	4	10
Sebele/Gaborone	5	11
Mahalapye	6	12
Francistown	7	13

1.2 PERSONNEL AND EQUIPMENT

There have been a number of changes over the last year. Mr. Mabongo and Mr. Tjirongo left, and have been replaced by Miss Tibone and Mr. Makhwaje, both of whom recently returned from long-term training. Mr. Ramolemana has also recently returned and has been appointed RELO. In terms of expatriates, Drs. Trent, Gray and Baker have

left while Drs. Hill, Persaud and Thedford arrived. Miss Bock also finished her tour as a Peace Corps Volunteer. Currently only Drs. Thedford and Norman have no counterparts working with them.

In terms of support staff, Mrs. Snyder was hired towards the end of the reporting year as another administrative assistant but, apart from this, there have been very few changes in support staff. A number of vacancies still exist. There were a number of consultants and visitors during the year. Consultants included Drs. Hansen, Molutsi, Esslinger and Messrs Brandsburg and Mogalakwe.

Apart from uncertainty over the future of Dr. Baker's position, it is anticipated there will be few changes in staffing during the coming year. A number of consultancies are planned.

In terms of equipment, a number of microcomputers have been purchased, both laptop and desk models, and a desk top publishing system has been purchased for the Agricultural Information Section in DAFS. Also three vehicles purchased out of project funds have been ordered, two of which will have GOB (BX) plates. It is anticipated that relatively little equipment will be purchased during the coming year.

1.3 TRAINING

In terms of individuals directly funded under ATIP, seven have returned in the last six months -- four at the MS level and three at the BS level. These included individuals from DAR, DPS and DAFS. In addition, two individuals departed for MS degrees under project financing, while a third will depart in January 1989. In addition, three individuals were sent for long term training under matching funds from GOB.

With reference to short-term training, a number of trips abroad have been financed out of ATIP funds, including a visit of farming systems projects by senior MOA personnel to Ethiopia and Zimbabwe. In addition, individuals have been sent on short-term training in the areas of irrigation, seed evaluation, and microcomputer and agronomy training.

For in-service training, people have been sponsored for training in word processing (Word Perfect) and technical writing.

ATIP staff have given a number of lectures at BAC and the University of Botswana, and a number of field days for farmers have been held.

Training activities will continue to receive considerable emphasis during the coming year.

1.4 LIAISON BETWEEN RESEARCH AND EXTENSION

The RELO's office was heavily involved in research/extension liaison activities throughout the year. Components of this involve numerous meetings, particularly with extension staff, sitting on a number of committees including the National Training Committee, facilitating the processing of farming systems type articles for Agrinews, producing more than 20 written and revised Agrifacts, helping get the desk top publishing system set up in the Agricultural Information Section in DAFS, and helping with the Training the Trainers Program in DAFS. Plans for next year are basically the same.

In addition, other staff in ATIP spent a lot more time in research/extension type activities, through discussing with extension personnel research planned and progress in

implementing it, informing ADs in the ATIP villages of the work being undertaken, in joint activities outside the ATIP villages, participating in training courses for farmers, etc. Still more effort is needed by all ATIP staff members to help bridge the gap between research and extension within the regions. At the moment ways are being explored of formalizing this linkage, rather than continue the current format where linkages are largely based on personal relationships.

1.5 RESEARCH ACTIVITIES

1.5.1 ACTIVITIES, SEPTEMBER 1987 TO AUGUST 1988

In terms of rainfall (Table 1.2), this last year has been the best since ATIP started. The rainfall up to the end of December was very satisfactory in both locations. However, this was followed by a very dry period in January after which the rains returned with a vengeance in February. Up to the end of March 1988 the total rainfall was 709mms (long term average 409mms) in the Francistown area, and 682mms (long-term average 398mms) in the Mahalapye area. This has created a very different type of season from the previous years and the expectation is that yields will be considerably higher and the failure rate will be lower. One area of concern is however, continuation of the rains for too long. There is some evidence that head mould in sorghum, aflatoxin in groundnuts and pod rot in cowpeas could be problems. Also, there was evidence of pest and disease attack on cowpeas and groundnuts as a result of the heavy rains.

TABLE 1.2: MONTHLY RAINFALL (MMS) AT MAHALAPYE AND FRANCISTOWN, 1982-87[a]

	Mahalapye							Francistown						
Month	30 Year Average	1982 -83	1983 -84	1984 -85	1985 -86	1986 -87	1987 -88	30 Year Average	1982 -83	1983 -84	1984 -85	1985 -86	1986 -87	1987 -88
July	2	0	2	0	0	1	0	0	0	0	0	0	0	0
August	3	0	1	0	0	0	0	1	4	12	0	0	0	0
September	10	0	0	5	0	0	6	8	0	0	0	0	12	4
October	31	85	20	34	44	64	6	24	63	89	34	33	66	7
November	65	51	99	45	10	62	64	62	24	123	76	14	67	54
December	77	35	64	30	67	62	149	102	39	84	49	49	61	238
January	85	49	58	58	7	36	35	99	61	5	137	34	68	41
February	71	30	43	26	71	15	350	84	42	20	134	33	31	254
March	54	46	97	45	14	12	91	46	42	146	18	59	7	114
April	30	22	6	0	59	14	72	26	108	17	0	112	0	12
May	7	6	1	5	0	0	0	11	6	0	0	0	0	0
June	1	5	0	0	0	0	0	2	0	0	0	0	0	21
Total	435	329	361	248	272	266	773	464	389	496	448	334	312	742

a. The figures for the individual years are the average for the ATIP villages in each area. The long term averages are for Mahalapye and Francistown.

A summary of the status of the trials and surveys at Mahalapye and Francistown is given in Tables 1.3 and 1.4. The section numbers refer to those in which they are discussed in Annual Report 5. In this report the numbers are recorded in brackets after the relevant section in which they are discussed.

(a). **Mahalapye.** The first rains arrived late in the season. Therefore farmers were unable to plough and plant early, which limited the final area planted and the interest in implementing early season tillage. However, after the end of November, rainfall was well above average and, as a result, crop production was generally impressive.

In spite of uncertainty about staffing, particularly with respect to the agricultural economics representation, considerable progress was made. A number of trials were undertaken. In fact approximately 160 trials were implemented on 60 separate farms in Makwate, Shoshong and Makoro villages. In general data

gathering procedures moved smoothly, allowing for extensive observation of trials' progress. The data analysis was enhanced due to an increase in field staff involvement in the FMFI trials program. FMFI work took place in the areas of dual purpose cowpea variety trials, forage cowpea variety trials, and groundnut hilling under sowing trial and a row planting custom hire scheme. Also linked with row planting, which considerable emphasis, was an evaluation of the hand pulled rotary injection planter.

At the same time a number of studies were undertaken at the RMRI level particularly revolving around the area of rainfall runoff measurement and management. Some of this work was coupled with development of high potential sites.

The departure of Dr. D. Baker also resulted in several working papers based on the work he did over the years. Also before he left, he participated in the preparation of the Agricultural Sector Assessment Study currently underway in GOB.

(b). **Francistown**. This year was a difficult year for farmers in the Francistown area for several reasons. Firstly, most areas received no rain between February and late November 1987, thus many farmers lost their plowing animals, and those animals that lived were in very poor condition. Secondly, there were almost continual rains during the months of December and February, causing water logged soils (particularly in Marapong) and limiting the number of days farmers could actually get into the field to plow/plant. Finally, the greater than average rainfall favored the invasion of birds and grasshoppers, which virtually destroyed many fields and trials.

During the 1987-88 cropping season, FMFI testing conducted through farmer groups became a major part of the overall research program. In the three ATIP villages, 143 farmers participated in group activities and they signed up to implement 241 separate trials. In actual fact 152 of the implemented trials actually produced some grain yield. They included the following technologies: double plowing, groundnut seed treatment, cowpea variety trials, row planting versus broadcast planting, fertilizer trials, and long and short season crop mix trials. Double plowing trials were significantly better than the traditional checks -- and gave the greatest percent yield increase. Similarly, trials with treated groundnuts and those with phosphate fertilizer were also successful, while of the cowpea varieties, B005C yielded best, followed by TVX.

An extension-led farmers' group in Mapoka had 30 members who provided some interesting demonstrations for a popular field day. This type of extension group is being expanded in 1988-89.

Other trials which produced interesting, but inconclusive results, were the cropping systems study, and the double plowing systems trials. The improved donkey harness, and the rotary injection hand row planter were both extensively tested, and suggested modifications are being made by RIIC. The regional ALDEP office in Francistown has ordered 66 harnesses for marketing test in the ALDEP program.

An initial demonstration of plants useful for agro/forestry conducted at the ATIP compounds and by one farmer, produced mixed results. Goat monitoring work continued, and several publications were completed by Dr. R. Gray before he left in February.

Monitoring of the farming system continued with the cooperating farmers study, the small stock and grain trading and prices study, and the rainfall and temperature monitoring activities. Indications are that use of the governmental agricultural programs remains high. There were also results indicating that there was a reduction in the number of families who used animal traction for plowing. This reduction may be attributed to the continued drought.

Finally, an extensive baseline survey was carried out on the Matsitama/Mokubilo Pilot Communal Grazing Project area. These data will aid the extension service in their project planning activities.

1.5.2 PROPOSED ACTIVITIES, SEPTEMBER 1988 TO AUGUST 1989

A summary of the proposed studies, trials and surveys for Mahalapye and Francistown is given in Table 1.5 and 1.6.

(a). **Mahalapye**. Most of the themes in the current work plan are a continuation of those from work in previous seasons (i.e., tillage, land and water management, commodity support research, etc.). Even when the work is on new technologies (i.e., soil building with kraal manure), research is building on previous research at Mahalapye and elsewhere. The soil building work is based on results from several season's work by INTSORMIL on-station and from high potential site developments of the past two years.

Design and testing work over the coming year will hopefully result in closure on several useful technologies before the end of the project. Nevertheless, other areas of work, for example, soil building are just beginning and probably will not be completed by 1990. However, these are useful research areas and the work being carried out now, will contribute to the establishment of a healthy technology development pipeline.

The current emphasis on a row planting package theme has brought many project activities together. While DAR has been very instrumental in promoting row planting, information on row planting with area farmers has been derived from research conducted by ATIP. As a result, the decision to co-sponsor or facilitate activities that promote row planting has generated a positive spirit of collaboration amongst MOA agencies in the region. It is intended that this collaboration will continue.

Apart from a major emphasis on various aspects with row planting, other areas of specific investigation will involve working with the cowpea program in evaluating varieties, and with the groundnut program in a similar way.

At the same time, it is expected that a great deal of writing up and analysis will be done over the coming year. Also it is intended that time will be spent with other farming system researchers in developing a handbook for farming systems work.

(b). **Francistown**. The primary thrust of the ATIP Francistown team will continue to be an integrated program to study specific interventions from the technical and economic standpoint. In order to identify specific interventions for promotion in this area, the team will continue to emphasize the collection of plot level technical and economic data so that comparative analysis can be made. More emphasis will be placed on the preparation of materials covering technologies which are provisionally ready for dissemination. In addition, databases created over the last

five years will be documented and the process of obtaining closure on several areas of research will be initiated. The entire team will participate in the drafting of a "Farming Systems Handbook for Botswana".

Agronomy trials will continue the thrusts started previously and will include a national level tillage system trial. FMFI testing with farmer groups will be an important part of the agronomy trials work. An additional extension led farmers group will be supported by ATIP staff.

The focus of the animal science work this year will be the testing of an improved management system for milk goats, coupled with a study of deceased kids to determine the major causes of kid mortality. Additional collaboration with extension staff is planned.

Farm management activities will include the continued monitoring of the farming system and support/collaboration with the agronomy and animal science trials. There will be increased emphasis on counterpart training and the documentation of data bases.

TABLE 1.3: STATUS OF SURVEYS AND TRIALS, ATIP MAHALAPYE, 1987-88 SEASON*

Theme	Survey or Trial	Section	Type	Status
Cropping Systems:				
	Sorghum/Melon Mix	6.2.1	RMFI Descript/Diagnos ST	Analysis 12 farms done
Commodity Systems:				
	Sorghum Variety Trial	6.3.1	RMRI Testing TR	Analysis of 3 sites done
	Dual-Purpose Cowpea Variety Trial	6.3.2	FMFI Testing TR	Analysis of 23 sites done
	Forage-Cowpea Variety Trial	6.3.3	FMFI Testing TR	Analysis of 23 sites done
	Groundnut Hilling-Undersowing Trial	6.3.4	FMFI Testing TR	Analysis of 17 sites done
Tillage and Planting Practices:				
	Row Planting Custom-Hire Scheme	6.4.1	FMFI Design/Testing TR	Analysis of 21 sites done
Post-Establishment Practices:				
	Weed Problem Study	6.5.1	Descript/Diagnos ST	1 village completed
Soil and Water Management:				
	Site Characterization Study	6.6.1	Descript/Diagnos ST	50 farms investigated
	Rainfall Run-off Measurement Study	6.6.2	Descript/Diagnosis ST	3 plots intensively studied
	Rainfall Run-off Management Study	6.6.3	RMRI Design/Testing TR	Analysis of 4 farms done
	Development of High Potential Sites	6.6.4	RMFI Design/Testing TR	Analysis of 10 sites done
Farm Equipment:				
	Row Planter Assessment	6.7.2	Descript/Diagnos SU	Incomplete
	Rotary Injection Planter Trial	6.7.1	FMFI Design/Testing TR	Analysis of 14 sites done
Markets:				
	Resource And Product Valuation	6.8.1	Descript/Diagnos ST	Analysis complete
Farmer Assistance Programs:				
	ARAP And DR Program Analysis	6.9.1	Descript/Diagnos SU	Analysis done, exec. report

See footnote in Table 1.4.

TABLE 1.4: STATUS OF SURVEYS AND TRIALS, ATIP FRANCISTOWN, 1987-88 SEASON*

Theme	Survey or Trial	Section	Type	Status
Cropping Systems:				
	Cropping Systems Studies	7.2.1	RMRI Testing TR	Implemented as planned; 6 farmers
	Evaluation of Triple Purpose - Cowpeas vs. Dolichos Lab-Lab	7.2.2	RMFI Testing TR	Not implemented; excess rain
	Agro-Forestry/Alley Cropping	7.2.3	RMFI Testing TR	Done ATIP compounds, 2 farmers
Tillage and Planting Practices:				
	Double Plowing Systems Trial	7.3.1	RMFI Testing TR	Implemented on 6 farms
Soil and Water Management:				
	Water Harvesting Trial	7.4.1	RMRI Testing TR	Implemented on 3 farms
Farm Equipment:				
	Evaluation of Improved-Donkey Harnesses and Ox Yokes	7.5.1	FMFI Testing TR	Implemented 15-20 farmers
	Evaluation of Rotary Injection Hand Row Planter	7.5.2	FMFI Testing TR	Implemented 20 plus farmers
	Testing Low Lift Hand Water Pump	7.5.3	RMFI Testing TR	Implemented 2 locations
Livestock Production Systems:				
	Goat Production	7.6.1	RMFI Testing TR	Done as planned; 20 farmers
Household Circumstances:				
	Cooperating Farmers Study	7.7.1	Descript/Diagnos SU	Done as planned; 28 farmers
Markets:				
	Small Stock/Grain Trading/Prices	7.8.1	Descript/Diagnos SU	Done as planned; 6 sources
Extension Linkages:				
	Matsitama/Mokubilo Pilot-Communal Grazing Project	7.9.1	Design Study	Baseline census of 307 households
Environmental Monitoring:				
	Rainfall/Temperature Monitoring	7.10.1	Descript/Diagnos ST	Done as planned
Methodology:				
	FMFI Options Testing with Farmer Assessment Groups	7.11.1	FMFI Testing TR	Done 4 villages; 150 farmers
	(Extension Led Farmer Group	7.11.1	FMFI Testing ST	Done 1 village; 30 farmers)

RMRI = Researcher Managed/Researcher Implemented
RMFI = Researcher Managed/Farmer Implemented
FMFI = Farmer Managed/Farmer Implemented
SU = Survey
ST = Study
TR = Trial
Descript/Diagnos = Descriptive/Diagnosis

TABLE 1.5: PROPOSED SURVEYS AND TRIALS, ATIP MAHALAPYE, 1988-89 SEASON*

Theme/Survey or Trial	Section	Type	No.*	Sample Size	Investigator Main	Investigator Co.	Final Year
Cropping Systems:							
Sorghum/Melon Mix	12.2.1	Descrip/Diag ST	1	12 farmers	AG	FM	1988-89
Evaluation of Agro-Forestry Improvement Potential	12.2.2	Descrip/Diag SU	0	Variable	FM	AG	1988-89
Phosphate Fertilizer and Utilization of D. lab-lab	12.2.3	RMFI Testing TR	1	5 farmers	FM/AG	EXT	1988-89
Commodities:							
Evaluation of Medium Maturity Cowpea Variety (TVX 2236)	12.3.1	RMFI Testing TR	1	6 farmers	FM	AG	1988-89
Evaluation of Drought Resist. Groundnut Variety	12.3.2	RMFI Testing TR	0	6 farmers	FM	AG	1988-89
Tillage and Planting Practices:							
National Tillage Trial	12.4.1	RMRI Design TR	2	3 farms	AG	FM	1989-90
Row Planter Condition Study	12.4.2	Descrip/Diag SU	0	Variable	AG/FM	EXT	1988-89
Cultivator Evaluation	12.4.3	RMFI Testing TR	0	5 farmers	AG	FM	1988-89
Row Plant Fertilizer Trial	12.4.4	RMFI Testing TR	1	9 farmers	AG	FM	1989-90
Field Development:							
Manure Resource Assessment	12.5.1	Descrip/Diag ST	1	30 farms	FM	AG	1988-89
Evaluation of Manure Appl.	12.5.2	RMRI Testing TR	1	9 farms	AG	FM	1989-90
Evaluation of Runoff Management Systems	12.5.3	RMRI Design TR	2	4 farms	AG	FM	1988-89
Whole Field Runoff Control	12.5.4	RMFI Design TR	0	4 farms	AG	FM	1988-89
Farm Equipment:							
Rotary Injection Planter	12.6.1	RMFI Testing TR	2	9 farmers	FM/AG		1988-89
Improved Donkey Harnesses	12.6.3	FMFI Testing TR	1	Variable	FM/AG	EXT	1988-89
Groundnut Planter	12.6.3	RMFI Testing TR	1	2 farmers	FM	AG	1988-89
Household Circumstances:							
Cooperating Farmers Study	12.7.1	Descrip/Diag SU	6	30 farmers	FM	AG	CONT
Environmental Monitoring:							
Rainfall and Temp. Monitoring	12.8.1	Descrip/Diag ST	6	Variable	AG		CONT
Rainfall Runoff Measurement	12.8.2	Descrip/Diag ST	1	3 plots	AG		CONT
Methodology:							
Standardization of Units of Measurement	12.9.1	Descrip/Diag ST	0	Variable	FM	AG	1988-89
Research Group Methodology	12.9.2	RMFI Design ST	3	Variable	FM/AG	EXT	CONT

See footnote in Table 1.6 for details.

TABLE 1.6: PROPOSED SURVEYS AND TRIALS, ATIP FRANCISTOWN, 1988-89 SEASON*

Theme/Survey or Trial	Section	Type	No.*	Sample Size	Investigator Main	Investigator Co.	Final Year
Cropping Systems:							
Sorghum/Cowpea Intercropping	13.2.1	RMRI Testing TR	2	6 farmers	AG	FM	1989-90
Crop Mix Study	13.2.2	FMFI Testing TR	1	FMFI Farmer Group	AG	FM	1989-90
Agro-Forestry/Alley Cropping	13.2.3	RMRI Testing TR	1	5 farmers	FM	AG	1989-90
Tillage and Planting Practices:							
Double Plowing Systems Trials	13.3.1	RMFI Testing TR	1	6 farmers	AG	FM	1988-89
Tillage Trials	13.3.2	RMRI Testing TR	0	2 sites	AG	EX,FM	1989-90
Farm Equipment:							
Evaluation of Improved Donkey Harnesses	13.4.1	FMFI Testing TR	2	5-10 farmers	AP	FM	1988-89
Evaluation of Rotary Injection Hand Row Planter	13.4.2	FMFI Testing TR	2	20-30 farmers	AG	FM	1988-89
Livestock Production Systems:							
Improved Production Goat Milk	13.5.1	RMFI Design TR	0	6 farmers	AP	FM,AG	1989-90
Diagnosis of Kid Mortality	13.5.2	Descrip/Diag SU	0	Variable	AP		1989-90
Household Circumstances:							
Cooperating Farmers Study	13.6.1	Descrip/Diag SU	5	28 farmers	FM	AG	CONT
Markets:							
Small Stock and Grain Trading and Prices	13.7.1	Descrip/Diag ST	4	5 sources	FM	AP	CONT
Extension Linkages:							
FMFI Options Testing with Extension Farmers Assessment Group	13.8.1	FMFI Testing TR	1	2 villages	AD,AG	FM	CONT
Environmental Monitoring:							
Rainfall and Temp. Monitoring	13.9.1	Descrip/Diag SU	5	Variable	AG		CONT
Methodology:							
Researcher FMFI Options Testing with Farmer Assessment Group	13.10.1	FMFI Testing TR	3	100-150 farmers	AG	AD,FM	CONT

RMRI = Researcher Managed/Researcher Implemented AG = Agronomy SU = Survey
RMFI = Researcher Managed/Farmer Implemented AP = Animal Production ST = Study
FMFI = Farmer Managed/Farmer Implemented FM = Farm Management TR = Trial
Descrip/Diagnos = Descriptive/Diagnosis EX = Extension and/or ALDEP CONT = Unknown

PART II: SUMMARY OF ACTIVITIES, SEPTEMBER 1987 - AUGUST 1988

CHAPTER 2: ATIP STATUS IN SEPTEMBER 1990: CURRENT EXPECTATIONS

2.1 INTRODUCTION

The Project Paper Supplement (PPS) was prepared in 1987, outlining the anticipated project outputs for the period December 1987 to September 28th, 1990. In recognition of the general desire to change some of the details of the project, a modified log frame was proposed. This is presented in Table 2.1, as it appeared in the PPS.

Over a year has passed since the PPS was written. There has been greater progress than expected in some areas and less in others. In general the outputs proposed in the PPS continue to represent project objectives for the next two years. However, there have been more recent developments which will probably necessitate some minor modifications. To facilitate comparisons, the following discussion (Section 2.2) is presented, using the same general headings used in the PPS. Recently, there was a meeting of USAID, GOB and ATIP officials to discuss possible modifications. It is anticipated that an agreed document will be produced shortly, which will firmly outline what will be done over the next two years. In particular it is important to facilitate the smooth transition to a continuation of on-farm work after the ATIP project finishes. In the following, very summarized discussion, many points are discussed in much greater detail in various parts of this Annual Report.

2.2 GENERAL STATUS

As the following summary indicates, there has been greater progress than expected in some areas, and less in others.

(a). **Farming Systems Approach Developed and Tested.** Progress has been about as expected. Mahalapye has made some progress towards local control. An outline of the methodology book has been finalized and a draft is expected during the next year. A document outlining ATIP's current thinking on a large number of technologies has been produced at the request of USAID/B (the Plain Language Document). It has been widely circulated for comments within the Ministry of Agriculture. Further action on this document is expected shortly.

(b). **National Capabilities Developed for Farming Systems Work in MOA.** Progress is about as expected. Currently individuals have not been identified for two of the long term training slots financed with ATIP funds and three of the slots financed with matching funds. Short term and in-service training also continues.

(c). **Linkages Strengthened.** There has been more progress than was earlier expected. This will be one of the most exciting areas during the next two years. Particularly on the extension front, there are promising activities at both locations. Formalization of these linkages is underway. Linkages with on-station researchers depend on the development of "research themes" groups, which are in the process of becoming established. Linkages within ATIP have improved with the increase in the number of project meetings. Another linkage that has developed over the last few months has been in the area of collaborative research with the Departments of Rural Sociology and Economics at the University of Botswana.

(d). **Information Dissemination and Monitoring Strengthened.** Progress here also has been better than expected. ATIP is now contributing articles every month to Agrinews. The biannual and activity reports have been done. A large number of research reports have been prepared. The distribution system for papers has been improved. A monthly activity newsletter has been initiated. A complete desk top publishing system including a printing press has been purchased for the Agricultural information Section in DAFS, is now operational, and provides services for other units in MOA. Agrinews, Agrifacts, reports and papers can now be produced in a much more timely manner. A laser printer has also been purchased for the use of ATIP and other DAR staff to improve the printing quality of manuscripts and reports. The current Annual Report is produced with the help of this printer.

(e). **Farming Systems Work Support Strengthened.** There are indications of growing support within DAR and DAFS for farming systems type work to continue after the current project finish. DAR has been asked by the Permanent Secretary to draw up a plan for continuing ATIP type activities after the end of the project in 1990. Hopefully, activities during the remaining time of ATIP can help facilitate this transition.

(f). **Data Made Generally Available.** More work than was expected will be required for this because of the changeover to IBM compatible software. However, the eventual value of ATIP data will be greatly increased as a result. Technical problems with reference to this transfer of data have been resolved. In addition an agreed format has recently been developed for database documentation, and documentation has started. Only data that has some potential value in terms of additional analysis will be documented for use by other individuals.

There are a number of issues with reference to many of the above areas, which have not been spelt out in detail. This is because, as mentioned earlier, they are under discussion, and when decisions have been made, possible modifications may be made.

TABLE 2.1: ATIP LOGICAL FRAMEWORK, 1987

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
A-1. Programme or Sector Goal: the Broader Objective to which this Project Contributes:	**A-2. The Measure of Goal Achievement:**	**A-3.**	**A-4. Assumptions for Achieving Goal Targets:**
To assist the GOB in developing an agricultural system that provides relevant technology leading to increased productivity for Botswana farmers.	Organizational changes made within MOA to institionalize FSW.	MOA official papers.	Agricultural research and extension continue to be high priorities of GOB, and that MOA will review the effectiveness of its approaches.
	Increased returns to labor and other inputs demonstrated.	Farm surveys.	
	Increased crop production under specified rainfall conditions.	Farm surveys and meterological data.	The amount and distribution of rainfall is sufficient to enable production to occur.
B-1. Project Purpose:	**B-2. Conditions that will Indicate Purpose has been Achieved: End-of-Project Status:**	**B-3.**	**B-4. Assumptions for Achieving Purpose:**
To improve the capacity of the Ministry of Agriculture's research and extension programmes to develop and effectively extend improved technology and practices relevant to the needs of small farmers in selected pilot areas.	The Ministry of Agriculture's DAR will be able to participate effectively in on-going FSW and be responsive to farmers' needs.		
Sub-Purposes:			
(a). Improve the capacity of the Ministry of Agriculture's Research (DAR) to develop technologies for small farmer needs.	1. On-station agronomic research at DAR strengthened in sorghum, millet and cowpeas.	DAR's Annual Report and records. Reports of INTSORMIL and Bean/Cowpea CRSP.	That potential exists in the agricultural system to improve productivity.
	2. Systems established for DAR to respond to requests from farming systems teams and conduct trials based upon these requests.	Records of meetings/workshops held with DAR/DAFS staff.	That research for small farmers continues to be given high priority.
(b). To improve the capability of the extension service to transfer appropriate technologies and strengthen the linkages between research, extension and farmers.	Improved linkages will have developed between the MOA research, extension and planning, resulting in more relevant adaptive technologies.		That the extension positions in the pilot area will be staffed and have sufficient time to engage in farming systems related work.
	1.The Subject Matter Specialists trained and working effectively.	MOA staffing pattern and manpower training plans.	
	2. DAFS disseminating tested technologies in the ATIP areas.	DAFS and contractor records.	That improved technologies can be identified, tested and made available for extension.

TABLE 2.1: ATIP LOGICAL FRAMEWORK, 1987 (CONTINUED)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
(c). To provide Botswana farmers in selected pilot areas with relevant innovations in agricultural production technology and methods through field trials, demonstration and farmer training.	Technologies identified which improve returns to labor/capital and/or increased production and/or reduce risk of failure.	Project Records.	
C-1. Project Outcomes	**C-2. Magnitude of Outputs:**	**C-3.**	**C-4. Assumptions for Achieving Outputs:**
(a). Farming systems designed, developed and tested in two areas.	1. Minimum of two localized teams installed and functioning.	Project Records.	That the GOB will implement its current research strategy.
	2. Handbook for farming systems work in Botswana prepared.	Project Records.	
	3. At least 10 alternative crop and livestock technologies tested on farmers' farms at ATIP locations and moved into DAFS farmer recommendation programmes.	Project Records.	That potential exists in system to improve new technologies. That DAR has capacity to test technologies. That DAR is able to respond to FSW requests for on-station trials.
(b). Institutional capability and skills developed within MOA to carry out FSW in selected pilot areas.	1. Qualified staff developed in needed speciality areas, 25 persons trained at the M.S. and B.S. level, 27 in short-term farming system related courses, and 156 in in-service training courses.	MOA Records.	That sufficient numbers of qualified staff can be released for training
	2. Evaluation of farming systems work concluded near end of the project and plan prepared regarding the further incorporation and expansion.	Project Records and GOB policy/planning documents.	That GOB concludes farming systems work has merit and has the resources to incorporate it.
	3. Organizational structure and systems established to integrate research, extension and planning in order to prove the benefits of FSW.	MOA Records.	That DAFS, DAR and DPS are willing and able to share responsibility for farming systems work.
(c). Necessary FSW support activities strengthened.	1. Seed Multiplication Unit strengthened and progress made on localization of all positions.	MOA Records.	
	2. Training plan implemented for at least 6 Subject Matter Specialists.		
	3. On-station agronomic research programmes on sorghum, millet and cowpeas strengthened.		Bean/Cowpea and INTSORMIL Projects will continue to receive the bulk of their training and TA support from centrally funded CRSP projects.

TABLE 2.1: ATIP LOGICAL FRAMEWORK, 1987 (CONTINUED)

Narrative Summary	Objectively Verifiable Indicators	Means of Verification	Important Assumptions
(d). Research and information	1. ATIP socio-economic and technological data systematically entered on microcomputers to facilitate future data collection and accessibility by trained Batswana.	Project Records.	
	2. Data collected by ATIP made available and used by other GOB personnel	Project Records.	That other GOB staff perceive a use for the data and can easily access it.
D-1. Project Inputs:	**D-2. Implementation Target**	**D-3.**	**D-4. Assumptions for Providing Inputs:**
(a). AID:			
Technical Assistance	56.5 person years long-term.	AID Records.	That funds are made available from bilateral and supporting centrally funded sources.
	52 person months of short-term consultancies.	AID Records.	
Local Staff Training	8 person years.	AID Records.	
	45 person months of short-term training.	AID Records.	
	52 person years of long-term training.	AID Records.	
(b). GOB:			
Counterparts	109 person years.	GOB Records.	That funds are available.
Other Staff	10 person years PCVs (local support costs).	GOB Records.	
	16 person years secretaries.	GOB Records.	
	24 person years drivers.	GOB Records.	
	176 person years technical staff.	GOB Records.	
	Casual labor (P4,000/year for eight years.	GOB Records.	
Commodities	5 vehicles and replacements.	GOB Records.	
	14 houses for MIAC staff and counterparts.	GOB Records.	
Training	15 person years.	GOB Records.	

CHAPTER 3: PERSONNEL AND EQUIPMENT

3.1 PROFESSIONAL STAFF [9.1]

In terms of the counterparts, Mr. B. Mabongo (agricultural economist) at Francistown returned to the Division of Planning and Statistics in July 1988, and at the beginning of September was replaced by Miss C. Tibone who has recently arrived back from long-term training. As far as Mahalapye is concerned, Mr. E. Makhwaje recently returned with a B.Sc in Agriculture from the UK, and has been posted to Mahalapye. He will eventually be trained as an agricultural economist. Mr. G. Ramolemana arrived back from long-term training in July 1988, and has been appointed RELO, with Dr. B. Hill as his advisor.

There have been a number of expatriate staff changes the during reporting year. Changes were as follows:

(a). Dr. N. Persaud filled the soil management specialist position in December 1987, and commenced work under INTSORMIL auspices.

(b). In terms of the RELO position, Dr. C. Trent left in November 1987, and was replaced by Dr. B. Hill from Oklahoma State University.

(c). s far as the animal scientist position is concerned, Dr. R. Gray left in February 1988 and, after some problems in recruiting, he was replaced by Dr. T. Thedford (also from Oklahoma State University) in July 1988.

(d). The agricultural economist at Mahalapye, Dr. D. Baker, transferred to Sebele to help on the Agricultural Sector Assessment Study in May 1988. He left the project at the end of August this year. At the moment it is uncertain what will happen to the position that he has vacated.

(e). With reference to Peace Corps volunteers, Miss Susan Bock (Francistown) finished her tour in September and is staying on a short-term assignment working on the Agricultural Sector Assessment Study. Mr. A. Caplan (Mahalapye) has returned for a third year with the project.

ATIP was unfortunate in losing the services of Drs. Gray, Trent and Baker, but were very fortunate to have such good replacements in the form of Drs. Hill and Thedford.

The problem of housing shortages and lack of incentives for the Batswana staff, still remain. It also appears unlikely that either GOB or USAID can do anything to resolve these problems. However, GOB is currently engaged in a move towards some form of institutionalization of farming systems type of work. Consequently, greater integration of the various projects into the GOB structure, although perhaps not solving the problems, may help project staff to more closely identify with their respective departments.

TABLE 3.1: PERSONNEL ON THE ATIP PROJECT SINCE ITS INCEPTION*

(A). CURRENT

Name	Position	Level	Rank	Station	Started
USAID TECHNICIANS:					
Norman, D.W.	Ag. Econ.	Ph.D	-	Sebele	Aug. 1982
Siebert, J.C.	Agronomist	Ph.D	-	Mahalapye	Sep. 1982
Heinrich, G.	Agronomist	Ph.D	-	Francistown	Aug. 1983
Worman, F.	Ag. Econ.	Ph.D	-	Francistown	July 1985
Hill, B.	REL.O Advis.	Ph.D	-	Gaborone	Nov. 1987
Thedford, T.	An. Scient.	DVM	-	Francistown	July 1988
COUNTERPARTS:					
Modiakgotla, E.	Agronomist	MS	-	Mahalapye	Aug. 1982
Ramolemana, G.	Agronomist	MS	-	Gaborone	Sep. 1983
Tibone, C. (Ms.)	Ag. Econ.	BS	-	Mahalapye	Sep. 1983
Lesotlho, J.	Rural Soc.	DA	-	Mahalapye	Sep. 1984*
Jonas, C. (Ms)	Rural Soc.	Camb.	-	Mahalapye	Jan. 1986*
PEACE CORPS VOLUNTEER:					
Caplan, A.	Ag. Econ.	MS	-	Mahalapye	Sep. 1986
ADMINISTRATIVE ASSISTANT:					
Selelo, L. (Ms)	-	-	-	Sebele	Mar. 1983
Snyder, J. (Mrs)	-	-	-	Sebele	Sep. 1988
OTHERS:					
Masikara, S.	Agronomist	CA	T3	Francistown	Sep. 1983
Mahilo, C.	Enumerator	-	T5	Shoshong	Sep. 1982
Okaile, K.	Enumerator	-	T5	Makoro	Sep. 1982
Dira, D.	Extension	-	T4	Mahalapye	Oct. 1982
Monyane, F. (Ms)	Computing	-	T5	Sebele	Feb. 1983
Monyadzwe, M.	Enumerator	-	GA6	Mathangwane	Oct. 1983
Seleke, K. (Ms)	Typist	-	S4	Mahalapye	Dec. 1983
Sibanda, C.	Extension	-	T4	Mathangwane	Jun. 1984
Baatlhodi, J.	Enumerator	-	GA6	Francistown	Oct. 1984
Bagai, B.	Extension	-	T4	Matobo	Oct. 1984
Nkhutelang, R.	Enumerator	-	GA6	Matobo	Oct. 1984
Tsabadira, R.	Driver	-	Ind. Cl	Francistown	Oct. 1984
Majeni, L. (Ms)	Extension	-	T5	Makwate	Jan. 1986
Gaobone, K. (Ms)	Messenger	-	Ind. Cl	Francistown	Jul. 1986
Molapisi, M.	Typist	-	S4	Francistown	Jul. 1986
Bani, I.	Enumerator	-	GA6	Shoshong	Sep. 1986
Motsokono, O.	Driver	-	Ind. Cl	Francistown	Oct. 1986
Batshani, P. (Ms)	Enumerator	-	GA6	Marapong	Oct. 1986
Moabi, D. (Ms)	Extension	-	T5	Marapong	Jan. 1987
Mpaesele, B.	Driver	-	Ind. Cl	Mahalapye	June 1988

*. The table does not include those that were employed as casual labor or as contract workers under Industrial Class. Also, it does not include the students who work with the project for short periods.

*. On study leave.

TABLE 3.1: CONTINUED

(B). PAST

Name	Position	Level	Rank	Station	Started	Ended
USAID TECHNICIANS:						
Hobbs, A.	Agronomist	Ph.D	-	Gaborone	Aug. 1982	Aug. 1985
Koch, B.	Animal Sc.	Ph.D	-	Francistown	Aug. 1983	Aug. 1985
Miller, W.	Ag. Econ.	Ph.D	-	Francistown	Aug. 1983	Aug. 1985
Trent, C.	Extension	Ph.D	-	Gaborone	July 1985	Nov. 1987
Gray, R.	Animal Sc.	Ph.D	-	Francistown	July 1985	Feb. 1988
Baker, D.C	Ag. Econ.	Ph.D	-	Mahalapye	Oct. 1982	Aug. 1988
COUNTERPARTS:						
Monyatsi, T.	Ag. Econ.	MS	-	Mahalapye	Aug. 1982	Dec. 1984
Moremedi, G.	Agronomist	BS	-	Gaborone	Dec. 1982	Jul. 1986
Mahabile, W.	Animal Sc.	MS	-	Francistown	Sep. 1983	Jul. 1988
Tjirongo, M.	Ag. Econ.	MS	-	Mahalapye	Sep. 1982	Jul. 1988
Mabongo, B.	Ag. Econ	BS	-	Francistown	Jan. 1986	Jul. 1988
Seleka, T.	Ag. Econ.	BS	-	Francistown	Sep. 1983	Aug. 1988
PEACE CORPS VOLUNTEER:						
Bock, S. (Ms)	Ag. Econ	BS	-	Francistown	Sep. 1986	Aug. 1988
ADMINISTRATIVE ASSISTANT:						
Mophuting, N. (Ms)		-	-	Sebele	Sep. 1982	Jan. 1983
OTHERS:						
Motlhokodise, B.	Enumerator	-	Trainee	Shoshong	Sep. 1982	Mar. 1984
Keipeile, W.	Extension	-	T4	Shoshong	Oct. 1982	Jul. 1985
Mmopi, M.	Driver	-	Ind. Cl	Francistown	Sep. 1982	Jul. 1985
Moile, P.	Driver	-	Ind. Cl	Francistown	July 1985	Sep. 1986
Sibanda, B. (Ms.)	Enumerator	-	GA6	Marapong	Oct. 1983	Dec. 1985
Clifford, J. (Ms.)	Typist	-	S3	Francistown	Sep. 1983	Jul. 1986
Serumola, R.	Enumerator	-	GA6	Makwate	Oct. 1984	Mar. 1987
Mosojane, R.	Extension	-	T4	Mahalapye	Oct. 1984	May 1987
Temba, M.	Enumerator	-	GA6	Matobo	Oct. 1984	Aug. 1988
Mogotsi, G.	Driver	-	Ind. Cl	Mahalapye	Oct. 1982	June 1988

* The table does not include those that were employed as casual labor or as contract workers under Industrial Class. Also, it does not include the students who work with the project for short periods.

3.2 SUPPORT STAFF [9.2]

The second administrative assistant position was filled at the beginning of September. The person appointed was Mrs. J. Snyder who will be doing administrative work for ATIP, and editing and getting papers in final publishable forms foster both ATIP and other DAR staff.

There have been few changes in other support staff. Those that have occurred are shown in Table 2.1. There are few vacancies, including one at the T4 level -- although two of those currently filled are of T5 rank. The Industrial Class enumerator positions that were given up last year have been replaced by additional casual labor funds.

3.3 ATIP RELATED VISITORS AND CONSULTANTS [9.3]

There have been numerous visitors during the last year. Many were here visiting either SACCAR or DAR as a whole. Some of them visited ATIP personnel outside the Sebele/Gaborone area. There were, however, some other visitors who came and spent a good deal of time with ATIP's staff. Of particular note were:

(a). Dr. J. Jorns (Kansas State University) and Mr. W. McKinsey (Executive Director of MIAC) visited towards the end of 1987 to negotiate the new ATIP/MIAC contract which started at the beginning of December 1987.

(b). Visits by INTSORMIL personnel namely Dr. Van Withee (soil scientist, Kansas State University), Dr. R. Vanderlip (agronomist, Kansas State University), and Dr. M. Clegg (agronomist, University of Nebraska). The major reason for their trip was to look at INTSORMIL work and linkages between INTSORMIL and ATIP.

(c). Mr. R. McColaugh, REDSO Nairobi, came a couple of times to discuss ATIP progress and ATIP plans over the next year or so. One of the specific outcomes of his visits was to make recommendations concerning evaluations scheduled for ATIP.

(d). Dr. G. Mitawa, agronomist (officer in charge, Ilonga Station, Tanzania) and Dr. T. Frankenburger, social scientist (University of Arizona) came on a mission to evaluate the impact of farming systems work in Botswana. They were involved in a study undertaken for the S and T Bureau, Washington, on the worldwide impact of farming systems work on national programs. Botswana was selected as one of the four countries for in-depth investigation. Preliminary indications indicate that they were pleased with what they saw, and a final report will be available shortly. A summary of the whole study will be presented at the Annual Farming Systems Research Symposium to be held at the University of Arkansas in October.

A number of consultancies were implemented during the reporting year. The current situation is as follows:

(a). Rural Sociology. Dr. A. Hansen (University of Florida), a repeat consultant, spent a total of five weeks in two separate visits to Botswana (May 24th to June 21st, and a week in early August). This is his third year as a consultant to the project. He helped the Rural Sociology Department at the University of Botswana, and the Rural Sociology Unit in the Division of Planning and Statistics, to design and start analyzing a survey in the ATIP villages (see (b) below).

(b). Rural Sociology. Dr. P. Molutsi and Mr. M. Mogalakwe were responsible for designing, supervising and implementing a survey in the ATIP villages on farmer participation and evaluation of groups in agricultural production technology. They were assisted by personnel from the Rural Sociology Unit (Mrs. Y. Merafe and Mrs P. Ntseane) in the Division of Planning and Statistics, and Dr. A. Hansen from the University of Florida (see (a) above). Analysis is still underway, and the report is expected by the end of 1988.

(c). Communication Specialist. Dr. D. Esslinger (University of Missouri) returned as a repeat consultant, to continue short courses in technical writing for staff in DAR and DAFS. The dates of his visit were June 18th to July 19th. Presently, he is creating a technical guide which will be distributed amongst course participants.

(d). Microcomputer and Technical Writing Expert. Accompanying Dr. D. Esslinger was Mr. G. Brandsburg (Kansas State University). He assisted in the technical writing courses, and is collaborating on the writing guide with Dr. Esslinger. In addition, he advised the Agricultural Information Section of DAES on the use of their desk top publishing system, and also helped DAR in the use of Pagemaker with a laser printer. Mr. Brandsburg came under the Kansas State University Memorandum of Understanding with Alabama A and M University, and therefore was not supported from project funds.

Another three consultants who were scheduled to arrive during the reporting year, are now expected before the end of this calendar year. They are as follows:

(a). Librarians. Ms P. Wetmore (USDA) and Mr N. Young (Developing Countries Librarian, Kansas State University) will be visiting Botswana for about three weeks starting October 24th. Specifically their job will involve supplying information to local scientists and institutions on the availability and accessibility of various bibliographic search routines; explaining the availability of relevant documents and papers outside the country (particularly in the USA) that can be obtained at little or no cost; delivering to the DAR library a set of 1600 microfiche documents from Kansas State University, which are relevant to farming systems and related types of work; and to provide any other services required by the DAR and possibly other libraries. Another objective will be to collect locally published documents and papers which can be readily accessed by Batswana and other interested individuals while they are at USDA and Kansas State University. Payment of Ms. Wetmore's per diem and airfares will be obtained from ATIP project funds, while Mr. N. Young will come under the Memorandum of Understanding between Kansas State University and Alabama A and M University. His visit will be at no cost to the project.

(b). Modelling and Risk Assessment. Dr. B. Schurie (agricultural economist, Kansas State University) will come on a repeat consultancy to look at how to assess the impact of technologies in the whole farming situation, and to work with existing data to develop ways of analyzing risk. The dates of his visit are still to be finalized, and much of the cost of his visit will be met through the Memorandum of Understanding. Some support will be given to analyze data back at Kansas State University.

The status on the other consultancies proposed for the current reporting year's work plan is as follows:

(a). Range Management Specialist. GOB have indicated that they do not wish to have short-term expertise in the range management area at the present time.

(b). Farm and Non-Farm Employment Linkages. No action was taken on this consultancy.

3.4 EQUIPMENT [9.4]

The major items of equipment that have been purchased or ordered over this reporting year are as follows:

(a). Equipment to support the work of the soil management specialist has been obtained through the Research and Operations Support Vote.

(b). Five Sperry (Unisys IBM compatible) microcomputers have been purchased. One each has been distributed to the Division of Planning and Statistics, the Animal Production Research Unit, ATIP Sebele, ATIP Mahalapye and ATIP Francistown. Printers have also been distributed. In addition, a laser printer has been purchased for use within DAR. This now enables reports to be produced in a format suitable for printing by the Government Printer or the Agricultural Information Services Section in DAFS.

(c). A total of seven laptop Zenith microcomputers have been purchased and delivered. They are IBM compatible and therefore completely compatible with the Sperry equipment. One has been given to INTSORMIL personnel, while the remaining are distributed amongst ATIP staff.

(d). The printing press plus related equipment ordered for the Agricultural Information Section in DAFS has arrived, and is being supervised by an experienced Peace Corp Volunteer (Mr. S. Harle). Over the next two years he will provide training, so that when he leaves, a desk stop publishing system, originally funded by ATIP, will be completely handled by Batswana. Already the printing press is having a major impact, not only as far as DAFS publications are concerned, but also with regards to papers produced by staff in ATIP and DAR.

(e). Three extra vehicles have been ordered. Two are four wheel drive Double Cab Toyota vehicles. These will be used for facilitating the research/extension link which is being increasingly emphasized in ATIP activities. These two vehicles will have BX number plates. The third vehicle is a two wheel drive Toyota Hilux which is being purchased for INTSORMIL use. All vehicles are expected shortly. All have been ordered with project funds through USAID/B.

CHAPTER 4: TRAINING

Three types of training for Batswana staff continued to be provided through ATIP: long-term and short-term formal training and on-the-job-training (in-service training).

4.1 LONG-TERM TRAINING [10.1]

Long-term training continues to be an important component of the ATIP program.

TABLE 4.1: LONG-TERM PARTICIPANT TRAINING SINCE INCEPTION OF PROJECT

Participant	Local affiliation	Training Details			
		Current	Objective	Place	Dates
ATIP Sponsored:					
Gaosegelwe, P.	ADNP, DAR	DA 1975	BS (Agronomy)	KSU	1/83- 7/85
		BS 1985	MS (Agronomy)	KSU	8/85- 3/88
Mchive, F.	DAO, DAFS	DA 1979	BS (Agronomy)	KSU	1/83- 1/86
Monyatsi, T.	ATIP, DPS	BS 1981	MS (Ag. Econ.)	KSU	1/83- 1/85
Modiakgotla, E.	ATIP, DAR	BS 1981	MS (Agronomy)	KSU	8/83- 8/85
Moremedi, G.	ATIP, DAFS	DA 1980	BS (Agronomy)	NMSU	8/83- 7/86
Tjirongo, M.	ATIP, DPS	DA 198	BS (Ag. Econ.)	ISU	8/83-12/85
		BA 1985	BS (Ag. Econ.)	NMSU	1/86- 3/87
Lesotlho, J.	ATIP, DPS	DA 1983	BS (Rural Soc.)	Oh. SU	1/86- 2/88
Luzani, J.	ATIP, DAK	DA 1983	BS (Agronomy)	KSU	1/86-12/88
Mahabile, W.	ATIP, DAR	BS 1984	MS (Animal Sc.)	KSU	1/86- 3/87
Motswasele, P.	ATIP, DAR	DA 1985	BS (Seed Tech)	Miss. SU	1/86- 7/88
Seleka, T.	ATIP, DAR	DA 1983	BS (Ag. Econ.)	Ok. SU	1/86- 7/88
Tibone, C.	ATIP, DAR	DA 1983	BS (Ag. Econ.)	Ok. SU	1/86- 7/88
Ramolemana, G.	ATIP, DAFS	BS 198	MS (Agronomy)	KSU, NMSU	8/86- 7/88
Sebinyane, A.	LUO, DAFS	Cert.	BS (Cartography)	SW Miss. U	8/87- 8/90
Ntseane, P.	RSU, MOA	BS 1985	MS (Rural Soc.)	KSU	8/88- 8/90
Masilo, B.	APO, DAR	BS 1984	MS (Animal Sc.)	KSU	8/88- 8/90
GOB Sponsored:					
Jonas, C.	ATIP, DPS	Camb.	BS (Rur. Soc.)	U of Flor.	8/87- 8/90
Nkane, D.	DAFS	BS	MS (An. Sci.)	Pr. View U	1/87- 7/89
Tabona, L.	MOA	DA 198	BS(Agronomy)	Utah State	1/88- 1/91
Senyatso, E.	APRU, DAR	BS	MS (Animal Sci)	ISU	8/88- 8/90

In terms of the individuals directly funded under ATIP, seven individuals have returned in the last six months: four at the MS level and three at the BS level. Mr M. Tjirongo returned with an MS degree in agricultural economics at the end of March and was stationed at Mahalapye, until leaving GOB to join the Bank of Botswana in July this year. Mr G. Ramolemana returned with an MS degree in agronomy, and has now been appointed as RELO in DAFS. Also, Mr P. Gaosegelwe returned in August having completed an MS degree in agronomy and is to be stationed in another farming systems project, ADNP. Ms W. Mahabile returned with an MS in animal science, and has been posted to APRU in DAR. Two participants returned with BS degrees in agricultural economics: Mr T. Seleka is now working in the Division of Planning and Statistics, while Ms C. Tibone has returned to the project and is now working with ATIP in Francistown. Mr P. Motswasele returned with a BS in seed technology, and is working with the Seed Multiplication Unit in DAR.

The grades of most of the participants appear to be satisfactory. Only one long-term participant is currently experiencing difficulty.

In terms of the 1 person years to be funded under the new ATIP contract, six individuals were identified by GOB. Two of the candidates originally nominated, later withdrew,

and one was not approved. In spite of considerable delays in the approval process, two individuals (Mrs P. Ntseane and Mr B. Masilo) left in August this year, and it is hoped that the third (Mr B. Moji) will depart in January 1989. At this time it seems unlikely that the other long term training slots, to be funded under the project, will be filled.

The method of approving participants for long-term training provided by ATIP has now been changed. A screening committee composed of representatives from MOA, USAID, and ATIP was formed to advise and interview the nominated candidates.

Unfortunately, of the six individuals identified for long-term training under matching funds from GOB, only three (Mr D. Nkane, Ms C. Jonas and Mr E. Senyatso) were placed in American universities. For three individuals, their grades at the BS level were not adequate for entry into the MS programs.

4.2 SHORT TERM TRAINING [10.2]

The term, short term training, includes funding attendance at conferences and workshops that contribute to the professional development of the participants. The reason for these both being combined is because of the way the budget is broken down for the project.

In terms of short term training outside the country the current situation is as follows:

(a). CIMMYT workshop. Although individuals were identified for this workshop, the approval system resulted in delays, and consequently it was not possible to send them this year. It is hoped that this will be rectified next year.

(b). Short courses for Crop Division, DAFS personnel. To date, one person (Mr. M. Mazebedi) has been sent on short-term training in irrigation and management at the Mananga Agricultural Management Centre in Swaziland, while another person is to go on a forestry course in Kenya, once the documentation is in order.

(c). Short course for a seed technician, SMU, DAR. ATIP has paid the airfare for Mr. T. Mpathi to attend a six week course (September 5th to November 11th) in Sweden.

(d). Visit to the USA by an ATIP staff member. ATIP funded a five week trip to the USA for Mr S. Masikara, agronomist, ATIP Francistown. Mr Masikara attended a MSTAT course at Michigan State University, visited agronomists at Kansas State University and the University of Nebraska, and gave a paper at the Annual Farming Systems Symposium at the University of Arkansas.

The following professional trips were also supported:

(a). Farming systems visit by senior Ministry of Agriculture personnel. Once again there were problems obtaining approval for individuals to go on this visit. Also arranging a mutually convenient time for everyone concerned was difficult. However, eventually in April, six individuals did go on a ten day trip to Ethiopia, and Zimbabwe. The individuals who went were: the Head of APRU (Dr L. Setshwaelo), the Coordinator of ALDEP (Mr. K. K. Mmopi), the RAO Francistown (Mr G. Moremedi), the RAO Southern (Mr B. Moji)), the RELO advisor (Dr B. Hill), and the farming systems agronomist at Mahalapye (Mr E. Modiakgotla).

(b). Attendance at Farmer Participation Workshop. ATIP funded the attendance of Mrs Y. Merate, Head of the Rural Sociology Unit, DPS, at a workshop in the

Philippines. After the workshop she went on an additional week's tour visiting the work of the extension service.

(c). Attendance at Dryland Farming Conference. ATIP helped fund the attendance of Dr. L. Gakale, Director of Agricultural Research, at the International Dryland Farming Conference, held at Amarillo, Texas, 15th-19th August, 1988.

TABLE 4.2 SHORT TERM AND IN SERVICE PARTICIPANT TRAINING SINCE INCEPTION OF PROJECT*

Participant	Local Affiliation	Current	Training Details: Objective	Place	Dates
Outside Country					
Professional Trips					
Tlale, B.	Dir., DAFS	BS	Visit US Institutions		7/83-8/83
Mmopi, K.K.	DAFS	B	Int. FS Tour	CIMMYT	July 1988
Moji, B.	RAO, DAFS	BS	Int. FS Tour	CIMMYT	June 1988
Moremedi, G.	RAO, DAFS	BS	Int. FS Tour	CIMMYT	June 1988
Setshwaelo, L.	CAPRO,DAR	PhD	Int. FS Tour	CIMMYT	June 1988
Modiakgotla, E.	ATIP, DAR	MS	Int. FS Tour	CIMMYT	June 1988
Hill, B.	RELO, DAFS	PhD	Int. FS Tour	CIMMYT	June 1988
Merafe, Y. (Mrs)	RSU, DPS	MS	S Workshop	Philippines	June 1988
Gakale, L.	Dir., DAR	PhD	Dryland Conf	USA	15/8-19/8
Short Term Training					
Sigwele, H.	ADNP, DPS	MS	ESAR Workshp	U. Zimb.	Mar. 1983
Tjirongo, M.	ATIP, DPS	DA	ESAR Workshp	U. Zimb.	Mar. 1983
Masikara, S.	ATIP, DAR	CA	CIMMYT Workshp	Malawi	May 1984
Monyamane, P.K.	Hort.,DAR	BS	Vegetable Course	USDA	1/84-/84
Modise, M.	DAFS	BS	Grain Storage	KSU	6/84-7/84
Lesothlo, J.	ATIP, DPS	DA	CIMMYT Workshp	Zambia	Nov. 1984
Ramolemana, G.	ATIP, DAFS	BS	ESAR Workshp	U. Zimb.	3/85-9/85
Masikara, S.	ATIP, DAR	CA	Agronomy Course	ICRISAT	9/85-3/86
Luzani, J.	ATIP, DAR	DA	MSTAT Workshp	Swaziland	June 1985
Jonas, C.	ATIP, DPS	Camb	ESAR Workshp	Gambia	Apr. 1986
Otsutswe, G.	CPO, DAFS	DA	ESAR Workshp	U. Zimb.	Feb. 1987
Ramanbana, K.	DAO, DAFS	DA	ESAR Workshp	U. Zimb	2/87-9/87
Jonas, C.	ATIP, DPS	Camb	CIMMYT	Lusaka	May 1987
Mosupi, P.	CPO, DAFS	BS	Quelea Control	CSU	July 1987
Mosarwe, D.	CPO, DAFS	LA	Quelea Control	CSU	July 1987
Masikara, S.	ATIP, DAR	CA	CIMMYT	Harare	July 1987
Modiakgotla, E.	ATIP, DAR	MS	CIMMYT	Harare	July 1987
Mabongo, B.	ATIP, DPS	BS	ILCA	Addis Ababa	Nov. 1987
Mazebedi, M.	Hort.,DAFS	DA	Irrigation Trng	MAMC	3/88-4/88
Mpathi, T.	SMU, DAR	DA	Seed Technology	Sweden	8/88-10/88
Masikara, S.	ATIP, DAR	CA	US Workshops and Institutions		9/88-10/88
In Botswana:					
4 Clerical staff	ATIP, DAR		Applewinter He	F'town	May 1984
5 Counterparts	ATIP		Dairy Statistics	F'town	May 1984
2 Staff	DAR		Dairy Statistics	F'town	May 1984
18 Staff	DAFS, BAMB		Grain Storage	Sebele	Sep. 1984
25 Enumerators	DPS		Enum. Workshp	Gaborone	July 1987
25 Enumerators	Farming Systems		Enum. Workshp	Mahalapye	July 1987
38 Specialists	DAR, DAFS		Writing Workshp	Sebele	July 1987
60 Senior staff	DAR, DAFS		Trng. Trainers	Sebele	July 1987
5 Ag. Info staff	DAFS		Computer Workshp	Gaborone	Jan. 1988
50 Specialists	DAR, DAFS		Writing Workshp	Gaborone	June 1988
15 Staff	AES, Vet Serv, ATIP		Writing Seminar	F'town	July 1988
5 Ag. Info staff	DAFS		Computer Workshp	Gaborone	July 1988
3 Clerical staff	ATIP, DAR		Word Perfect	Gaborone	July 1988

* The table includes professional visits by more senior level officers in GOB

4.3 ON THE JOB TRAINING [10.3]

Four technical writing workshops, organized by visiting consultants (Dr. D. Esslinger and Mr. G. Brandsburg), were held in June and July for DAR, DAFS, and veterinary service staff, and once again were well received. Some guidelines for technical writing are being prepared by the consultants, and will be distributed shortly.

An offer was made for ATIP to sponsor courses in software packages. As a result, three DAR staff were trained in a three week course in Word Perfect at the Institute of Development Management, at the University of Botswana. Two computer training workshops were organized for the Agricultural Information Section staff who work with the desk top publishing system purchased by ATIP. The first of these was held in January by a local company who supplied the equipment, and the second workshop was conducted by Mr. G. Brandsburg in July.

ATIP consultant, Dr. A. Hansen, held a one-day workshop to prepare ATIP long-term training nominees for taking the Graduate Record Examination (GRE).

The RELO assisted the DAFS training officer, and the National Training Committee in conducting in-service training for regional and district agricultural officers.

In addition, during the reporting year, ATIP staff, have been involved in a number of talks and lectures at various institutions in Botswana, including the University of Botswana.

GOB approval for a farmer participatory workshop was not granted, and no enumerator workshop was held during the reporting year.

Seven farmer field days have been held. These have proved to be very successful and well attended. Over the next few months, discussions will be held on the positive and negative points of the field days in order to suggest some possible improvements for next year. Unquestionably however, these are becoming important events in the lives of farmers who attend them.

CHAPTER 5: SEBELE/GABORONE WORK

5.1 TEAM LEADER [11.1]

Agricultural Economist: D. W. Norman

As in previous years, most of the team leader's time on professional work has involved supporting other team members.

5.1.1 ATIP ADMINISTRATION AND OPERATION [11.1.1]

The team leader has continued to spend a considerable amount of time on administering the project. Careful attention is needed to ensure that operations are undertaken in such a way that is compatible with the systems used in GOB, USAID/B, MIAC and KSU.

The Monthly Activity Newsletter has continued to be published, and improvements have taken place in the timely production and dissemination of papers produced by ATIP.

The occasional visits by the PCV from Francistown (Ms. S. Bock), before she completed her assignment with ATIP, were very useful in helping to improve the administration and operation of the project.

Recently two other events have occurred that should greatly help improve the efficiency of the administration of the project. These were:

(a). A second administrative assistant (Mrs. J. Snyder), who will also provide editing functions, has recently been appointed, and is being paid out of project funds. As well as helping with administrative tasks within the project, she will also provide editing, and facilitate final preparation of manuscripts for publication, by both ATIP and other DAR staff.

(b). The team leader was recently allocated an office to himself which will no doubt improve productivity and facilitate professional interaction.

5.1.2 PROFESSIONAL SUPPORT TO ATIP TEAM MEMBERS [11.1.2]

During the current reporting year, more time was spent working with team members at Mahalapye and Francistown, in visiting the work in the field, and in discussing issues. Unfortunately, as was the case last year, the proposed monthly visit to Sebele by a member of each team failed to materialize. This was due to a combination of reasons. Although more time was spent in the field -- including most of March -- fewer visits took place towards the end of the reporting period. However, like last year, this was supplemented by more frequent ATIP meetings. At least six have been held during the current reporting year. These meetings have been very useful in debating topics of common interest. Although, on occasion, staff members complain about the time these take, there is no question that this increased communication has been beneficial for the project as a whole.

An Executive Summary of the Impact of the ARAP and Drought Relief Programs was produced, based on the published reports of the ADNP and FSSR surveys, and a draft

report produced by ATIP.

5.1.3 MICROCOMPUTER SUPPORT [11.1.3]

Supervision of the SMU data entry on the ATIP microcomputers continued. In addition, entry of data from ATIP field stations has been undertaken. As a consequence of the change over from Apple to IBM compatible machines, increasing amounts of time have been taken up in designing systems to facilitate this transfer. With the help of other DAR staff members, a software package called Apple Turnover was installed on an IBM XT microcomputer at Sebele. Apple Turnover facilitates the transfer of Applewriter IIe files, Omnis database files, and Visicalc IIe files to corresponding IBM compatible software packages (i.e., Word Perfect, DBase III Plus, and Lotus III). Bugs in this transfer were sorted out, and with the help of two university students, much of the data have been transferred. Time has also been spent in learning to use the new software packages, and it is anticipated this learning process will continue over the next few months.

Recently a number of other developments have taken place:

(a). Problems in the operation of the recently purchased laser printer have been worked out, and the printer can be conveniently accessed with an update of Word Perfect 4.2 (Word Perfect 5.0).

(b). The Apple Turnover program, although effective, is somewhat laborious. Thanks to a tip from the former animal scientist at Francistown (R. Gray), a software package called Matchpoint has been purchased, which greatly improves the efficiency of the transfer process and enables IBM AT compatible machines to be used. This is advantageous since all the Sperry machines purchased by ATIP are in fact AT compatible.

(c). SPSS and MSTAT have also recently been obtained for use on the new IBM compatible machines. These have now been installed. It is anticipated that, particularly with SPSS, there will be a learning cycle over the next few months.

5.1.4 METHODOLOGICAL MANUAL [11.1.4]

Agreement has been reached on the outline for the proposed methodological manual for farming systems work in Botswana. This has been cleared with other farming systems teams, and writing has commenced. It is anticipated that the agricultural economist in Francistown (Dr. F. Worman) and the team leader of ATIP will take major responsibility for producing a draft, although many sections will be written by other members of ATIP.

5.1.5 PUBLIC PRESENTATIONS [11.1.5]

During the last year, much less time has been spent travelling outside the country. Only two "invited" papers were given during the report year: one co-authored and given at the Third Annual Conference on Food Security Research in Southern Africa (sponsored by SADCC in Harare), and the other was a keynote address at the Annual Farming Systems Symposium held in Arkansas. A number of talks have been given internally within Botswana.

In addition, a series of four lectures were given at the University of Botswana on farming systems research, and a series of fifteen lectures on Principles Agricultural

Economics have recently been started in the Faculty of Agriculture, at the University of Botswana.

5.1.6 LIAISING AND INFORMATION AVAILABILITY [11.1.6]

A great deal more time has been spent in developing relationships with other institutions in GOB. The Plain Language Document, written by ATIP staff, at the request of the USAID Director, has been disseminated to people in GOB. Unfortunately, this is still to be published but, hopefully, this will be remedied within the next few months. Also database documentation is commencing and should be implemented to a greater extent over the next few months by ATIP staff in Mahalapye and Francistown.

5.1.7 OTHER PROFESSIONAL ACTIVITIES

During the year, many meetings were attended, and some were in the capacity of a committee member. Also considerable time was spent talking to many visitors during the reporting year.

Two visits were made to Kansas State University near the beginning of the reporting year, to consult on project matters, and to interview possible replacements for Dr R. Gray.

In addition to the papers referred to above, two documents were prepared. Both were co-authored. One paper which was on Farmer Groups was recently published, and the other on the Evolution and Status of Farming Systems Research has been accepted as a chapter in a book on Small Farm Development.

Finally, near the end of the reporting period, some time has been spent in starting to prepare, with others, a background paper on policy tradeoffs for the Agricultural Sector Assessment Study.

5.2 RESEARCH EXTENSION LINKAGE, GABORONE

RELO: B. Hill

As in previous years, the RELO helped the ATIP Team Leader with administration, particularly with respect to training issues, and handling some of the visitors and consultants.

With reference to training this involved:

(a). Coordinating with the Academy for Educational Development (AED) staff on numerous occasions to facilitate the admission and placement of long term training participants.

(b). Spending a great deal of time in individual conferences with staff members planning for long term degree programs and short term training.

The primary objective of the Research Extension Coordination Unit (RECU) is to increase the cooperation and communication between these two branches of agriculture. With the return of Mr. G. Ramolemanna to RECU afterar receiving hims MS in Agronomy from New Mexico State University, it is anticipated that the two-way flow of information between research and extension will be greatly enhanced. The following

activities were designed and carried out during 1987-88 to accomplish the annual objectives.

5.2.1 VISITS WITH EXTENSION AND RESEARCH STAFF [11.2.2.1]

Visits to regional and district field services officers were made throughout the year as time was available. Individual and group conferences were held with RAOs, DAOs, DAFS, ADs, APOs and LUOs. Individual visits with research staff members at Sebele, Mahalapye and Francistown served to acquaint the new RELO with the various research projects and to facilitate cooperative efforts in producing extension publications.

5.2.2 MEETINGS AND CONFERENCES [11.2.2.2]

During the first three months of this reporting period (September through November), the departing RELO played an active leadership role in many meetings and conferences. In many of these activities he served as chairman and/or did the major part of the planning and communicating necessary for the successful operations of the activity. The new RELO, during the first months in the position, has attempted to maintain the high standards set by his predecessors. Following are some of the more important mediums by and through which the RELO has endeavored to accomplish this goal.

(a). Attended the Regional Training Course on Locust Forecasting Techniques jointly organized and sponsored by the Botswana MOA, the FAO Locust Control Project, and the SARCCUS member states in Southern Africa. He also served as chairman for the second day of training.

(b). Served as secretary of the National Training Committee and assisted the Training Officer in arranging the Training of the Trainers Programs in the in-service training sessions.

(c). Served as a member of the Advisory Board for the Arable Lands Development Programme (ALDEP). He also attended three meetings and did a written review on a FAO report, 'Strengthening the Agricultural Extension Service,' by Chow-Kam Foo, Agricultural Extension Consultant.

Meetings with USAID officials are a necessary and essential part of the RELO's job. More than five meetings per week is the estimated average.

Meetings and conferences with extension, research and farmers were greatly enhanced by the return of G. Ramolemana in June. His knowledge of local conditions and his personal acquaintance with many of those involved in Botswana agriculture facilitated communication and contributes to the achievement of Research and Extension Coordinating Unit (RECU) goals.

5.2.3 AGRINEWS [11.2.2.3]

There continues to be a substantial flow of articles for Agrinews from farming systems work, although it would be desirable to have more from projects other than ATIP. Efforts are being made to encourage this.

5.2.4 AGRIFACTS [11.2.2.4]

A concentrated effort has been made toward producing new and updated Agrifacts. Through the efforts of RECU, more than 20 were written or revised and printed during the last year. This is considered a major achievement. Efforts are continuing toward making these and other Agrifacts available in every extension office of Botswana, upon request.

5.2.5 EXTENSION PUBLICATIONS [11.2.2.5]

Quoting the cover page editorial in the April 1988 issue of Agrifacts, Volume 20, Number 4:

"This issue marks a milestone in the 20 year history of Agrinews, the official magazine publication of the MOA. The Agricultural Information Section, which is responsible for publishing Agrinews, has installed printing equipment with which this issue was used for the first time to print the magazine".

ATIP was among the first to congratulate Agrinews on this milestone and add that all extension publications have reached the same milestone. The long-term planning, equipment purchases and training involved in this achievement were largely due to the RELO.

5.2.6 TRAINING [11.2.2.6]

At the beginning of the reporting year, a great of time was spent by the RELO's office in helping with the Training the Trainer's Program in DAFS. This was facilitated with the hiring of a consultant (Mr. D. Styles). However, it is now important to play less of a dominant role in this activity, so that the many other responsibilities of the RELO's office do not suffer.

5.2.7 TOURS AND FIELD DAYS [11.2.2.7]

Due to changes in staffing and many other obligations, activities in this area during the reporting met only with limited success. Efforts will be made to rectify this during the coming year.

5.2.8 FARMING SYSTEM INTER PROJECT ACTIVITIES AND COORDINATION [11.2.2.8]

The major responsibilities of coordinating the farming systems inter-project activities were assume by the ATIP team leader during this year.

5.3 FARMING SYSTEMS RESEARCH LIAISON AGRONOMIST, SEBELE [11.3]

The proposed move of Dr. L. Siebert (farming systems agronomist at Mahalapye) was not approved by GOB. However, some of the work program proposed has been undertaken, and is reported in Chapter 6 on activities in Mahalapye.

5.4 AGRICULTURAL SYSTEMS ECONOMIST, SEBELE [11.4]

The proposed move of Dr. D. Baker (former farming systems agricultural economist in Mahalapye) was not initially approved by GOB. Some of the work program earlier proposed was in fact undertaken, and is reported in Chapter 6 on activities in Mahalapye. At the end of May, his move was approved so that he could participate more efficiently in the Agricultural Sector Assessment Study that GOB is currently undertaking in conjunction with USAID. During the period that he was in Sebele he worked on this, and also produced a number of papers summarizing his six years work with ATIP. He left ATIP at the end of August. What to do with the position vacated by him still has to be resolved.

CHAPTER 6: ATIP MAHALAPYE ACTIVITIES, SEPT. 1987 - AUG. 1988

USAID:	J. Siebert	(Agronomist)
	D. Baker	(Agricultural Economist) Departed Aug. 1988
GOB:	E. Modiakgotla	(Agronomist, DAR)
	M. Tjirongo	(Agricultural Economist, DPS) April - June 1988
	E. Makhwaje	(Agricultural Economist, DAR) Commenced Sept. 1988
PCV:	A. Caplan	(Agricultural Economist)

6.1 OVERVIEW

In progressing toward localization of the Mahalapye team, roles were divided so that the GOB contingent should assume greater responsibility for the testing program. This goal was only partially achieved because the team was without a GOB Agricultural Economist for the greater part of the season. Mr. E. Makhwaje began work in the second week of September. He replaced Mr. M. Tjirongo, who resigned from the Division of Planning and Statistics in July following four months in Mahalapye. Mr. E. Modiakgotla assumed major responsibility for researcher managed trials and for coordinating research-extension linkage activities. Mr. A. Caplan had major responsibility for farmer managed trials.

Drs. D. Baker and J. Siebert concentrated their efforts primarily in diagnostic, design, and dissemination work. In addition to diagnostic surveys, Dr. D. Baker has been involved with the preparation of materials for dissemination and assisted with the terms of reference for the Agricultural Sector Assessment Study. Dr. Baker finished his contract and departed from Botswana during the first week of September. Dr. Siebert concentrated his efforts on the Rainfall Run-off Management Study (see Section 6.6.3 for further details) and in building linkages with district extension personnel concerning the promotion of row planting.

Because of the trend toward localization, GOB office staff and village enumerators have played a larger role in ensuring that the testing component of the work plan was acted on. Village staff, in particular, took more responsibility for farmer managed trials, acting more autonomously than during previous seasons, but with continued back stopping.

The rainfall pattern of this season had two primary effects on the cropping season:

(a). Because the first rains arrived late in the season, farmers were unable to plant plow and plant early, therefore limiting the final area planted and the interest in implementing early season tillage.

(b). Because the rainfall after the end of November was well above average, crop production was generally impressive.

Approximately 160 trials were implemented on 60 separate farms in Makwate, Shoshong, and Makoro villages. Data gathering proceeded smoothly, allowing for extensive observation of trials' progress. Data analysis was enhanced due to an increase in field

staff involvement in the FMFI trials program.

Collaboration with extension personnel, on regional and district levels, increased markedly over past seasons. Highlights included collaboration during village field days, co-sponsorship of a plowing and planting contest at the Mahalapye Agricultural Show, and co-sponsorship of a Row Planting Field Course for the Machenang District. Discussions between ATIP and DAOs on how linkages can be maintained and extended are on-going.

6.2 CROPPING SYSTEMS

6.2.1 SORGHUM/MELON MIX STUDY

Objective: The objective was to measure the competitive impact of melon growth, as occurring in the farming system, on sorghum grain yield.

Justification: Monitoring of farming practices in the research area shows that a majority of the land area planted in sorghum has an undergrowth of melons. Information is not available for Botswana on the impact of melon growth on sorghum grain yield. A strongly negative impact would indicate the possible advantage of separate plots for melon production. A neutral or positive impact could be explained by low melon populations, shading benefits of the melon canopy in reducing weed growth, and soil-water evaporation losses.

Approach: In this RMFI work participating farmers were asked to plant sole sorghum and sorghum mixed with melon seed on adjacent plots (15m by 50m) using their standard single plowing/broadcast operation. Sorghum seeding was the same on both plots (6 kg/ha). Melon seeding was determined by the farmer and in all cases was exceedingly low. Early stage plant emergence counts and harvest plant stand and yield component data were the only measurements made on a plot basis. Twelve comparisons were planted in three village areas. Sorghum and/or melon harvests were obtained on only eight of these plantings. Results are given for these eight comparisons only.

Results: Average melon plant stands at harvest was 4810 plants/ha in the mixed crop plots. These plants resulted in an average soil cover of 28 percent. Even though sorghum and melon were seeded simultaneously, emergence counts for melon were very low indicating a high level of delayed emergence response to later rains.

Average sorghum plant stands and grain yield were not significantly affected by the presence of a melon crop (Table 6.1). This indicates that for wet seasons, the impact of melon on sorghum cannot be measured. When only those comparisons in which melon cover exceeded 35 percent (average melon population equals 7958 plants/ha) are included, grain yield of sorghum still is not significantly affected by melon growth during a wet season.

TABLE 6.1 IMPACT OF MELON IN SORGHUM-MELON MIX ON SORGHUM GRAIN YIELD*

Variable	Sorghum Harvest Stand (plants/ha)	Sorghum Grain Yield (kg/ha)
Sorghum with Melons	41786	391
Sorghum without Melons	38018	449
Change in Sorghum Due to Melons	+ 3768	- 58

* There were no significant differences.

Additional analysis will be conducted on these data to determine how sorghum and melon behave towards each other within a plot. An assumption is that variation in soil type and soil moisture within plots will favor both crops simultaneously. Future work on sorghum-melon mixtures must also consider the impact on weed growth and soil moisture during the cropping season.

6.3 COMMODITY STUDIES

6.3.1 SORGHUM VARIETY TRIAL [12.4.2]

Objectives: Objectives of this trial are to:

(a). Provide verification of varietal performance under traditional broadcast conditions for several sorghum lines to be released by the Sebele sorghum and millet program.

(b). Expose new variety options to area farmers.

Justification: Elite material requires exposure to farmers before release. This exposure provides vital information on how well the variety performs under farmer managed conditions and how acceptable it is to the local farmers

Approach: The trial was planted in Shoshong and Makoro. Due to the limited amount of seed, one site within a village was selected. Planting was done by the farmers through broadcasting seed on pre-marked plots (5m by 20m). The trial consisted of five pre-released early maturity lines from DAR and three checks composed of one early maturity and two medium maturity lines. There were two replications per site.

Results: None of the varieties yielded better than Segaolane.

6.3.2 DUAL-PURPOSE COWPEA VARIETY COMPARISON [12.4.3]

Objective: The objective was to compare grain and leaf yields and farmer assessments of a locally-popular variety (Blackeye) with an exotic variety obtained from IITA in Nigeria (TVX3236).

Justification: During the 1986/87 cropping season TVX3236 was identified as a dual-purpose variety ready for on-farm testing under various soil and climate regimes.

Approach: All interested farmers were given equal weights of Blackeye and TVX3226 seed and instructed to plough/plant both varieties on the same day. Farmers determined their own plot sizes and planting dates. The FMFI trial format was used in order to implement as many comparisons as possible under varying planting environments.

Results: Results from a sample of 23 farmers indicate a significant emergence-stand and grain yield advantage for TVX3226 over Blackeye. Relatively more variation in stand and grain yield was explained by variety than management practice, despite variable seeding rates and planting dates across farms for both varieties. TVX3226 emergence stands and grain yields averaged approximately from 1.5 to 3 times those of Blackeye, respectively, across farms.

Of the 23 farmers who planted, 19 (83 percent) harvested grain from both varieties. Reasons cited for not harvesting grain included: no emergence, failure to produce grain, complete insect damage, and lack of harvest labor. Results based solely on the farmers

who harvested grain from both varieties indicated a significant yield advantage for TVX3226. Sixteen of the 19 farmers (84 percent) preferred the grain taste of TVX3226.

Leaf harvest samples across 14 randomly selected farms in each village indicate that Blackeye and TVX3226 mean green weights were not significantly different. Of the 21 farmers who compared spinach taste, 52 percent preferred TVX3226, 33 percent preferred Blackeye, and the remainder were undecided.

By substituting one hectare of TVX3226 for one hectare of Blackeye a farmer could expect a positive net gain of approximately P14.00 from grain harvest alone. However, this expected outcome pertains only to farmers who planted this season under similar conditions as those experienced in the Central Agricultural Region.

From an agronomic perspective, TVX3226 emergence stands and grain yields were significantly larger than Blackeye in this trial.

The production of TVX3226 grain was more profitable than Blackeye. Only when yield differences were small did TVX3226 production become relatively unprofitable. Because this was a relatively high rainfall season, further comparisons of TVX3226 with other locally popular varieties are desirable before its wide-scale release.

6.3.3 FORAGE COWPEA COMPARISONS [12.4.4]

Objective: The general objective of this trial was to compare the forage potentials of triple-purpose cowpea and single-purpose fodder varieties, including comparisons with phosphate fertilizer.

Justification: Lack of dry-season feed resources often diminishes the survivability and quality of livestock herds in the Central Agricultural Region, especially during periods of prolonged drought. Diminishing survivability in turn reduces crop production potential. Draught animals cannot obtain essential proteins and energy nutrients during the final months of the dry season. During the onset of spring rains they are unfit for timely plowing operations.

ATIP's on-farm trials were meant to improve understanding of socio-economic and technical constraints farmers face in producing and utilizing forage crops. This information is requested by the ALDEP fodder program. Although crop-residue utilization and forage production have been long-standing extension recommendations, few limited resource farmers have followed suit. However, prolonged drought has convinced most farmers of the potential advantages associated with growing fodder crops.

Approach: Farmers broadcast planted Dolichos lab lab and BOO5C on the same day, setting equal plot sizes for each variety. During the planting operation, plots were split - one half of each plot receiving single superphosphate fertilizer. The FMFI trial format was used in order to establish as many comparisons as possible under different planting and harvesting environments.

Because hay storage is a crucial component of forage production, one improved drying rack was constructed in each village by ATIP staff. Other farmers were encouraged to construct their own racks using local materials.

Results: Twenty three farmers in Shoshong, Makwate, and Makoro villages implemented the trial. Of the 23, two farmers compared Dolichos lab lab and BOO5C only with P applications.

Table 6.2 presents means for the variables included in the analysis. Since little socio-economic information is known about forage production under such conditions, the values presented give some indication of what a farmer might expect if he/she chooses to produce forage crops in the Central Agricultural Region of Botswana.

TABLE 6.2 PRODUCTION PRACTICES MEANS USED FOR ANALYSIS AND INTERPRETATION, FORAGE COWPEA COMPARISON TRIAL, MAHALAPYE AREA, 1987/88

Variable	BOO5C	Dolichos lab lab
Amount of P Applied (kgs/ha)	220.4	229.2
Number of Days Between Planting and Hay Cutting	204	179
Hay Cutting Labor Time (Person hrs/ton)	28.5	25.5
Number of Days Between Hay Cutting and Moving	4.3	4.2
Hay Moving Labor Time (Person hrs/ha)	68.5	133.0

BOO5C emergence stands with and without P were significantly higher than those for Dolichos lab lab and seeding rates were not significantly different.

Fifteen farmers (65 percent) harvested BOO5C grain. There was a significant BOO5C grain yield response to P. The mean BOO5C with P grain yield equaled 420 kgs/ha. BOO5C without P yielded an average 200 kgs/ha. Only one farmer, in Shoshong village, harvested a small amount of Dolichos lab lab grain. The remainder cut Dolichos lab lab for hay before pods had filled.

Dolichos lab lab and BOO5C hay yields showed significant responses to P application. Dolichos lab lab achieved significantly higher hay yields than BOO5C in comparisons with and without P. Break even hay yields for Dolichos lab lab exceeded three tons per hectare only when fertilizer was applied and hay cutting and moving labor was slow. The break-even yield dropped as low as 2.07 tons per hectare when hay cutting labor was fast.

BOO5C break-even hay yields were somewhat larger than Dolichos lab lab's under most scenarios. This result is due to the relatively high hay cutting and moving times recorded in this trial for BOO5C.

Several findings from this trial are clear:

(a). Dolichos lab lab and BOO5C showed significant responses to P fertilizer applications.

(b). At an average of eleven days after cutting, Dolichos lab lab hay yields were significantly larger than BOO5C's, with and without P fertilizer. Farmers mentioned that BOO5C leaves senesced before they were able to harvest them, therefore BOO5C hay yields are underestimates.

(c). BOO5C with and without P achieved significantly higher emergence stands than Dolichos lab lab, but higher stands did not translate into higher hay yields.

(d). BOO5C produced grain yields which are responsive to P fertilizer.

(e). If valued at the price of lucerne hay, Dolichos lab lab break-even yields indicate a possible net gain from forage production in the Central Agricultural Region.

6.3.4 GROUNDNUT HILLING-UNDERSOWING COMPARISON [12.4.5]

Objectives: The objectives of this FMFI trial are to:

(a). Make agro-economic comparisons between hilled and unhilled plots.

(b). Measure the profitability of gap-filling unhilled plots with the early-maturing cowpea variety ER-7.

Justification: Previous surveys and on-farm trials in the ATIP Mahalapye villages have indicated that hilling remains a popular cultural practice in spite of the additional labor required. On-station research indicates that, although hilling can ensure the filling of secondary pods, per-hectare yields and nut quality are reduced due to rotting and, under high residual soil moisture conditions, germination of primary pods. On-farm research with gap-filling has indicated returns to labor which exceed the per-hour labor-based drought relief and minimum urban wage rates. However, most farmers continue to leave gaps unfilled in their fields.

This trial was designed to complement station-based research by testing popular cultural practices under farmer-managed conditions. The trial also allowed for further measurement of the profitability associated with groundnut hilling and gap-filling.

Approach: Farmers were instructed to broadcast the groundnut seeds following the first rains and then divide the plot into three equal sub-plots. Plot and sub-plot sizes were determined by the farmers.

One sub-plot was left alone throughout the season and labeled the unhilled portion. Groundnut plants in the second sub-plot were hilled by farmers shortly after flowering, when pegs had formed and were elongating toward the soil surface. The third sub-plot was left unhilled, but shortly following emergence gaps between plants were filled by farmers with ER-7 cowpeas.

This trial was implemented in the FMFI trial format in order to increase the number of observations from which to compare hilling and gap-filling practices.

Results: Seventeen farmers in Shoshong and Makwate villages implemented hilling-no hilling comparisons. Of the seventeen, only one farmer did not superimpose the gap-filling portion of the trial. All farmers harvested their hilled and unhilled groundnuts. However, seven farmers (44 percent) did not harvest gap-filled cowpeas. Reasons cited for not harvesting cowpeas included lack of harvest labor, complete pest damage, and lack of harvestable grain.

Mean seeding rates across sub-plots were not significantly different. Hilling labor averaged 87 hours per hectare. Gap-filling labor averaged 70 hours per hectare, and the average groundnut harvesting time was 80 hours per hectare.

Hilled and unhilled plant productivity measures were compared across farms and villages. Stands and grain yields were not significantly different by farm or village. Samples taken from 19 randomly selected farms across all villages also indicate no significant difference between mean shelling percentages and "good seed" hundred weights. Therefore, other management variables besides hilling and soil type explain stand and grain yield differences between hilled and unhilled plots.

Assuming no yield difference between hilled and unhilled groundnuts, a farmer should expect a net loss of approximately P30.00 per hectare hilled. Net losses of approximately P15.00 per hectare were incurred by all farmers who gap-filled. The gap-

filling net losses are underestimates due to the exclusion of extra-harvest labor times and any negative impacts gap filled cowpeas may have had on the development of densely seeded groundnuts.

The results from this trial clearly indicate that hilling groundnuts will not lead to significant grain yield increases over unhilled groundnuts. Due to the lack of a yield advantage and extra labor requirements, hilling decreases farmer net income.

Gap-filling ER 7 cowpeas was also an unprofitable practice in this trial, with net losses ranging from P3.00 to P15.00 per hectare, depending on how grain yields and gap-filling labor times are valued. These results do not conform to previous gap-filling research -- which showed positive net returns to gap filling labor - possibly because the cowpeas were generally gap filled into relatively high stands of groundnuts.

6.4 POST-ESTABLISHMENT PRACTICES

6.4.1 ROW PLANTING CUSTOM HIRE SCHEME [12.3.2]

Objective: The objective is to increase the row planting/cultivation resource available in a village area through the development of a custom hire scheme.

Justification: Many farmers indicated an interest in row planting but do not have access to planting resources. Interest in inter-row cultivation is less developed, but this may be due to the unavailability of cultivation resources. Research on the custom hire unit could have implications for increasing the area row planted on a village basis and increasing the quality of row planting.

Approach: A total of nine farmers from ATIP villages were selected to be operators. These farmers were selected on the basis of active interest, available labor and draft as well as sufficient resources to maintain their own arable operation. Money for the operations were claimed through the government subsidy for row planting operations and inter-row cultivation. Operators were trained on conditions required for good row planting, seeding and organization for quality row planting. Farmers were selected after a kgotla meeting in which the scheme was introduced.

Results: Results can be reviewed for two groups of participants in this scheme, the custom hire operators and the hiring farmers.

Table 6.3 gives the returns to hours worked for participating operators. This assumes a payment of P20.00 per ha for row planting. Organization of the operators' resources (particularly at the onset of the rainy season) was observed to be the key to making this type of operation successful. Early season draft condition, condition of planters and harnesses, schedule of work to be done, etc., were all important items for operators to organize. Two row planters would be very useful for such a scheme in order to reduce the amount of time spent on a hectare. Operators did not perform inter-row cultivation operations. Shortage of labor in the operators' families during the weeding period was cited as a reason for not inter row cultivating. This aspect of the custom-hire scheme will require further planning if the full planting and cultivating package is to be implemented.

Results indicate a significant yield advantage due to row planting for the hiring farmers: 766 kg/ha for row planting versus 433 kg/ha for broadcast. At the current BAMB price paid for sorghum (P0.313/kg), return to hiring row planting during this past season was more than P100.00/ha which more than offsets the hire costs. This estimate of benefit is based on the yield returns alone and does not consider the potential labor savings due to

the possibility for inter-row cultivation.

TABLE 6.3: RETURNS TO PLANTING LABOR FOR CUSTOM-HIRE OPERATORS*

Farmer	Average Planting Time Per Operator (Hours)	Returns Pula/hr
1	4.08	4.90
2	9.63	2.08
3	4.82	4.15

Returns per hectare equals ARAP subsidy for row planting.

6.5 POST-ESTABLISHMENT PRACTICES

6.5.1 WEED PROBLEM STUDY [12.2.2]

Comment: This is an investigation which was also done several seasons ago. For an explanation of the study objectives and past findings, see Section 7.1.1.2(2) of Annual Report Number 3.

Results: This season, a compilation of major and minor weed species in the research area has been completed. This list includes 17 grasses and 75 forbs, herbs and sedges. More importantly, information on local adaptation and importance to crop production has been collected on a majority of these species. Included in the information on local adaptation are the soil type or circumstances in which the weed is likely to be found in the research area and the time of the season in which growth of the weed occurs.

Examples of local adaptation relate to a number of species regarded as important in other crop production areas. Rothwe (Gynandropsis gynandra), thepe (Amaranthus spp.), mokhure (Datura spp.) and serepe (Portulacea olerace), weeds with major importance in crop production elsewhere, are usually only found in abundance on old kraal sites in the Central Agricultural Region.

Mothwa (Cynodon dactylon), a major perennial grass weed across a range of soils, including sandy loams in Southern Region, is largely limited to sites with heavy textured soils in the Central Agricultural Region. This local adaptation is probably related to the higher moisture status usually associated with the run-on potential of clayey sites. The importance of site specific water status for this perennial could be related to the fact that less rainfall is expected in Central Agricultural Region than in other parts of Botswana, where the species is a problem weed.

Grass species with a quick growth response to rainfall are more of a problem on loamy sands than on sandy loam or sandy clay loams. Selekangwetsi (Eleusine africana), namele (Digitaria milanjiana) and rathathe (Eragrostis rigidior) are common weeds on the light textured cultivated land of the eastern belt near the Limpopo River. Pilato (Tricholena monachne) is common on sandy loam fields in Makoro village. Certain grass species are very common early colonizers of disturbed sites in the fields but are generally well controlled by plowing. These species include segowe (Tragus racemosus) and seloka (Aristida spp.).

Motantanyane (Ipomea purpurea/Convolvulus arvensis) and khonkhorose (Acanthospermum hispidium) are broadleaf annuals with early to mid-season growth that can be major weed pests for cropping in both wet and dry seasons. Mothomaganyane (Sesamum triphylum) appears as a problem in mid and late season on sandy loams and

sandy clay loams. The early season growth of the Cucurbitaceae (mokate, monyaku and mokununu) is common but sparse and not considered an important constraint on crop production by area farmers. Mosetho (Tribulus terrestris) is an early, rapid colonizer of disturbed areas but is readily controlled by tillage in the cultivated areas.

Molelwane (Striga asiatica) and matebele (Alectra volgeii) both have an insidious period of growth early after planting but visible growth doesn't occur until late in the season. The impact of these two species is field specific but it has not been possible to associate this pattern with any particular soil type pattern.

Motswalakoro (Sida cordifolia) is a common perennial weed occurring mostly on medium to deep soils with some clay in the sub-soil (luvisols). These sites apparently provide sufficient moisture for survival of this plant through the dry season. The extent of motswalakoro in cultivated lands is certainly related to the shallow and irregular cultivation system practiced on many portions of local fields. Normally, intensive and deep tillage operations would eliminate this plant as an important weed.

Several very common weeds only occur late in the cropping season and are not generally considered important by farmers nor are their names always known. Included in this group are mathlapitse (Kohautia virgata), mathlapitse (Kohautia coespitosa) and mogatololo (Ocium americanum). These perceptions maybe related to the fact that these weeds are not generally of importance during hand weeding earlier in the season and that sorghum roots are usually well established to depth by the time growth of these weeds is most vigorous.

6.6 SOIL AND WATER MANAGEMENT

6.6.1 SITE CHARACTERIZATION STUDY [12.2.1]

Objectives: The objectives of this diagnostic study were to:

(a). Characterize the hydrology and soil profile, as they relate to crop production potential, of important research sites within fields of cooperators.

(b). Provide data for drawing up recommendations that target specific cropping practices to specific field situations.

Justification: Results from researcher implemented trials indicate that soil characteristics can make the difference between profit and loss in the shift to alternative tillage-planting and phosphate fertilizer options. In addition to the soil profile, surface hydrological features in the traditional cropping areas are observed to play a major role in determining the soil moisture status at any given site. High potential for crop development and for payoffs from recommendations such as fertilizer usually results from higher than average levels of soil moisture available for plant growth.

Data on agro-ecological characteristics of trial sites need to be combined with rainfall data and information on how farmers choose to implement cropping options in order to understand what works and how it works. Soils data were not available for most farmer implemented trial sites.

Approach: This study was a major activity of the 1986-1987 season. Thus a detailed discussion of the approach used is given in Section 6.1.1 of Annual Report Number 5.

Results: Results from this study show that the three village areas selected for research represent a good range of site situations. Shoshong and Makoro fields possess deep soils

with a range of medium-low to high water holding capacity. Makwate soils are generally more shallow with more sandy textures. Topography in the Shoshong landscape generates the most interesting hydrological events. This range of characteristics encompasses the important types of field situations that can be found in the major crop production areas of the Central Agricultural Region. An interesting pattern of site characteristics following the slope can be observed within most lands areas and sometimes within individual fields. In the valley areas, soils are deepest, pH values most neutral, and clay content highest. At the lowest points, rainfall run-off water with sediment accumulates and produces heavy clay flood zones. At the high points in this "catena", soils tend to be shallow with clay and basic nutrients washed out by water run-off. Sites with the highest potential for production intensification can usually be located just above the flood zones where soil water storage, water run-on and nutrient status are good but where surface drainage of excessive water is still adequate.

The range in soil values, particularly water holding capacity and infiltration rates, indicate that two divergent crop production strategies should be followed depending on the site and on the farm resources. Sandy sites, especially those that are relatively shallow, do not possess a water holding capacity sufficient to justify an emphasis on water conservation or water harvesting, other than through weed and plant population control. On the other hand, these sites are very manageable and usually produce the best crop stands in terms of plant numbers. They also make excellent use of small showers during drought periods and permit good root penetration. In contrast, some of the higher potential sites can hold sufficient moisture to produce a respectable sorghum crop on residual moisture alone once the soil profile is full. Infiltration of water is slower on these sites resulting in greater losses to evaporation and run-off. For farmers who can manage the investment, water conservation and/or water harvesting, possibly before planting, should be the emphasis on these sites.

6.6.2 RAINFALL RUN-OFF MEASUREMENT STUDY [11.3.1.2]

Objective: This study at the RMRI level is designed to define relationships between rainfall, soil type, slope, land-use, and run-off.

Justification: This effort is justified since good data on the field level relationships between rainfall intensity, soil/slope characteristics and the resulting water run-off do not exist for Botswana. This information will be important for planning and technology design in both DAR and the Soil Conservation Section of DAFS.

Approach: In collaboration with the SACCAR Land and Water Management Project (LWRM), bunds were constructed around three 40m by 100m plots, on a loamy sand site with approximately a 2% slope, in the Shoshong area. Land within these three plots fell into three distinct use patterns: sorghum cultivation, fallow/grass, and uncleared bush.

Unfortunately, automatic water level recorders to monitor run-off flow from these three plots did not arrive until after most of the season's heavy rainfall had already occurred. Simple crest gauges were used to estimate total run-off following heavy storms. Also intensity rain gauges were installed only following the December period. This apparatus for complete monitoring is now in place for the upcoming season. ATIP is encouraging an expansion of this measurement study to include more soil types and more slope situations. The expansion will not take place in the ATIP research area.

6.6.3 RAINFALL RUN-OFF MANAGEMENT STUDY [11.3.1.3]

Objectives: The objectives of this RMRI trial are to:

(a). Evaluate the design of systems to manage rainfall run-off.

(b). Compare systems designed to manage rainfall run-off in terms of their design and management requirements, soil moisture benefits and grain yield benefits.

Justification: Observations on rainfall run-off and run-on and the potential for increased water storage in many soil profiles indicate that yield potentials could be dramatically raised in drought seasons with more effective water management. Two basic questions need to be asked related to effective water management. The first is whether or not better management of in situ rainfall is sufficient to achieve desired yield objectives or if concentration of water is warranted. The second question has to do with whether these systems should be largely tillage based (see Section 4.2.3 of ATIP Research Report Number 1 for discussion of tillage resource constraints in the project area) such as early season tillage or double plowing or based on the construction of permanent water control structures. This trial compares systems that are tillage based with systems that are structure based.

Permanent structures have an important advantage over tillage systems in that they may not require re-implementation every season by farmers. Initial costs may be high in terms of labor, etc., but this investment can often be made during an off-season period.

On many sites water control structures that prevent flooding would also be of value. Twenty-four hour rainfall events of 65mm or more occur in more than 70 percent of seasons in the Mahalapye area.

Approach: Five plots were placed on each of four fields in the Shoshong area. Systems included:

(a). Contour terraces. Permanent ridges with water concentrating just above the ridge.

(b). Double plowing. Two plowing operations resulting in improved water infiltration before planting, good tilth, and weed control.

(c). Single plowing. Traditional check.

(d). Cultivation bands -- 2m fallow strips alternating with 2m cultivation strips. Rainfall run-off from the fallow strips concentrates in the down slope cultivated strip.

(e). Bunded plot positioned to receive water run-on from areas off the field. Same as for contour terraces but with possibility of additional water added from off the field.

Two fields were on upland deep loamy sands with slopes of 1.2 to 2 percent. The other two fields were on lower positions with higher levels of clay, slopes less than one percent but with adequate surface and internal drainage. All plots in each field were positioned along the contour or the field. All plots were broadcast seeded (6 kg/ha).

Plots were 15m wide but with slightly variable lengths (150 to 200m). Plant growth and harvest measurements were made on a constant sample size from each plot. Soil moisture was monitored weekly through most of the season with a neutron probe. Two access tubes were installed per plot on each field. Installation of tubes and monitoring were done by a technician of the Land and Water Management Project.

The four host farmers for this trial met on a semi-regular basis to discuss the

management requirements of these treatments and, more importantly, ways in which designs need to be changed.

Results: The five systems should be compared in four important ways: crop responses, soil moisture benefits, design requirements and design modifications. Above average rainfall in the Shoshong area during the months of December and February provided an excellent opportunity to evaluate design requirements and design modifications required. Crop responses were not greatly affected by treatments. Data on soil moisture are not yet completely analyzed.

Sorghum grain yields were not improved by the better moisture management systems (Table 6.4). This result is explained in part by the above average rainfall. More importantly, though, erratic plant stands in the plots reduced the potential benefit of any of these systems. Treatment plots' stands were more erratic than most of the remaining portion of the farmers' fields. Because rainfall for the season began late and one preparatory tillage was required in double plowing before planting could be done, trial plots were planted relatively late and just before a January dry spell. Broadcast seeding under these conditions resulted in unsatisfactory plant stands. Row planting will be required to achieve appropriate plant stands in these intensive water management systems. This requirement is particularly acute for the strip cultivation and terrace systems where plants must be positioned to benefit from micro-level concentrations of water.

TABLE 6.4: SORGHUM GRAIN YIELD (KG/HA) FOR RAINFALL RUNOFF SYSTEMS ON TWO LAND TYPES

Tillage System	Upland	Lower	Combination
SP	261	630	446
DP	198	448	323
Strip	102	133	118
Terrace	373	349	361
WH/Terrace	465	408	436
Farmer's Own	637	447	542
LSD (0.05)	158	158	112

* SP = Single Plowing DP = Double Plowing
Strip = Strip Cultivation Terrace = Contoured Terraces
WH/Terrace = Original off-field water harvesting becoming terrace system when water supply channels eliminated.
Upland = loamy sand field, deep profile with significant slope.
Lower = sandy clay loam field, deep profile with little slope effect.

Design criteria for these systems were evaluated by a number of researchers and the host farmer group. It was clear during the December storm period that water flowing from off the field would be very difficult to manage and tap unless it was well channeled. Where flood waters came onto fields, terrace ridges or bunds on the field served only to create hazardous concentrations of water. To achieve safe benefit from terraces across good and poor rainfall patterns, storm protection above the terraces is required. In order to achieve storm protection on an individual field basis, large graded bunds with upslope drainage channels were suggested.

Additional design modifications are required with the strip cultivation system. Weed growth in the fallow strip is unacceptable. Use of chemical herbicides or separate mechanized weeding must be considered for this type of system.

6.6.4 DEVELOPMENT OF HIGH POTENTIAL SITES [12.3.1]

Objectives: The objectives of this trial were to:

(a). Implement a series of intensified production schemes at high potential sites (HPS) to determine yield potentials.

(b). Assess the benefit of a range of inputs including application of phosphate, nitrogen fertilizer as a starter, and tillage as a water conservation strategy at high potential sites.

Justification: Observations over the past five seasons indicate that areas of many fields remain relatively productive even in drought. Results from RMRI studies indicate that sites with greater natural water storage or water run-on capacity are most likely to give economic return to inputs such as double plowing and phosphate and nitrogen applications. It is logical that if a farmer is considering higher inputs into arable production hoping for greater returns, he/she should first work at the HPS.

Approach: Twelve farmers with appropriate sites in Shoshong and Makoro villages were selected. ATIP provided the first plowing for double plowing and helped apply fertilizer comparisons on sub plots. Farmers were requested to review the plant populations in specified plots and thin over populated areas and gap-fill areas that had poor emergence.

Results Grain yield averages at HPS were again much higher than yields observed on other parts of the same fields or on neighboring fields. This result and the results from last season indicate that HPS can be identified that have high yield potential in both good and poor rainfall. Data on yields in the farmer's own part of the field are not yet available for this past season.

None of the 12 farmers chose to gap-fill or thin out plots. Plant populations were quite high but appropriate for this type of season. It is the project's assessment that unless plant populations are exceedingly high, farmers will be very reluctant to practice post-planting management of plant populations. Results given in Table 6.5 show that tillage treatment had no significant effect on yield. Tillage has failed to improve yield in two seasons at HPS. Again, as was observed during the drought of last season, only fertilizer treatments are significant. Phosphate alone provides only a marginal yield improvement that is on the borderline in terms of statistical significance but is clearly not profitable. The addition of nitrogen to phosphate significantly improved yield and is profitable at HPS. The N and P combination has not been tested during drought.

TABLE 6.5: EFFECTS OF TILLAGE, FERTILIZER TREATMENTS AT HIGH POTENTIAL SITES

Treatment	Yield (kg/ha)
Single Plowing*	1233
Double Plowing*	1240
LSD (0.05)	NS
P + N	1848
P	1410
Control	1236
LSD (0.05)	269

* No fertilizer added.

6.7 FARM EQUIPMENT

6.7.1 ROW PLANTER ASSESSMENT [12.1.9]

Comment: This assessment was not completed as planned during the 1987-88 season. An inventory check showed that very few farmers in the research area actually owned planters. Informal assessment of a limited sample of planters indicates that some maintenance problems do occur.

A decision was made to expand the scope of this activity in order to gather information on maintenance issues after different periods of planter use. The survey needs to be conducted in areas where row planting has existed for varying periods of time. A broader participation of different MOA agencies in the region will also strengthen this study. The information gathered will be useful in designing support for the ALDEP planter subsidy program. The importance of such a survey has been made clear by the interest of both research and extension in developing/promoting row planting in the Central Agricultural Region. It has therefore been put into the proposed work plan for the coming year (see Section 12.4.2).

6.7.2 ROTARY INJECTION PLANTER [12.4.1]

Objective: The primary objective of this trial was to compare the traditional broadcast system with rotary-injection planted plots under random planting environments.

Justification: Due to the persistence of drought and attendant rural-urban labor migration limited resource farmers are substituting owned draft resources for hired traction. This substitution negatively affects timeliness of plowing/planting under the traditional broadcast system.

Farmers wishing to row plant, but who have switched almost entirely to hired traction, are doubly penalized. By hiring traction they forfeit control over the timeliness of separated plowing and planting operations.

The rotary injection planter was identified as a technology which could give farmers more control over row planting operations when draft arrangements are unreliable.

Approach: Nine rotary injection planters were distributed to farmers. In cases where the number of interested farmers exceeded the number of available planters, the planters were shared by neighbors. Farmers were asked to mark off an area on their fields and during subsequent plowing operations to plow/plant one half of the plot and leave the other half of the plowed area unplanted. They were instructed to row plant the unplanted half on adequate soil moisture. The FMFI trial format was used in order to maximize the planter's exposure to farmers, and to test its performance under as many different planting environments as possible.

Results: Eight farmers implemented comparisons between the rotary injection planter and broadcast systems using Blackeye cowpeas. Six farmers implemented comparisons using groundnuts. On average, farmers injection planted their plots approximately three days following broadcasting.

Planting with the injection planter took an average of 15 person hours per hectare. Farmers seeded at lower rates with the injection planter than under broadcast, the average difference being slightly less than 1:2 for cowpeas and 1:1.6 for groundnuts.

Mean cowpea and groundnut stands in injection-planted and broadcasted plots were not significantly different ($p < 0.05$). Mean grain yields for both crops were also not significantly different across injection-planted and broadcasted plots. Therefore, in this trial, management and environmental effects accounted for more stand and grain yield variation between planting systems, than the planting systems themselves.

The seed-savings effect of the injection planter outweighed the extra planting labor required to pull it, resulting in positive net gains of approximately P2.00 and P7.00 per hectare of cowpea and groundnut, respectively. When factoring in a hypothetical, government-subsidized purchase price of P20.00 for the planter, along with other contingencies, only injection-planted groundnuts achieved competitive rates of return. Therefore, even with no yield advantage attributed to the injection planter, a farmer can expect positive net gains from injection-planting groundnuts.

Despite clear results from this trial, it should be noted that the number of farmers who implemented comparisons and harvested grain was small -- six for each crop. As a result of this season's testing, several manufacturing faults of the injection planter have been identified. Improvements recommended by ATIP and other research teams who have tested the current model and surveyed farmers who used it are being incorporated into a subsequent model manufactured by RIIC. Therefore, results pertaining to secondary crops may change in future comparisons.

6.8 MARKETS

6.8.1 RESOURCE AND PRODUCT VALUATION STUDY [11.4.2.1]

Objective: The objective was to prepare and circulate a paper giving local market prices for agricultural labor, traction hire, seeds, and agricultural commodities.

Justification: Prices are needed for agricultural resources and products in order to carry out economic analyzes of modified production technologies. When used to assess farmer decision making, the prices should reflect the opportunity cost of resources and the utility of farm products. Guidelines on economic analysis generally recommend the use of local market prices for valuing resources and products since these more nearly represent the competitive equilibrium than do marketing board prices and legal minimum wages.

Until the present, different approaches have been used by the farming systems economists to value resources and products, many of which are clearly inappropriate. For example, the BAMB price for products often has been used even though few farmers ever have transactions with BAMB, and BAMB prices often differ by more than 100 percent from local prices. To facilitate analytical relevancy and consistency, information on local market prices should be made available to station and on-farm researchers. Ideally, this information could be updated on an annual basis.

Approach: The resource valuation survey was administered throughout the Mahalapye area during May - July, 1988. Rather than using a second round of trader enumeration, informal farmer interviews will be conducted prior to planting in December for pre-planting seed prices.

Fourteen cooperatives and general traders and two cattle agencies in Mahalapye, Shoshong, Machenang, Makwate, and Radisele villages were contacted during the survey. Information was collected on the following types of businesses -- the number of traders engaged in the business are in parentheses:

(a). Selling/buying food grain, meal, or other crops (13).
(b). Selling seed, fertilizer, or insecticide (5).

(c). Selling traction drawn implements, carts, hand tools, or fencing material (10).
(d). Selling/buying cattle, small stock, or chickens (2).

TABLE 6.5: MEAN PRICES OF LOCAL RESOURCES, RESOURCE AND PRODUCT VALUATION STUDY, MAHALAPYE AREA, 1987-1988

Item	Price	Item	Price
Grain, Meal, or Other Crops[a]:			
Sorghum Grain	0.41	Sorghum Meal	0.69
Maize Grain	0.40	Maize Meal	0.60
Cowpea Grain	1.81	Groundnuts (Shelled)	1.23
Jugobeans (Shelled)	2.78	Water Melons	1.75
Sweet Reed	0.05		
Insecticide[b]:			
Blue Death	2.05	Malathion	6.96
Traction Implements:			
Double-Furrow Plough	304.00	IS-8	76.00
IS-10	81.00	IS-12	150.00
VS-12	125.80	Two-hole Plough Share	4.17
Three-hole Plough Share	6.52	Double Harrow	118.98
Single Harrow	74.41	Cultivator	109.50
Safim Planter	315.00	Sebele Standard Planter	356.00
Sebele Plough/Planter	172.66		
Carts:			
Four-wheel Cart	857.50	Donkey Cart Tube	17.00
Hand Tools:			
Wheel Barrow	67.12	Spade	15.18
Hand Hoe	4.90	Sickle	4.50
Pick	15.67	Rake	12.30
Small Axe	13.30	Large Axe	26.54
Digging Fork	16.90	Watering Can	19.56
Hammer	8.62	Chain (30 m)	67.00
Pliers	5.85	Dehorning Iron	9.01
Burdizzo	57.00	Syringe (10ml)	14.50
Bicycle Pump	3.95	Motor Pump	14.80
Fencing:			
Galvanized Wire (kg)	1.63	Diamond-Mesh Anchor Wire	1.65
Barbed Wire (kg)	1.92	Binding Wire (kg)	1.68
Small Gate (1.8m)	43.05	Double Large Gate (3.6m)	107.93
Timber Pole (4.8m)	16.82	Metal Corner Post (1.8m)	13.43
Metal Dropper	0.91		
Animals[c]:			
Ox	360.00	Cow	280.00
Bull	412.54	Goat	42.00
Sheep	51.39		

[a] All prices are per kg, except watermelons and sweet reed, which are per melon and reed. These prices should also serve as seed prices. Few traders were selling seed at the time of the survey. Of those who did sell seed, the prices between grain and seed did not differ. It is expected that during November and December seed prices will rise to reflect excess demand. Prices during peak demand periods will be surveyed informally beginning in November.
[b] Insecticide prices are per kg. No traders stock fertilizer.
[c] Most common prices offered by cattle agencies. Prices for draft animals during peak demand periods (plowing and planting) will be surveyed informally beginning in November.

Results: Table 6.5 presents the mean prices of various local resources across villages covered in the survey. These prices will be used in future economic analyses to complement valuation at official government cost.

6.9 FARMER ASSISTANCE PROGRAMS

6.9.1 ARAP AND DROUGHT RELIEF PROGRAM ANALYSIS [11.4.1.1]

Comments: Since this survey was carried out in 1986-1987 details on the objectives, justification, and approach can be found in Annual Report Number 5, Section 6.1.3.

An Executive Summary of findings from the joint survey administered in West Ngamiland, Tutume District, Mahalapye, and Gaborone areas, and Kanye and Jwaneng

lands areas was recently published (June 9, 1988). Among the general recommendations which arose out of the survey findings, four are most significant:

(a). The objectives of programs such as ARAP and Drought Relief need clarification and before policy changes are introduced, clear, simple, and comprehensive guidelines on administration, implementation, and eligibility need to be drawn up. Where possible regional variation in implementation needs to be considered and any overlapping policies need to be streamlined.

(b). Some of the impact of ARAP and Drought Relief has been through income transfer, which is not the underlying goal of either program.

(c). The ARAP program should be confined to plowing, seed distribution and row planting. Components involving building productive capacity, such as the fencing, destumping, and water components, should be transferred to ALDEP.

(d). The area per farmer under a combined program should be reduced and strategies should be implemented which would encourage direct farmer benefit.

6.10 OTHER PROFESSIONAL ACTIVITIES

6.10.1 LINKAGES WITH FARMERS [12.6.1]

During the final week of September 1987, kgotla meetings were held on behalf of ATIP in each village. ATIP used these meetings to present results from previous seasons' research, explain this last season's proposed trials, and receive immediate feedback from farmers and village officials.

Since then, monthly farmer group meetings have been held in each village, primarily for trials management and assessment purposes. Some of the these activities included the following:

(a). **Row Planting Farmer Groups** [12.5.1.] By focusing on custom-hire row planting this season (see Section 6.4.1), the ATIP Mahalapye team disseminated its ideas on row planting in Makwate through a farmer group previously established by the village AD. The AD continued monitoring farmers who previously participated in the group and assisted ATIP staff in organizing and implementing the custom hire scheme.

(b). **Double Plowing** [12.5.2]. Farmers who participated in the high potential sites (HPS) trial (see Section 6.6.4) formed groups in order to discuss advantages and disadvantages associated with double plowing. These groups also discussed other aspects of the HPS trial, such as application of nitrogen and phosphate fertilizer and post establishment management practices. Despite three years of exposure to double plowing through ATIP field trials, farmers in the Central Agricultural Region do not seem to be adopting this strategy on a wide scale.

(c). **Hand Planting/Gap Filling** [12.5.3]. The benefits of hand planting for gap filling were first discussed with farmers during September kgotla meetings in each village. Since then, all farmers participating in the FMFI trials have been encouraged to gap-fill portions of their fields, if needed, with short-season crop varieties. All farmers participating in the HPS trials were given a gap-filling demonstration. Village field staff have been informally monitoring the acceptance of gap filling as a post establishment management practice. However, wide-scale farmer adoption of gap filling has not been witnessed.

(d). **Seed Treatment** [12.5.4]. The benefits of treating domestic seed (primarily groundnuts) with the fungicide Captan were first discussed during September kgotla meetings in each village. Farmers who then wished to have domestic seed treated with Captan for their own comparison were assisted in treating their seeds. Due to the lack of Captan currently available in government and private markets, ATIP has been unable to assist all farmers who wish to treat their seed. DAFS must decide if they wish to make Captan fungicide available directly to farmers for treatment of domestic seed.

Monthly management meetings have been held in Mahalapye for village staff, primarily for data-collection training. With assistance and direction from the Mahalapye staff, village staff have collected all necessary post-establishment and harvest data.

During the month of March, farmer field days were held in each village, in conjunction with DAFS, in order to exhibit and explain ATIP and DAFS on-farm experiments and related agricultural and livestock activities.

During the month of July, ATIP initiated and co-sponsored a contest at the Mahalapye Agricultural Show with other regional MOA agencies. This contest served to promote quality row planting and inter-row cultivation to the local farming community.

6.10.2 LINKAGES WITH EXTENSION [12.6.2]

In addition to collaborative efforts between the Mahalapye team and DAFS officers during the March field days and the Agricultural Show Contest, several linkages with extension have been made over the past year. These linkages include:

(a). The Makwate AD has worked closely with ATIP personnel in organizing, implementing, and monitoring the Custom-Hire Row Planting Scheme (see Section 6.4.1). The AD was particularly active in arranging timely ARAP payments for the custom-hire operators and assessing the overall impact of the custom-hire scheme.

(b). The Macheneng DAO has been actively involved in advising and encouraging the custom-hire operators in Makwate to successfully row plant contracted hectares. He has been particularly active in advising farmers on planting straight rows with a two-row planter.

(c). The Agricultural Officer for the Shoshong Development Trust (SDT) attended the February farmer group meeting in Shoshong and explained his village woodlot/horticulture program. He subsequently exhibited SDT's woodlot during Shoshong's farmer field day. It is hoped linkages with the SDT will be expanded during future seasons.

(d). Two farmers from Makoro have attended RIIC's February bakery training session. With Village Development Committee (VDC) members, they will construct an oven on the ATIP compound and begin baking bread for sale. The Makoro Bakery Project has been funded by the USA Ambassador's Self-Help Fund.

(e). The Regional ALDEP forage officer, based in Mahalapye, has been consulted on the building of model, improved drying/storage racks in the three ATIP villages.

(f). Contacts with the Palapye Development Trust (PDT) have been made and discussions with PDT personnel have followed in order to map out a strategy for

collaboration next season, particularly concerning the promotion of row planting in the Palapye District.

6.10.3 LINKAGES WITH ON-STATION RESEARCH [12.6.3]

Current areas of collaboration include:

(a). Cowpea varietal testing under farmer managed conditions.

(b). Testing of sorghum varieties under field level conditions in collaboration with the cereal breeder at Sebele.

(c). Implements development, testing, and modification with the Farm Machinery Development Unit of the rotary injection planter.

(d). Collaboration with the Land and Water Management Project and INTSORMIL on water/soil studies.

(e). Collaboration with the Sebele groundnut scientist on groundnut related trials.

6.10.4 LINKAGES WITH POLICY/PLANNING [12.6.4]

There were two activities in this area:

(a). Supporting a study by the Sociology Department of the University of Botswana.
(b). Completing analysis on the ARAP/Drought Relief Survey.

6.10.5 VISITS OUTSIDE THE COUNTRY

Trips outside the country included the following:

(a). Dr. D. Baker went to the University of Zimbabwe Third Annual Conference on Food Security in Southern Africa, Harare, Zimbabwe, 2nd to 5th November, 1987.

(b). Dr. D. Baker gave a paper at a SACCAR Workshop on the Integration of Research, Extension and Training, Arusha, Tanzania, 22nd to 24th February, 1988.

(c). Mr. E. Modiakgotla went on a trip visiting farming system projects in Ethiopia and Zimbabwe, in June.

(d). Mr. E. Modiakgotla attended an ISNAR workshop on Agricultural Research Management held at Maseru, Lesotho, 23rd May - 3rd June, 1988.

(e). Dr. J. Siebert gave apaper at an IGADD conference on On-Farm Research In Arid and Semi-Arid Regions of Member States, Djibouti, 23rd-27th May, 1988.

(f). Dr. J. Siebert gave a paper at the Dryland Farming Conference, Amarillo, Texas, 15-19th August, 1988.

CHAPTER 7: ATIP FRANCISTOWN ACTIVITIES, SEPT. 1987 - AUG. 1988

USAID:	R. Gray	(Animal Scientist) Departed Feb. 1988
	G. Heinrich	(Agronomist)
	F. Worman	(Agricultural Economist)
GOB:	B. Mabongo	(Agricultural Economist, DPS) Transferred Aug. 1988
	S. Masikara	(Agronomist, DAR)
PCV:	S. Bock (Ms)	(Agricultural Economist) Departed Aug. 1988

7.1 ECONOMIC AND TECHNICAL MONITORING SURVEYSANDSTUDIES [13.2.1]

The surveys and studies included in the work plan Section 13.2.1 have been disaggregated by themes. The objectives, justification and approach are presented in this section, while results are presented in the appropriate thematic sections.

Objectives: The objective of collecting economic and technical data on a continuing basis was to identify major changes and trends over time in the farming systems in Tutume Agricultural District. Of particular interest were data on:

(a). Crop environments, crops planted, cropping systems used, and harvested yields.
(b). Animal traction used, livestock inventory, and management changes.
(c). Market participation (both input and output)
(d). Smallstock and grain prices.
(e). Timing of labor activities, particularly plowing activities to establish labor coefficients for cropping activities.

Justification: Arable agricultural production in Botswana fluctuates greatly from year to year. This situation can be mainly attributed to the harsh climatic environment and changing government policies. Consequently to adequately describe crop production activities it is necessary to survey the situation across several years. Livestock enterprises also fluctuate with climatic conditions, although to a lesser extent. A continuing monitoring program provides information on the fluctuations in the system over time, and allows for the identification of trends, such as shifts from one source of traction to another. This information is useful in the identification of economically feasible technologies which can lead to increased incomes without substantially increasing risk or investment.

Approach: To provide system monitoring information, several approaches were combined. For environmental information, daily readings of rainfall and temperature were collected. Cropping and animal management practices, livestock inventories, and market participation were assessed using an annual questionnaire to the households which participated in the multiple visit study undertaken in earlier years of the project. Smallstock and grain prices were collected from the same sources on a monthly basis. Timings for plowing activities under farmers' field conditions were collected for animal and tractor traction.

Results: Results are reported in the following sections:

Household Characteristics	7.7.1
Markets	7.8.1
Environmental Monitoring	7.10.1

7.2 CROPPING SYSTEMS:

7.2.1 CROPPING SYSTEMS STUDIES [13.4.6]

This study was initiated in 1986-1987 and was continued in 1987-1988 to collect a second year of observations. The only change was that the cowpea variety used in 1986-1987 (Tswana), was changed to ER7. This was because unpublished data from the cowpea work at Sebele found that this variety was the most effective for a sorghum/cowpea intercropping system.

Objectives: The objectives of this RMRI trial were:

(a). To examine whether a sorghum-cowpea intercropping system can reduce the risk of crop failure relative to sole crop sorghum production.
(b). To examine whether an intercrop system is actually more productive than a sole crop system under farmers' field conditions.

Justification: Intercropping has been shown to reduce the risk of crop failures in some countries. The rate of crop failures under the drought conditions, which have prevailed in recent years in Botswana has been very high (e.g., up to 80 percent failure of plots planted in 1983-1984). Any technology which reduces the rate of crop failures should be of benefit to farmers.

In their final report the DLFRS team concluded that adding a cowpea component to a sole sorghum system actually increased the probability of failure of the sorghum crop in dry years. However, this effect was most severe in sorghum stands of 40,000 plants per hectare and above. The effect was less severe with lower sorghum densities. In the experiment described below, plant populations were held at 20,000 and 10,000 plants per hectare for sorghum and cowpeas, respectively. Moreover, the between-row spacing was increased from the usual 75cm to 100cm, reducing the between-row and between species competition still further.

The addition of a legume in this cropping system was intended to:

(a). Provide farmers with increased food (and possibly income) through the use of cowpea leaves during the growing season.
(b). Provide a buffer crop in case of failure of the sorghum or destruction of the sorghum by birds.
(c). Add to the long term productivity of the soil by increasing nitrogen content to some extent.

Approach: The intercropping system being tested consisted of two rows of sorghum (v. Segaolane) followed by one row of cowpeas (v. ER7). Rows were on one meter spacing, and were planted with the rotary injection hand row planter. All plants within rows were on 33.3 cm spacing. Comparisons were made against sole stands of both sorghum and cowpeas, planted in the same row arrangements, and against a traditional broadcast mixture (2:1 sorghum/cowpea).

The trials were conducted with two farmers per village, with two replications per field,

giving a total of 12 replications. Plot sizes were 15 meters by 20 meters. Trials were planted in randomized complete block designs, with three treatments and two replications per field.

The economic focus for these trials was to collect sufficient labor use, input cost, and yield information from the individual trials to allow the formulation of budgets for each proposed intervention. The budgets were used in comparing potential interventions with traditional technologies, in order to determine which interventions were economically feasible.

Results: At the time of writing, the results have not been fully analyzed because the officer in charge is away on short term training. The complete data, plus results of the statistical analysis will be made available in a AHP Progress Report. A brief overview of the grain yield data is presented below.

An intercrop system could work to reduce the risk of crop failure. However, this was not a good year to test this, since rainfall (usually the most limitive factor) was generally above normal, and in some locations was twice the long term average. The objective of the sorghum/cowpea intercrop mix (vis a vis risk) was to reduce the risk of crop failure in harsh years, and at least not limit it drastically in "good" years. In this respect, mean (total) grain yields from the sorghum/cowpea row planted plots exceeded mean yields from the sole sorghum (row planted) plots in three out of six locations. Overall mean yields for the former were 713 kg/ha versus 475 kg/ha for the latter. Comparing mean grain yields from the broadcasted sorghum/cowpea intercrop (TC) plots with the row planted sorghum plots, the TC plots had higher mean (total) grain yields at four out of six locations, and gave an overall average of 508 kg/ha versus 475 kg/ha. Thus, it would appear that these particular intercropping systems would not be likely to reduce total per hectare grain yields in "good" rainfall years.

The second objective was to examine whether an intercrop system might actually be more productive than a sole cropping system. It is interesting to note that at three of the six locations (locations 3, 4, and 5), the sorghum grain yields from the row planted intercropped plots were the same or greater than the grain yields from the sole sorghum plots, even though the former had sorghum on only two thirds of the plot area. At location 4, the sorghum yields from row planted, intercropped plots exceeded the yields from the row planted sole sorghum plots by 700 to 1200 kg/ha.

A land equivalent ratio (LER) was calculated by dividing the mean total grain produced (across two replications at each location) on intercropped plots, by the mean amounts that would have been produced from two thirds of a hectare of sole planted sorghum plus one third hectare of sole planted cowpeas. The LER for intercropping (row planted plots) was greater than 1.4 at three out of six locations. For the broadcast planted intercropped plots, the LER was slightly greater than 1 at four out of six locations. Averaged across all locations, both row planted and broadcasted intercropping gave LER's greater than 1 (1.38 and 1.10 respectively).

Cowpea yields were generally poor this year. Damage to the crops often occurred because of problems in establishment, lack of grain filling because of insects, in some cases waterlogging, and also sometimes were subject to mold damage during seed ripening. In no replication did sole cowpea plots yield more than 290 kg/ha. Mean yields from sole cowpea plots were 151 kg/ha. Had the cowpeas performed better, they might have contributed significantly to the productivity of the intercrop system.

In summary, while there was no concrete proof that these sorghum/cowpea intercrop systems were consistently more productive or less risky than sole crop systems, there were sufficient encouraging indications to warrant continued examination of the systems.

7.2.2 EVALUATION OF TRIPLE PURPOSE COWPEAS AND DOLICHOS LAB LAB [13.4.4]

Objective: The objective of this RMFI work was to evaluate the acceptability of purposively growing fodder crops as a source of supplemental feed (creep feed) for goat kids.

Justification: Farmers traditionally take large amounts of milk from their goats for home consumption. A supplemental source of feed is not readily available to replace the milk which is robbed from the kids. A triple purpose cowpea (leaves for morogo, grain for human consumption, and residues for livestock) may be more acceptable to the farmer than a single purpose fodder crop such as Dolichos lab lab.

Approach: A sample of goat farmers were selected to plant 0.15 ha each of a triple purpose cowpea (B005C) and 0.15ha of Dolichos lab lab. Farmers were asked to row plant both crops using the rotary injection planter. Single superphosphate was to be applied at the rate of 200 kg/ha. An evaluation was to be made of the cowpeas for leaves picked for morogo or for creep feeding to goat kids, of grain yields, and of forage residue yields. Similar information was to be obtained for Dolichos lab lab on leaves picked for creep feeding and for forage yields.

Results: One trial was planted but because of water logged soil it did not germinate adequately and was abandoned. Other trials were not planted due to delayed planting of primary crops.

7.2.3 AGRO-FORESTRY/ALLEY CROPPING [13.4.2]

Objectives: The objectives of this RMRI work were to:

(a). Identify problems associated with establishment of agro-forestry/alley cropping.
(b). Evaluate cultivars of leucaena and pigeon peas for their acceptability.

Justification: Alley cropping has been shown to prevent wind and water erosion. Leguminous plants such as leucaena and pigeon peas also fix appreciable amounts of nitrogen in the soil. In addition, agro-forestry/alley crops can supply valuable feed for livestock as well as firewood and building materials.

Approach: Arrangements were made with the Impala Forestry Nursery to start approximately 1,000 leucaena and 1,000 pigeon pea plants in pots. These were then transplanted to test sites at ATIP compounds and on farmers' fields early in the 1987-1988 crop season. Problems associated with establishment of plants were identified with the aim of developing a system which can be recommended to smallholder farmers. If establishment is successful, subsequent work will deal with the utilization of these species in livestock feeding programs.

Results: Leucaena hedges were planted at all ATIP compounds. One has reached one meter in height, a second one-half meter, and the third has been heavily damaged by chickens and goats. One farmer has fenced his compound and planted leucaena and fruit trees. One farmer planted pigeon peas as a trial. They produced well and created considerable interest during a field day visit.

7.3 TILLAGE AND PLANTING PRACTICES:

7.3.1 DOUBLE PLOWING SYSTEMS TRIAL [13.4.3]

Objectives: The objectives of this RMFI work were:

(a). To test three different double plowing (DP) systems on a large scale, and to assess their feasibility and profitability in practice.

(b). To collect labor and input data on operational scale plots, to clarify the relationship between small and large plot labor data and to determine actual labor requirements from large scale plots.

Justification. Plot level studies in Tutume Agricultural District indicate that DP could profitably boost per hectare grain yields as long as the opportunity cost of the first plowing is minimized (ATIP PR 1-87-5). Also, economic analysis has indicated that it would be beneficial to switch from two hectares single plowed (SP2) to one hectare DP on farm units with a weeding labor constraint, and/or with limited plowing opportunities.

Theoretically, several practical systems are envisioned which could minimize the cost of the first plowing, and allow farmers with different resource constraints to implement DP. However, these have never been tested on a large scale to verify the theory. In order to round out the work on DP, it is proposed that these systems be subject to a full scale test.

Approach. The three systems to be tested apply to farmers in different traction categories. These categories and the appropriate systems are described below.

(a). **For Farmers Who Own Their Own Draft Power (Largely Cattle).** On with the first rains when the animals were ready to plow, the farmer plow/planted an area of 50 meters by 50 meters. This required one day. When the soil dried slightly below a reasonable moisture level for planting, an area of 50 meters by 50 meters was to be plowed in preparation for DP with the next rain.

When the next rain occurred, the prepared plot was planted, together with an adjacent 5 meters by 50 meters strip, to act as a traditional check. As the soil moisture dropped below the optimum for planting, another 50 meters by 50 meters strip was prepared. This system was to continue on with subsequent rains into January, with the farmer planting on good moisture and preparing more land as the soil dried. Each DP plot had an adjacent check plot 5 meters wide.

It was envisaged that this trial would determine the feasibility of using drying soil moisture periods for land preparation, and to provide some estimate of the potential benefits on a whole farm level.

(b). **For Farmers Who Share Animal Draft.** This trial assumed that farmers received the subsidy on tractor tillage, and that tractors were available. In this trial, a tractor was hired to plow the land, either before the rains or during the early rains, before animals were in condition for plowing. The tractor plowed a one hectare strip, 25 meters by 100 meters. With the first planting rain that animals were available, the farmer planted half of this area (25m by 50m), plus an adjacent (unplowed) area of 25 meters by 50 meters. All of this land (0.25 hectare total) was broadcast planted in the traditional manner. With the second rain, the process was repeated using the second half of the prepared land.

As long as there is a subsidy on tractor plowing, this system will allow farmers

with limited access to cattle draft to double plow without increasing their direct costs. The double plowing should allow them to increase their production and profit from plowing a limited area.

(c). **For Farmers Without Access to Animal Draft**. This trial also assumed that a subsidy on tractor plowing was available. Before the rains, or with the first rains, a tractor was hired to plow an area of 50 meters by 200 meters. With the next rain, half of the area was replowed/planted by tractor (50m by 100m), plus an adjacent area of 50 meters by 100 meters was plowed. The same procedure was repeated on the second half of the plowed area, plus on an equal adjacent area, with the next rain.

As well as allowing assessment of the double plowing system using tractors on a large scale, this system was to shed some light on the relative merit of DP versus single plowing using tractors.

Each of these three systems was implemented by two farmers in different villages. All labor and input data were collected to allow budgets to be constructed, and to provide comparative data on labor requirements for large and small plots.

Results:

(a). **For Farmers Who Own Their Own Draft Power**. This system was implemented at two trial sites in Matobo. Full details on the implementation procedures and the plot grain yields will be provided in a ATIP Progress Report. The preparation (first plowing) of DP plots was carried out on the same day as planting, due to a misunderstanding. Otherwise the trials were properly implemented. The farmers did not appear to encounter or perceive difficulties with the implementation. In fact they both appeared quite positive about double plowing. Overall grain yields were 3552 versus 2933 kg per 5 ha for the DP and single plowing systems respectively at location one, and 1549 versus 1090 kg per 5 ha at location two. Yields are on the basis of five hectares because there were five plots in each of the systems, and not all plots in the DP system were double plowed. Overall, the DP system, as implemented this year, seemed entirely workable. Next year the preparation of DP plots will be carried out on when soil moisture is not optimal for planting.

(b). **For Farmers Who Share Draft Animals**. These trials were implemented at two locations. Complete details of implementation and grain yields will be reported in an ATIP Progress Report. Unfortunately, logistical and environmental problems occurred during the season which rendered the grain yield results basically invalid. At location one, the farmer was absent for a few days during grain ripening, and yields were severely damaged by birds and grasshopper plagues (replication 2 was completely destroyed). At location two, severe water logging virtually destroyed the crop in the first replication. The second replication was not planted because the farmer lost both her herdsman and her cattle in the middle of the planting season. Overall, it appeared that this tillage system has logistical merit. The problems that occurred reflected difficulties that often occur in practice and could affect the productivity of any improved technology. These trials will be repeated in 1988-89.

(c). **For Farmers Without Access to Draft Animals**. Full details of the implementation of these trials will be presented in an ATIP Progress Report. Technical difficulties occurred in implementation, which resulted in the loss of three out of four replications. Thus it was not possible to draw conclusions from this year's data on these trials.

7.4 SOIL AND WATER MANAGEMENT

7.4.1 WATER HARVESTING TRIAL [13.4.1]

Objectives: The objectives of this RMRI trial were to determine whether:

(a). A simple system could be used to concentrate rainfall and runoff water in specific cropped areas of the field.
(b). This system would improve per hectare crop yields and reduce the risk of crop failures over the traditional cropping system.
(c). This system would improve on the yield and stability benefits of double plowing on the contour.
(d). Implementing this system in the field could be both practical and economical.

Justification: The low, and highly variable rainfall in Botswana poses considerable risks to arable crop production, and limits crop production potential in most seasons. The system being tested was designed to concentrate rainfall from the whole field into half of the field area. On soils with good water holding capacity, the increased moisture available to plants growing in the cropped area should:

(a). Improve the growth and productivity of those plants generally; and
(b) Reduce the risk of crop failure by ensuring that more water has been stored in the soil beneath the cropped areas when dry periods begin.

Approach: The system being tested was referred to as contour band plowing (CBP). Soil contours were first laid out using a string level. Then bands two meters wide were plowed along the contour. Between these bands, two meter strips were left unplowed to enhance runoff into the plowed areas. Thus half the field was plowed, and half was not. In Tutume Agricultural District, unplowed soils tend to become quite hard, causing considerable runoff during heavy rains.

After an interval of one rainfall (of more than 10mm) seed and fertilizer were broadcast on plowed areas (beds) and plowed down (so the beds were plowed twice.) Beds and inter-bed areas were weeded by hand, although the inter-bed areas were to be weeded mechanically. (An implement for this purpose was being designed by the Farm Machinery Development Unit at Sebele.) Theoretically, this system should have:

(a). Increased moisture available in the beds through both double plowing and collection of runoff from the adjacent unplowed areas;
(b). No increase in plowing labor requirements per hectare (because only half the field was double plowed); and
(c). Reduced weeding time requirements because half the field could be mechanically weeded.

Double plowing has been shown to produce approximately twice the per hectare grain yield of single plowing (in researcher managed trials). Thus double plowing half the area should produce the equivalent of what could have been produced on the whole area with the traditional system. The fertilizer plus runoff from the unplowed areas should help to increase yields and reduce risk.

This system was tested in Tutume Agricultural District in 1986-1987, and water conservation was observed. It was also tested both in Tutume Agricultural District and at Sebele in 1987-88.

In Tutume Agricultural District, the trial was conducted as follows. Three systems were compared: CBP, double plowing, and the traditional system. Plots were 10 meters wide by 50 meters long, and were laid out across the slope, in a randomized complete block design, with two replications. Preliminary plowing was carried out by tractor. Later plow/planting was done with animal draft power. Trials were conducted on three sites with soils of 70cm or deeper. All labor and input data were collected, and soil texture, depth and nutrient status were examined. Plant stand and grain yield data were collected, but soil moisture status was only monitored at Sebele.

The economic focus for these trials was to collect sufficient labor use, input cost, and harvested output information for the formulation of budgets for each proposed intervention. The budgets were used in comparing potential interventions with traditional technologies in order to determine which interventions may be economically feasible.

Results: Complete details on implementation and grain yields will be presented in a ATIP Progress Report. In summary, some logistical difficulties were encountered in plowing the CBP treatment because both tractor drivers and the oxen teams were unfamiliar with the technique. However, these problems were not insurmountable.

During the season, water logging in certain plots, plus heavy bird and grasshopper attacks during grain ripening, combined to produce much variability in trial results. In general, yields from CBP plots were similar to yields of the other two treatments despite the fact that it had lower plant stands and was planted on half the area of the other two plots. The primary problem with the system was the labor required to control weeds on the unplowed strips. An effective animal drawn cultivator would need to be developed before this system could be practical in the field.

7.5 FARM EQUIPMENT

7.5.1 EVALUATION OF IMPROVED DONKEY HARNESSES AND OX YOKES [13.4.7]

Objectives: The objectives of this EMFI work were to:

(a). Evaluate the durability of the Kenya donkey harness and the improved Sebele ox yoke under farm conditions.
(b). Evaluate farmer acceptance of the Kenya donkey harness and the improved Sebele ox yoke.

Justification: A high percentage of arable agriculture depends on animal draft power for plowing, cultivating and planting. Little improvement has been made in the traditional harnesses and yokes which have been used in the past. Improved harnesses and yokes have been shown to increase the efficiency of draft animal utilization by as much as 30 percent. This study was to test two such improved designs with the aim of introducing them nationwide through ALDEP, if they proved acceptable.
Approach: Fifty Kenya donkey harnesses and 50 improved Sebele ox yokes were manufactured by the Rural Industries Innovation Center at Kanye. Farmers were selected from among ATIP cooperators in the Francistown and Mahalapye areas to test the harnesses and yokes during the 1987-1988 crop season.

Results: Three farmers tested the Kenya donkey collars this year in Tutume Agricultural District. They were also tested in Maun and Gomare by farming systems projects, and by ATIP in the Mahalapye area. Initial reaction from the Gomare team was quite positive, while reaction from Maun was more negative. An informal survey of farmers using the collars in TAD (ATIP PR F88-5) showed that after an initial period of learning

to use the collars (during which time they were put on upside down by some farmers), the farmers took less time to harness the donkeys, the donkeys worked faster for longer periods, and less animals were needed to plow. The major problem with the locally manufactured collars was the poor quality of leather used for the hame strap. The collars have been returned to the manufacturer and re-enforced hame straps have been added. Farmers also suggested that different size harnesses be manufactured. Farmers indicated a willingness to purchase the harnesses at a price of P30-40 per harness. The harnesses were also tested by one ALDEP farmer, and the regional ALDEP officers in Francistown have now placed an order for 66 harnesses which will be sold to farmers.

7.5.2 EVALUATION OF ROTARY INJECTION HAND ROW PLANTER [13.4.8]

Objectives: The objective of this FMFI trial was to evaluate the effectiveness and practicality of the rotary injection planter as an alternative to the traditional broadcast plow system.

Justification: The rotary injection planter may enable farmers with little or no control over traction resources to obtain increased production and farm income through better control over seed depth placement, and the timing of planting vis a vis rains.

Approach: The rotary injection planter was evaluated through the farmer assessment groups as a tool for row planting in terms of its practicability and performance, vis-a-vis the traditional broadcast plow system.

Results: Both imported and locally manufactured rotary injection planters were heavily used by farmers in the technology options testing groups in TAD. The planter was also used by members of the extension led farmer options testing group in Mapoka. Further testing was done by farmers in the ATIP Mahalapye area and by researchers in the Gomare, Maun and Pelotshetlha farming systems programs.

All researchers who used the planter plus 19 farmers in the Mahalapye area, and 20 in the Francistown area were surveyed to obtain their evaluation of the planter. Findings from the survey are reported in ATIP PR F88-4. Generally, the planter received positive reviews. A number of recommendations concerning modifications were made to the manufacturer (RHC), based on both farmer and researcher observations. These modifications have now been made on the original machines, and these machines will be re-tested by farmers in the coming season.

7.5.3 TESTING OF LOW LIFT HAND WATER PUMPS [13.4.10]

Objectives: The objective of this trial was to test a low lift-low cost hand water pump under farmer field conditions for use at lands areas and cattle post areas.
Justification: Many farmers have hand dug shallow wells at lands areas which tend to dry up during the season, and when in use may provide contaminated water. Also many cattle posts rely on water from hand dug wells located in rivers for watering the animals. A well constructed low lift hand pump attached to a sand point, could provide water in these situations which is cleaner and available for longer periods. Sinking a sand point is also less work than digging a well and pumping may take less labor than filling water troughs with buckets.

Approach: Several sand points and pitcher pumps, capable of lifting water up to 6 meters, were obtained and tested at lands areas. Farmer assessments were obtained.

Results: Three pumps were installed, one with a locally manufactured sand point.

Unfortunately, two were placed in the Shashe river, and were lost when the river flooded. The one remaining pump received much attention during a farmer field day visit, and several farmers asked where they might acquire a pump. Further testing does not seem feasible unless a locally manufactured pump becomes available. The tests did generate enough interest so that RIIC and Zimplow at Bulawayo -- which has the casting facilities -- will be approached to determine if the pumps can be made locally at a reasonable cost.

7.6 LIVESTOCK PRODUCTION SYSTEMS

7.6.1 GOAT PRODUCTION [13.4.5]

Objectives: The objectives of this RMFI study were to:

(a). Monitor goat production on smallholder farms to identify production parameters.
(b). Evaluate the benefits to be obtained by supplementary feeding (creep feeding of cowpea and Dolichos lab lab leaves) to young goats.
(c). Collaborate with the DAFS smallstock extension personnel in establishing smallstock management groups in villages.
(d). Evaluate the benefits of housing for protection of young stock from the elements.

Justification: Renewed interest was expressed in the role of smallstock at the smallholder level at a workshop on "Research and Development in Smallstock Production" held at Sebele on May 25th, 1987. The outcome of the workshop was the identification of research priorities for on-station and on-farm (farming systems) work. The objectives listed above address priority areas that were identified for on-farm research.

Approach: Twenty farmers (eight in Marapong, six in Mathangwane, and six in Matobo) participated in this study. All goats in each farmer's herd were ear tagged and weighed when the herd entered the program. Detailed records were kept on herd dynamics and production parameters. All goats were weighed at the end of the rainy season in May, and at the end of the dry season in November. New born kids were weighed and tagged at birth and periodically thereafter.

Housing facilities were constructed on three farms to study the effects on survival and performance of kids. Additional types of housing were designed in collaboration with DAFS smallstock personnel.

Results: All goats in the study herds were weighed (semi-annually) and weekly records were kept on births and deaths. An additional goat house was completed, and materials were obtained for several more houses. A goat production study begun in 1986 was continued in 1987. The 1987 results (ATIP PR F88-1) indicate a kidding rate of 132 percent, with a death loss of 62.4 percent. Mean total milk production for all farmers was 1.4 liters/day, with a mean daily production per goat (of 198mls) through May when farmers stopped milking due to the drought. Even through production was down due to the drought, the data indicate that genetic potential exists for improvement of both milk and meat production. It was concluded that a high priority should be given to interventions to:

(a). Decrease kid mortality,
(b). Improve herd health, and
(c). Improve breeding programs.

Dr. R. Gray presented a paper on these findings, entitled "Production Parameters of the Tswana Goat", at a meeting of the Small Ruminant CRSP.

7.7 HOUSEHOLD CIRCUMSTANCES

7.7.1 COOPERATING FARMERS STUDY [13.2.1]

Objectives and justification of this study were discussed in Section 7.1 above.

Results: Results from the 1987-1988 planting season Cooperators Survey are to be reported in an ATIP Progress Report.

A brief survey was conducted of 50 farmers who participated in the 1987 ARAP/Drought Relief Survey. The survey was to determine if there were any changes in the participation in government relief programs, and if there were a change in traction patterns (due to severe drought preceding the 1987 planting season). The percentage of farmers receiving plowing subsidy dropped from 98 percent to 94 percent. Ninety percent of the farmers received seed in 1988, but there was still confusion as to whether the seed was ARAP or Drought Relief. The number of farmers who received obtained from ARAP assistance for weeding jumped from 65 percent in 1987 to 92 percent in 1988. The number of farmers row planting increased from one in 1987 to five in 1988. The number of farmers receiving help for fencing remained constant at two, but the total number of farmers receiving help for destumping jumped from two to nine (six under ARAP, two under ALDEP and one under Drought Relief).

In 1987, 86 percent of the households used at least some animal traction. This dropped to 68 percent in 1988. The percentage of households using at least some tractor traction remained constant at 32 percent. There was a decrease in the number of families who controlled their own traction -- from 57 percent in 1987 to 49 percent in 1988. The drop in households owning their own traction, and the drop in households using animal traction may be attributed to the severe drought prior to the 1987 season. On the other hand, there was a drop in the percentage of households which were completely dependent from 23 percent in 1987 to 13 percent in 1988, possibly indicating that farmers were trying to keep at least part of the plowing subsidy for themselves. Coupled to the decrease in households completely dependent and those completely controlling their own traction, there was in increase in households with partial control from 20 percent in 1987 to 38 percent in 1988. Five households shifted from animals to some or all tractor plowing, while two households shifted from some tractor plowing to all animal plowing. Three households shifted from cattle traction to donkey traction, perhaps because donkeys survived the drought in better condition than cattle.

7.8 MARKETS

7.8.1 SMALL STOCK AND GRAIN TRADING AND PRICES [13.2.1]

Objectives and justification of this study were discussed in Section 7.1 above.

Results: Agricultural markets (grain and small stock) and prices were monitored through monthly interviews of six local businesses. Only one cooperative was willing to purchase grain, but had not done so in the last four years. Grains were exchanged in an informal market. A price survey of village prices, both commercial establishments and farmer to farmer prices, was made in February 1988. Results are given in Table 7.1.

Small stock purchases data were collected for the period covering September 1987 through August 1988. A total of 16 goats were sold to restaurants in Mathangwane, with prices ranging from P29 to P50 and averaging P36 per goat. Over the same period

Matobo villagers sold a total of 30 goats to restaurants for prices ranging from P25 to P50. The average price per goat in Matobo was approximately P39.

TABLE 7.1: GRAIN PRICES, FRANCISTOWN AREA, FEBRUARY 1988

Commodity	BAMB Price[a] Pula/Kg	Village Price[b] Pula/Kg
Sorghum	0.29	0.70 - 1.00
Maize	0.27	0.50 - 0.80
Cowpeas	0.39 - 0.51	2.00 - 2.60
Jugo Beans	0.41	2.50 - 2.80
Groundnuts	0.28	2.60 - 3.50
Millet	0.26	1.00

BAMB guaranteed producer prices for 1987 harvest.
Local prices near end of 1987-1988 planting season.

7.9 EXTENSION LINKAGES

7.9.1 MATSITAMA/MOKUBILO PILOT COMMUNAL GRAZING PROJECT [13.3.1]

This work was carried out in collaboration with the animal production and range extension officers of the Francistown regional agricultural office.

Objective: The long-term objective of this project was to develop productive methods of animal husbandry and range management in a communal area which are compatible with the long-term carrying capacity of the range land. Specific objectives were to:

(a). Improve the productivity of the herds that are kept in communal areas, and to increase the benefits that the herd owners may derive from them by methods that are acceptable and practical to the local community.

(b). Maintain and improve the productivity of the range such that its value as a production resource is conserved to sustain the grazing animal at acceptable levels.

Justification: The previous extension approach to communal problems has been centered on the management of the animal through Services to Livestock Owners in Communal Areas (SLOCA). Very little consideration was given to range management. Currently, the extension strategy has changed to include the disappearing range resource. The SLOCA Project is funded by the EEC while the new Range Management Project is funded through a loan from the World Bank. While there is an urgent need to do something in the communal areas, it is acknowledged that there is little information to adapt from elsewhere. Thus, justification exists for the application of a "farming systems" approach to range management, particularly in communal areas, and especially in describing the dynamics of existing grazing/livestock management systems in communal areas.

Approach: An area of approximately 1200 sq kms located in the vicinity of Matsitama and Mokubilo, in the Tutume Agricultural District was selected in 1986 as a pilot project site. ATIP was requested to assist the extension service in preparing a project proposal. Kgotla meetings were held in the two villages in late 1986 and the objectives of the proposed project were explained to the farmers. Agreement was reached among the villagers that the proposed project was desirable and should proceed. A census of the households and cattle posts in the project area was made.

Cattle owners who reside in the project area consulted with absentee cattle owners. After due deliberation, a meeting was called of all cattle owners. At this meeting they were

asked to form a management committee to assist in formulating a proposal which would be submitted to the Animal Production Division (APD), DAFS, for funding].

Results: A census of 307 households was completed, and the baseline information obtained is reported in ATIP PR F88-3. This baseline information was made available to the extension service for use by the management committee in formulating a proposal. Several meetings of the steering committee, with representatives of extension, ATIP, the villages, and the Ministry of Agriculture were held. A general meeting of all livestock owners in the area was held in October, and planning committees from each of the two villages were selected. Dr. R. Gray presented a paper entitled "Farming Systems Work Applied to a Communal Grazing Management Pilot Project in Botswana" to the SARCCUS Subcommittee for Veld and Pasture. ATIP is prepared to respond to further requests by extension (through the steering committee) for assistance with this project.

7.10 ENVIRONMENTAL MONITORING

7.10.1 RAINFALL AND TEMPERATURE MONITORING [13.2.1]

Objectives and justification of this study were discussed in Section 7.1 above.

Results: The 1987-1988 cropping season began in late November after a drought of almost nine months. This extended dry period was followed by a crop year which saw almost daily rains in December and February, and averaged almost 60 percent more rainfall than the 30 year average. (See Table 1.2) Farmers received 137 percent more rain in 1987-1988 than in 1986-1987.

There was a great deal of variability in the amount of rain received in the three participating villages (Table 7.2). Matobo with 635mm received almost 42 percent less rain than Marapong with 899mm. Mathangwane with 690mm of rain was eight percent ahead of Matobo. The distribution of the rain, with two months of heavy rains, meant that many farmers had relatively few days of good planting conditions, particularly in Marapong where water logged soil was a common problem.

7.11 METHODOLOGY

7.11.1 EMFI OPTIONS TESTING WITH FARMERS' ASSESSMENT GROUPS [13.4.9]

The work with farmer groups in 1986-1987 was very popular among farmers and was continued in the three study villages in the Tutume Agricultural District with only a few minor changes.

Objectives: The objectives were to:

(a). Test a broad range of innovations under farmer managed conditions for increased productivity and grain yield dependability.
(b). Involve farmers and ADs directly in the farming systems development process.
(c). Determine what types of innovations are most appealing to different types of farmers.
(d). Examine methods for creating similar groups outside of the ATIP villages through the collaboration of the CPOs, DAOs and ADs.
(e). Determine the extent of adoption of double plowing by participants in the 1986-1987 farmer trials in Matobo.

TABLE 7.2: MONTHLY RAINFALL (MM), FRANCISTOWN AREA, 1983-88

Month	1983-84 Mean	1984-85 Mean	1985-86 Mean	1986-87 Mean	1987-88 Mean
Matobo:					
September	NA	0	0	18	1
October	NA	17	42	41	4
November	NA	119	0	63	39
December	31	36	77	51	209
January	29	114	38	95	58
February	53	126	34	18	212
March	74	43	52	10	92
April	0	0	74	0	0
June	0	0	0	0	20
Total Matobo	187	455	317	296	635
Mathangwane:					
September	NA	0	0	9	0
October	NA	42	29	66	9
November	NA	44	31	94	45
December	15	63	24	83	249
January	24	185	28	41	36
February	25	142	33	27	198
March	77	0	67	5	128
April	16	0	146	0	5
June	0	0	0	0	20
Total Mathangwane	156	476	358	325	690
Marapong:					
September	0	0	0	10	0
October	NA	43	17	91	7
November	NA	64	1	57	78
December	20	48	37	50	256
January	39	112	28	69	30
February	73	133	31	48	354
March	70	12	54	7	123
April	22	0	124	0	30
June	0	0	0	0	21
Total Marapong	244	412	292	332	899
Overall Average	192	448	322	318	741

Months not indicated had insignificant rainfall.
Data collection began in December 1983.

Justification: Numerous technological innovations have been developed in Botswana (and elsewhere) which may be relevant to subsistence farmers in the Tutume Agricultural District. However, it is difficult to evaluate a very wide range of these innovations under researcher managed conditions in on-farm tests (due to time constraints). Further, it is often difficult to assess which innovations might be most relevant to specific farmers. It was therefore decided to present to a group of farmers a wide range of technological options (especially relating to specific contingencies at different times of the year). Farmers were then asked to select innovations on-farm that seemed most relevant to their situation, and to test those with some researcher guidance (and provision of inputs). Monthly meetings were held with the groups to discuss problems and progress. In this way, farmers demonstrated which types of innovations seem most appropriate to them, and researchers were able to observe the effectiveness of those innovations and work with farmers towards the development of improved production systems. By including ADs in the group monthly meetings, the ADs also became part of the systems development process.

Approach: In late September, an open kgotla meeting was held for all participating farmers, members of village farmers' committees and the local AD's in the three villages where ATIP has been working. At this meeting ATIP staff presented:

(a). The results from last year's research.

(b). An invitation to all interested farmers to attend a special meeting where technical

options were reviewed -- these included both new technologies and currently recommended ones.

At this meeting, a wide range of technology options were discussed. Farmers were then be asked to select any innovation or package of innovations they wished to test. Those farmers electing to perform a test (or tests) formed the farmer groups that met monthly. The ADs were also be invited to attend these meetings, where progress and problems were discussed.

The types of innovations introduced included:

(a). Tillage/water conservation techniques.
(b). Planting method options (with some emphasis on evaluating hand row planters).
(c). Crop varieties.
(d). Manure and fertilizer possibilities.
(e). Forage and fodder production options.
(f). Seed protection options. Depending on the degree of interest, and availability of equipment, some or all of the farmers wishing to test a specific innovation were supplied with the necessary inputs and machinery by ATIP. Trials were laid out side by side with a traditional control. Generally, a record was kept by ATIP staff regarding the dates of all operations, and grain yield. An End-of-Season Farmer Assessment Survey was administered.

Field days were held in each of the three villages. At these field days, selected participating farmers had the chance to show off their trials to the rest of the group, as well as to farmers from outside the group and to regional extension staff. They described the trial, their observations and opinions, and answered questions from the group of visitors.

Some of the changes that were made this year included the following:

(a). Farmer comparisons were slightly more controlled. For example, a farmer who wished to test double plowing with fertilizer versus double plowing/row planted (as happened last year) was encouraged to separate his trials into double plowing with and without fertilizer, double plowing with and without row planting, and to include traditional checks in each.

(b). ATIP sometimes requested farmers to take on additional tests to those they self-selected. This situation arose where farmer feedback on a new technology was required, or where an insufficient number of farmers participated in a particular trial, e.g. variety trials.

(c). It was agreed with the RAO that group research and extension activities would be expanded in the region. The new group was supervised by the DAO and run by the AD. ATIP provided a field assistant to the AD, attended all meetings, assisted with the training of the AD and field assistant, and provide some material inputs (i.e., new machinery). DAFS staff organized and led meetings, provided equipment available in the ALDEP package, and presented current recommended practices.

The exact format, conduct and location of the new group was decided in a meeting of ATIP and DAFS staff in October. The format and objectives of the group differed slightly from those groups being led by ATIP. This was because the group led by DAFS had more of an extension perspective than those led by research-owned people. The DAFS-led group focused more on tested technologies. However, by participating in DAFS-led groups, the ATIP personnel could:

(a). Observe the effectiveness of tested technologies in different and numerous environments;

(b). Help to guide extension personnel in the application of new technologies; and

(c). Be present in the early stages of dissemination to help out when problems arose, and thereby help create a continuum for technological development and dissemination by encouraging the participation of extension personnel research groups and vice-versa.

Results:

Researcher-Led Group. The number of participants this year increased to 40 in Marapong, 46 in Mathangwane, and 57 in Matobo. Participating farmers signed up for 241 separate trials. Of these, 89 trials were deleted from the analysis either because they were never planted, were improperly implemented and became invalid comparisons, or for numerous reasons they failed to produce any yield. Thirty-one percent of these were not implemented due to draught power limitations, and another 34 percent were excluded because they were invalid comparisons of a new technique, or were planted too late in the season to mature before the cold weather. A detailed discussion of these trials will be provided in an ATIP Progress Report. The remaining 152 trials were divided among the six types listed in Table 7.3.

TABLE 7.3: NUMBERS AND TYPES OF TRIALS SUCCESSFULLY IMPLEMENTED, BY VILLAGE, FGTOT TRIALS, FRANCISTOWN AREA, 1987-88.

Type of Trial	Matobo	Marapong	Mathangwane	Total
Double Plowing	49	9	4	62
Groundnut Seed Treatment	11	19	14	44
Cowpea Variety Trials	5	13	3	21
Row Plant v. Broadcast	0	1	9	10
Fertilizer (20 kg/ha)	1	2	5	8
Long/Short Season Crop Mix	4	3	0	7
Total	70	47	35	152

In addition to these formal comparisons, three farmers also successfully used a two furrow plow, and three tried an improved model of the tractor mounted plow/planter.

Table 7.3 illustrates how differences between villages can affect farmers' selection of technology. For example, double plowing (DP) was far more popular in Matobo, where most farmers either owned or shared oxen for draft power, than it was in Mathangwane, where many farmers relied on hired tractors for plowing. In the latter, DP was difficult because tractor owners were loath to return to a particular field once it had been plowed, and because the hire price was high. In contrast, row planting comparisons were more popular in Mathangwane. This possibly occurs because these farmers were more interested in separating their plowing and planting operations because they could not control the timing of the tractor plowing. Also, tractor plowing tends to bury broadcast seed too deeply to be sure of good emergence.

Details of trial implementations and outcomes (e.g., plowing/planting dates, traction source, planting methods, plot yield data, etc.) will be presented in an ATIP Progress Report.

In general, cowpea yields were low due to water logging, and were particularly subject to pest damage. Cereal yields tended to be somewhat better, but a number of cereal plots were hurt by loss of soil nitrogen during the heavy rains, and by bird and insect pests. Mean yield data are presented in Table 7.4. For trials with paired comparisons, a paired t-test was used to determine whether observed differences were significant.

Double plowing gave the greatest yield increase again this year, almost up to the 70 percent level on cereals that has been observed in farmers' trials for the last three years. Cowpea yields were greatly reduced by insect pests. However, the continued increase in cereal yields was surprising in view of the above average rainfall this year. The "good" rainfall also contributed to producing a consistent and considerable yield increase from the application of phosphate fertilizer.

Though row planting produced an increase in mean yields, the differences were not sufficiently large or consistent to result in a statistically significant difference. ALso, there was some variability in the way trials were implemented (see forthcoming ATIP Progress Report).

Both the groundnut seed treatment and the cowpea variety trials were very popular this year. Trial numbers were only limited by the amount of seed available. Part of the attraction of these trials (aside from technical interest) was the fact that farmers regarded both the groundnuts and cowpeas as high value crops, and apparently felt that their own seed supplies were low -- see list of village prices in Table 7.1. With these trials, farmers exhibited a willingness to make a greater investment, (e.g., double plowing, hand row planting) and seemed to place a higher priority on getting them planted than was true with other types of trials. This could possibly affect the types of recommendations that would be practical for these crops.

TABLE 7.4: MEAN YIELD DATA FOR SELECTED TRIALS, FGTOT TRIALS, FRANCISTOWN AREA, AREA, 1987-1988*

Trial Name	Crops	Yield Improved Kg/Ha	Yield Trad Check Kg/Ha	% Increase In Yield	No. Trials
Double Plowing	Cereals	488***	288	69	32
	Cowpeas	181***	130	39	30
	Combined	339***	212	60	62
Groundnut Seed Treatment	Groundnut (v. Sellie)	342**	276	24	44
Row Planting vs. Broadcasting	80% Sorghum 20% Cowpea	173 NS	131	32	10
Phosphate Fertilizer	75% Cereals 25% Cowpea	550*	366	50	8
Cowpea Variety Trials*.	Blackeye	171	--	--	13
	ER7	145	--	--	13
	TVX	210	--	--	13
	BOO5C	318	--	--	13

*. *, **, *** denote significant differences between treatments at the 5%, 1% and 0.1% level of probability, respectively. NS means not significant.

*. Includes only trials where all four varieties were tested together.

Farmer group meetings were held regularly throughout the cropping season, and field days were held in each of the three villages. Participation on the part of ADs was good, and the DAFS participated fully in the farmer field days. Some of their demonstrations and projects were also exhibited at field days. The dates of all group meetings and field days will be presented in a future ATIP Progress Report.

Farmer perceptions of research group activities, and the overall approach, were reviewed by the Rural Sociology Unit, DPS. Results of their study are reported in ATIP WP 11, 1988.

In summary, farmer participants showed continued interest in testing new technologies under researcher guidance, showed considerable ability to do so, and generated much useful information.

Extension-Led Group. The AD at Mapoka organized and led a farmer testing group with the assistance of the Tati DAO and ATIP. This group had approximately 30

members, and tested a limited number of technologies under farmer field conditions. Technologies tested included: Sebele row planters, Sebele plow/planters, rotary injection row planters, cultivators, phosphate fertilizer, fodder crops, and cowpea varieties. Farmers tested the technologies in their fields but did not undertake side-by-side comparisons except in the cowpea variety trials. Monthly meetings were held where members reported on their trials and discussed problems. A field day (attended by the Director of DAFS) was attended by over 100 farmers, extension staff, and researchers. A survey of farmers perceptions of the technologies tested, and the group experience is being conducted and will be reported, along with other data on the farmer group in a forthcoming ATIP Progress Report.

7.12 OTHER PROFESSIONAL ACTIVITIES

In order to promote the acceptance of farming systems work, the ATIP Francistown team has sought ways to increase contacts between the team, farmers and other agencies. This contact invoices conducting joint research and in the inclusion of extension and research staff in farmer group work, field days and joint visits to fields. Linkages and collaboration have been strengthened through the following activities.

7.12.1 LINKAGES WITH FARMERS [13.5.1]

Linkages with farmers were accomplished in the following ways:

(a). The number of farmers participating in the researcher-led farmer technology assessment groups continued to expand, growing from 97 in 1986-1987 to 143 in 1987-1988.

(b). Farmers continued their active involvement in RMFI trials with 34 farmers participating in this type of trial. Fifty-eight households were interviewed for the ARAP/Drought Relief Survey, and 307 for the Matsitama/Mokubilo Baseline Survey.

(c). Annual reports on ATIP activities were made at kgotla meetings in each ATIP village.

7.12.2 LINKAGES WITH EXTENSION [13.5.2]

This involved:

(a). Continuing participation by DAFS staff in the FMFI design and testing of systems' options through involvement of local ADs in monthly farmer group meetings, and field days with district and regional DAFS officers. Field days this year involved over 450 farmers, researchers and extension personnel (including the Directors of DAR, DAFS and the CARO), and included DAFS demonstrations as well as ATIP trials.

(b). Assisted in the formation of one extension led farmer options testing group led by the DAO and AD. The group was located at Mapoka in the CFDA, Northeast District, and involved 30 farmers.

(c). Collaboration with ALDEP on forage trials was continued and ALDEP testing of the Kenya donkey collars, improved ox yolks and the rotary injection planter was initiated. ATIP staff took part in several ALDEP meetings to discuss local

extension - research collaboration.

(d). Regular meetings were held with the RAO and his staff to actively seek their suggestions concerning the identification of research problems, to review the Francistown ATIP Work Plan, and to keep them fully informed of ATIP's activities.

(e). ATIP staff collaborated with the regional animal production and range officers, Francistown, on the Matsitama/Mokubilo Pilot Communal Grazing Project, producing a baseline study of the area for use in project planning.

(f). Six articles on ATIP activities, with pictures, were included in the AGRINEWS extension publication. An article on ATIP activities in the Francistown area was published in the Northern Advertiser.

(g). ATIP senior technical officers regularly attended DAFS Monthly Management Meetings and discussed ATIP activities.

7.12.3 LINKAGES WITH ON-STATION RESEARCH [13.5.3]

Collaboration with DAR took place in the following areas:

(a). Cowpea varietal testing under farmer managed conditions.

(b). Early screening of short season sorghum genotypes -- from the sorghum breeding program and the University of Nebraska.

(c). Implements development, testing and modification with the Farm Machinery Development Unit and Rural Industries Innovation Center, i.e., improved ox yokes and donkey harness, light weight cultivator, and rotary injection planter.

(d). Began collaboration with soil scientist (INTSORMIL) on closing the double plowing studies.

(e). Tested treated versus untreated groundnut seeds.

(f). Presented a seminar at Sebele on ATIP's experience with double plowing, participated in thematic group meetings, and the Crops Division annual meetings.

(g). Participated in APRU meetings and collaborated on the annual report.

(h). Provided support and data for APRU economist studying goat farmers who worked with the ATIP smallstock studies. (The Farm Management Unit of the Division of Planning and statistics was also involved in this study.)

7.12.4 LINKAGES WITH POLICY/PLANNING [13.5.4]

Linkages in the policy/planning area were strngthened as ATIP:

(a). Began documentation on data sets so they would be available to potential users in GOB.

(b). Requested and supported a Rural Sociology Unit study of the researcher managed technology options testing groups.

(c). Supported a study by the Sociology Department of the University of Botswana in the ATIP villages.

(d). Reviewed a research proposal by the Economics Department, University of Botswana, and agreed to support the research by providing data and facilitating access to ATIP cooperating farmers.

(e). Participated in a seminar on farmer participation held at the National Institute of Research.

7.12.5 METHODOLOGY DEVELOPMENT [13.5.5]

Activities in the area of methodology development included:

(a). The Francistown ATIP team continuing to work with other members of ATIP in the preparation and dissemination of methodological materials including the "Farming Systems Handbook for Botswana".

(b). Two papers were prepared on farmer participation in research for the Information Centre for Low External Input Agriculture, the Netherlands.

(c). The participation of the Francistown agricultural economist and the head of the Rural Sociology Unit, MOA, participated as facilitators in the Philippines Upland Research/Extension Training Workshop where a paper on farmer participation was given.

7.12.6 VISITS OUTSIDE THE COUNTRY

(a). Dr. Worman gave a paper and acted as a facilitator at the Philippine Upland Research/Extension Training Workshop.

(b). Mr. S. Masikara spent six weeks in the USA working with INTSORMIL personnel, attending two microcomputer short courses, and giving a paper at the Annual Farming Systems Symposium in Arkansas.

CHAPTER 8: VISITORS

The following is a partial list of visitors to ATIP during the reporting year. Often they came for other purposes than simply visiting ATIP. Those listed visited either Mahalapye or Francistown. The list does not include those who were at Sebele only. Also it is not a complete record since, for some, a record was not kept.

8.1 NAMES RECORDED

D. Anderson, AID Consultant
D. Andrews, INTSORMIL, University of Nebraska
G. Brandsburg, ATIP Consultant, Kansas State University
D. Collier, National Food Strategy Coordinator
P. Devitt, MOA Consultant
D. Esslinger, ATIP Consultant, University of Missouri
T. Frankenburger, AID Contractor, University of Arizona
J. Jorns, Office of International Agriculture, Kansas State University
W. McKinsey, MIAC Executive Director, U. of Missouri.
N. Macala, Farm Management Economist, MOA
Y. Merafe, Head Rural Sociology Unit, MOA
G. Mtawa, Officer-In-Charge, Ilonga, Tanzania
K. Mokgotle, Economist, APRU, DAR
P. Ntseane, Rural Sociology Unit, MOA.
G. Rhebergen, FAO Soils Team, Maun
F. Schultz, Animal Scientist, Kansas State University
V. Withee, INTSORMIL, Kansas State University

8.2 NAMES NOT RECORDED

Three members of a Congressional Investigating Committee.
Nine Zambian agricultural engineers.
SACCAR agronomist and soil physicist.
CFDA research team leader from Netherlands
Three members of ALDEP Technical Evaluation Team.

PART III: WORK PLAN, SEPTEMBER 1988 - AUGUST 1989

CHAPTER 9: PERSONNEL AND EQUIPMENT

9.1 PROFESSIONAL STAFF

The only outstanding issue with reference to professional staff is what will be done with Dr. D. Baker's position. As indicated earlier in the report (Section 3.1) he left at the end of August and negotiations are still underway with GOB as to how this position might be filled. Time is now running short and if a decision is not reached very soon, it is unlikely that another technical assistance person will be able to be recruited who could spend more than one year on the project.

9.2 SUPPORT STAFF

An approach has been made to DAES about the possibility of obtaining two more individuals on secondment to further the research-extension linkage in the areas where ATIP is working. This is becoming a new focal point of ATIP activities. It is hoped that these positions will be filled at the T4 level. Also a request has been made to fill the slots that are currently vacant.

9.3 CONSULTANTS

Currently, plans to employ the services of consultants during the coming year are in a state of flux. The list that appears below is very tentative in nature and may change in the light of developments over the coming year. Thus the list should be considered illustrative in nature and subject to change. In any case, all consultancies will initially have to be approved by both GOB and USAID before they can be implemented.

(a). **Study of Farmer's Evaluation Criteria.** It would be helpful to know what set of criteria are most important to farmers (e.g., reliability of yield, total yield, labor requirements, capital input requirements, technical complexity, simplicity of implementation, etc.) so that it would be possible to evaluate the farmer acceptability of technologies more quickly.

(b). **Appropriate Decision Making Unit.** There are questions concerning the unit being used in the ATIP studies, i.e., the "farm household". Is the current definition appropriate to both the Mahalapye and Francistown areas?

(c). **Adoption Study.** A consultant with experience in adoption studies is needed to help design and implement an adoption study to determine if participants in the farmer groups have adopted technologies they have tested.

(d). **Animal Science.** It may be desirable to have a consultant in the production of goat milk products and/or the marketing of goat meat and/or milk.

(e). **Computer Applications Specialist.** The desktop publishing system at the Agricultural Information Section in DAES, which was purchased by ATIP, needs to be more fully utilized. The training by Mr. G. Brandsburg, KSU Extension Publications Specialist, during July of this year, served to emphasize the potential

of the system and the need for more training. The services of a local specialist is now needed, who can assist in solving problems as they arise.

(f). **Agricultural Extension Management (Consulting and Training).** The Mananga Agricultural Management Centre (MAMC) in Swaziland has developed an outreach programme, which has some potential for Botswana. At the present time, a proposal from MAMC is being considered for a training needs assessment, a series of training courses and follow-up seminars.

(g). **Agro-Forestry.** With increasing concern about production versus conservation, and the possible role of forage trees, it is proposed that a consultant be used to help in designing a baseline survey (see Section 12.2.2), and to give advice on work in this area. Such a consultant would be used in conjunction with FAB, who are cooperating in the baseline survey.

It is anticipated that the Memorandum of Understanding between Kansas State University and Alabama A and M, can continue to help in facilitating some consultancies. This arrangement provides a strengthening experience for the consultant, while at the same time providing a contribution to Botswana at little or no cost to the project.

9.4 EQUIPMENT

It is anticipated once the three vehicles ordered (Section 3.4) have arrived there will be few additional purchases.

Most additional purchases are likely to revolve around relatively minor items, with reference to computer equipment and computer software.

CHAPTER 10: TRAINING

10.1 LONG-TERM TRAINING

Long term training can be divided into two classes based on funding source:

(a). **ATIP Funded Support**. In Table 4.1 there are four people who are currently away (Mr. J. Lesotlho, Mr. A. Sebinyane, Mrs P. Ntseane and Mr. B. Masilo). In addition, it is hoped that one person will go in January '089 (Mr. B. Moji). In terms of the 12 person years funded under the new contract, only six have currently been filled with participants. Currently there is a request, pending from DAR, to send an additional person. Nevertheless the constraint will be to get them all back before September 1990. Alternatively if they are not finished by that time, it will be necessary to get an agreement from GOB, that they will fund the remaining part of the training program.

(b). **Matching Funds From GOB**. Under the original ATIP agreement, GOB agreed to fund 15 person years of long term training. Currently, 10 of these have been funded. Thus there are five person years of long term training that can still be funded. Whether or not these will be filled will depend upon availability of suitable candidates.

10.2 SHORT-TERM TRAINING

Possibilities for short term training often arise at relatively little notice. Therefore it is difficult to make specific plans for sending people on short term training. When opportunities arise they will be considered on their merits.

However, it is definitely planned that efforts will be made to ensure that people will attend the CIMMYT Workshop on farming systems work. The short course they offer is divided into two parts, so that both individuals that will attend each workshop. ATIP will help fund the attendance if other sources of funds are not forthcoming.

Other possibilities for ATIP funding, that are currently under consideration, are a forestry course (DAFS staff member) in Kenya, a tissue culture conference (DAR staff members) also in Kenya, and a course in making videos (DAFS staff member) in the USA.

10.3 ON-THE-JOB TRAINING

Once again in-service training opportunities also often arise at relatively short notice. Therefore, there needs to be some flexibility in planning activities in this area. Tentatively, that slated to date, include the following:

(a). **Training with Pagemaker**. This training will be provided by a consultant available locally, for individuals in the Agricultural Information Section in DAFS.

(b). **SPSS Training**. It is likely that ATIP may fund training for DAR personnel in SPSS, which is the statistical package to be used within the department. This training will probably be facilitated through a commercial computer firm in Gaborone.

(c). **Farmer Groups and Training Workshops.** Currently, there are several activities where ATIP personnel either work in training farmers directly through groups or via workshops, held in conjunction with DAFS and other agencies. It is anticipated that these activities will continue. Some details on these can be found in other parts of the work plan.

(d). **DAFS In-Service Training.** It is anticipated that the RELO's office will continue to have some input into Training the Trainers Program in DAFS. When called upon to do so, ATIP personnel will also help in implementing such training activities.

(e). **Farmer Field Days.** As in previous years, farmer field days will continue this coming year. Depending on the season, it is anticipated that at least six will be held.

CHAPTER 11: SEBELE/GABORONE WORK PLANS, SEPT. 1988 - AUG. 1989

11.1 TEAM LEADER

Agricultural Economist: D. W. Norman

11.1.1 ATIP ADMINISTRATION AND OPERATION

The team leader will continue to have major responsibility for the administration and day to day operation of ATIP. Every effort will be made to ensure that this is undertaken in a way that is compatible with the operations of the Ministry of Agriculture. Continuing efforts will be made to liaise with other staff in the Ministry of Agriculture, and with the other institutions - GOB, USAID/B, MIAC and KSU. Additionally, throughout the next year the project will be concerned with maintaining the timely production and dissemination of papers, and the continuance of the most recent ATIP publication - the Monthly Activity Newsletter.

11.1.2 PROFESSIONAL SUPPORT TO ATIP TEAM MEMBERS

Efforts will continue to emphasize visiting team members in the field, and organizing ATIP meetings on a regular basis to discuss professional matters. At least six will be held during the coming year. Also, where relevant, cooperative work will be undertaken with other ATIP team members.

11.1.3 MICROCOMPUTER SUPPORT

During the coming year, it is expected that more Sperry IBM compatible machines will be ordered. Supervision of the SMU data entry on the ATIP microcomputers will continue. Also, when requested, data from ATIP field stations will be entered on the microcomputers at Sebele, under the supervision of the team leader. Over this next year, it is also expected that there will be a great deal of collaboration with other DAR staff to ensure a smooth change over from the Apple microcomputers to the IBM compatible machines. Undoubtedly, a considerable amount of time will be spent in mastering the proposed new software packages for the new machines, and working out any problems for their utilization. At the moment, it is anticipated that Word Perfect, Lotus 123, dBase4 plus, MSTAT, and possibly SPSS or SASS will be the main packages in operation.

11.1.4 METHODOLOGICAL MANUAL

Throughout the next year, a great deal of time will be spent collaborating with other ATIP staff members on completing a first draft of a methodological manual. This manual will be used for conducting farming systems work in a harsh climatic environment, such as Botswana.

11.1.5 PUBLIC PRESENTATIONS

When requested to do so, lectures will be given at the Botswana Agricultural College (BAC) and the University of Botswana, and talks will be given at MOA sponsored meetings, workshops, conferences, etc. Currently, for example, an introductory course on the Principles of Agricultural Economics is being given to Faculty of Agriculture students at the University of Botswana.

11.1.6 LIAISING AND INFORMATION AVAILABILITY

Efforts will continue in order to encourage liaison activities with other institutions in GOB. Along with other ATIP staff, time will be spent documenting the project's ideas and activities, and arranging to have them disseminated. Related to this will be increased efforts to document the ATIP databases, so that data can be made readily available to other potential users.

11.2 RESEARCH EXTENSION COORDINATION UNIT

USAID:	B. Hill	(RELO Advisor)
GOB:	G. Ramolemana	(RELO)

Since this is a joint work plan, the various responsibilities are marked with a "(R)" indicating that Mr. G. Ramolemana will take major responsibility for that particular category or a "(H)" indicating Dr. B. Hill will take major responsibility, or a "(J)" indicating joint responsibility.

Some time will be spent on administrative duties, but the major responsibility will be in furthering the linkage between research and extension. The key to agricultural development is a close working relationship between agricultural research and extension. For progress to be made there must be:

(a). An adequate supply of tested agricultural technology applicable to farms in the various section of the country, and:
(b). An adequate diffusion system whereby technology can be disseminated and adopted by the majority of farmers.

The focus for the Research Extension Coordination Unit (RECU) during the coming year will be on helping Regional and Headquarters Crop Production Officers acquire the necessary training and experience necessary for carrying out their two main functions -- serving as a link between the extension field staff and the Department of Agricultural Research and serve as trainers of the field staff.

11.2.1 ATIP ADMINISTRATION AND OPERATIONS

(a). Serve as acting team leader in his absence (H).
(b). Administer the KSU Revolving Account and the Research and Operations Account (H).
(c). Manage the long term and short-term ATIP participant training programs (H).
(d). Assist the Team Leader in the preparation of annual reports and work plans (H).
(e). Process requests for consultants and arrange itineraries (J).

(f). Organize and conduct training for ATIP local staff on farming systems work and communications (H).
(g). Assist in organizing field days at regional ATIP locations (R).
(h). Prepare educational material for use in explaining ATIP to its various publics (H).
(i). Visit ATIP sites at Mahalapye and Francistown regularly to keep abreast of activities and to foster closer working relationships with extension personnel at the regional level (J).
(j). Assist with other administrative and organizational duties as requested by the Team Leader (H)

11.2.2 VISITS WITH EXTENSION AND RESEARCH STAFF (J)

Objective: One of the most effective approaches to improving communications between research and extension is face-to-face discussions between research and extension workers. The objective is to increase the number and frequency of these face-to-face encounters.

Approach: RECU staff will continue to visit and confer regularly with on-station and on-farm researchers and extension specialists as well as research and extension administrators. A special effort will be made to bring researchers and extension specialists together through cooperative work on extension publications.

11.2.3 MEETING AND CONFERENCES (J)

Objectives: Relaying current information and fostering the interchange of ideas among the participants will be the major objectives. The interchange of ideas between researchers and extension staff should enhance cooperative work between these two branches of agriculture

Approach: The RECU staff will continue to attend and participate in district AD monthly management meetings, CPO conferences, RAOs' planning meetings, department and division meetings and research conferences, and other pertinent meetings and conferences. Participation by both research and extension personnel will be encouraged.

The RECU staff will continue to visit regularly with RAOs, DAOs and other regional and district staff members. An effort will be made to include an extension specialist and/or a researcher in these visits.

11.2.4 AGRINEWS (R)

Objectives: Agrinews is the only agricultural publication which reaches all MOA personnel on a regular basis. The objectives are to increase the quality and quantity of contributions to this publication by extension specialists and farming systems teams. Decreasing the amount of time and effort required to prepare each issue for publication will be another objective.

The RECU staff will continue to work with the Agricultural Information Section in arranging training workshops to facilitate the full utilization of the new desk top publishing system and to cooperate with the PCV printer in his efforts to train personnel who will replace him (H).

The RELO will continue to serve as the liaison person between farming systems and the Agricultural Information Section for feature articles and articles prepared by the teams for

the farming systems page.

The RELO will also work with extension specialists in the development of articles for publication in Agrinews.

1.2.5 AGRIFACTS (R)

Objectives: Agrifacts are the primary source of agricultural research information for the agricultural field staff. The objectives are to update all outdated crops Agrifacts, produce new ones on topics of current concern, and speed up the process of production.

Approach: A committee representing research and extension will be formed for the purpose of analyzing the current Agrifact situation and implementing the plans developed.

1.2.6 EXTENSION PUBLICATIONS (J)

Objective: The objective is to initiate the production of a series of extension leaflets, pamphlets and bulletins on various agricultural topics that can be utilized by ADs or others interested in agricultural production.

Approach: Efforts will continue in assisting extension and research specialists in publication writing. Specialists will be asked to prepare material in their area of expertise for publication as a leaflet, pamphlet or bulletin.

The RECU staff will continue to read all publications in the area of crop production and make suggestions for improvement.

11.2.7 TRAINING (J)

Objectives: The objective is to assist the DAFS Training Officer. The primary objective of the training effort is to increase the basic competency levels of specialists and other field services staff in subject matter and extension methods. If extension specialists are to work with researchers as peers, their overall competencies should be comparable. There is a need for a continuing in-service training program for all field services staff to keep abreast of new developments in agriculture.

Approach: The RECU staff will continue to promote and assist in arranging for in-service and short-term training for extension subject matter specialists (H).

The RECU staff will continue to work with and advise the National Training Committee in the implementation of the long-term AD in-service training program.

The RECU staff will assist in organizing and conducting in-service training for ATIP field staff and arrange for short term training activities to be funded from ATIP funds.

11.2.8 TOURS AND FIELD DAYS (R)

Objectives: A well planned and properly conducted tour or field day is one of the best teaching methods available to agricultural workers. The objectives are to increase the level of participation in planned tours and field days by both research and field services staff and to improve the quality and effectiveness of tours and field days.

Approach: The RELO will keep CPOs, RAOs and DAOs informed of scheduled research tours and field days and encourage attendance. He will in turn keep researchers informed of extension tours and field days and encourage researchers to attend.

The RELO will assist in organizing field days and tours at regional ATIP locations.

11.2.9 FARMING SYSTEMS WORK LIAISON (R)

Objectives: The objective is to develop closer ties among the various farming system groups operating in Botswana and increase the exchange of information among the groups.

Approach: The RELO will continue to visit the various farming systems projects to keep abreast of activities and research results. He will also assist in planning and conducting the semi-annual conferences/workshops for active farming systems personnel. Finally he will work closely with the farming systems teams and the editor of Agrinews on articles for publication.

CHAPTER 12: ATIP MAHALAPYE WORK PLAN, SEPT. 1988 - AUG. 1989

USAID:	J. Siebert	(Agronomist)
GOB:	E. Modiakgotla	(Agronomist, DAR)
	E. Makhwaje	(Agricultural Economist, DAR)
PCV:	A. Caplan	(Agricultural Economist)

12.1 OVERVIEW

The ATIP Mahalapye program has shifted from early emphasis on description and diagnostic studies in the first three years, to a larger emphasis on design and testing in the fourth and fifth seasons. However, last season and the work plan for the coming season indicate a slight reverse in the trend with a mix of activities from diagnostic stage to design and testing. New, potentially important constraints are still being identified resulting in new diagnostic work (see Section 12.4.1 on Row Planter Condition Survey). This mix is due in part to the interests of new people in the program. As farming systems research becomes more a part of the DAR mainstream, it is anticipated the program will sometimes reflect new interests of researchers who have started work in the program.

Design and testing work will result in closure on several useful technologies before the end of the project. However, other areas of work (i.e., soil building) are just beginning and probably will not be completed by 1990. All of these are very useful research areas, and the work being carried out now will contribute to the establishment of a healthy technology development pipeline.

Staffing for Mahalapye is a key issue and is related to the team's ability to conduct useful research. Given the likely turnover problem and the prospect that in the future such teams will be staffed with individuals with lower academic qualifications, it has been proposed that individuals from DAR (outside of Mahalapye) participate with the local team on a research management committee. This proposal is also consistent with the concern of the Mahalapye team to avoid operating in isolation from the rest of DAR, regardless of the qualifications of the researchers on site. The larger management group focusing on Mahalapye work could meet bimonthly with meetings alternating between Mahalapye and Sebele. In this way, more DAR people could be involved in the program even though some individuals may participate only on specific issues.

The current emphasis on a row planting package theme has brought together many project activities into a coherent whole. Although DAR has been instrumental in promoting row planting for some time, useful information on row planting with area farmers has been derived from research conducted by ATIP. The decision to co-sponsor or facilitate activities that promote row planting has generated a positive spirit of collaboration among MOA agencies in this region. This has lead to much improved credibility for the project. Increasingly, the agricultural agencies have found their own roles to play in the collaborative mode. One useful forum has been the organization of a farmer training program on row planting. In this forum, the district agricultural offices and the extension specialists supervise activities and promote recommendations; ALDEP officers provide training; the Rural Training Centre provides trainers and logistical support; and ATIP (DAR) provides information from farm level testing on what makes

the package succeed or fail. ATIP is also involved in an impact assessment of the promotional campaign and in problem identification and training follow-ups to the farmer participants. Feedback from this work can be used to design the research program. It should be noted that several items on the proposed work plan do relate to row planting.

The key to the research-extension linkage is that the areas of collaboration are largely extension-led, and the activities have been relatively focused on a major theme. It is the feeling of the project that collaborative efforts can soon be extended to other themes. Major theme areas could include rainfall runoff management systems, or soil building with kraal manure. Many important technologies but with a smaller leverage potential in the farming system (i.e., improved donkey harnesses), can be readily promoted with major themes such as row planting.

It is also noteworthy that several themes in the research agenda involve a number of research and/or extension activities -- for example, the row planting work, the soil building agronomic trial coupled with the inventory survey, and the fodder economic research coupled with the two extension programs. Even where description and diagnostic stage work is beginning, current investigations are building on previous research conducted at Mahalapye and elsewhere. For example, the soil building work is based on results from high potential site developments of the past two years.

12.2 CROPPING SYSTEMS

12.2.1 SORGHUM/MELON MIX STUDY

Objective: To assess the impact of the traditional melon component in the sorghum/melon mix, on the sorghum enterprise. An impact assessment will be made on yield, weed control and weeding, and soil moisture.

Justification: This season will provide a second year's data to this diagnostic study. Previous indications, from an above average rainfall season, are that sorghum yields are not significantly affected by concurrent melon production. Soil moisture and weeding were not measured in the first season.

Approach: The approach will involve a randomized complete block design (RCBD) and regression analysis. The same 12 farmers recruited for this trial in 1987-1988 will again be requested to put in this simple comparison. Treatments are 6kg sorghum seed broadcast/hectare compared with the same seeding rate of sorghum mixed, by the farmer, with melon seed at a rate the farmer chooses. The levels of sorghum and melon populations are measured at harvest. Inter-relationships are determined on both the plot and two meter square quadrats within the plot. Gravimetric moisture samples will be taken from under the sole sorghum and crop mixture canopies during the cropping season.

12.2.2 EVALUATION OF AGRO-FORESTRY IMPROVEMENT POTENTIAL

Objectives: The objectives of this survey are to:

(a). Ascertain how indigenous trees are managed in village and lands areas throughout Botswana.

(b). Assess farmer attitudes about the various uses of trees and other woody species.

(c). Assist in identifying intervention points for practices such as woodland management, fruit tree establishment, and agro-forestry.

Justification: Although earlier SADCC and Botswana Renewable Energy Team (BRET) reports have documented trends in national tree usage, several questions concerning tree usage and farmer attitudes in the Central Agricultural Region and Tutume District remain unanswered. A survey administered on a national basis would provide the necessary background from which to coordinate future extension and on-farm testing programs.

Approach: Following an exploratory survey in the Mahalapye area during the 1987/1988 season, an initial farmer questionnaire was drafted. This questionnaire was presented to the Forestry Association of Botswana (FAB) and discussed among ATIP team members. FAB is keen for such a study to be undertaken, while several ATIP team members have submitted their comments. Therefore, a second draft of the survey will be completed -- possibly with the aid of an outside consultant -- and used for enumerator training. Following a pretest and selection of a sampling, the survey, in its final form, will be administered in all ATIP villages, including those in Tutume District.

12.2.3 PHOSPHATE FERTILIZER AND UTILIZATION STUDY OF DOLICHOS LAB-LAB

Objectives: The objectives of the RMFI trial are to:

(a). Test the response of Dolichos lab-lab hay yield to phosphate fertilizer applications.
(b). Work with on-going ALDEP and DAFS small stock feeding programs.

Justification: Response to phosphate fertilizer in a wet year was favorable. Hay yield and fertilizer responses have be more problematic in dry years. In all cases, enterprise analysis is difficult because of the variable value associated with a unit of the hay crop. The ALDEP Fodder Program has indicated that assessment of phosphate response for one more season would provide useful information.

Previous ATIP research and ALDEP demonstration efforts have indicated that, in certain seasons, a favorable fodder-crop production potential exists in Botswana. Animal-owning farmers who have suffered through repeated drought seasons have indicated a willingness to participate in on-farm testing of several forage varieties, under various production strategies. Farmers have also indicated a desire to learn more about fodder crop utilization.

In conjunction with ALDEP and small stock regional officers, ATIP is in a pivotal position to provide the on-farm component to fodder crop testing, particularly where socio-economic assessments are required.

Approach: The approach for assessing fodder crop production and utilization will be multidimensional, incorporating a forage trial, a small stock feeding study, and analysis of a crop residue survey.

The forage study will be implemented at five sites in two villages (Makwate and Makoro). On two sites, ALDEP/ATIP will superimpose phosphate fertilizer comparisons under an RMFI format. The remaining sites will also be run in the RMFI mode. The Regional Small Stock Officer will work through farmer groups consisting of the ten trial farmers and other farmers who will been provided extra seed by ALDEP. The small stock officer will assist them in devising utilization strategies.

A crop residue survey, administered in Mookane and Chadibe villages during August 1988, will be analyzed in order to provide further insights into fodder crop potential in the central region.

12.3 COMMODITIES

12.3.1 EVALUATION OF MEDIUM MATURITY COWPEA VARIETY TVX3236

Objective: The objective is to compare a new variety ready for on-farm testing with ER-7 and Blackeye.

Justification: The cowpea program at Sebele annually identifies new dual- and triple-purpose varieties which have performed well on-station but require on-farm comparisons before wide-scale release. On-farm testing is needed to qualify several varietal characteristics such as pest and disease resistance and grain and morogo yield response to various growing conditions.

Approach: Six farmers will test the cowpea varieties in the RMFI mode. Two sites per farm will be identified by researchers so that plantings are implemented along a topo-sequence. INTSORMIL researchers will characterize the topo-sequence.

12.3.2 EVALUATION OF DROUGHT RESISTANT GROUNDNUT VARIETY

Objective: The objective is to compare a new, drought resistant groundnut variety (identified by Sebele oil crops research) with Sellie.

Justification: Endemic risk of drought in Botswana makes drought resistance in any crop variety essential. Improved resistance will increase the attractiveness of a crop. Groundnut (v. Sellie), though adapted to semi-arid conditions, does not survive severe drought, particularly at high plant populations.

Approach: Six farmers will test the groundnut varieties in the RMFI mode. Two sites per farm will be identified by researchers so that plantings are implemented along a topo-sequence from upland light soils to lower slopes.

12.4 TILLAGE AND PLANTING PRACTICES

12.4.1 NATIONAL TILLAGE TRIAL

Comment: This trial will be carried out on three fields with relatively contrasting soil types in the Mahalapye area. The Mahalapye West extension office participated in selecting sites that would be easily accessible and contain soils representative of the Mahalapye area. All treatments at all sites will be implemented using a tractor and other equipment available through DAR. This activity is expected to provide an excellent opportunity for coordination between ATIP and other DAR regional staff, regional ALDEP technical advisors, and CPOs. It is believed that the interest and discussion generated from trials like this one could lead to even more problem solving studies being run on a national level.

The objectives, justification and approach for this trial were written by Dr. N. Persaud and are presented along with a useful introduction in Section 13.3.2 of this report.

12.4.2 ROW PLANTER CONDITION SURVEY

Objective: The objective is to assess the condition of row planters currently owned by

farmers and to determine how this condition is affected by use and care of the machine and by the availability of spare parts and repair facilities.

Justification: Previous work with farmers owning row planters has shown that many parts of the machines are not working correctly (i.e., fertilizer hoppers, seed metering plates). MOA (ALDEP) is making a large investment to supply row planters to farmers, but not enough is known about deterioration of the planter, or about what type of advice/training should be given to protect the farmer's and government's investment. This survey should also provide information on the constraints imposed by the lack of spare parts or qualified repairmen.

Approach: The credibility of this activity will be greatly affected by the design of the questionnaire, the sample surveyed, and the participants in the design of the study. ATIP will evaluate interest in DAFS, ALDEP, FMDU, and RIIC in participating in the design of this survey. Early consultations are probably more beneficial than asking for comments on a prepared document. The sample chosen for such a study will need to go beyond the ATIP villages in the Mahalapye and Francistown areas. Relatively few farmers in these villages row plant, and most planters have been recently obtained. Other villages, even in the Central Agricultural Region, have a longer row planting tradition.

12.4.3 CULTIVATOR EVALUATION TRIAL

Objectives: The objectives of this RMFI trial are to:

(a). Compare the operation of different cultivators that are currently available or are under test on-farm.
(b). Assess weed levels on row planted fields before and after inter-row cultivation to measure relative effectiveness.

Justification: With the current emphasis on early plowing and row planting, weed control can be a major issue. Good inter-row cultivation is considered critical. The Mahon cultivator appears to be effective for weed control but is somewhat heavy and a little difficult to manage if row planting is irregular. Lighter, more maneuverable cultivators may do a better job.

Approach: This trial will be similar to that conducted last season at Kanye. It is hypothesized that different cultivators will perform differently in terms of ease and speed of operation and in terms of effectiveness on weed control. The AD will identify farmers who have previously row planted and would be willing to test different cultivators. A type of mobile unit with several cultivators will be brought to the field for use on long field sections.

Approach: If possible five to seven farmers will be selected on different soils in Makwate. The cultivators to be tested at the RMFI level will be the Mahon-7, the new Maun implement developed by the MDP, and the Unibar.

12.4.4 ROW PLANT FERTILIZER TRIAL

Objective: The objective is to compare, under row planting, sorghum grain yield response to banded 2.3.2 fertilizer at two rates, and farmer assessment of it, with a broadcast application.

Justification: This trial is designed to support the promotion of row planting. Fertilizer (2.3.2) has been generally available in recent years through the introduction of the ARAP

scheme. Some farmers have been broadcasting the fertilizer, but there is an interest among row planting farmers to know more about applying the fertilizer with the planter. It should be noted that responses to phosphate fertilizer were not reliable or substantial enough, even on deficient soils, in the USA until fairly precise banding methods were employed. The former CARO (Dr. W. Stewart-Jones) suggested that a phosphate fertilizer application, much below the standard 20 units P/ha (e.g., 6 units P/ha), should provide as much as 75 percent of the 20 units P response, whatever that would be.

Approach: A range of soils will be considered (both light and heavy). One row planting farmer using a tractor and two row planting farmers owning animal traction will be recruited for each of three village areas. The trials will be at the RMFI level and RCBD analysis will be used.

There will be four treatments as follows:

(a). A control -- row planted without fertilizer
(b). Banded -- 2.3.2 equivalent to 6 units P/ha plus LAN
(c). Banded -- 2.3.2 equivalent to 20 units P/ha
(d). Broadcast -- 2.3.2 equivalent to 20 units P/ha

Dr N. Persaud will work with ATIP Mahalapye in designing and implementing simple measures of soil characteristics that can be used by ADs in the field. If successful these will help ADs in targeting -- where necessary -- extension recommendations to specific soil conditions.

12.5 SOIL AND WATER MANAGEMENT

12.5.1 MANURE RESOURCE ASSESSMENT STUDY

Objective: The objective is to assess the availability of kraal manure and farmers' perceptions of its use.

Justification: A successful recommendation on the use of kraal manure not only depends on achieving technical and economical responses at the plot level, but also on whether manure is available, and on farmers' perceptions about the use of manure. Project experience with using manure in the fields indicated the possibility of major logistical and labor problems for many, if not most farmers.

Approach: A survey will be undertaken on the availability of manure, transport, labor, and interests in the research area. Aerial photos will be used to evaluate distances of fields from kraals. Also the quantity of manure in selected kraals will be estimated.

12.5.2 EVALUATION OF MANURE APPLICATION

Objectives: The objectives of this study are to:

(a). Assess yield differences between kraal manure and two controls; N and P fertilizer and no fertilizer.
(b). Assess the residual effect of kraal manure through yield.
(c). Assess the interaction of manure benefit with season.
(d). Assess the change in effect of manure application when moving from upland to lower slopes in a topo-sequence.

Justification: Most soils on farmers' fields are deficient in nutrients. Although fertilizers

are available at cooperatives or BAMB, farmers don't buy them. This trial intends looking at manure as an option for adding nutrients to the soil. Bulk density is likely to decrease, while water content will increase. The questions relate to the use of an already designed kraal manure recommendation. On which land types is the benefit most reliable? Across seasons, how reliable is the response, considering both areas that have received manure just before that season and areas that received manure one season back?

Approach: This will be an RMFI multi-season trial with a limited number of farmers on representative soil types. If possible different soils situated in a topo-sequence will be investigated. These will be soils in the upper, middle and well drained lower parts of the slopes. Sites within the village will be selected in consultation with the Farmer's Committee.

Three farms will be selected per ATIP village. The treatments will be as follows:

(a). Control
(b). Twelve tons/ha kraal manure every second year beginning year one
(c). Twelve tons/ha kraal manure every second year beginning year two
(d). Twenty units P/ha plus 60Kg LAN/ha every year

A standardized data collection system will be used while the design will be RCBD..

12.5.3 EVALUATION OF RUNOFF MANAGEMENT SYSTEMS TRIAL

Objective: To evaluate at three levels (design criteria, soil moisture benefit and crop production outcomes) several runoff management systems. Production outcomes can be evaluated both agronomically and economically.

Justification: Observations on rainfall runoff and the potential for increased water storage in many soil profiles indicates that yields could be dramatically raised in drought with effective control of runoff. Permanent structures and tillage systems can both be employed to reduce runoff. Permanent structures have an important advantage over tillage systems in that they do not need to be re-implemented every season during the bottleneck tillage-planting period. A benefit/cost assessment of such systems is required.

A second season of testing for runoff control systems is required. Last season with its higher than normal rainfall produced no measurable agronomic differences between the systems tested. However, several design problems were identified. These include the need for better control of plant populations and plant placement in systems with micro-level water concentration effects,and more attention needs to be paid to plowing patterns within systems because water readily moves along the plowing lines. The most important design problem is related to flood water from off the field or above the trial block. Storm protection is required before shallow bunds within fields can work These are discussed in Section 12.5.4.

Testing of the redesigned systems is required. Testing in another rainfall pattern is also important.

Approach: Six treatments will be compared. These include four from last season which will be placed on precisely the same plot areas as before. These four include single plowing, double plowing, strip cultivation and level terracing. All plots will be row planted in 1988-1989. A macro-catchment water harvesting area will not be included. Added to these four treatments are a massive ridge and furrow system that is designed to completely eliminate runoff and optimize water concentration and plant placement. This

design is not practical for area farmers but will be constructed by the SACCAR Land and Water Management Project at Shoshong and elsewhere in an attempt to assess grain yield potential, given only rainfall and soil profile factors as variables. Use of the Mahon cultivator for tied ridge making will also be evaluated. Tied ridges are achieved with the unit set for groundnut hilling. ALDEP staff have recommended this operation and the resulting soil shaping looks to be beneficial, but the operation is laborious.

The Land and Water Management Project will continue to monitor soil moisture on these plots.

12.5.4 WHOLE FIELD RUNOFF CONTROL

Objective: The objective is to implement and evaluate simple storm drainage followed by contoured ridges on portions of fields above the rainfall runoff management trial (see Section 12.5.3).

Justification: For fields with large upland watersheds, water control structures that prevent flooding would be of value. At least one 24 hour rainfall event of more than 65mm is expected in 70 percent of all seasons for farms in the Mahalapye area. Flooding has been observed as a major problem on many fields in both drought and wet years and farmers indicate that this is a serious problem.

Approach: The approach involves the construction of a massive graded bund at the upslope side of a field. By taking soil from the upslope side, a diversion drainage channel is created. Construction will be with a tractor and grader provided by DAR. Below the bund, smaller contoured ridges will be spaced at 15-20m intervals creating a series of level terraces. These will be placed on four fields. Two of these fields are lighter textured with 1.2 to 2.0 percent slope, and two are heavier textured with less slope.

12.6 FARM EQUIPMENT

12.6.1 EVALUATION OF ROTARY INJECTION PLANTER

Objectives: Objectives of the RMFI evaluation are to:

(a). Test the operation of the improved injection planter currently under manufacture at RIIC.
(b). Evaluate the operation over light and heavy texture soils, and over cloddy and fine seed beds.
(c). Measure cropping outcomes.

Justification: The rotary injection planter was originally identified as a technology which could give farmers more control over row planting operations. Because it is designed to be pushed or pulled by humans, reliance on animal draft and tractor power for timely row planting is effectively eliminated.

Last season, several design and manufacturing faults were identified with locally produced models. Corrections must be tested. This planter was originally designed for no-till planting, but information is not available on how well it will do on poor seed beds in Botswana. Previous use, in a dry year, also indicated that the planter does much better on sandy rather than on heavier textured soils. This should be tested.

Approach: A small group of farmers will test the planter's performance, under various

soil types and conditions (e.g., differing soil moisture and clod size conditions), in the RMFI mode. First hand subjective assessment is important. These farmers may be previous users of the 'unimproved' injection planter tested during the 1987/1988 season. To locate fields that would permit poor versus good seedbed conditions, farmers who are plowing early in order to row plant will be contacted.

Some testing will also be carried out at the FMFI level (see Section 13.4.2).

12.6.2 EVALUATION OF IMPROVED DONKEY HARNESS

Objective: The objective is to evaluate the Kenya donkey harnesses under farmer conditions.

Justification: Previous ATIP research conducted with the improved Kenyan donkey harness indicate a problem with the hame strap which has now been strengthened. Tests undertaken by RHC indicated increased efficiency of donkeys using the harnesses.

Approach: Harnesses will be given to a selected group who, this season, plan to plow, plant and /or inter-row cultivate with their donkeys. Throughout the season, researchers will observe the harness in use, and farmers will be informally surveyed as to their opinions.

12.3.3 EVALUATION OF GROUNDNUT PLANTER

Objective: To assess the performance of a planter especially designed for groundnuts.

Justification: Because groundnuts are a soft seed prone to cracking and most planters currently used in Botswana were not originally designed for oblong seeds, the need for an appropriate planter is evident. Sebele researchers have identified a planter which may solve the seed cracking problem. However, on-farm comparisons with common planters currently used by farmers are necessary in order to test the new planter's relative performance and assess its potential in the farm system.

Approach: One groundnut planter will be compared with the Sebele Standard and Rotary Injection Planter at two sites. Performance measures will include agronomic responses, such as stand and yield, and technical assessments of handling.

12.7 HOUSEHOLD CIRCUMSTANCES

12.7.1 COOPERATING FARMERS STUDY

Objectives: The objectives of this RMRI descriptive and diagnostic study would be to:

(a). Identify changes overtime in the farming system.
(b). Provide a whole farm production assessment with which to compare specific trial or intervention results.

Justification: This is the same as given in Section 13.6.1.

Approach: A single visit survey will be administered to approximately 30 core farms per season, but with the flexibility to add additional farms if research activities on those

farms requires a whole farm production assessment.

12.8 ENVIRONMENTAL MONITORING

12.8.1 RAINFALL AND TEMPERATURE MONITORING

Objective: The objective of this RMRI study is to measure rainfall and temperature for all research sites.

Justification: Large temporal and spatial variation in rainfall and temperature accounts for a large part of the variation in agricultural production. From a research perspective, not only should the effect of these climatic factors be measured, but different technologies must be evaluated on the basis of how well they do under different climatic situations.

Approach: Approximately 40 rain gauges are distributed throughout three research areas. Most of these have been in place since the beginning of the season. In many cases, more than one neighbor participating with the project are grouped with a single gauge reading. The distribution of rain gauges will be studied during this season and repositioning of some gauges may be made. A single maximum minimum thermometer [illegible] in each village area.

12.8.2 RAINFALL RUNOFF MEASUREMENT STUDY

Objective: This is an RMRI descriptive/diagnostic study to define relationships between rainfall, soil type, slope, land use, and runoff.

Justification: Data on expected runoff in the traditional lands area are not available for Botswana. Such data are useful in designing or evaluating the potential of runoff management structures or systems for agricultural purposes.

Approach: Three bunded plots of 50m by 100m were built last season in one field of the Shoshong area. Land use patterns in the plots are: uncleared bush, cleared fallow, and cultivated. Runoff and soil moisture will be monitored with automatic flow recorders and neutron probe readings. This study site is one of several directed by the hydrologist of the Land and Water Management Project.

Stream flow for important flows in the lands area will also be calculated using the manning equation.

12.9 METHODOLOGY

12.9.1 STANDARDIZATION OF MEASUREMENT UNITS

Objective: The objective is to standardize weights for more accurate local pricing, especially of high-value crops sold in small quantities.

Justification: Precise economic valuation of crops is contingent on accurate local prices. Yet, high-value crop seed and grain is often traded in small quantities, making weight conversions to common units difficult. If units are standardized, then more accurate conversions are possible.

Approach: ATIP research villages will be surveyed in order to assess how certain crops

are sold. The measurement units will then be weighed for each crop and conversions to standard measuring units (kgs.) will be estimated

12.9.2 RESEARCH GROUP METHODOLOGY

Objective: The objective is to iterate on previous group methodology and set a framework for the Mahalapye team's use of farmer groups during the coming season.

Justification: As previous ATIP work and studies have shown, use of groups is an effective strategy for trials management and dissemination. The group strategy facilitates message delivery, and allows for immediate farmer interaction on points of mutual interest. Group formats also utilize research resources more efficiently.

Stages throughout the season may be reached when farmer groups no longer contribute to the efficient use of research resources, and continued meetings for the sake of group cohesion inhibit trials progress. Therefore, it is important to identify how groups can be structured so that this point of diminishing returns is never reached.

Approach: As soon as the trials program is decided upon, field enumerators will attend a comprehensive trials training session(s). During November and December, general farmer group meetings will be held in each village for FMFI trials management purposes. Each field enumerator will then be responsible for visiting farmers individually during the implementation process to ensure that mistakes are minimized.

Beginning with the month of January, group meetings will be held in each village, but these will resemble mini-farmer field days, more than structured meetings. All ATIP staff will be encouraged to attend the meetings cum field days, as general farmer problems and successes, both specific and non-specific to trials work, will be discussed and observed. This meeting format will continue throughout the season. Sebele researchers and area extension agents will be encouraged to attend selected meetings.

12.10 OTHER PROFESSIONAL ACTIVITIES

12.10.1 LINKAGES WITH FARMERS

This will be accomplished in the following ways:

(a). Continue farmer research groups for the purpose of FMFI trial management and technology assessment.

(b). Increase farmer participation in technology screening and design through the use of farmer assessment groups in RMRI land and water management work.

(c). Increase farmer participation in RMFI testing of farm equipment.

(d). Give annual research report on ATIP activities at kgotla meeting in each ATIP village.

(e). Modify the format used for farmer field days to increase the focus and number of field days, and to increase focus on farmer related issues by limiting participation of extension and research staff.

12.10.2 LINKAGES WITH ON-STATION RESEARCH

Linkages will be maintained or improved by:

(a). Providing on-farm research support/feedback to commodity programs such as cowpea, groundnut, sorghum, and FMDU research.

(b). Providing on-farm research input into research working groups based on themes.

(c). Providing on-farm research management for locations of the National Tillage Trial.

(d). Providing on-farm research support and management for technology screening related to land and water management.

(e). Providing on-farm research sites and historical yield data, by rainfall by land type by management analyses, for further technology research.

12.10.3 LINKAGES WITH EXTENSION

Different types of activities that could play a part in future formal linkages between research and extension at the regional level will be investigated. These activities all constitute dissemination forums for recommendations but they can also provide information, through research-extension-farmer interaction, feeding back into the research program.

(a). **Macheneng Agricultural District.** Promotion of a basic row planting package will take place. Three main sub-activities are involved; farmer training on row planting, an assessment study on the impact of the training, and visits to the farms of the trainees to provide training follow-up and identify problem areas.

(b). **Mahalapye West Agricultural District.** A contest will be organized focussing on row planting and inter-row cultivation that promotes the basic row planting package to the local farming community.

(c). **Palapye Development Trust/Palapye Agricultural District.** Working through the PDT Tswapong Hills extension program, farmer training on row planting and follow-up using a participants group format will be used. An impact assessment study along with follow-up visits similar to those employed in the Macheneng District will also be undertaken.

In addition to the training and follow-up work focused specifically on a row planting package, another dissemination forum with a general technology focus will also be tested. The "technology options testing" procedure tested last season at Mapoka village in North-East District will be tested with farmer groups organized and led by Palapye Development Trust AD staff.

Other linkages with extension will involve:

(a). Crop Production Officer direct involvement in the team's trial program. Two to four CPOs could be involved.

(b). Requesting ADs in the research villages to participate in farmer groups and review other trial activities.

(c). Providing a research component to ALDEP's fodder production program and to DAFS' small stock feeding program.

(d). Involving other DAFS staff in the village based research program (review of work plans, review of trial results, etc.).

(e). Preparing articles on ATIP activities for extension publications.

(f). ATIP Technical Officers attending DAFS Monthly Management Meetings in three Districts to discuss ATIP activities.

12.10.4 LINKAGES WITH POLICY/PLANNING

Documentation of Mahalapye data sets will be undertaken and duplicate sets will be sent to Sebele.

CHAPTER 13: ATIP FRANCISTOWN WORK PLAN, SEPT. 1988 - AUG. 1989

USAID:	G. Heinrich	(Agronomist)
	T. Thedford	(Animal Scientist)
	F. Worman	(Agricultural Economist)
GOB:	S. Masikara	(Agronomist, DAR)
	C. Tibone	(Agricultural Economist, DPS)

13.1 OVERVIEW

The ATIP Francistown team collected much descriptive technical and socio-economic data during the first two years of its work. At the beginning of the third year, the team shifted its emphasis away from descriptive/diagnostic research, except for analyzing existing data, and placed more emphasis on design/testing research. The team plans to continue the same basic research thrust during the 1988-1989 year. More emphasis will be placed on preparation of materials covering technologies which are provisionally ready for dissemination. In addition databases created over the last five years will be documented, and the process of obtaining closure on several areas of research will be initiated. The entire team will participate in the drafting of a "Farming Systems Handbook for Botswana." For continuity, most research activities will continue to be located in the villages of Matobo, Marapong, and Mathangwane.
The primary thrust of the ATIP Francistown team will continue to be an integrated program to study specific interventions from the technical and economic standpoint in order to facilitate comparisons between interventions. Because of the desirability of identifying specific interventions for promotion in this area, the team will emphasize the collection of plot level technical and economic data, as a basis for developing budgets on different systems or trials, so that comparative analysis can be made. Thus the team will concentrate on system testing, local dissemination activities, and rely on short-term consultancies and station based research to resolve some of the more basic technical diagnostic and design questions.

Within this framework, specific disciplines will have different, but interlinked focuses:

Agronomy: In the 1988-1989 season, the focus of the agronomy research in Tutume Agricultural District will expand on the same primary issues as last season. That is, it will continue to focus on water conservation and improved tillage/planting systems, with some additional work on reducing the risk of total crop failure. The approach for the latter will be through improved crop systems. Further, examination of the potential of useful (but not crucial) interventions will be continued through farmer group activities. Slight expansion in this area will be used to strengthen ties with the extension service. Highlights of this year's research program include:

(a). A large scale evaluation of three double plowing (DP) systems to test the practicality and profitability of DP at the whole farm level;

(b). Increased work with an effective, easy to use, modified hand row planter to assist non-draught power owners and others with timely row planting, and testing of two light weight inter row cultivators to assist with more timely weeding;

(c). Examination of modified cropping systems to reduce the risks of total crop failure; and

(d). Expanded collaboration with extension in the area of technology testing, adaptation and dissemination through work with two farmer groups in the Communal First Development Area, NE District. (Extension takes the lead role in this work.)

Animal Production: Work will continue in collaboration with the socio-economists and agronomists at ATIP Francistown and Mahalapye, the livestock extension personnel, the personnel at the National Veterinary Laboratory, and the Francistown Veterinary Services Division with the objectives of improving animal traction efficiency and livestock production, with emphasis on smallstock.

Descriptive work will continue on the identification of production parameters of goats in the smallholder sector. The focus of the testing stage will center on the management systems for goats, purpose grown fodder and its intensive usage, and improved donkey harnesses. In the dissemination stage, emphasis will continue on the introduction of fodder crops into the farming system and harvesting, and storing crop residues for feeding during the latter part of the dry season.

Farm Management: The 1988-1989 season will mark the beginning of localization for the farm management section, with many of the trial related activities supervised by the Motswana agricultural economist assigned to the team. Activities will be in five major areas.

(a). There will be the analysis and documentation of descriptive/diagnostic data already collected, and the integration of this data with technical data in order to provide as much comparative information for analyzing trials and different proposed interventions as is possible.

(b). A major priority for 1988-1989 will be the continued collaboration in the agronomy and animal production trials to collect data and to provide an economic analysis of the trials. The proposed interventions will be analyzed in terms of their economic feasibility when compared with traditional technology checks.

(c). A related area is to participate in farmer groups. The purpose of the groups is to promote interaction and the exchange of information between farmers, extension, and the ATIP team; to obtain farmer assessment of trials during the year: and to increase team understanding of farmers' attitudes. Assistance will be provided to DAFS staff who are working with similar groups in non-ATIP villages.

(d). A work area will be continued technical and economic monitoring to identify long term system changes.

(e). In order to promote the acceptance of the farming systems approach to research, emphasis will be placed on improving channels of communication with other organizations, providing information on ATIP for dissemination in extension publications, and addressing methodological issues with the entire ATIP team.

13.2 CROPPING SYSTEMS

13.2.1 SORGHUM/COWPEA INTERCROPPING STUDY

This study was initiated in 1986-1987 and will be continued in 1988-1989 to collect a third year of observations. This is necessary because of the extreme drought that occurred in the first year and the change in the cowpea variety last season.

Objectives: The objectives of this RMRI testing stage trial are:

(a). To examine whether a sorghum-cowpea intercropping system can reduce the risk of crop failure relative to sole crop sorghum production.
(b). To examine whether an intercrop system is actually more productive than a sole crop system under farmers' field conditions.

Justification: Intercropping has been shown to reduce the risk of crop failures in some countries. The rate of crop failures, under the drought conditions now prevailing in Botswana has been very high in recent years (e.g., up to 80 percent failure of plots planted in 1983-1984). Any technology which reduces the rate of crop failures should be of benefit to farmers. Further, published reports from other countries indicate that, in some cases, a cowpea/sorghum association can actually increase sorghum yields over that of sole sorghum.

In their final report, the DLFRS team concluded that adding a cowpea component to a sole sorghum system actually increased the probability of failure of the sorghum crop in dry years. However, this effect was most severe in sorghum stands of 40,000 plants hectare and above. The effect was less severe with lower sorghum densities. In the experiment described below, plant populations will be held at 20,000 and 10,000 plants per hectare for sorghum and cowpeas, respectively. Further, the between-row spacing will be increased from the usual 75 cm to 100 cm, reducing the between row and between species competition still further.

Hopefully, the added legume crop in this cropping system will:

(a). Provide farmers with increased food (and possibly income) through the use of cowpea leaves during the growing season.
(b). Provide a buffer crop in case of failure of the sorghum or destruction of the sorghum by birds.
(c). Add to the long-term productivity of the soil by increasing nitrogen content to some extent.

Approach: The intercropping system being tested will consist of two rows of sorghum (Segaolane) followed by one row of cowpeas (v. ER7 variety). Rows will be on one meter spacing, and planted with the rotary injection hand row planter. All plants within rows will be on 33.3 cm spacing. Comparisons will be made against sole stands of both sorghum and cowpeas, planted in the same row arrangements, and against a traditional broadcast mix of the same plant populations.

The trials will be conducted with two farmers per village, with two replications per field, giving a total of 12 replications overall. Plot sizes will be 15 meters by 20 meters. Trials will be planted in randomized complete block designs, with four treatments and two replications per field.

The economic focus for these trials will be to collect sufficient labor use, input cost, and yield information from the individual trials to allow the formulation of budgets for each proposed intervention. The budgets will be used in comparing potential interventions with traditional technologies, in order to determine which interventions may be economically feasible.

13.2.2 CROP MIX STUDY

Objective: The purpose of this FMFI testing stage study is to determine the degree of

crop yield stabilization that can be achieved by planting a mix of different crops (and/or varieties with different maturity lengths) at different times of the year.

Justification: At present, farmers tend to plant one or two sorghum genotypes throughout the planting season. (This may be due to lack of seeds of different varieties or lack of strategy.) The same is true of millet. Yet the length of the growing season and the distribution of rainfall in a given year are both highly variable. By planting a planned mix of different crops and crop varieties throughout the season (mostly long season crops at the beginning, mostly short season crops near the end), it is possible that farmers could improve the reliability of their grain production.

Farmers already do this to some extent, but it would be useful to develop guidelines for farmers, extension agents, and policy planners who make seed available for farmers.

Approach: These trials will again be handled through the farmer groups, in an FMFI mode. Much data are required to examine stability effects, so it is expected that this activity will continue for several years -- particularly given the low number of volunteer participants. Farmers will be encouraged to plant mixes of 75 percent long season cereal and legume crops (25 percent short season ones) in any plantings prior to January 15, and to plant a mix of 75 percent short season crops/varieties and 25 percent long season ones after that date. Records will be kept on planting dates, crop varieties and plot grain yields.

13.2.3. ESTABLISHMENT OF PERENNIAL FORAGE SPECIES

Objectives: The objectives of this RMRI testing work are to:

(a). Identify problems associated with the establishment of agro-forestry/establishment of perennial forage species.
(b). Evaluate cultivars of leucaena and pigeon peas for their acceptability.

Justification: Alley cropping has been shown to prevent wind and water erosion. Leguminous plants such as leucaena and pigeon peas also fix appreciable amounts of nitrogen in the soil. In addition, such agro-forestry/establishment of perennial forage species can supply valuable feed for livestock as well as firewood and building materials.

Approach: Leucaena, pigeon pea and other plants suitable for alley cropping will be planted in pots for later transplanting to test sites in ATIP compounds, and on farmers' fields. Problems associated with plant establishment will be identified with the aim of developing a system which can be recommended to smallholder farmers. If establishment is successful, subsequent work will deal with their utilization in livestock feeding programs.

13.3 TILLAGE AND PLANTING PRACTICES

13.3.1 DOUBLE PLOWING SYSTEMS TRIALS

Objectives: The objectives of this RMFI testing stage work are:

(a). To test three different double plowing (DP) systems on a large scale, and to assess their feasibility and profitability in practice.
(b). To collect labor and input data on operational scale plots, to clarify the relationship between small plot labor data, and actual requirements from large

scale plots.

Justification: Plot level studies in Tutume Agricultural District indicate that DP could profitably boost per hectare grain yields as long as the opportunity cost of the first plowing is minimized (ATIP PR F87-5). Also, economic analysis indicates that it would be beneficial to switching from 2 hectares single plowed (SP2) to 1 hectare DP on farm units with a weeding labor constraint, and/or with limited plowing opportunities.

Theoretically, several practical systems are envisioned which could minimize the cost of the first plowing, and allow farmers with different resource constraints to implement DP. However, these have never been tested on a large scale to verify the theory. In order to round out the work to date on DP, it is proposed that these systems be subject to a full scale test.

Approach: The three systems to be tested apply to farmers in different traction categories. These categories and the appropriate systems are described below.

(a). **For Farmers Who Own Their Own Draft Power (Largely Cattle).** With the first rains when the animals are ready to plough, the farmer will plough/plant an area of 50 meters by 25 meters. This should require one day. When the soil dries slightly below a reasonable moisture level for planting, an area of 50 meters by 25 meters will be plowed in preparation for DP with the next rain.

When the next rain occurs, the prepared plot will be planted, together with an adjacent 5 meters by 50 meters strip, to act as a traditional check. As the soil moisture drops below the optimum for planting, another 50 meters by 25 meters strip will be prepared. This system will continue on with subsequent rains into January, with the farmer planting on good moisture and preparing more land as the soil dries. Each DP plot will have an adjacent check plot 5 meters wide.

This trial will help determine of the feasibility of using drying soil moisture periods for land preparation, and provide some estimate of the potential benefits on a whole farm level.

(b). **For Farmers Who Share Animal Draft.** This assumes a subsidy on tractor tillage will be offered, and tractors are available. In this case, a tractor will be hired to plough the land, either before the rains or during the early rains, before animals are in condition for plowing. The tractor will plough a quarter hectare strip, 25 meters by 100 meters. With the first planting rain that animals are available, the farmer will plant half of this area (50m by 25m), plus an adjacent unplowed area of 50 meters by 25 meters. All of this land (0.25 hectare total) will be either row planted or broadcast planted in the traditional manner at the farmer's discretion. With the second rain, the process will be repeated using the second half of the prepared land.

As long as there is a subsidy on tractor plowing, this system would allow farmers with limited access to cattle draft to double plow without increasing their direct costs. The double plowing should allow them to increase their production and profit from a limited plowed area.

(c). **For Farmers Without Access to Animal Draft.** This trial will also assume that subsidy on tractor plowing is offered. Before the rains, or with the first rains, a tractor will be hired to plough an area of 50 meters by 200 meters. With the next rain, half of the area will be re-plowed by tractor (50m by 100m). Both areas (adjacent plowed and unplowed plots) will be planted on the same day with the same planting method. This procedure will be repeated on the second half of the

the plowed area, plus on an equal adjacent area, with the next rain.

As well as allowing assessment of the double plowing system on a large scale, this system will shed some light on the relative merit of DP using tractors.

Each of these three systems will be implemented by two farmers in different villages. All labor and input data will be collected to allow budgets to be constructed, and to provide comparative data on labor requirements for large and small plots.

13.3.2 TILLAGE TRIALS

Introduction: These trials are a collaborative effort between DAR, ALDEP, ATIP, and INTSORMIL and the SACCAR Land and Water Management Project. They are similar to the collaborative tillage trials performed by ATIP and DAR in 1985-1987. The main differences between the current trials and previous ones within the Francistown region are:

(a). They will include a modified deep-ripping treatment;
(b). They will be truly national in scope;
(c). They include participation by more research and extension groups; and
(d). A soil physicist is assisting in quantifying the physical effects of the different tillage practice on soil characteristics.

The trial design was agreed to by representatives of all the groups involved, in a meeting at Sebele on 1st August, 1988. Objectives, justification and approach were written by Dr. N. Persaud and are included below. The only variation that will occur in the Francistown region is that at one location a sixth treatment will be included. This treatment will be "skip row planting". Skip row planting is planting two rows of sorghum on 75 cm between-row spacing, and then leaving an adjacent area of 1.5 m empty.

Objectives: The objectives of this RMRI testing stage work are:

(a). To evaluate the performance of the deep ripping system on seed-bed and root-bed preparation, on yields, on soil moisture conservation, and use on various soils and for different rainfall conditions.

(b). To evaluate the effects of several possible improved tillage options on sorghum yields, seedbed and root-bed conditions during the growing season, and use on various soils and for different rainfall conditions.

Justification: Primary and secondary tillage are essential operations to ensure proper physical seedbed and root-bed conditions for sorghum establishment and growth, and for weed control on soils of Eastern Botswana. Previous studies on sorghum yield response to tillage (mainly on station by the DLFRS and on-farm by ATIP) have shown:

(a). All else remaining equal, the deeper the tillage, the higher the yield.

(b). Response to tillage is governed by the seasonal rainfall pattern.

(c). Response to tillage is influenced by any soil management factor such as weed control operations that directly affect soil profile moisture content.

(d). That over several years, the deep-ripping tillage system may have potential to increase yields.

(e). That two primary plowing operations, the first early in summer and the second at a later date, depending on the rainfall, may provide economic yield benefits over the conventional single plow/plant operation.

More tillage studies are needed to develop a more fundamental understanding of the sorghum crop responses to tillage. Specifically the following need to be evaluated:

(a). The direct influence of various tillage practices on soil physical properties over time.
(b). Sorghum yield response to these tillage practices for various soil types and seasonal rainfall patterns.

Approach:

Treatments: Proposed treatments are as follows:

(a). Conventional tillage: single plowing/row planting operation.
(b). Double plowing: a first plowing done as early as possible, followed by a plow/row planting operation simultaneously with treatment (a).
(c). Deep-ripping: deep-ripping when soil is dry followed by a discing/row planting operation simultaneously with treatments (a) and (b).
(d). Conventional tillage with wide row spacing: same as in treatment (a) but with rows spaced as for the deep ripping treatment.
(e). Plowing and cultivation: as in treatment (b) but with the second tillage replaced with a cultivation/row planting operation.

Design and field layout: Experimental plots will be laid out in randomized, complete blocks with at least two blocks at each location. Experimental plots will be at least 40 meters long by 25 meters wide, with a 10 meter allowance at each end to allow for turning.

Locations: Locations are as follows:

(a). Sebele: one site
(b). Mahalapye: three sites at Mahalapye.
(c). Francistown: two sites at Mathangwane.

Measurements:
(a). Site characterization: location and landscape characteristics of each site using 9x9 panchromatic 1:50000 aerial photographs. Profile description of each site using the guidelines for soil profile description developed for Botswana by the FAO/UNDP/GOB Soil Mapping and Advisory Services Project. In situ bulk density measurements, sampling and chemical analyses on samples from all horizons to 125cm. Infiltration rate versus time curves and surface bulk density samples for 0-5, 0-10, and 0-15cm depth intervals for each elementary plot for all sites.

(b). Physical measurements: profile soil moisture, bulk density at 0-5, 0-10, and 0-15cm depths, and infiltration rate versus time curves, and if possible penetrometer measurements on each elementary plot at regular intervals from the beginning to the end of the season.

(c). Meteorological measurements: non-recording rain gauges installed at each site.

(d). Crop measurements: observations on plant stands, weed counts, rooting pattern,

and crop yields made at appropriate times during the growth of the crop.

(e). All labor and input data will be collected so that economic comparisons can be made between the different technologies.

13.4 FARM EQUIPMENT

13.4.1 EVALUATION OF IMPROVED DONKEY HARNESSES

Objectives: The objectives of this FMFI testing stage work are to:

(a). Continue evaluating the durability of the locally produced Kenya donkey harness, as reinforced, under farm conditions.
(b). Evaluate farmer acceptance of the Kenya donkey harness.

Justification: A significant percentage of arable agriculture depends on donkey power for plowing, cultivating and planting. Little improvement has been made in the traditional donkey harnesses which have been used for centuries. Improved harnesses have been shown to increase the efficiency of draught animal utilization by as much as 30 percent. This study will continue the testing of an improved design which was initially tested in 1986-87. If the modified version tested this year is of acceptable quality, the aim will be to introduce them nationwide through ALDEP.

Approach: Fifty Kenya donkey harnesses have been manufactured and later modified (reinforced) by the Rural Industries Innovation Center, in Kanye. Farmers who tested the equipment last season will continue testing the harnesses during the 1988-1989 crop season. ALDEP Francistown has ordered 66 harnesses for sale to farmers in their participatory trials program.

13.4.2 EVALUATION OF ROTARY INJECTION HAND ROW PLANTER

Objectives: The objective of this FMFI testing stage trial is to test the modified rotary injection planter to ascertain its durability, and improved acceptability under farm conditions.

Justification: The rotary injection planter may enable farmers with little or no control over traction resources to obtain increased production and farm income through better control over seed depth placement, and the timing of planting vis-a-vis rains.

Approach: The improved rotary injection planter will be tested through the farmer assessment groups, as a tool for row planting in terms of its practicability and performance. Modified units may also be tested in Mahalapye and by other farming system projects.

13.5 LIVESTOCK

13.5.1 IMPROVED PRODUCTION OF GOAT MILK

Objectives: The objectives of this RMFI design trial are to:

(a). Select one or two outstanding female goats from each cooperating farmer's herd.

(b). Determine the maximum production possible from these does by manipulating

nutrition, in the form of supplemental feeding and management, by removing kids from these does (transplanting to does of lesser milk production who have lost kids or had single births), and milking twice per day.

(c). Intensify production of kids by allowing them complete milk production from all other does on the farm.

(d). Initiate permanent identification (via tattoo) of all goats on the farm, so selection processes can be started.

(e). Develop a record keeping system tied to the permanent identification system.

(f). Establish a working relationship with DAFS.

Justification: Most subsistence farmers keep goats, and 90 percent of those who do keep goats, milk them. There is, however, a potential market for fresh liquid milk, and a market for milk products which could possibly be developed. If animals of a dairy type were kept under improved management and a selection program was initiated, it should be possible to increase family cash flow as well as provide a rapid return on investment through small stock.

Malnutrition appears to be a cause of young goat mortality. This is partially because too much milk is taken from the doe by the farmer to sell and is not being replaced with supplemental feed. Development of a fodder production and storage program utilized to increase milk production from two or three does for home use and sale would allow all other does to be devoted to raising kids. The kids should be allowed to go with the adults to graze and browse, thereby offering them better quality forage as well as additional milk.

Approach: Two farmers, in each of the three ATIP villages, will be invited to participate in this trial. These individuals will be selected because of their interest in cooperating, and because of their exceptional managerial capability. The two or three highest milk producers will be selected from their herds, and at kidding or soon thereafter their kids will be transferred to other does so that the complete supply of milk will be available for human use. These animals will be allowed to graze during the day, but during milking both in the morning and afternoon will be fed a supplemental feed calculated to be that amount required for lactation above maintenance. These animals will be housed separately from other goats at night and fed free choice, either green chopped or dried fodder raised on the farm. The milk off-take will be measured and recorded on a record book provided by ATIP. Data will also be collected on how the product is used, and price received. Analysis of feed versus return will be determined from farm records. This will allow all other kids the complete supply from their dams, reducing malnutrition.

Cooperating goat farmers will be asked to plant 0.1 ha of triple purpose cowpea (B005C) and 0.4 ha of Dolichos lab lab. Single superphosphate will be applied at the rate of 200 kg/ha to one half of the area. An evaluation will be made of the cowpeas for leaves picked for feeding to milk goats. Data on grain yields and forage residue yields will be collected. Similar information will be obtained on the Dolichos lab lab leaves picked for green feeding and estimates forage yields will also be obtained.

13.5.2 DIAGNOSIS OF KID MORTALITY

Objectives: The objectives of this RMRI descriptive and diagnostic study are:

(a). Arrive at the most common causes of kid mortality from birth to weaning.
(b). Design management strategies, including housing, to prevent this mortality.
(c). Devise methods of management, including housing, to decrease morbidity.
(d). If immunization would be a deterrent, then develop recommendations for immunizing against those specific diseases.
(e). Develop working relationships and linkages with Veterinary Services Department and DAFS.

Justification: Death losses in kids vary in severity from year to year and has been reported from 9 percent to 62 percent by both APRU and ATIP. This loss of income potential, as well as future breeding potential, is of great concern to farmers and government officials alike.

Approach: All kids that die will be collected and stored in a cooler or transported to Francistown for a post mortem exam. A post mortem report form will be developed. This is to be completed at time of examination and submitted with those tissue samples that are to be submitted to the Veterinary Diagnostic Laboratory in Gaborone for work up.

13.6 HOUSEHOLD CIRCUMSTANCES

13.6.1 COOPERATING FARMERS STUDY

Objective: This is an RMRI descriptive and diagnostic study. The objective of collecting economic and technical data on a continuing basis is to identify major changes and trends over time in the farming systems in Tutume Agricultural District. Of particular interest are data on:

(a). Crop environments, crops planted, cropping systems used, and harvested yields.
(b). Animal traction used, livestock inventory, and management changes.
(c). Market participation (both input and output).
(d). Timing of labor activities, particularly plowing activities to establish labor coefficients for cropping activities.

Justification: Since arable agricultural production in Botswana fluctuates greatly from year to year, due in large part to the harsh climatic environment and changing government policies, several years are required to adequately describe crop production activities. Livestock enterprises also fluctuate with climatic conditions, although to a lesser extent. A continuing monitoring program provides information on the fluctuations in the system over time and allows the identification of trends, such as shifts from one source of traction to another. This information will assist in the identification of economically feasible technologies which can lead to increased incomes without substantially increasing risk or investment.

Approach: To provide system monitoring information, several approaches will be combined. For environmental information (Section 13.8), daily readings of rainfall and temperature will be continued. Cropping and animal management practices, livestock inventories, and market participation will be assessed using an annual questionnaire administered to the households which participated in the MVRQ study. Timings for plowing activities under farmers' field conditions will be collected for animal and tractor traction.

13.7 MARKETS

13.7.1 SMALL STOCK AND GRAIN TRADING AND PRICES

Objective: The objective of this RMRI descriptive and diagnostic study is to ascertain the extent of within village formal marketing opportunities and the prevailing prices, both formal and informal.

Justification: Formal marketing channels are not well established and most local sales by village farmers are inter-household sales. Some limited opportunities exist to sell small stock to local restaurants, and in one village the cooperative will purchase grain. A monitoring of the number of animals purchased and the price gives some indication of the local market opportunities. There has been no formal trading in grain due to the drought, but the monitoring of local informal prices for grain is useful data for economic analysis of crop production technologies.

Approach: Monthly surveys of local restaurants will be used to monitor small stock trade and prices. One or two informal surveys will be used to estimate the local informal price for grain.

13.8 EXTENSION LINKAGES

13.8.1 EMFO OPTIONS TESTING WITH EXTENSION LED FARMERS' ASSESSMENT GROUPS

Objectives: The objectives of the extension managed farmer (EMFF) testing groups are:

(a). Provide a method for ADs to increase their efficiency by addressing a large number of farmers (on technical issues) at once, rather than having to make numerous individual visits to households and fields. (The group format allows the AD to perform a teaching function at the beginning of the year, and a backup function throughout the cropping season, through monthly meetings.)

(b). Provide a forum for researcher backup in extension activities.

(c). Provide a test to see if farmer groups are practical under extension conditions.

Justification: The extension service in Botswana to date has been very committed to administering drought relief programs. Thus, the traditional role of extending recommended agricultural technologies has been greatly reduced. The 1987-88 annual report from extension in the Francistown Region states that virtually no extension was done this year and that 95 percent of ADs' time was taken up with administration of government relief programs. Further, a single AD may have well over 500 households under his/her responsibility. Without a good communication system, many of the constraints these households face may go unaddressed. The farmer group approach offers a means of working with a number of farmers at one time, thus improving the efficiency of the AD. ADs are officially encouraged to work with groups of farmers, but to date, the system has not been employed for the testing and teaching of extension recommended technologies in the Francistown Region.

Approach: Prior to the cropping season ATIP staff will meet with regional agricultural officers and CFDA coordinators to discuss the extension managed options testing farmer group. With the RAO's approval, the DAO will identify two extension areas for the groups. The DAO and the ADs from the areas will meet with ATIP staff to discuss the

group work. The regional CPO and the ALDEP manager will also be included in the discussions. This group will decide on a limited number of technologies, including types of equipment provided through the ALDEP program, which are to be presented for testing. Logistical details will also be arranged.

Just prior to the normal beginning of the cropp'ng season, the ADs will ask the village headman to call a traditional village meeting at which he, and the ATIP Francistown staff, will describe the farmer group work in other villages and invite interested farmers to attend the initial group meeting to be held two weeks later. At the initial group meeting the AD and ATIP staff will discuss the technologies available for testing and how tests are to be conducted. Farmers will be asked to indicate in which tests they wish to participate.

At subsequent monthly meetings the implementation of trials will be discussed. The farmers will be asked to decide on their own how large to make the test plots, and to stake the plots accordingly. Side-by-side comparisons will be recommended. A field assistant will be hired to assist the AD in working with farmers to collect data, provide seeds and equipment etc.

Monthly meetings to discuss trials will be held. Farmers will be asked to described their trial experiences, identify problems, and report their observations on the trial to the group. The farmer group meetings will be chaired by the AD. All meetings will be attended by ATIP and district level extension staff. ATIP and extension staff will visit all trials at least once during the season.

A field day will be held near the end of the season. Farmers from other villages, extension staff and research staff will be invited to participate.

Following harvest the ATIP staff will conduct a formal end-of-season survey of participating farmers to obtain farmer assessment of the trials they participated in and the group activities. This information will be included with extension and researcher evaluations of the group activity in a progress report.

13.9 ENVIRONMENTAL MONITORING

13.9.1 RAINFALL AND TEMPERATURE MONITORING

Objective: The objective of this RMRI descriptive and diagnostic activity is to obtain daily rainfall and temperature data from experimental sites for use in agronomic and economic evaluations of trials.

Justification: Rainfall and temperature are two important parameters in crop production, and to a lesser extent in animal production. Over the past several years rainfall has been a major limiting factor in determining the amount of area planted, the quality of stand emergence and the quantity of grains and forage harvested. Because of high variability in rainfall within village areas monitoring must be done on a plot by plot basis. Temperature is more constant within an area so can be monitored at a central location.
Approach: Daily rainfall readings will be taken on rain gauges located on experimental plots. Maximum and minimum temperatures will be recorded at the ATIP compounds.

13.10 METHODOLOGY

13.10.1 RESEARCHER LED FMFI OPTIONS TESTING WITH FARMER ASSESSMENT GROUPS

The work with farmer groups in 1987-88 was very popular among farmers and will be continued in the three study villages in Tutume Agricultural District with only a few minor changes.

Objectives: The objectives of this FMFI testing activity are:

(a). To test a broad range of innovations under farmer managed conditions for increased productivity and grain yield dependability.
(b). To involve farmers and ADs directly in the farming systems development process.

(c). To determine what types of innovations are most appealing to different types of farmers.
(d). To determine the extent of adoption of technologies tested by participants in the 1986-88 farmer trials.

Justification: Numerous technological innovations have been developed in Botswana (and elsewhere) which may be relevant to subsistence farmers in Tutume Agricultural District. However, it is difficult to evaluate a very wide range of these innovations under researcher managed conditions in on-farm tests (due to time constraints). Further, it is often difficult to assess which innovations might be most relevant to specific farmers. It was therefore decided to present to a group of farmers a wide range of technological options. Farmers can then select innovations that seem most relevant to their situation, and test those with some researcher guidance (and provision of inputs). Monthly meetings are held with the groups to discuss problems and progress. In this way, farmers demonstrate which types of innovations seem most appropriate to them, and researchers are able to observe the effectiveness of those innovations and work with farmers towards development of improved production systems. By including ADs in the group monthly meetings, the ADs also become part of the systems development process.

Approach: In late September, an open kgotla meeting will be held for all participating farmers, members of village Farmers' Committees and the local ADs in the three villages where ATIP has been working. At this meeting ATIP staff will present:

(a). The results from last year's research.

(b). An invitation to all interested farmers, to attend a special meeting where technical options are reviewed (these will include both new technologies and currently recommended ones).

At this meeting, a wide range of technology options will be discussed (see list in Table 13.1). Farmers will then be asked to select any innovation or package of innovations they wish to test in the coming year. Those farmers electing to perform a test (or tests) will then form the farmer groups that will meet monthly. The ADs will also be invited to attend these meetings, where progress and problems can be discussed.

The types of innovations introduced will include:

(a). Tillage/water conservation techniques
(b). Planting method options (with some emphasis on evaluating hand row planters)

(c). Crop varieties
(d). Manure and fertilizer possibilities
(e). Forage and fodder production options
(f). Seed protection options

Depending on the degree of interest, and availability of equipment, some or all of the farmers wishing to test a specific innovation will be supplied with the necessary inputs and machinery by ATIP. Trials will be laid out side by side with a traditional control. Generally a record will be kept by ATIP staff regarding the dates of all operations, and grain yield. An end-of-season farmer assessment survey will be administered and, where possible, economic interpretations will be made.

Field days will be held in each of the three villages. At these field days, selected participating farmers will have the chance to show off their trials to the rest of the group, as well as to farmers from outside the group and to regional extension staff. They will describe the trial, their observations and opinions, and answer questions from the group of visitors. This will be primarily an extension activity.

Some of the changes that will be made this year include the following:

(a). Farmer comparisons will be slightly more controlled. For example, a farmer who wishes to test double plowing with fertilizer versus double plowing/row planted will be encouraged to separate his trials into double plowing with and without fertilizer, double plowing with and without row planting, and to include traditional checks in each.

(b). Where farmer feed back on a new technology is required, or where requests have been made by other researchers for tests on items like variety trials, if insufficient farmers elect to test them, ATIP will actively seek farmers in the group to take on these tests in addition to tests they have selected themselves.

(c). It has been observed by the Rural Sociology Unit in DPS that the groups are a bit too large to allow detailed discussion with all participants. Therefore new members will only be included if others drop out, and the total number of group participants drops below 25.

13.11 OTHER PROFESSIONAL ACTIVITIES

In order to promote the acceptance of farming systems work, it is important to continue and increase contacts between the team, farmers and other agencies, both in terms of conducting joint research and in the inclusion of extension and research staff in farmer group work, field days and joint visits to fields. Linkages and collaboration will be strengthened through the following activities:

13.11.1 LINKAGES WITH FARMERS

(a). Continue activities with researcher managed farmer testing groups.
(b). Expand activities with extension managed farmer testing groups.
(c). Continue active involvement of farmers in RMFI trials implementation.
(d). Make an annual report on ATIP activities at a kgotla meeting in each ATIP village.

13.11.2 LINKAGES WITH EXTENSION

(a). Have a regional review of work plans, and coordination of regional activities with regional DAFS personnel.

(b). Continue to involve DAFS in the FMFI design and testing of systems' options through involvement of local ADs, and district and regional DAFS officers, in researcher managed farmer testing groups monthly meetings and field days.

(c). Assist in the continuation of the existing extension managed farmer testing group and in the formation of one additional group. Both groups will be located in the CFDA in Northeast District.

(d). Collaborate with ALDEP on tillage forage trials and trials as part of the Goat Milk Study.

(e). Cooperate with the Regional Agricultural Office, actively seek their suggestions concerning the identification of research problems and the Francistown ATIP work plan, and keep them fully informed of ATIP's activities.

(f). Collaborate with the Regional Small Stock Officer on goat management studies.

(g). Prepare articles on ATIP activities, with pictures, for inclusion in extension publications.

(h). ATIP senior technical officers regularly attend DAFS Monthly Management Meetings and discuss ATIP activities.

(i). Assist ALDEP with their Participatory Trials Program and District Demonstration Farms.

13.11.3 LINKAGES WITH ON-STATION RESEARCH

Collaborate with DAR on tillage systems research, crop variety testing, equipment development, and other activities, including theme group meetings for planning research strategies, and presenting seminars.

13.11.4 LINKAGES WITH VETERINARY SERVICES

With the addition of an animal scientist/veterinary scientist there exists an opportunity to work in conjunction with the Veterinary Services field staff and Central Diagnostic Laboratory in the investigation of goat diseases and mortality, and methods of control using management, nutrition and husbandry.

13.11.5 LINKAGES WITH POLICY/PLANNING

All data sets will be reviewed and documented. These data sets will be made available to the DPS, DAR, other Botswana governmental bodies, and to other interested groups for their use in research.

13.11.6 METHODOLOGY DEVELOPMENT

The Francistown ATIP team will continue to work with other members of ATIP in the

preparation and dissemination of methodological materials. Emphasis will be placed on the preparation of a draft of a "Farming Systems Manual for Botswana". The Francistown agricultural economist will continue to coordinate team efforts to further develop and utilize the sequential decision system framework.

TABLE 13.1: TECHNOLOGIES TO BE OFFERED FOR TESTING TO FARMER GROUPS, FRANCISTOWN AREA, 1988-89*

Technology	Uses	Conditions for Applications (and Timing)	Resources and Inputs Required (Labor, Cash)
Subject: Water Conservation			
A) Double plowing	Reduce runoff & erosion, conserve water.	Preliminary tillage to be done a) on very early season rains(S/O) b) on dryer periods between rains NB: Not to be done after mid Jan.	Non restricted access to draft power. Will increase plowing labor and draft use where animal draft only is used.
B) Contour plowing	Reduce runoff & erosion. Conserve water.	Field contours should be marked before onset of rains	Nothing extra (contouring done free by SCS (GOB)
C)Fallow	Conserve water between years.	Field not planted, weed control	Chemical or mechanical weed control.
Subject: Crop Mixtures			
A) Mixing long and short crops and varieties.	Reduce risk of total crop failure due to early termination of rain.	Suggested mixes through season: 1) Before Dec 1 - 75% LS, 25% SS 2) Dec 1 - Jan 15 - 50% LS, 50% SS 3) Jan 15 onwards - 25% LS, 75% SS	Labor available for harvesting, drying from early Mar. onwards Purchase seed? Bird scaring may be necessary earlier than usual.
B) Annual forage crops	Provide supplemental dry season feed of good quality for for sale, milk production)	Livestock needs (eg early feeding of draft animals, fattening	Planting labor in Feb,weeding in Mar. Seeds (free from ALDEP) Harvesting May-June
Subject: Planting Methods			
A) Hand row planter	Plough on poor soil water, plant on good moisture (for farmers without draft) - ensures good plant stand	Anytime, best on good moisture. or completely dry soils. Good soil preparation required.	Well tilled seed bed. Sanitas hand row planter or RIP. Extra labor at planting. (RIP to be emphasized)
B) Sebele row planter and plow planter.	Ensure good plant stand.	Requires good soil water condition. for effective use. Also requires understanding of mechanics. Use anytime before Jan 15 (plough/plant same time there after). Well trained draft power.	Sebele planter. Planting labor. Well trained draft power
C) Improved harnesses, yokes, and animal care. Proper plough adjustment.	Improve efficiency of plowing operations, improved animal well being.	Throughout plowing operations	Improved equip. Knowledge of animal husbandry (small). Cost of equipment
Subject: Weeding			
A) Inter-row weeder (modified Indian design and Zimplow design).	Reduce weeding time Increase timeliness of weeding	Row planting situation	Donkeys, weeder. Depending on availability from Sebele.

TABLE 13.1: TECHNOLOGIES TO BE OFFERED FOR TESTING TO FARMER GROUPS, FRANCISTOWN AREA, 1988-89* (CONTINUED)

Technology	Uses	Conditions for Applications (and Timing)	Resources and Inputs Required (Labor, Cash)
Subject: Forages			
A) Annual forages Babala millet and lab lab	Provide supplemental dry season feed of good quality for early feeding of draft animals	Anytime but only on good moisture or completely dry soils. Good soil preparation required.	Well tilled seed bed. Broadcast and plow down or use Sebele row planter. March weeding? May-June harvesting
B) Perennial forages Buffel grass and Siratro	Draft animals, stall feeding, supplemental feeding selected livestock.	Land available for permanent pasture. Seed before Feb.15. Good soil preparation required.	Broadcast on well tilled seed bed cover with brush harrow. Seeds (free from ALDEP). Draft power, weeding labor (late season), harvest labor
Subject: Manure/Chemicals			
A) Animal manure spread on fields	Increase soil fertility and moisture holding capacity	Use on all soils in TAD	Donkey cart, considerable labor for transport to fields and increased weeding
B) Chemical fertilizer	Increase soil fertility	Use P on all soils, use N on poor soils under higher rainfall conditions	Transport for fertilizer to field, labor for broadcasting, and cash to purchase fertilizer
C) Captan	Seed treatment for groundnuts. Protect expensive seed. Improve germination percentage.	Availability of Captan and G. nut seed. Farmer must understand basics of toxic chemical use.	Cost of Captan.
Subject: Crop Variety Testing			
A) Advanced selection of genotypes	Farmer evaluation of potentially improved sorghum and cowpea genotypes	Availability of seed	None extra.

LS = Long Season, SS = Short Season, TAD = Tutume Agricultural District

PART IV: FINANCIAL PLAN, SEPTEMBER 1988 - AUGUST 1989

CHAPTER 14: FINANCIAL PLAN

One of the main objectives of presenting a financial plan in the Annual Report was to give some idea of the costs that GOB would have to incur if ATIP type and related (INTSORMIL and SMU) activities were to continue after the end of the project on September 28th 1990. To address this, commitments required have been broken into two components:

(a). Fixed or overhead costs which cannot easily be costed.
(b). Recurrent costs which have to be met on an annual basis.

Commitments currently made that will not likely be necessary after donor funding ceases, have been listed separately. GOB commitments with respect to these have been costed in this report. Commitments not likely to continue have been divided into two parts:

(a). GOB commitments.

(b). USAID commitments.

No attempt is made to separate GOB commitments into individual departments in MOA. The costs given should be considered very tentative in nature. Also in the tables it is assumed that ATIP and ATIP related activities will continue in the future in much the same way as they are now.

14.1 COMMITMENTS THAT WILL NEED TO CONTINUE IN THE LONG-RUN IF CURRENT ACTIVITIES ARE TO CONTINUE

14.1.1 FIXED

These are given in Table 14.1. No attempt is made to put a value on these components.

TABLE 14.1 OVERHEAD FOR ATIP AND ATIP RELATED ACTIVITIES, SEPT. 1987 - AUG. 1988*

Unit	Place	Number	
		Offices	Houses
ATIP	Gaborone I	1	
	Sebele	3	2
	Mahalapye	4	4
	Francistown	4	5
INTSORMIL Related	Sebele	2	2
SMU Related	Sebele	1	1

* This list includes houses for professional staff only. It does not include houses for the support staff in Gaborone, Sebele, Mahalapye and Francistown, or the 12 rondevals in the ATIP villages.

14.1.2 RECURRENT

The following assumptions were made in drawing up the recurrent estimates for the coming year.

(a). GOB (i.e., BX) Vehicles. The Central Transport Organization (CTO) were planning to rent vehicles to governmental departments. However this has now been abandoned. Nevertheless for want of better estimates, the same figures are

used as last year, plus 10% allowance for inflation. .Table 14.2 gives some details. The costs in Table 14.2 seem remarkably low indicating that funds channelled directly to CTO heavily subsidize vehicles. However the degree to which this done is impossible to determine. Therefore vehicle costs are underestimated as far as GOB is concerned.

TABLE 14.2: COSTS OF RUNNING GOB VEHICLES

Toyota Type	Number	Cost/Vehicle/Year (Pula)	
		Hire Cost	Running cost[a]
Landcruiser Station Wagon	1	3,268	4,440
Landcruiser	6[b]	2,815	4,440

Assumes vehicle travels 30,000 kms per year and at rate of five kilometers per liter. Cost of petrol per liter is P0.74.
This also includes one vehicle for SMU and one for the RELO.

(b). Salaries of Staff. In order to simplify the calculations the median salary in each rank is used. Also there are allowances (support costs that are budgeted for transport, travelling and subsistence). Assumptions used are given in Table 14.3.

TABLE 14.3: MEDIAN SALARIES AND ALLOWANCES OF GOB STAFF, SEPT. 1988-AUG. 1989

Rank[a]		Numbers in Activity		Cost/Person/Year (Pula)	
Old	New	ATIP	INTSORMIL[b]	Salary	Allowances[c]
PR3	C2	2		14,892	1,936
PR4	C3	1		11,424	1,485
T3	C4	2	2	9,852	1,281
T4	B2	4		7,332	953
T5	B3	5	1	4,992	649
S4	B4/5	2	2	3,828	498
GA5/6	B4/5	5		3,144	409
Industrial Class		4		2,540	330

During the last year there has been a review of the Civil Service grades and as a result the ranks have been changed.
SMU positions have not been given.
These have been estimated to be 13% of the salary.

Estimated recurrent costs for running the ATIP and ATIP related activities in the form that might exist after donor funded support finishes are given in Table 14.4.

TABLE 14.4: ESTIMATED RECURRENT COSTS FOR UNDERTAKING ATIP AND ATIP RELATED ACTIVITIES, SEPT. 1987 AUG. 1988[a]

Item	Amount (Pula) By Whom Is Currently Paying			
	For ATIP		For ATIP Related[b]	
	GOB	Project	GOB	Project
Salaries and Allowances:				
Other than Industrial Class	156,593		36,559	
Industrial Class	11,480			
Casual Labor	24,290		3,300	1,000
Vehicles[c]	58,490	60,000	7,255	20,000
Miscellaneous[d]		100,000		30,000

This table only includes recurrent expenditure that will need to be continued by GOB in the long run after donor funding is withdrawn. Some of the entries in the table are based on figures in Tables 14.1 to 14.3.
Unless indicated otherwise "ATIP Related" refers to support for INTSORMIL. However, apart from vehicle support it includes nothing for SMU.
Includes running costs of two vehicles being purchased by ATIP which will have BX number plates -- these are not included in the list in Table 14.2. Project expenses include the purchase costs of these vehicles plus another one INTSORMIL that will not have BX plates.
Includes purchase of equipment such as microcomputers and implements, consumable stores, etc.

14.2 CURRENT COMMITMENTS THAT WILL NOT BE NECESSARY AFTER END OF DONOR FUNDING

14.2.1 GOB

These commitments are listed in Table 14.5. They include houses, allowances, and short

and long term training.

TABLE 14.5: CURRENT COMMITMENTS OF GOB THAT WILL NOT CONTINUE AFTER DONOR FUNDED SUPPORT IS WITHDRAWN

Item	ATIP Number	ATIP Cost	ATIP Related Number	ATIP Related Cost
Houses: Gaborone	1			
Sebele	2		3	
Mahalapye	2*			
Francistown	3			
Allowances ATIP Technicians*	7	13,552	3	5,808
PCV Support*	1	1,324		
Short Term Training		33,000		
Long Term Training*	4	200,000		

Includes a PCV.
Assumed to be at a rate equivalent to PR3 (P1,936) in Table 14.3).
GOB pays P62 per month for utilities and an estimated allowance of P580 per year for travelling on official business. The P580 (Table 14.3) is based on the rate assumed for individuals at a salary about equivalent to that of PCVs which is about P4,020 per year.
This is very rough estimate. Individuals sent on short term training can use ATIP funds for per diem and tuition but air fares have to paid by GOB.
Expressed in person years and estimated at a cost of P50,000 per year.

14.2.2 DONOR FUNDED COMMITMENTS

Table 14.6 gives the commitments planned by ATIP and ATIP related activities that are being met through funds originating from USAID. It is anticipated that these commitments will not need to be assumed by GOB once donor funding is withdrawn.

TABLE 14.6: COMMITMENTS TO BE MADE WITH DONOR FUNDS THAT WILL NOT NEED TO BE ABSORBED BY GOB IN THE LONG RUN, SEPT. 1987 - AUG.1988

Item	Unit	Number ATIP	Number ATIP Related
Staff:			
Long Term	Person years	7	2.75
Consultants	Person months	7*	1
Training:			
Long Term	Person years	3	
Short Term*	Person months	5	

This is a very rough estimate.
It does not include those who will receive in service training.

These commitments are satisfied from a number of places: ATIP under the MIAC contract, ATIP under USAID/B, and INTSORMIL.

14.3 CONCLUSIONS

It is anticipated that on the basis of the data presented above, which must be considered very tentative in nature, the recurrent cost to GOB of ATIP and ATIP related activities for the period September 1988 to August 1989 will be in the region of P551,654 (see Tables 14.4 and 14.5), of which P253,684 (Table 14.5) is a short-run commitment that GOB should not have to incur in the long run.

As far as USAID support is concerned, costs that will eventually have to be absorbed by GOB are estimated to be around P211,000 -- or P131,000 if the costs of the new vehicles are excluded -- for the period September 1988 to August 1989 (see Table 14.4), while commitments they are currently making that will not have to be absorbed by GOB in the long run after USAID funding is withdrawn, are given in Table 14.6.

APPENDIX: ATIP DOCUMENTATION

A.1 POLICY

Papers written by ATIP staff are disseminated in the following manner.

A.1.1 EXTERNALLY PUBLISHED PAPERS (EP SERIES)

Copies of articles and papers on ATIP work that are externally published are kept in limited quantities. Many of these are likely to have earlier been produced as Progress Reports, Miscellaneous Papers, etc. Likely audience: national and international.

A.1.2 RESEARCH PAPERS (RP SERIES)

Research Reports are published by the Government of Botswana and are submitted to external review (review by individuals outside ATIP). This generally means approval by the Chief Arable Research Officer and the Director of Agricultural Research. These consist of comprehensive summaries of ATIP work plus detailed reports on specific topics. Likely audience: local and international.

A.1.3 WORKING PAPERS (WP SERIES)

These are papers that are deserve wide circulation and have particular methodological or empirical value. They are submitted to internal review amongst ATIP members. They have a standard designed cover, with a hole in the middle of the front page showing the title. They are numbered ATIP WP-1, ATIP WP-2, etc. Likely audience: local and other people interested in farming systems work both nationally and internationally.

A.1.4 MISCELLANEOUS PAPERS (MP SERIES)

These consist of conference papers, trip reports, etc, and are not generally subject to review. They are numbered with the year followed by the number in that year (e.g., ATIP MP 84-1, ATIP MP 84-2, etc.). Likely audience: mainly ATIP and other interested individuals inside and outside of Botswana.

A.1.5 PROGRESS REPORTS (PR REPORTS)

These are primarily papers written by staff members in ATIP, are not reviewed, and consist of research results, methodological issues, etc. They can be drafts of material to be published in another form. The idea is to systematize the way in which information is produced and circulated. Each location produces its own series. Therefore each area Mahalapye, Francistown and Gaborone identify their papers with M, F or G. followed by the year (e.g., 84) followed by the number of the Progress Report in that year (e.g., 1, 2, etc.). An example might be ATIP PR F84-3. No cover is produced for these Progress Reports and circulation of the information is limited. Likely audience: ATIP staff and other interested individuals in Botswana.

A.1.6 REPORTING DOCUMENTS (RD SERIES)

These are reporting documents required by USAID. They consist of an annual report containing material not only on professional matters, but also covering staffing, training and administrative matters, and an annual work plan. Likely audience: primarily ATIP staff, USAID and MIAC, and institutions within Botswana.

A.2 PAPERS WRITTEN BY ATIP

Copies of most of the papers listed below are available on request. This is a cumulative list and includes all papers written since the inception of ATIP.

A.2.1 EXTERNALLY PUBLISHED PAPERS

1983

ATIP EP 83-1. Baker, D., E. Modiakgotla, D. Norman, J. Siebert and M. Tjirongo. "Helping the Limited Resource Farmer through the Farming Systems Approach to Research". Culture and Agriculture 19: 1-8.

1984

ATIP EP 84-1. Norman, D., D. Baker and J. Siebert. "The Challenge of Developing Agriculture in the 400-600mm Rainfall Zone within the SADCC Countries". Zimbabwe Agricultural Journal 81(6):205-214.

1985

ATIP EP 85-1. Norman, D.W. "Some Problems in the Implementation of Agricultural Research Projects with a Farming Systems Perspective". FSSP Networking Paper No. 3. Gainesville: International Programs, University of Florida, 1985.

ATIP EP 85-2. Norman, D.W. "The Limited Resource Farmer and Africa's Food Production Crisis". In IFDC (Ed.), Fertilizer Efficiency Research and Technology Transfer Workshop for Africa South of the Sahara. Muscle Shoals: International Fertilizer Center, 1985. pp. 23-67.

1986

ATIP EP 86-1. Baker, D.C. and J. A. Hobbs. "Institutionalization of FSR and E in Botswana: Current Programmes and Issues". In C. Flora and M. Tomecek (Eds.), Selected Proceedings of KSU's 1984 Farming Systems Research Symposium, Farming Systems Research and Extension: Implementation and Monitoring, Farming Systems Research Paper No. 9. Manhattan: Kansas State University, 1986. pp. 110-134.

ATIP EP 86-2. Koch, B.A. "Farming Systems Research on Animal Husbandry Problems in Tutume Agricultural District of Botswana". In C. Flora and M. Tomecek (Eds.), Selected Proceedings of KSU's 1984 Farming Systems Research Symposium. Farming Systems Research and Extension: Implementation and Monitoring, Farming Systems Research Paper No. 9. Manhattan: Kansas State University, 1986. pp. 258-268.

ATIP EP 86-3. Norman, D. and M. Collinson. "Farming Systems Research in Theory and Practice". In J. Remenyi (Ed.), Agricultural Systems Research for Developing Countries, ACIAR Proceedings No. 11. Canberra: Australian Council for International Agricultural Research, 1986. pp. 16-30.

ATIP EP 86-4. Norman, D. and D. Baker. "FSR Credibility and Experiences in Botswana". In Moock, J. (Ed.), Understanding Africa's Rural Households and Farming Systems. Boulder: Westview Press, 1986. pp. 36-57.

ATIP EP 86-5. Trent, C., Monyatsi, T. and E. Modiakgotla. "Progress and Needs in On-Farm Research in Botswana". In CIMMYT (Ed.), Report of a Networkshop of Eastern and Southern African Senior Agricultural Administrators on Issues in Systems Based On-Farm Research. Nairobi: CIMMYT, July 1986. pp. 13-16.

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